



**Health  
Information  
and Quality  
Authority**

An tÚdarás Um Fhaisnéis  
agus Cáilíocht Sláinte

# **Report - High level review of configuration and reform of Public Health systems in selected countries**

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## **About the Health Information and Quality Authority**

The Health Information and Quality Authority (HIQA) is an independent statutory authority established to promote safety and quality in the provision of health and social care services for the benefit of the health and welfare of the public.

HIQA's mandate to date extends across a wide range of public, private and voluntary sector services. Reporting to the Minister for Health and engaging with the Minister for Children, Equality, Disability, Integration and Youth, HIQA has responsibility for the following:

**Setting standards for health and social care services** — Developing person-centred standards and guidance, based on evidence and international best practice, for health and social care services in Ireland.

**Regulating social care services** — The Chief Inspector within HIQA is responsible for registering and inspecting residential services for older people and people with a disability, and children's special care units.

**Regulating health services** — Regulating medical exposure to ionising radiation.

**Monitoring services** — Monitoring the safety and quality of health services and children's social services, and investigating as necessary serious concerns about the health and welfare of people who use these services.

**Health technology assessment** — Evaluating the clinical and cost-effectiveness of health programmes, policies, medicines, medical equipment, diagnostic and surgical techniques, health promotion and protection activities, and providing advice to enable the best use of resources and the best outcomes for people who use our health service.

**Health information** — Advising on the efficient and secure collection and sharing of health information, setting standards, evaluating information resources and publishing information on the delivery and performance of Ireland's health and social care services.

**National Care Experience Programme** — Carrying out national service-user experience surveys across a range of health services, in conjunction with the Department of Health and the HSE.

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## List of abbreviations used in this report

<b>AFPHM</b>	Australasian Faculty of Public Health Medicine
<b>AHMAC</b>	Australian Health Ministers' Advisory Council
<b>AHPPC</b>	Australian Health Protection Principal Committee
<b>AICIS</b>	Australian Industrial Chemicals Introduction Scheme
<b>ARHAI</b>	Antimicrobial Resistance and Healthcare Associated Infection
<b>ARPANSA</b>	Australian Radiation Protection and Nuclear Safety Agency
<b>ARTG</b>	Australian Register of Therapeutic Goods
<b>AWMSG</b>	All Wales Medicines Strategy Group
<b>CARI</b>	Community Acute Respiratory Infection
<b>CCG</b>	Clinical Commissioning Group
<b>CDEM</b>	Civil Defense Emergency Management
<b>CDNA</b>	Communicable Diseases Network Australia
<b>CIBG</b>	Central Information Point for Health Care Professions
<b>CIHR</b>	Canadian Institutes of Health Research
<b>CIMO</b>	Context, Intervention, Mechanism, Outcome
<b>CMO</b>	Chief Medical Officer
<b>COAG</b>	Council of Australian Governments
<b>COBR</b>	Cabinet Office Briefing Rooms
<b>COHERE</b>	Council for Choices in Health Care

<b>COSLA</b>	Scottish Government and the Convention of Scottish Local Authorities
<b>COVID-19</b>	coronavirus disease 2019
<b>CPRD</b>	Clinical Practice Research Datalink
<b>CQC</b>	Care Quality Commission
<b>DECIPHer</b>	Centre for the Development and Evaluation of Complex Interventions for Public Health ImpRovement
<b>DEMA</b>	Danish Emergency Management Agency
<b>DHA</b>	Danish Health Authority
<b>DHBs</b>	District Health Boards
<b>DHSC</b>	Department of Health and Social Care
<b>DOH</b>	Department of Health
<b>DVFA</b>	Danish Veterinary and Food Administration
<b>EAG</b>	expert advisory group
<b>EAVE</b>	Early Pandemic Evaluation and Enhanced Surveillance
<b>EC</b>	Epidemics Commission
<b>ECOSS</b>	Electronic Communication of Surveillance in Scotland
<b>eDRIS</b>	electronic Data Research and Innovation Service
<b>EHK</b>	electronic first aid report
<b>EPHF</b>	essential Public Health functions

<b>ESR</b>	Environmental Science and Research
<b>EU</b>	European Union
<b>Fimea</b>	Finnish Medicines Agency
<b>FinCCHTA</b>	Finnish Coordinating Center for Health Technology Assessment
<b>Finlex</b>	Communicable Diseases Decree
<b>FSANZ</b>	Food Standards Australia New Zealand
<b>GP</b>	general practitioner
<b>HCEF</b>	Health Chief Executives Forum
<b>HEIW</b>	Health Education and Improvement Wales
<b>HIQA</b>	Health Information and Quality Authority
<b>HIV/AIDS</b>	Human immunodeficiency virus/ Acquired immunodeficiency syndrome
<b>HIW</b>	Healthcare Inspectorate Wales
<b>HMM</b>	Health Ministers' Meeting
<b>HSC</b>	Health and Social Care
<b>HSCB</b>	Health and Social Care Board
<b>HSE</b>	Health and Safety Executive
<b>ICEG</b>	Infection Control Expert Group
<b>ICSs</b>	Integrated Care Systems
<b>IHPA</b>	Independent Hospital Pricing Authority

<b>IOS</b>	International Operational Staff
<b>LRFs</b>	Local Resilience Forums
<b>LTP</b>	Long Term Plan
<b>MHRA</b>	Medicines and Healthcare products Regulatory Agency
<b>mRNA</b>	messenger RNA
<b>NCCDH</b>	National Collaborating Centre for Determinants of Health
<b>NCCPH</b>	National Collaborating Centres for Public Health
<b>NESA</b>	National Emergency Supply Agency
<b>NFRC</b>	National Federation Reform Council
<b>NHMRC</b>	National Health and Medical Research Council
<b>NHRA</b>	National Health Reform Agreement
<b>NHS</b>	National Health Service
<b>NIBSC</b>	National Institute for Biological Standards and Control
<b>NICE</b>	National Institute for Health and Care Excellence
<b>NIHR</b>	National Institute for Health Research
<b>NITAG</b>	National Immunisation Technical Advisory Group
<b>NOST</b>	National Operational Staff
<b>NQB</b>	National Quality Board
<b>NSS</b>	National Services Scotland



<b>NSU</b>	National Screening Unit
<b>NWSSP</b>	NHS Wales Shared Services Partnership
<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>OHID</b>	Office for Health Improvement and Disparities
<b>OMT</b>	Outbreak Management Team
<b>ONRHC</b>	Office of the National Rural Health Commissioner
<b>PAO</b>	Principal Accounting Officer
<b>PCE</b>	Partnerships and Citizen Engagement
<b>PHA</b>	Public Health Agency
<b>PHAC</b>	Public Health Agency of Canada
<b>PHE</b>	Public Health England
<b>PHLN</b>	Public Health Laboratory Network
<b>PHNs</b>	Primary Health Networks
<b>PHOs</b>	Primary health organisations
<b>PHS</b>	Public Health Scotland
<b>PHUs</b>	Public Health units
<b>PHW</b>	Public Health Wales
<b>PRISMA</b>	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
<b>PS!</b>	Danish Society for Patient Safety

<b>RACP</b>	Royal Australasian College of Physicians
<b>RIVM</b>	National Institute for Public Health and the Environment
<b>RQ</b>	research question
<b>RQIA</b>	Regulation and Quality Improvement Authority
<b>SAC</b>	Special Advisory Committee
<b>SBU</b>	Swedish Agency for Health Technology Assessment and Assessment of Social Services
<b>ScotPHO</b>	Scottish Public Health Observatory
<b>SCPHRP</b>	Scottish Collaboration for Public Health Research and Policy
<b>SGHD</b>	Scottish Government Health Directorates
<b>SHPN</b>	Scottish Health Protection Network
<b>SSI</b>	Statens Serum Institut
<b>STUK</b>	Radiation and Nuclear Safety Authority
<b>TGA</b>	Therapeutic Goods Administration
<b>THL</b>	Finnish Institute for Health and Welfare
<b>TLV</b>	Dental and Pharmaceutical Benefits Agency
<b>TUKIJA</b>	National Committee on Medical Research Ethics
<b>UK</b>	United Kingdom
<b>UKHSA</b>	UK Health Security Agency
<b>VATT</b>	Government Economic Research Institute

**ViBIS** Knowledge Center for User Involvement in the Health Service

**WHO** World Health Organization

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HIQA would like to thank the key representatives from each country who verified data collected for research question 1 and participated in the interviews for research question 2.

### **Members of the Evaluation Team**

Natasha Broderick, Karen Cardwell, Marie Carrigan, Paul Carty, Fearghal Comaskey, Patricia Harrington, Jingjing Jiang, Louise Larkin, Gwinyai Masukume, Cillian McDowell, Michelle Norris, Mark O'Loughlin, Michelle O'Neill, Máirín Ryan, Debra Spillane, Susan Spillane, Conor Teljeur, Barrie Tyner.

Not all members of the Evidence Synthesis Team are involved in the response to each research question.

### **Conflicts of interest**

None declared.

## Key points

- The findings of this report will support the work of the Public Health Reform Expert Advisory Group in Ireland. It addresses the following two research questions:
  - How do Public Health systems and or structures of selected countries function at a high level?
  - What were the lessons learned with regard to establishment of, or transition to, those structures in other countries, including any lessons learned regarding their suitability in light of the COVID-19 pandemic?
- The functioning of Public Health systems was considered according to the 12 essential Public Health functions (EPHFs) as defined by the World Health Organization (WHO). The 12 EPHFs relate to: surveillance; emergency management; governance and regulation; planning and financing; health threats; disease prevention; health promotion; engagement; adequate workforce; quality and access; research; and medicines access.
- The 12 countries selected for inclusion described the configuration of all 12 EPHFs at a national level, that is, there is some degree of national strategic oversight and decision making for all functions. Within some countries, there is a single national body or agency with responsibility for several EPHFs. For example, the Ministry of Health in New Zealand oversees nine of the 12 EPHFs.
- Some EPHFs have a stronger national presence than others. Those with a stronger national presence relate to surveillance; governance and regulation; adequate workforce; quality and access; research; and medicines access.
- All 12 EPHFs were described at either a regional or local level by at least one country. Those functions with a well-defined presence at regional and or local levels were emergency management; planning and financing; health threats; disease prevention; health promotion; and engagement.
  - Although these functions are governed at a national level, their implementation is typically the remit of regional and local authorities.
  - While planning and financing decisions are made at a national level these are informed by data from regional and local levels.

- For countries with decentralised systems such as Sweden or Finland, regions typically have a greater role in deciding how or if national guidance will be implemented.
- Across all countries, there was a lack of clarity on the mechanisms of communication between national, regional and local levels.
- New structures implemented during the COVID-19 pandemic broadly related to:
  - Legislation and decision making – the legislation that was put in place and advisory groups established to inform decision making
  - Data collection, surveillance, evidence synthesis and collaboration – data collection and surveillance methods (including sufficient IT infrastructure) used to monitor the pandemic, evidence synthesis undertaken to inform decision making, and partnerships established across different organisations and or sectors
  - Public Health interventions – the implementation of testing, contact tracing, COVID-19 vaccination programmes and establishment of facilities to treat patients with COVID-19
  - Public participation, public messaging and communication – the inclusion of public opinion in decision making and public engagement regarding communication of information and guidance
  - Continuation of healthcare services – how countries maintained routine healthcare and screening services during the pandemic
  - Workforce capacity and resilience – how workforce capacity was scaled up to meet the demand and the issues faced with respect to workforce resilience.
- In considering all these findings, the lessons for Ireland are:
  - Having sufficient IT infrastructure in place to allow for data collection, surveillance and linkage to outcomes is vital. Ideally this infrastructure would be implemented during a period of relative stability, to allow for good governance and a faster response during a pandemic or emergency situation.

- Policy decisions relating to the COVID-19 pandemic were made at government level, and were informed by evidence syntheses undertaken by various organisations. Having an established evidence synthesis function to inform Public Health decision making is a key feature.
- There is a need to carefully identify which EPHFs or which elements of an EPHF should be delivered at a national, regional or local level. During the pandemic, decentralised systems had the advantage of good communication with the local population, particularly in relation to communication of guidance and execution of track-and-trace systems. However, they face disadvantages, such as inefficiencies in resourcing particularly with respect to digital infrastructures and a scarcity of specialist skills in smaller or less populous regions, and the lack of a unified national response.
- As Public Health systems internationally work towards “business as usual”, it is important that Public Health is not viewed as just health protection. Instead, the other pillars of Public Health (that is, health promotion and well-being, health intelligence and health service improvement) should be strengthened, especially if health inequalities are to be addressed.

## **1 Background**

Public Health, as defined by Donald Acheson of the World Health Organisation in 1988, is “the science and art of preventing disease, prolonging life and promoting health through the organized efforts of society.”<sup>(1)</sup> Public Health is vital to protecting, promoting and restoring the public’s health and combines science, skills and beliefs, culminating in the maintenance and improvement of population health through collective or social actions.<sup>(2)</sup>

In Ireland, the Sláintecare report (a vision and strategic plan for healthcare) was adopted by the government and published in May 2017.<sup>(3)</sup> The overall aim of Sláintecare is to re-orientate healthcare in Ireland from a two-tier structure of health provision to a universal single tier system, ensuring equal access to services for every citizen. Sláintecare reform will create a health and social care service where people can access the right services closer to home (that is, in the primary and social care settings).<sup>(4)</sup>

The Sláintecare Implementation Strategy approved by the government in 2018 was later reviewed and refined for 2021-2023.<sup>(5)</sup> There are eight key principles in Sláintecare: patient is paramount; timely access; prevention and Public Health; free at the point of delivery; workforce; public money and interest; engagement; accountability. In the context of the COVID-19 pandemic, these principles have been shown to be even more important, particularly prevention and Public Health. As such, one of the immediate priorities within the Sláintecare implementation plan, is to reform Public Health in Ireland.

Internationally, the COVID-19 pandemic has caused additional disease burden and mortality, impacted mental health and well-being and delayed investigations and treatment of non-COVID cases (for example, cancer).<sup>(6)</sup> It is argued internationally that, had sufficient funding of Public Health functions, including pandemic preparedness, been in place historically, many shortcomings of the COVID-19 pandemic response could have been mitigated.<sup>(7)</sup> As a result, strengthening Public Health systems is on the agenda of governments internationally. Areas of specific interest are, Public Health emergency preparedness, international cooperation and solidarity, health equity and health literacy.<sup>(8)</sup>

On 25 January 2022, the Minister for Health in Ireland established the Public Health Reform Expert Advisory Group (EAG). The Public Health Reform EAG is seeking to identify international best practice and lessons learned regarding the systems and structures that deliver core Public Health functions, with a view to recommending an appropriate operating model to develop and oversee the delivery of Public Health in Ireland.<sup>(9)</sup>



To support the work of the Public Health Reform EAG, this report will address the following two research questions:

1. How do Public Health systems and or structures of selected countries function at a high level?
2. What were the lessons learned with regard to establishment of, or transition to, those structures in other countries, including any lessons learned regarding their suitability in light of the COVID-19 pandemic?

## **2 Methods**

A description of the methods used in this report are detailed in the [protocol](#). In brief, this involved a systematic search of the literature and semi-structured qualitative interviews with key stakeholders. The research undertaken to identify the lessons learned with regard to establishment of, or transition to, the new structures implemented during the COVID-19 pandemic (that is, the semi-structured qualitative interviews) received ethical approval from the Royal College of Surgeons in Ireland University of Medicine and Health Sciences Research Ethics Committee (reference number: REC202202016).

### **2.1 Search methods for identification of data**

Data relating to Public Health systems and structures (research question 1 (RQ1)), and lessons learned (research question 2 (RQ2)), for a select group of 12 countries were identified from the following sources:

- organisations' websites
- electronic database and grey literature searching
- representatives from key national-level organisations.

A search was performed to identify and describe the configuration of the Public Health systems for the following countries selected for inclusion in this review:

- Australia
- Canada
- Denmark
- Finland
- Netherlands
- New Zealand
- Norway
- Sweden
- England

- Northern Ireland
- Scotland
- Wales.

These countries were selected based on a combination of geographical proximity to Ireland, population size, organisation of health services, European Union membership and or availability of documents in English.

A targeted scoping search of organisations' websites, together with a search of electronic databases and grey literature was used to identify any official documents, reports and or peer-reviewed publications describing:

- the configuration and functioning of Public Health systems and structures in each of the countries identified for inclusion in the report (RQ1)
- lessons learned with regard to the establishment of, or transition to, new Public Health structures (within the last five years) in that country, and their suitability in light of the COVID-19 pandemic (RQ2).

All citations identified from the search strategy were exported to EndNote (Version X8) for reference management, where duplicates were identified and removed. Using Covidence ([www.covidence.org](http://www.covidence.org)), the titles and abstracts of the remaining citations were reviewed by four reviewers to identify those for full-text review. The full texts were obtained and evaluated by four reviewers applying the defined inclusion and exclusion criteria. Where disagreements occurred, discussions were held to reach consensus and where necessary, an additional reviewer was involved. Citations excluded during the full-text review stage were documented alongside the reason for their exclusion and included in the PRISMA flow diagram.

For RQ1, data relating to Public Health systems and structures from any of the 12 selected countries were eligible for inclusion. Articles and websites not meeting these criteria were excluded.

For RQ2, the inclusion and exclusion criteria were formulated in line with the CIMO (Context, Intervention, Mechanism, Outcome) framework;<sup>(10)</sup> see [Table 1](#). The CIMO framework describes "the problematic Context, for which the design proposition suggests a certain Intervention type, to produce, through specified generative Mechanisms, the intended Outcome(s). The context describes the environment within which change occurs, the intervention is what influences a change, the mechanism is triggered by the intervention and this produces the outcome."

**Table 1 Context, Intervention, Mechanism and Outcome**

<b>Context</b>	<ul style="list-style-type: none"> <li>▪ The configuration of Public Health structures within one of the eligible countries as per the 12 essential Public Health functions.*</li> </ul>
<b>Intervention</b>	<ul style="list-style-type: none"> <li>▪ Event/circumstances that triggered the need to reform configuration of Public Health structures, for example COVID-19 pandemic.</li> </ul>
<b>Mechanism</b>	<ul style="list-style-type: none"> <li>▪ Changes/reforms made to the configuration of Public Health structures (within the last five years to ensure currency of the data included).</li> </ul>
<b>Outcome</b>	<ul style="list-style-type: none"> <li>▪ New configuration of Public Health structures in place as per the 12 essential Public Health functions</li> <li>▪ Lessons learned with regard to the establishment of, or transition to, new Public Health structures in that country, and their suitability in light of the COVID-19 pandemic.</li> </ul>

\*The 12 essential Public Health functions, as defined by the World Health Organization, are described in [Section 2.2](#).

Non-English documents and websites from the included EU member states were translated where necessary via Google Translate, with this noted as a potential caveat.

## 2.2 Data collection

The essential Public Health functions (EPHFs), as defined by the WHO,<sup>(11)</sup> are a set of interconnected and interdependent activities, they are:

1. Monitoring and evaluating populations health status, health service utilisation and surveillance of risk factors and threats to health
2. Public Health emergency management
3. Assuring effective Public Health governance, regulation, and legislation
4. Supporting efficient and effective health systems and multisectoral planning, financing, and management for population health
5. Protecting populations against health threats, including environment and occupational hazards, food safety, chemical and radiation hazards
6. Promoting prevention and early detection of diseases including non-communicable and communicable diseases
7. Promoting health and wellbeing and actions to address the wider determinants of health and inequity
8. Ensuring community engagement, participation and social mobilization for health and wellbeing
9. Ensuring adequate quantity and quality of Public Health workforce

10. Assuring quality of and access to health services
11. Advancing Public Health research
12. Ensuring equitable access to and rational use of essential medicines and other health technologies.

The first step in the data collection process was to map the 12 EPHFs to the four pillars of Public Health<sup>(12)</sup>:

- Health protection: the prevention and control of infectious disease and environmental and radiation risks, and emergency response to major incidents and health threats.
- Health promotion and well-being: developing an integrated approach to promoting health and preventing disease, with a particular emphasis on health inequalities.
- Health intelligence: using population health surveillance and monitoring of trends, and using an evidence-based assessment of policies, programmes, and services to inform health planning.
- Health service improvement: working towards delivering effective, efficient, and accessible health services.

For RQ1, data describing the configuration and functioning of Public Health systems and structures were extracted from official documents, reports and peer-reviewed publications and mapped to the 12 EPHFs. Data extraction was completed by one reviewer and checked for inaccuracies or omissions by a second reviewer. There was no quantitative assessment of the quality and or standard of EPHF delivery undertaken as part of this report.

For RQ2, relevant data describing the lessons learned with regard to the establishment of, or transition to, new Public Health structures (within the last five years to ensure currency of the data included) in that country, and their suitability in light of the COVID-19 pandemic were extracted from organisations' websites, official documents, reports and peer-reviewed publications. Data extraction was completed by one reviewer and checked for inaccuracies or omissions by a second reviewer.

### **2.3 Data verification by key representatives and analysis**

Key representatives from national level Public Health organisations in each of the 12 countries were contacted by email and invited to participate in the project. For those who did not respond to the initial invitation, reminder emails were sent weekly for

three weeks. Participation included reviewing the extracted data for RQ1 and participating in a semi-structured interview to collect data for RQ2. The purpose of these steps was to both verify and supplement the extracted data. Informed consent was obtained from interviewees.

Those that consented to participate were sent a summary of the data extracted for RQ1 and invited to verify and, where necessary, supplement it. They were also sent an invitation to attend an interview for RQ2. The interview was semi-structured and an interview topic guide was developed, piloted and refined as necessary; the interview topic guide is available in the [protocol](#). The focus of the interview was to understand recent, ongoing or planned changes to Public Health systems and structures, including their suitability to COVID-19 pandemic preparedness. The interviews considered changes brought about both by surge capacity protocols and those aimed at reform Public Health structures on a permanent basis. The questions broadly related to:

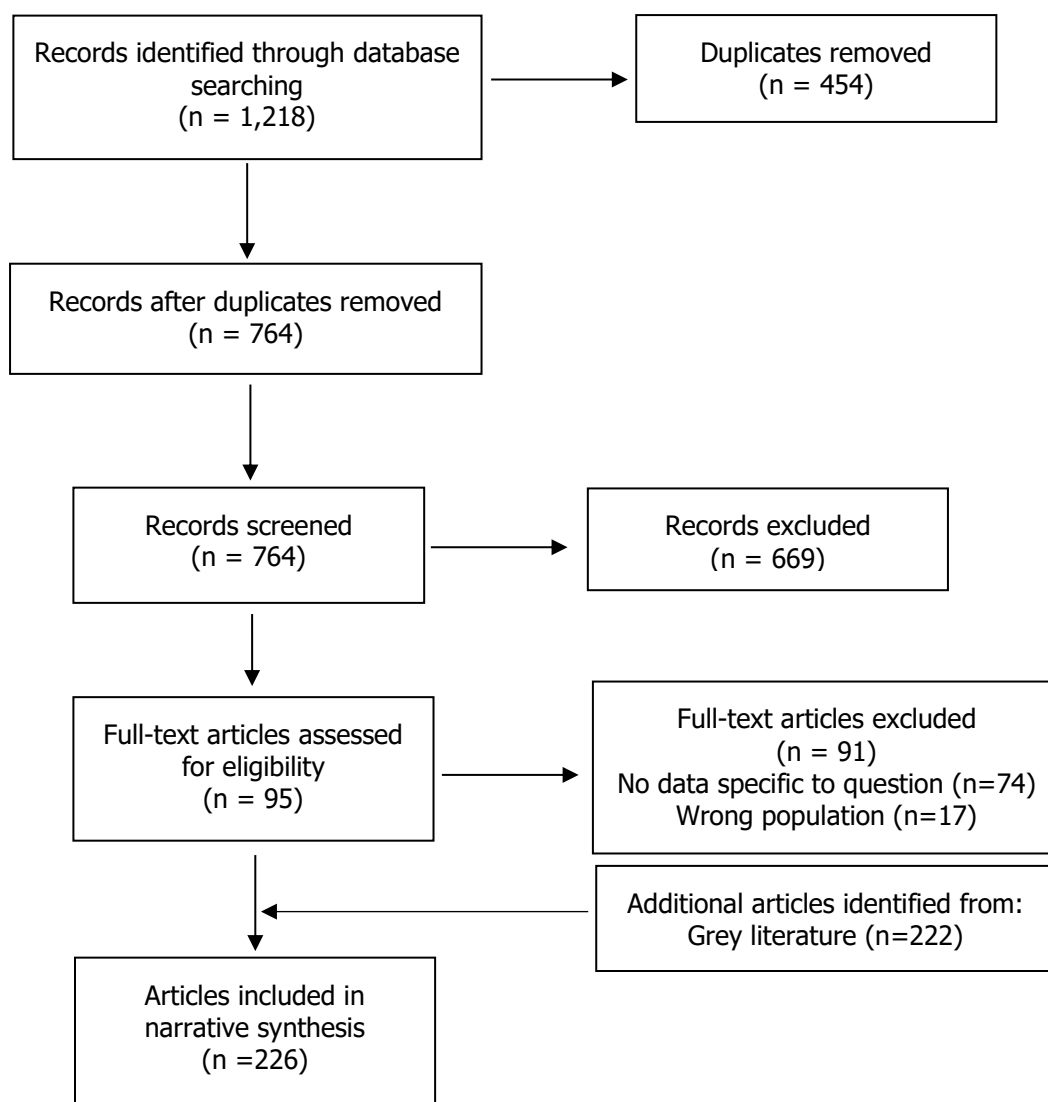
- pre-COVID-19 pandemic Public Health structures
- changes to Public Health structures during the COVID-19 pandemic
- Public Health structures planned for the post-COVID-19 pandemic period.

The interviews were conducted remotely via Zoom with a minimum of three team members present during the interview (one main interviewer and two note takers). Interviews were recorded but not transcribed. Interviews were on average 60 minutes long. Using a deductive approach, thematic data analysis was conducted following a six step process.<sup>(13)</sup> One researcher reviewed the interview notes and recordings to familiarise themselves with the data and conduct verification of the interview data compared with data extracted from organisations' websites and from the electronic database and grey literature searches. Direct participant quotes were not included within the report. Themes identified related to post-pandemic evaluation and reform were identified. There were no themes relating to pre-pandemic identified. All themes were checked by a second reviewer.

### 3 Results

Across all the databases searched, the collective search up until 14 February 2022 resulted in 1,218 citations. Following removal of duplicates, 764 citations were screened for relevance, with 95 full-texts assessed for eligibility and 91 subsequently excluded. An additional 222 articles were identified from grey literature searching. In total, 226 articles were included in the narrative synthesis. See [Figure 1](#) for a PRISMA flow diagram of the articles included in this report.

**Figure 1. PRISMA flow diagram of included studies**



The number of articles included for each country ranged from n=7 (Sweden) to n=27 (Finland); see [Table 2](#).

Of the 12 key representatives contacted, six (Denmark, Finland, Northern Ireland, Sweden, the Netherlands and Wales) verified the data for RQ1 and participated in the interview for RQ2, three (England, New Zealand and Scotland) did not verify the data for RQ1, but participated in the interview for RQ2, and three (Australia, Canada and Norway) declined to participate (that is, did not verify data for RQ1 or participate in the interview for RQ2); see [Table 2](#).

**Table 2. Summary of articles identified, verification of data and participation in interviews**

	Number of articles included	Key representative verified RQ1 data	Key representative participated in RQ2 interview
Australia	14	No	No
Canada	17	No	No
Denmark	24	Yes	Yes
Finland	27	Yes	Yes
Netherlands	17	Yes	Yes
New Zealand	14	No	Yes
Norway	22	No	No
Sweden	7	Yes	Yes
England	26	No	Yes
Northern Ireland	12	Yes	Yes
Scotland	12	No	Yes
Wales	19	Yes	Yes

### 3.1 Research question 1: Configuration of public health systems

For RQ1, the results are reported in three main sections:

- a summary of how the 12 EPHFs map to the four pillars of Public Health
- an overview of Public Health structures within each country
- a description of the delivery of the EPHFs at national, regional and local levels.

#### 3.1.1 Mapping essential Public Health functions to the pillars of Public Health

There is considerable overlap in mapping the EPHFs to the four pillars of Public Health. As such, the EPHFs represent an integrated approach to sustainable health



system strengthening. [Table 3](#) provides a summary of how the 12 EPHFs were mapped to the four pillars of Public Health. Mapping was undertaken by the evaluation team in consultation with a specialist in Public Health. The purpose of the mapping exercise was to provide a pragmatic means of presenting the data under a limited number of headings.

**Table 3 Summary of how the 12 essential Public Health functions map to the four pillars of Public Health**

Essential Public Health Function	Health protection	Health promotion and well-being	Health intelligence	Health service improvement
1. Monitoring and evaluating populations health status, health service utilisation and surveillance of risk factors and threats to health	✓		✓	✓
2. Public Health emergency management	✓		✓	
3. Assuring effective Public Health governance, regulation, and legislation	✓	✓	✓	✓
4. Supporting efficient and effective health systems and multisectoral planning, financing, and management for population health		✓	✓	✓
5. Protecting populations against health threats, including environment and occupational hazards, food safety, chemical and radiation hazards	✓		✓	
6. Promoting prevention and early detection of diseases including non-communicable and communicable diseases	✓	✓		
7. Promoting health and wellbeing and actions to address the wider determinants of health and inequity		✓		✓
8. Ensuring community engagement, participation and social mobilization for health and wellbeing		✓		✓
9. Ensuring adequate quantity and quality of Public Health workforce			✓	✓
10. Assuring quality of and access to health services			✓	✓
11. Advancing Public Health research				✓
12. Ensuring equitable access to and rational use of essential medicines and other health technologies			✓	✓

### **3.1.2 Overview of Public Health structures in each country**

Data relating to the Public Health structures in each country were primarily gathered from organisational websites and documents identified from the electronic database and grey literature searches. Key representatives verified and, if necessary, supplemented the collected data. However, we were unable to recruit key representatives from all countries, and some participants did not verify the data extracted. Therefore, the descriptions of Public Health structures of five countries (Australia, Canada, England, New Zealand, Norway and Scotland) are solely based on information available in the public domain. It was noted that some Public Health functions are delivered UK-wide for the UK countries (England, Northern Ireland, Scotland and Wales). A high level summary of the Public Health structures in each of these individual countries is provided below.

#### **Australia**

There are three levels of government that are collectively responsible for providing universal healthcare, namely, federal, state and local.<sup>(14)</sup> The federal government is responsible for regulating private health insurance, pharmaceuticals, and therapeutic goods; however, it has a limited role in direct service delivery. States (n=6) are responsible for the management of service delivery for public hospitals, ambulances, public dental care, community health (primary and preventive care), and mental health care. Local governments play a role in the delivery of community health and preventive health programmes, such as immunisations and the regulation of food standards.<sup>(14)</sup>

Up until May 2020, intergovernmental collaboration and decision-making occurred through the Council of Australian Governments (COAG), with representation from the Prime Minister and the First Ministers of each state. However, the establishment of the National Federation Reform Council (NFRC) saw the cessation of the COAG.<sup>(15)</sup> The NFRC is largely comprised of the same representatives with the addition of treasurers from each jurisdiction and the President of the Australian Local Government Association. The NFRC discusses and tackles issues such as emergency management in relation to the COVID-19 pandemic, climate change and economic issues, such as unemployment.<sup>(15)</sup>

#### **Canada**

The health of Canada's population is the responsibility of the Minister of Health. The Minister is supported in this by the Health Portfolio.<sup>(16)</sup> The Health Portfolio is an institution that consists of several governmental departments, namely, Health

Canada, the Public Health Agency of Canada, the Canadian Institutes of Health Research, the Patented Medicine Prices Review Board and the Canadian Food Inspection Agency.<sup>(16)</sup> Health Canada is the governmental department responsible for national health policy. They work to reduce health risks by ensuring high quality health services are accessible. The federal government works with organisations within the Health Portfolio, other federal departments and agencies, non-governmental organisations, other countries, indigenous partners and the private sector to maintain and improve health.<sup>(16)</sup> The Public Health Agency of Canada's work focuses on preventing disease and injuries, responding to public health threats, promoting good physical and mental health, and providing information to support informed decision making.<sup>(17)</sup>

Through the Department of Health Act and the Public Health Agency of Canada Act, the federal government legislates aspects of Public Health.<sup>(18)</sup> The organisation of Public Health systems varies across Canada's 13 provincial and territorial jurisdictions. Provincial governments administer budgets, provide technical assistance and support planning. They are also responsible for coordinating regional health authorities and municipal or local Public Health units across the country. There are approximately 80 of these authorities and units; they deliver Public Health services directly to local populations.<sup>(19)</sup>

## **Denmark**

The Danish healthcare system has a universal coverage system financed via taxes; this provides free and equal access to healthcare for all citizens.<sup>(20)</sup> The health system as a whole operates across three political and administrative levels, namely, the state, regions and municipalities (that is, at national, regional and local levels). Regional and local governments deliver healthcare, while planning and regulation are overseen nationally.<sup>(20)</sup> The Ministry of Health is responsible for defining the overall framework for the national healthcare system and health-related social services for the elderly. This includes legislation on formulating national health policies, the provision of healthcare and the responsibilities of the regions and municipalities.<sup>(20)</sup> There are several agencies that sit under the Ministry of Health, including, the Danish Health Authority<sup>(21)</sup> (also referred to as the National Board of Health), Danish Medicines Agency,<sup>(22)</sup> Danish Agency for Patient Safety,<sup>(23)</sup> Danish Health Data Authority<sup>(24)</sup> and Statens Serum Institut.<sup>(25)</sup> As per the Danish Health Act 2005 (Sundhedsloven),<sup>(26)</sup> the above agencies are tasked with the intelligence-oriented health services and the enabler functions of regulation, planning, and supervision. They have high-level responsibility for the core Public Health functions, delegating

many of the responsibilities to the municipalities such as financing, and delivery of Public Health and health promotion.

There are five regions within Denmark.<sup>(27)</sup> Danish Regions is the independent umbrella organisation that represents the five regional authorities and negotiates the annual financial framework with the national government.<sup>(27)</sup> At the end of 2020, the Danish Regions secured increased resources for preventive healthcare to improve access to services, and to increase the decision-making capacity of the regions and municipalities.<sup>(28)</sup> The 98 municipalities in Denmark are local administrative bodies governed by municipal councils.<sup>(29)</sup> In line with guidance from the government, the municipalities are responsible for implementing disease prevention and health promotion policies and a number of health and social services. General practitioners (GPs) are the gateway for citizens to access preventive health services and treatment and act to coordinate services provided to their patients from various health professionals.

## **Finland**

Finland's healthcare system is decentralised. At a national level, the Ministry of Social Affairs and Health,<sup>(30)</sup> which is part of the Finnish Government, is in charge of the planning and implementation of health and social policy. Its functions include preparing legislation and budgets, and working with the Finnish Institute for Health and Welfare to plan, guide and supervise primary healthcare and specialised medical care. The Finnish Institute for Health and Welfare<sup>(31)</sup> is an independent expert agency working under the Ministry of Social Affairs and Health, it monitors the welfare of the population, provides health guidance to the population, conducts research and development work, functions as a statistical authority and engages in international co-operation.<sup>(30)</sup>

Mainland Finland has six Regional State Administrative Agencies.<sup>(32)</sup> Some of their functions include, providing direction and oversight of healthcare services, supervising healthcare professionals, communicating on national occupational safety and health, supervising environmental health issues and oversight of health protection. Municipalities are responsible for organising primary healthcare for their residents. This is delivered in accordance with the national guidelines and includes health promotion, health counselling, health checks, screening, school-based healthcare and environmental healthcare.<sup>(30)</sup>

## **Netherlands**

The Dutch national government is responsible for Public Health, including its regulation, funding, supervision and international collaboration.<sup>(33)</sup> It also provides direction and outlines the priorities for Public Health policy-making. It leads the response to Public Health emergencies and oversees screening and vaccination programmes.<sup>(33)</sup> The Ministry of Health, Welfare and Sport<sup>(34)</sup> has responsibility for developing Public Health policy, legislation and regulation, health inspection, providing fiscal resources for national government healthcare infrastructure and determining the scope of the statutory health insurance package available to all Dutch residents. The National Institute for Public Health and the Environment (RIVM),<sup>(35)</sup> Central Information Point for Health Care Professions (CIBG),<sup>(36)</sup> Medicines Evaluation Board<sup>(37)</sup> and Health and Youth Care Inspectorate<sup>(38)</sup> all report to the Ministry of Health, Welfare and Sport.<sup>(34)</sup>

There are currently 25 regional Public Health services. Regional authorities have a restricted role in setting their own Public Health policy priorities. The 25 Public Health services serve 344 municipalities.<sup>(33)</sup> Municipalities only carry out tasks that directly affect local residents.<sup>(39)</sup> The responsibilities of the municipalities include, but are not limited to: providing preventative healthcare and social care at a local level, providing healthcare services for the elderly and chronically ill and providing some financial contribution to public health financing.<sup>(40)</sup>

## **New Zealand**

In New Zealand, policy for health and disability is developed and overseen by the Minister of Health, supported by the Cabinet and government. The Minister is supported by the Ministry of Health and the District Health Boards (DHBs).<sup>(41)</sup> The Ministry of Health (which is the strategic prioritisation function) advises the Minister, as do other ministerial advisory committees such as Health Workforce New Zealand. Most of the day-to-day business of the system, and around three quarters of the funding, is administered by DHBs.<sup>(42)</sup> DHBs plan, manage, provide and purchase health services for the population of their district. This includes funding for primary care, hospital services, Public Health services, aged care services, and services provided by other non-government health providers including Māori and Pacific providers.<sup>(42)</sup>

Public Health services are delivered by Public Health units (PHUs).<sup>(43)</sup> These units are the responsibility of DHBs and their services are funded by the Ministry of Health. Some PHUs cover more than one district health board area to provide the most effective coverage across an area. Each PHU contract usually includes a component that requires the delivery of services to Māori and other specific ethnic populations.

PHUs deliver both health protection and health promotion activities, such as monitoring food and safety and providing information to the public about nutrition and physical activity.<sup>(43)</sup>

## **Norway**

The Ministry of Health and Care Services is responsible for delivering health and care services for the people of Norway.<sup>(44)</sup> The Department of Public Health is a department within the Ministry of Health and Care Services. Its main responsibilities relate to preventive health and health promotion, health surveillance, nutrition and food safety and alcohol, drug and tobacco issues. The Department of Public Health also has responsibility for including mental health as an integral aspect of Public Health work.<sup>(44)</sup> The Norwegian Institute of Public Health<sup>(45)</sup> is a subordinate agency of the Department of Public Health. The Norwegian Institute of Public Health works across five areas, namely, infection control, mental and physical health, health data and digitisation, health services and climate and environment.

There are four regional health authorities, the Central, Northern, Southern and Eastern, and Western Norway Regional Health Authorities.<sup>(46)</sup> These regional health authorities are responsible for hospitals and their pharmacies, laboratories, psychiatric services, ambulance services and emergency telephone operations. Municipalities are responsible for primary care and Public Health. As such, they implement measures to address Public Health challenges like childhood environments and living conditions, housing, education, employment and income, physical and social environments, physical activity and nutrition, as well as injuries and accidents, tobacco use, alcohol use and use of other psychoactive substances.<sup>(46)</sup>

## **Sweden**

Healthcare in Sweden is decentralised. The decentralisation of healthcare is regulated by the Health and Medical Service Act.<sup>(47)</sup> The role of the central government is to establish principles and guidelines, and to set the political agenda for health and medical care. The National Board of Health and Welfare<sup>(48)</sup> is a government agency under the Ministry of Health and Social Affairs<sup>(49)</sup> that compiles information and develops standards to ensure good health, social welfare and high-quality health and social care for the whole population.

The implementation of Public Health policy is coordinated at the national level, but much of the responsibility for implementation lies with regional and county councils (with regard to health services) and municipalities (with regard, for instance, to

environmental issues, physical planning, school education and other social services). Sweden is divided into 290 municipalities and 21 regional councils.

## **England**

Responsibility for publicly funded healthcare rests with the Secretary of State for Health, who is accountable to the UK Parliament. The Department of Health and Social Care (DHSC)<sup>(50)</sup> is the central government body responsible for setting policy on the National Health Service (NHS), Public Health, adult social care and other related areas.

In October 2021, there was a re-organisation from Public Health England to the UK Health Security Agency (UKHSA)<sup>(51)</sup> and Office for Health Improvement and Disparities (OHID).<sup>(52)</sup> The UKHSA has a leadership role in protecting the public's health, supporting the Public Health system to be ready for threats through working with the DHSC, the Office for Health Improvement and the Disparities, Transformation Directorate (who lead on health and social care data policy), central government departments, local government, devolved administrations, the wider NHS and health and social care partners. The health protection capabilities of Public Health England and NHS Test and Trace were also combined into the UKHSA. Also in 2021, NHS Digital and NHSX were incorporated into NHS England and NHS Improvement.<sup>(53)</sup> NHSX is a UK Government unit with responsibility for setting national policy and developing best practice for National Health Service technology, digital and data, including data sharing and transparency.

Healthwatch committees are patient and public involvement bodies.<sup>(54)</sup> These exist at the local level and are supported by local authorities. A national Healthwatch England committee has a clear mandate to be involved with and contribute to preventive and Public Health measures.<sup>(54)</sup> The OHID supports the delivery of national and regional priorities for prevention and health inequalities and ensures a joined-up approach to Public Health, with different teams and areas of Public Health across the regional system. There are seven regional health boards in England (East of England, London, Midlands, North East and Yorkshire, North West, South East, South West) who support local systems to provide consistent and sustainable care for patients.<sup>(55)</sup> Regional teams are responsible for the quality, financial and operational performance of all NHS organisations in their region. They also support the identity and development of sustainability and transformation partnerships and integrated care systems.<sup>(55)</sup>



Local health policy is coordinated through local Health and Wellbeing Boards, these are led by local authorities. Local authorities are expected to produce a health and wellbeing strategy. This is agreed and adopted by the Health and Wellbeing Board to produce joint strategic needs assessments, which form the basis for their priority setting.<sup>(56)</sup>

## **Northern Ireland**

The Department of Health is a department in the Northern Ireland Executive, the devolved government in Northern Ireland.<sup>(57)</sup> The Minister of Health has overall responsibility for the department. The Department of Health discharges the duty of service commissioning and provision to the Health and Social Care Board (HSCB)<sup>(58)</sup> and the Public Health Agency (PHA)<sup>(59)</sup> and to a number of other health and social care (HSC) bodies created to exercise specific functions on its behalf. All these HSC bodies are accountable to the Department of Health which in turn is accountable, through the Minister, to the Executive.<sup>(60)</sup> The PHA and HSCB is responsible and accountable for commissioning of services, resource allocation and performance management.

## **Scotland**

Public Health Scotland<sup>(61)</sup> is the national Public Health body and is Scotland's lead national agency for improving and protecting health and wellbeing. Public Health Scotland comprises NHS Health Scotland,<sup>(62)</sup> Health Protection Scotland<sup>(63)</sup> and the Information Services Division.<sup>(64)</sup> It is jointly sponsored by the Scottish Government<sup>(65)</sup> and the Convention of Scottish Local Authorities (COSLA)<sup>(66)</sup> and collaborates across the public sector. The functions of Public Health Scotland include sharing data and intelligence, protecting health, improving health and wellbeing and improving services.

NHS Scotland consists of 14 regional NHS Boards<sup>(67)</sup> which are responsible for the protection and the improvement of their population's health and for the delivery of frontline healthcare services. Each regional health board provides a comprehensive range of health services to their area.

## **Wales**

The Welsh Government<sup>(68)</sup> is responsible for making legislation, policy and investment decisions on matters regarding health, which is a fully devolved function. There are seven local health boards. Each local health board is responsible for NHS services within their specified geographical area. They are responsible for promoting wellbeing, improving physical and mental health outcomes, reducing health

inequalities across their population and commissioning services to meet the needs of their residents.<sup>(69)</sup> Health Boards, within their area are also responsible for the planning, delivery and funding of primary care services, community services (including those provided through community health centres and mental health services) and hospital services for inpatients and outpatients.<sup>(69)</sup>

### **3.1.3 Delivery of essential Public Health functions**

As described in [Section 3](#), for Australia, Canada, England, the Netherlands, New Zealand, Norway and Scotland, descriptions of the delivery of the 12 EPHFs at national, regional and local levels are solely based on information available in the public domain. As such, the absence of a description relating to delivery of an EPHF at a specific level, should not be interpreted as a lack of delivery at that level.

[Table 4](#) provides a summary of which EPHFs are delivered at national, regional or local level within each country. All 12 functions are delivered at a national level, with variation within countries as to whether regional and local delivery also occurs, as described in the following sections. It is noted however that the terminology used by the included countries differed. For example, Australia, described federal, state and territory level delivery, and Canada described federate, territory and province; these were equated with national, regional and local level delivery, respectively. In Sweden, county councils and municipalities were equated with regional and local level delivery, respectively. The UK, England, Northern Ireland, Scotland and Wales were all considered as individual nations, with UK-wide delivery being highlighted, were relevant.

**Table 4 Summary of the delivery of the essential Public Health functions at national, regional and local levels within each country**

	Surveillance	Emergency management	Governance and Regulation	Planning and financing	Health threats	Disease prevention	Health promotion	Engagement	Adequate workforce	Quality and access	Research	Medicines access
<b>Australia</b>	N	N, R	N	N	N, R, L	N, R, L	N, L	N	N	N	N	N
<b>Canada</b>	N	N	N	N, R, L	N	N	N	N	N	N, R	N	N
<b>Denmark</b>	N	N, R, L	N	N, R	N, R, L	N, R, L	N	N, R, L	N	N	N	N
<b>Finland</b>	N, R	N, R	N, R	N, R, L	N, R, L	N, R, L	N, R, L	N, L	N, R, L	N, L	N	N
<b>Netherlands</b>	N, R, L	N, R, L	N	N, R	N	N, R, L	N	N, R	N	N	N	N, R
<b>New Zealand</b>	N	N, R	N	N, R	N	N, R, L	N	N	N	N	N	N
<b>Norway</b>	N	N, L	N	N	N	N, L	N	N	N	N	N, R	N
<b>Sweden</b>	N	N	N	N, R, L	N, R, L	N	N	N	N	N, R, L	N	N
<b>England*</b>	N	N, L	N	N	N, L	N, R, L	N, R, L	N, L	N	N	N	N
<b>Northern Ireland*</b>	N	N	N	N, L	N	N	N	N	N	N	N	N
<b>Scotland*</b>	N	N, L	N	N	N	N	N	N, L	N	N	N	N, L
<b>Wales*</b>	N	N	N	N, L	N, L	N	N, L	N	N	N	N	N

Key: L, Local; N, National; R, Regional. \*Some EPHFs are delivered at a UK-wide level

## **Essential Public Health function 1 (Surveillance)**

Essential Public Health function 1 is, *"Monitoring and evaluating populations' health status, health service utilisation and surveillance of risk factors and threats to health."* All 12 countries described the delivery of this function at a national level; Finland also described the delivery of this function at a regional level, and the Netherlands described delivery at a regional and local level. Typically, across all countries, this function is overseen by the government in collaboration with governmental agencies and or organisations. For example, in Canada, Finland and New Zealand, it is the respective Ministries of Health; in Denmark, the Netherlands and Norway, it is the Statens Serum Institut, National Institute for Public Health and the Environment and Norwegian Institute of Public Health, respectively; these organisations are governmental Public Health and research institutions operating under their respective Ministries of Health. In Northern Ireland, Scotland, Sweden and Wales, Public Health agencies are responsible for this function; they are accountable to the government in their respective country. In England, it is the UK Health Security Agency (UKHSA), the agency that replaced Public Health England in October 2021, and the Office for Health Improvement and Disparities (OHID). In Australia, the National Cabinet (which is the Australian intergovernmental decision-making forum), supported by several committees, is responsible for this function.

## **Essential Public Health function 2 (Emergency management)**

Essential Public Health function 2 is, *"Public Health emergency management."* All 12 countries described the delivery of this function at a national level; Australia, Denmark, Finland, the Netherlands and New Zealand also described delivery at a regional level. Denmark, England, the Netherlands, Norway and Scotland also described the delivery of this function at a local level. Typically, across all countries, this function is overseen by the government in collaboration with governmental agencies and or organisations; some countries also detailed the role of regional and local authorities such as the District Health Boards in New Zealand. Specifically, this function is overseen by relevant ministerial committees in Australia (Australian Health Protection Principal Committee), Canada (Health Portfolio), England (Department of Health and Social Care), Finland (Ministry of Social Affairs and Health), the Netherlands (Ministry of Health), New Zealand (Ministry of Civil Defence and Emergency Management and Ministry of Health), Northern Ireland (Department of Health) and Norway (Ministry of Justice and Public Security); relevant Public Health agencies in Canada (Public Health Agency Canada), Denmark (Danish Health Authority), Northern Ireland (Public Health Agency), Scotland (Health Protection Scotland), Sweden (Public Health Agency of Sweden) and Wales (Public Health Wales); governmental organisations operating under their respective Ministries of Health in Denmark (Statens Serum Institut), England (Joint Biosecurity Centre), the

Netherlands (National Institute for Public Health and the Environment), Sweden (National Board of Health and Welfare) and the UK Health Security Agency (which is UK-wide).

### **Essential Public Health function 3 (Governance and Regulation)**

Essential Public Health function 3 is, *"Assuring effective Public Health governance, regulation, and legislation."* All 12 countries described the delivery of this function at a national level; Finland also described the delivery of this function at a regional level. This function is overseen by various agencies and or organisations that report to the national government within that country. In Denmark, Finland, the Netherlands, New Zealand, Norway and Sweden, this function is overseen by the Ministries of Health in collaboration with their relevant agencies (Danish Health Authority, Danish Data Protection Agency and Danish Society for Patient Safety (Denmark), National Supervisory Authority for Welfare and Health and Regional State Administrative Agencies (Finland), National Healthcare Authority (the Netherlands), District Health Boards (New Zealand) and National Board of Health and Welfare (Sweden)). Across all four UK countries, it is the respective Public Health agencies (or UKHSA in England) in collaboration with the Care Quality Commission (England), Business Services Organisation (Northern Ireland), Care Inspectorate (Scotland) and Healthcare Inspectorate Wales.

### **Essential Public Health function 4 (Planning and financing)**

Essential Public Health function 4 is, *"Supporting efficient and effective health systems and multisectoral planning, financing, and management for population health."* All 12 countries described the delivery of this function at a national level. Canada, Denmark, Finland, the Netherlands, New Zealand and Sweden also described the delivery of this function at a regional level; Canada, Finland, Northern Ireland, Sweden and Wales described it at a local level. While decisions relating to this EPHF are made at a national level by the government in collaboration with governmental agencies and or organisations, these decisions are informed by data from regional and local levels. Specifically, this function is overseen by relevant ministerial committees in Australia (National Cabinet and Health Chiefs Executive Forum), Finland (Ministry of Social Affairs and Health), the Netherlands (Ministry of Health, Welfare and Sport), New Zealand (Ministry of Health), Norway (Ministry of Health and Care Services), and Sweden (Ministry of Health and Social Affairs) and relevant Public Health agencies in Canada (Public Health Agency Canada), Denmark (Danish Health Authority), Northern Ireland (Public Health Agency) and Scotland (Public Health Scotland). Data from regional and local levels to inform these decisions come from state and territory authorities in Australia, Danish Regions (Denmark), Municipalities (Finland), Regional Public Health Services (the Netherlands), District Health Boards (New Zealand), the Health and Social Care

Board and Local Commissioning Groups (Northern Ireland) and local health boards (Wales). In England, the NHS Business Services Authority manages over £35 billion of NHS spend annually delivering a range of national services to NHS organisations, NHS contractors, patients and the public.

### **Essential Public Health function 5 (Health threats)**

Essential Public Health function 5 is, *"Protecting populations against health threats, including environment and occupational hazards, food safety, chemical and radiation hazards."* All 12 countries described the delivery of this function at a national level; Australia, Denmark, Finland and Sweden also described this function at a regional and local level. England and Wales also described the delivery of this function at a local level. All 12 countries delivered elements of this function through relevant national agencies. Some examples of these are in Australia (Australian Radiation Protection and Nuclear Safety Agency), Canada (Health Canada and Canadian Food Inspection Agency), Denmark (Danish Health Authority, the Danish Veterinary and Food Administration), Finland (Finnish Institute of Health and Welfare, Finnish Food Agency and Finnish Institute of Occupational Health), the Netherlands (Centre for Zoonosis and Environmental Biology), New Zealand (Environmental Protection Authority), Norway (Norwegian Food Safety Authority, the National Institute of Occupational Health), Sweden (Public Health Agency), England (National Infection Service), Northern Ireland (Health Protection Service within the Public Health Agency), Scotland (Health Protection Scotland, Food Standards Scotland) and Wales (Health and Safety Executive). In some countries, government ministries are responsible for the delivery of some elements of the EPHF; for example, in Australia (Department of Agriculture, Water and the Environment); Finland (Ministry of Social Affairs and Health); and in New Zealand, three ministries, specifically the Ministry of Health, the Ministry of Social Development, and the Ministry for the Environment are responsible for elements of this EPHF. As noted, this function is also delivered at a local or regional level in a number of countries. Examples include delivery in Denmark (local municipalities), Finland (Regional State Administrative Agencies), Sweden (county administrations and municipal Environment and Health Protection Committees), England (local health protection teams) and Wales (local Environmental Health Officers).

### **Essential Public Health function 6 (Disease prevention)**

Essential Public Health function 6 is, *"Promoting prevention and early detection of diseases including non-communicable and communicable diseases."* All 12 countries described the delivery of this function at a national level; six countries, Australia, Denmark, England, Finland, Netherlands and New Zealand also described the delivery of this function at a regional and local level. Norway described the delivery of this function at a local level. All 12 countries delivered elements of this function

through relevant national agencies. Some examples of these are the Communicable Diseases Network Australia, Public Health Agency of Canada, Ministry of Health (Denmark), National Board of Health (Denmark), Danish Health Authority, Statens Serum Institut (Denmark), Finnish Institute of Health and Welfare, Centre for Population Screening (the Netherlands), Centre for Research Infectious Diseases Diagnostics and Screening (the Netherlands), National Screening Unit within the Ministry of Health (New Zealand), Norwegian Institute of Public Health's Division of Infection Control and Environmental Health, Cancer Registry of Norway, Norwegian Directorate of Health, National Board of Health and Welfare (Sweden), Public Health Agency of Sweden, Office for Health Improvement and Disparities (England), Public Health Agency (Northern Ireland), Department of Health (Northern Ireland), Public Health Scotland and Public Health Wales. Additionally, UK-wide provision of this EPHF was delivered by the UK National Screening Committee which is part of Department of Health and Social Care (England), Welsh Government, Scottish Government, and Northern Ireland Department of Health, as well as the Joint Committee on Vaccination and Immunisation. This function was also delivered regionally; examples include the District Health Boards in New Zealand and Integrated Care Systems in England.

### **Essential Public Health function 7 (Health promotion)**

Essential Public Health function 7 is, *"Promoting health and wellbeing and actions to address the wider determinants of health and inequity."* All 12 countries described the delivery of this function at a national level; England and Finland also described the delivery of this function at a regional and local level (Clinical Commissioning Groups and Integrated Care Systems (England), and regional and local authorities (Finland)). Australia and Wales also described the delivery of this function at a local level (Primary Health Networks (Australia) and local health boards (Wales)). All 12 countries delivered elements of this function through relevant national agencies. Some examples of these are the Australian Institute of Health and Welfare, Public Health Agency of Canada, National Board of Health (Denmark), National Institute of Public Health (Denmark), Danish Health Authority, National Institute for Public Health and the Environment (the Netherlands), Health Promotion Agency (New Zealand), Research Council of Norway, Norwegian Institute of Public Health, Public Health Agency of Sweden, Office for Health Improvement and Disparities (England), Health and Social Wellbeing Improvement within the Public Health Agency (Northern Ireland), Scottish Public Health Observatory, Public Health Scotland, NHS Health Scotland, Public Health Wales and the Centre for Population Health and Wellbeing Research (Wales). In some countries, government ministries are responsible for the delivery of some elements of the EPHF; for example, the Ministry of Social Affairs (Finland) and Ministry of Health (New Zealand).

## **Essential Public Health function 8 (Engagement)**

Essential Public Health function 8 is, “*Ensuring community engagement, participation and social mobilization for health and wellbeing.*” All 12 countries described the delivery of this function at a national level; Denmark and the Netherlands also described the delivery of this function at a regional level (Danish Regions and Regional Public Health services in the Netherlands). Denmark, England, Finland and Scotland also described the delivery of this function at a local level. All 12 countries delivered elements of this function through relevant national agencies. Some examples of these are the Australian Department of Health, Canadian Institutes of Health Research, National Board of Health (Denmark), Danish Patients, National Board of Health (Denmark), Knowledge Center for User Involvement in the Health Service, Research Council (Norway), Public Health Agency of Sweden, Lausuntopalvelu (Finland), NHS Assembly (England), National Institute for Health Research (England), National Institute for Health and Care Excellence (England), Care Quality Commission (England), Healthwatch committees (England) and Public Health Wales. In some countries, government ministries are responsible for the delivery of some elements of the EPHF; for example, Ministry of Health (Denmark), Ministry of Health Welfare and Sport (the Netherlands), Ministry of Health (New Zealand), Health and Social Wellbeing Improvement within the Public Health Agency (Northern Ireland).

## **Essential Public Health function 9 (Adequate workforce)**

Essential Public Health function 9 is, “*Ensuring adequate quantity and quality of Public Health workforce.*” All 12 countries described the delivery of this function at a national level; Finland also described the delivery of this function at a regional and local level. Overall EPHF 9 is overseen by national agencies (for example Ministries of Health, Public Health agencies and research institutes), all of which report to the government within their country. In Denmark, it is the Danish Health Authority, in New Zealand, it is the Health Workforce Directorate and in Sweden, it is the Swedish Agency for Health and Care Services Analysis (all of which are within the respective Ministries of Health). In Canada and Scotland the respective Public Health agencies are responsible for ensuring adequate quantity and quality of Public Health workforce. In Finland and the Netherlands, research institutes (Government Economic Research Institute in Finland and the Netherlands Institute for Health Services Research) develop forecasts on future workforce including health workforce and related educational needs. In Northern Ireland, the Department of Health are responsible for workforce planning, through their regional workforce planning group. Additionally, there are various educational organisations, for example, Health Education England, NHS Education for Scotland and Health Education and



Improvement Wales that are responsible for planning and implementing workforce training.

### **Essential Public Health function 10 (Quality and access)**

Essential Public Health function 10 is, "*Assuring quality of and access to health services.*" All 12 countries described the delivery of this function at a national level. Additionally, Sweden described delivery of this function at both regional and local levels, while Canada and Finland described its delivery at regional and local levels, respectively. In Denmark, Finland, the Netherlands, New Zealand and Norway, this function is overseen by the respective Ministries of Health; in Denmark, it is the Danish Health Authority, and in Sweden, it is the National Board of Health and Welfare (both of which operate under the Ministry of Health). In England, the National Quality Board and Care Quality Commission are some of the agencies responsible for assuring quality. The Regulation and Quality Improvement Authority in Northern Ireland is an independent body responsible for monitoring and inspecting the availability and quality of health and social care services in Northern Ireland.

### **Essential Public Health function 11 (Research)**

Essential Public Health function 11 is, "*Advancing Public Health research.*" All 12 countries described the delivery of this function at a national level. Norway also described the delivery of this function at a regional level. In general, this function is undertaken by national research institutes (in Denmark, England, Finland and the Netherlands) and Public Health Agencies (in Canada, Northern Ireland, Sweden and Wales), funded by the respective national governments. Some academic institutions (for example in Australia, New Zealand and Norway), are also supported in undertaking Public Health research to inform policy and practice.

### **Essential Public Health function 12 (Medicines access)**

Essential Public Health function 12 is, "*Ensuring equitable access to and rational use of essential medicines and other health technologies.*" All 12 countries described the delivery of this function at a national level. The Netherlands also described its delivery at a regional level and Scotland at a local level. Across all countries, governmental regulatory agencies are responsible for this function. Additionally, Canada, Denmark, Finland and Sweden also described the role of Health Technology Assessment organisations in synthesising the evidence to inform decision making; these organisations are funded by the respective national governments within each country.

## **3.2 Research question 2: Structural change in response to the pandemic, lessons learned and post-pandemic reform**

Data relating to the lessons learned with regard to the establishment of, or transition to, new Public Health structures (within the last five years), and their suitability in light of the COVID-19 pandemic are described below. These data were gathered from organisational websites and documents identified from the electronic database and grey literature search (see [Figure 1](#)), and from the nine interviews conducted with key representatives (one each from Denmark, England, Finland, the Netherlands, Northern Ireland, New Zealand, Scotland, Sweden and Wales). However, as described in [Section 3](#), we were unable to recruit key representatives from three countries (Australia, Canada and Norway). Therefore, for these three countries, data relating to lessons learned were solely based on that available in the public domain. Despite not being able to conduct interviews with representatives from three eligible countries, it is worth noting that consistent themes were identified across the nine interviews conducted.

Interview notes were read by at least two members of the team and, together with data gathered from organisations' websites and documents identified from the electronic database and grey literature search, themes were identified relating to the new structures implemented during the pandemic, their impact on existing structures, the strengths and weaknesses of these new structures in light of the pandemic, post-pandemic evaluation and planned reform. Results are presented within themes in turn for each country as an amalgamation of the data identified from the electronic database and grey literature search and the data from interviews with key representatives.

### **3.2.1 New structures implemented during the pandemic and their impact, strengths and weaknesses**

Regarding the new structures implemented during the pandemic, their impact on existing structures and their strengths and weaknesses in light of the pandemic, six broad themes were identified.

- Legislation and decision making – describes the legislation that was put in place and advisory groups established to inform decision making in relation to the pandemic.
- Data collection, surveillance, evidence synthesis and collaboration – describes data collection and surveillance methods (including sufficient IT infrastructure) used to monitor the pandemic, evidence synthesis undertaken to inform decision

making, and partnerships established across different organisations and or sectors.

- Public health interventions – describes the implementation of interventions relevant to the management of the COVID-19 pandemic including contact tracing, testing strategies, vaccination programmes and establishment of facilities to treat patients with COVID-19.
- Public participation, public messaging and communication – describes the inclusion of public opinion in decision making and public engagement regarding communication of information and guidance.
- Continuation of healthcare services – describes how countries attempted to ensure existing routine healthcare and screening services were maintained during the pandemic.
- Workforce capacity and resilience – describes how workforce capacity was scaled up to meet the demand and the issues faced with respect to workforce resilience.

## **Legislation and decision making**

### **Legislation**

Most countries put legislation in place or amended existing legislation to allow restrictive measures, or allow for temporary flexibilities across a range of policy areas to permit a quick response to the COVID-19 pandemic.

New legislation to deal with the COVID-19 pandemic was enacted in six countries:

- Denmark - The Epidemic Act was implemented to allow for emergency legislation in relation to Public Health.
- Norway - temporary Corona Act passed in March 2020 it remained in place until 27 April 2021.
- Sweden - temporary pandemic law for COVID-19 allowing the government to bring in restrictive measures was in place until 31 March 2022, additionally, they increased their legal support capacity (from 2-3 lawyers to 20 lawyers) to facilitate the increased production of Public Health guidance and regulations.
- England - Coronavirus Act 2020 passed in March 2020, awarded a suite of powers and temporary flexibilities across a range of policy areas and enabled the public sector to respond to the COVID-19 pandemic.

- Scotland - Coronavirus (Scotland) Act complements and regulates the use of emergency powers given to Scottish Ministers under the UK Parliament's Coronavirus Act 2020.
- Wales - Coronavirus Act 2020 provided extensive powers relating to events, gatherings and premises.

Five countries had existing legislation in place that was deemed sufficient or was amended or supplemented to deal with the COVID-19 pandemic:

- The Australian states and territories had existing generic emergency and disaster response legislation which authorises officials to declare emergencies in a variety of circumstances and make orders to deal with an emergency. However, at a national level, specific legislative powers to deal with emergencies were not available nor were they introduced.
- Canada amended existing Acts and introduced Bills to provide emergency funding, COVID-19 sickness leave and carer payments, border controls and to allow for remote court appearances.
- In Finland, on 14 February 2020 a law on prevention and control of infectious diseases was added to the existing Preparedness law. It outlined the specific roles for government, the Finnish Institute for Health and Welfare (THL), municipalities and regions. It also allowed the government to decide upon the period of quarantine and isolation required for cases and contacts, as well as the introduction of mandatory or voluntary vaccination against COVID-19. On 15 June 2020, the government assessed that the epidemic could be managed using the regular powers of the authorities.
- In the Netherlands, existing legislation and regulations were considered to provide sufficient powers to address the crisis. The central legislative instrument used in the control and prevention of the COVID-19 virus is the Public Health Act, which provides for quarantine measures and a clear division of tasks and powers between central and local government, depending on the classification of the infectious disease.
- In New Zealand, existing legislation, the Health Act 1956, Epidemic Preparedness Act 2006 and the Civil Defense and Emergency Management Act 2002 were used and supported with additional new legislation. New legislation mostly relates to isolation and quarantine, tax relief and employment protection, and authorisation of capital injections to departments and Offices of Parliament.

## **Decision making**

In order to streamline decision making relating to the emergency response, specific groups were set up in all included countries. In general, expert advisory groups or scientific committees were established to provide their respective governments with advice.

In Australia, the Pandemic Influenza Plan was adapted in February 2020 to include the Australian Health Sector Emergency Response Plan for Novel Coronavirus (COVID-19) to manage the national COVID-19 response. The COVID-19 Response Plan made the Australian Department of Health responsible for national coordination of the health sector emergency response, under the direction of the Australian Health Protection Principal Committee (AHPPC). On 21 January 2020, the Chief Medical Officer issued a determination adding 'human coronavirus with pandemic potential' to the Biosecurity (Listed Human Diseases) Determination 2016. This decision triggered the activation of the National Incident Room, the National Medical Stockpile, and the National Trauma Centre, daily meetings of the AHPPC, and meetings of state, territory and Commonwealth health ministers to discuss pandemic readiness. On 13 March 2020, the National Cabinet (consisting of the most senior ministers from each of the territories and chaired by the Prime Minister) was established. The National Cabinet's COVID-19 response involved health and crisis management as well as economic recovery and job creation. As per the Australian Government Crisis Management Framework, the Australian government adopted a whole government response in order to limit the spread of the virus and protect the population of Australia. This whole government approach involved various expert committees advising on topics such as vaccine rollout, therapeutics and testing. The Australian Technical Advisory Group on Immunisation COVID-19 Working Group provides advice to the Minister for Health on the immunisation programme for COVID-19 vaccines. The National COVID-19 Coordination Commission was set up in March 2020 to coordinate public-private contracts, mitigate the social and economic impact of COVID-19, and advise on the national economic recovery post-pandemic; this committee has since been dissolved. An Aboriginal and Torres Strait Islander Advisory Group on COVID-19 was also established on 5 March 2020 to inform decision making.

The public health response in Canada was guided by the existing Canadian Pandemic Influenza Plan. This plan was updated in 2018 after the H1N1 pandemic to include new actions such as strengthened linkages across surveillance activities, epidemiology capacity and primary care. The Public Health Agency of Canada (PHAC) activated its Emergency Operations Centre on 15 January 2020. The federal government in Canada assumed roles concerning national coordination and leadership, international relationships, provision of healthcare to First Nations Peoples living on-reserve, and quarantine at national borders. Each province and

territory assumed its responsibilities and tailored its responses to meet the needs of its citizens. The Special Advisory Committee on COVID-19 (SAC) was set up to facilitate joint federal and provincial and territorial leadership across jurisdictions. This involved meetings between all Chief Medical Officers of Health and senior Public Health officials several times a week to discuss coordination across Canada's health system. The SAC also published national recommendations and guidance on a variety of pandemic-related topics. At the federal level, the PHAC collaborated with other departments to ensure Canada's pandemic response was nationally coordinated and supported.

Prior to the COVID-19 pandemic, the Danish Health Authority (DHA) was responsible for the Public Health response to outbreaks of infectious diseases. Due to the COVID-19 pandemic being a cross-sectoral crisis, it was recognised that a collaborative approach across all sectors would be needed. As such, the Epidemic Committee was established and consisted of representatives from all relevant ministries within government, Danish Regions and the municipalities. Advice was provided to the Danish Government on a national level, the DHA created the guidance and the regional and municipal authorities were responsible for its implementation. Following on from the pandemic preparedness plans (developed in the early 2000s and updated as a result of the H1N1 pandemic), Denmark delegated responsibility to the regions for developing contingency plans to ensure hospital capacity during national emergencies. Additionally, regions and municipalities played a major role in implementing the guidance at regional and local levels.

In Finland, the Government announced on 16 March that the COVID-19 epidemic constituted a state of emergency. The state of emergency was in force in Finland for three months. The Ministry of Social Affairs and Health was responsible for the general planning, guidance and monitoring of the prevention of infectious diseases. Finland's preparedness measures are based on a national preparedness plan for an influenza pandemic. The Prime Minister's Office of Finland established a multi-sectoral group (which included representatives of business, communities and non-governmental organisations) to provide data and produce evidence summaries with input from the THL. This group also reported on the developments in other countries. A scientific expert panel was also set up consisting of experts on policy relating to society, education, the economy and the environmental and climate, to support the work of the multi-sectoral group. Public Health advice came from THL and, since the regions were legally in charge, they decided upon the suitability of this advice with respect to their region, and its implementation. However, for the hospitality sector, the government retained control across all regions and made the legal decisions on restrictions within this sector.

In the Netherlands, the Dutch Government did not declare a state of emergency or separately activate any emergency provisions. Initially, the pandemic response was led regionally by the municipal Public Health Services. However, when the outbreak became more severe, it was scaled up to national level and co-ordinated by the National Institute of Public health and the Environment (RIVM). An Outbreak Management Team (OMT) was created to advise the Dutch cabinet on Public Health decisions during the COVID-19 pandemic via the Administrative Consultative Committee. This committee assessed the advice in terms of administrative feasibility and implementation, and ultimately determined the control policy. The OMT consists of physicians, epidemiologists, virologists, microbiologists and the chair, who is the director of RIVM. The OMT also included representatives from various other organisations, (such as the Dutch College of General Practitioners, Netherlands Centre for Occupational Diseases, Dutch Society of Medical Microbiology, Infectious Diseases Society of the Netherlands, and National Consultation on Infectious Disease Control). Also present were organisations that advise the government on long-term effects, such as the Netherlands Bureau for Economic Policy Analysis, the Netherlands Institute for Social Research and the Netherlands Environmental Assessment Agency.

In New Zealand, it is the responsibility of the Ministry of Health to lead on responding to national emergencies. However, it was acknowledged that the Ministry of Health did not have sufficient resources to adequately respond to this role. The Ministry of Health created a national response team within the Ministry that worked with other government agencies (including the Ministry of Civil Defense and Emergency Management, Biosecurity New Zealand, the Ministry for Primary Industries, the Ministry of Foreign Affairs and Trade, the Ministry of Business, Innovation and Employment, and the Ministry of Education) to develop responses to the COVID-19 pandemic. This team evolved into the COVID-19 Directorate, established on 1 July 2020. Membership of this group consisted of representatives from the Ministry of Health and the Government. A Community Panel was established by the Department of the Prime Minister and Cabinet in July 2021; it provides insights across the COVID-19 system direct from communities. Panel members were chosen after consultation with other government agencies to ensure there was cross-agency collaboration. A COVID-19 Independent Continuous Review, Improvement and Advice Group was also established to provide advice to the Minister for the COVID-19 Response. Their advice provides an alternative and independent perspective on where improvements in the response could be made. The Strategic COVID-19 Public Health Advisory Group in New Zealand provides independent advice on the ongoing COVID-19 response. This advice is informed by the advisory group's expertise in epidemiology, infectious diseases, public health, and modelling. A COVID-19 Vaccine Independent Safety Monitoring Board was

established in February 2021 to provide advice on the safety of COVID-19 vaccines to the Centre for Adverse Reactions Monitoring, Medsafe and the Ministry of Health.

In Norway, a whole government approach led by various government Ministries was adopted to tackle COVID-19. In April of 2020, the Norwegian government appointed an independent Coronavirus Commission to evaluate the government's response to COVID-19. In April 2021, the Corona Commission report highlighted that the government and the Norwegian Directorate of Health were late to inform and involve the municipalities in decisions that were to be implemented locally. In addition, the report noted shortcomings in relation to communication between authorities and municipalities, delays in the procurement of personal protective equipment and the speed of implementing infection containment measures. There was also tension between national, regional and rural entities because of differing perspectives on local infection control measures. The report concluded that there was a need to develop a cross-sectoral system that captures how the risks in the different sectors interact with each other.

The Swedish Public Health Agency coordinated the pandemic preparedness at a national level and provided support for planning at regional and local levels, where the operational work is conducted. The Swedish strategy relied heavily on non-binding recommendations coming from this agency and the State Epidemiologist.

Each of the devolved administrations in the UK has a CMO and a Chief Scientific Adviser who provide coordinated advice to government departments in all four nations. Expert scientific advisory groups were convened at a UK level to provide advice to the CMOs of the four nations, health authorities and governments in the devolved administrations. These included the New and Emerging Respiratory Virus Threats Advisory Group, an expert committee of the UK Department of Health and Social Care, the Advisory Committee on Dangerous Pathogens, and the Scientific Pandemic Influenza Group on Modelling.

- In England, during the early phases of the pandemic (January to February 2020), the Department of Health and Social Care played a leading role in the government response. The first Cabinet Office Briefing Rooms (COBR) meeting on COVID-19, held on 24 January 2020, brought together all relevant ministers, officials and agency staff to discuss the response to the COVID-19 pandemic. Daily COBR meetings were held to refine measures and monitor progress. As a precautionary measure, the Scientific Advisory Group for Emergencies first met on 22 January 2020. In March 2020, ministerial implementation committees were developed to focus on key areas of the pandemic such as public services, the economic response and the international response.



- In Northern Ireland, the Department of Health (DOH) was overall lead and assumed lead for a number of functions including vaccine roll out with input from the Public Health Agency (PHA). An emergency response plan was already in existence pre-pandemic at the DOH. For the pandemic, approximately 15 cells (that is, working groups) were developed to support different aspects of the regional response as specific issues arose. For example, a strategic intelligence cell was set up in Northern Ireland between the PHA, DOH and Queen's University Belfast with input from the Scientific Advisory Group for Emergencies in the UK, to provide advice and guidance to the DOH. A COVID-19 modelling Group was also established in Northern Ireland to track and monitor the trajectory of the pandemic.
- In Scotland, the First Minister led the pandemic response. Senior ministers were supported by the Scottish Government COVID-19 Advisory Group, which received input from the Scientific Advisory Group on Emergencies and other appropriate sources of evidence and information to inform local decisions in Scotland during the pandemic.
- The Welsh Government was responsible for the Public Health response to the pandemic. All major decisions in relation to the pandemic were taken or approved by the First Minister, in consultation with the Welsh Government Cabinet. Key decisions at the national level included measures relating to travel restrictions, shop and restaurant closures, and guidance for schools, sports and events. Public Health Wales engaged closely with the CMO during the pandemic to address Public Health protection across the Welsh healthcare system. In the early stages, the Welsh Government or CMO requested topics at meetings with a rapid turnaround time, (that is, less than one day). Regional health protection cells (that is, working groups) were set up and co-led by the Director of Public Health and a nominated Director of Public Protection from each of the local health authorities. The CMO also had a Health Protection Advisory Group.

### **Data collection, surveillance, evidence synthesis and collaboration**

Australian national notification data on COVID-19 confirmed cases is collated in the National Interoperable Notifiable Diseases Surveillance System based on notifications made to state and territory health authorities under the provisions of their relevant public health legislation. National surveillance of clusters and outbreaks has been developed through the establishment of COVID-Net, a network of epidemiologists embedded in state and territory health departments. On the 23 January 2020, the Communicable Disease Network of Australia and the COVID-19 Working Group developed guidelines on the national minimum standard for reporting of surveillance data including laboratory testing, case management and contact management for

COVID-19. Jurisdictions could implement data collection policies that exceed the national minimum standard based on local epidemiological context. Clinical guidelines for the management of COVID-19 are produced by the COVID-19 Task Force, an independent consortium funded by the Commonwealth Department of Health consisting of 33 national clinical groups, including major medical colleges and specialist societies.

The Public Health Agency of Canada (PHAC) developed a population based surveillance system to monitor COVID-19 activity in Canada. However, reporting of confirmed and probable case data by provinces and territories to PHAC was voluntary. In a report published by the Chief Public Health Officer of Canada, it was noted that obtaining timely, complete and consistent national COVID-19 case data was difficult, given that provincial and territorial jurisdictions did not always report or collect information in the same way. Additionally, information on hospitalisation status, geographical location, pre-existing conditions, and deaths, was not always available. This highlighted historic challenges with limited workforce capacity, data-sharing agreements and data infrastructure. Delays in access to complete national data sets reduced the quality of analyses, such as disease symptoms and close contacts, as well as the ability of models to predict spread of the virus. In a similar way, the ability to collect and link health data to socio-demographic information, such as income and occupation was not available at a national level.

In March 2021, a unified data portal was launched to strengthen access to health data for researchers in Denmark. Sharing and access to data was a challenge due to legal frameworks in Denmark. The newly enacted Epidemics Act addressed some of these challenges allowing for the exchange of data between Public Health groups such as the EC and the Danish Patient Safety Authority. The Danish IT infrastructure played a significant role in management of the pandemic by providing real time epidemiological surveillance to aid the emergency response. Improvements in the infrastructure helped make healthcare data in Denmark readily available to the research community through real-time remote access services or a research data centre. Vaccination and microbiological databases were linked with hospitals and civil registration systems which was beneficial as it provided a richer data source. Co-ordination and cross-sectorial collaboration has been highlighted as a positive outcome from the COVID-19 pandemic and it is regarded as vital to having an efficient response to future Public Health emergencies. Initially, building networks for research collaborations between institutions in Denmark proved challenging; this challenge could have been mitigated, had these networks been in place prior to the emergency situation. Similarly, having sufficient IT infrastructure in place prior to an emergency situation is advantageous, rather than spending time developing and implementing new systems during a crisis.

Finland used an existing infectious disease register managed by the Finnish Institute of Health and Wellbeing (THL) to collect COVID-19 case data and supplement the personal data for COVID-19 cases using the Population Information System.

Previously, cases confirmed with a coronavirus test (PCR or antigen) were reported to the National Infectious Diseases Register by physicians as well as laboratories. As a result of a decree amendment, as of 21 January 2022, reports by physicians are no longer included. Although the surveillance system in Finland for infectious disease was deemed to be sufficient pre-COVID, a temporary system had to be set up to provide online access to the hospital discharge registry. However, a major weakness was the absence of a database for reporting infections in nursing homes.

Epidemiological data in the Netherlands is collected by the Municipal Public Health Services and sent to the National Institute for Public Health and the Environment (RIVM). There is no centralised health record system in the Netherlands and this caused some challenges during the pandemic. Dutch digital health record systems were found to be disjointed and lacked interoperability. Patients were often transferred to different regions and as a result, health data was provided to health organisation facilities often without the patient's direct consent. This issue generated debate around patient data privacy and third party access. A report by the Organisation for Economic Co-operation and Development recommended that the Netherlands develop a national strategy towards an integrated health information system. It also recommended that legal and operational changes are made to overcome inefficient exchange and sharing of health data; this should be led by the Ministry of Health, Welfare and Sport.

Prior to the pandemic, a digital team had been working on developing a national screening programme register in New Zealand. This technology was tailored and further developed to capture data on contact tracing. This data were subsequently reported to the Ministry of Health. Technologies developed by the digital team helped to facilitate New Zealand in implementing their elimination strategy, which relied heavily on the strong contact tracing system that had been put in place. A platform was set up to link COVID-19 vaccination data with cases and close contact status. Moreover, the existing immunisation register (that only captured children) was updated to capture population-wide immunisation status. Going forward, this technology will continue to be used to capture information in relation to vaccinations. For example, the platform will be used to monitor annual influenza vaccinations, regardless of whether they are administered privately or publically.

Sweden used an existing infectious disease surveillance system, SmiNet, to track COVID-19 cases. A field code for COVID-19 was added to SmiNet and database

linkage was reported to be have been straight forward. SmiNet is the system that all infection control doctors, infection control units and the Swedish Public Health Agency use jointly to monitor diseases that are subject to notification under the Infection Control Act. The system facilitates the work of handling reported cases, outbreaks and other infection control matters. In 2021, SmiNet was forced to close down its database (once in May and another time in June) due to cyber-attacks. The Public Health Agency of Sweden produced recommendations and guidance on the pandemic response with input from other responsible agencies at national level, the 21 regional medical officers and international actors such as the European Union and the WHO. The Swedish Agency for Health Technology Assessment and Assessment of Social Services (SBU) Enquiry Service identifies and summarises systematic reviews or scientific studies which answer specific questions posed by decision makers and health care personnel relating to COVID-19. The SBU also facilitated publicly led research; people affected by long COVID-19 could jointly prioritise research questions drawn from an inventory of possible questions developed by the SBU. Sweden reported challenges relating to international collaboration on international travel and border control, coherence of regulations, sharing of information and avoiding duplication of efforts.

In England, Public Health decision making has become increasingly reliant on the efficient use of data. During the early stages of the pandemic, delays in data sharing hindered and slowed down the local response. It has been acknowledged that there is a need for harmonisation of data, timely access to data across organisations and a code of conduct for data producers and data users. The pandemic has highlighted some challenges between the local and national parts of the system. For example, delays and policy changes relating to the Test, Track and Trace system caused confusion for many local Public Health teams who were responsible for implementing the system.

At the start of the pandemic, data analysis skills were noted to be a challenge for the Public Health agency (PHA) in Northern Ireland. However, partnering with academia helped address this. As such, positive developments in terms of collaboration between the PHA and Department of Health and academia have been reported, particularly in relation to IT and data analysis.

In Scotland, the EAVE II (Early Pandemic Evaluation and Enhanced Surveillance of COVID-19), was established by the University of Edinburgh; this project leveraged off the original EAVE project, which was developed as part of Scotland's pandemic planning after the H1N1 pandemic. This group works closely with Public Health Scotland and the Scottish Government to undertake epidemiological analysis and report on health related outcomes and vaccine effectiveness. Scotland have also set up a multicomponent surveillance system called the Community Acute Respiratory

Infection (CARI) which is an adaptation of the existing GP Influenza Surveillance Scheme. The aim of CARI is to monitor how much infection within the community (using a representative sample of approximately 1,000 patients) is due to different respiratory viruses, including COVID-19. The acceleration of data processing capabilities and online data availability in Scotland ensured swift and decisive Public Health responses. Improvements included the Community Health Index, which was enhanced and provided effective patient data identification which assisted in surveillance and vaccination information. Other systems identified as being beneficial, were the new national vaccine management system, testing and tracing application system called Test and Track, and a national tool for monitoring organisms, infections and microbial intoxications called Electronic Communication of Surveillance in Scotland (ECOSS).

Collaboration and partnership in Wales between central and local government, the NHS and Public Health providers, employers, trade unions and the public were an essential feature in responding to the pandemic. Wales has agreed a plan around health data which is reported to have the potential to radically change the data system.

The process of providing evidence based advice to governments and those making decisions was strengthened or changed in a number of countries during the pandemic:

- A Canadian COVID-19 modelling network was set up by PHAC made up of federal, provincial, territorial and university-based modellers and epidemiologists. This group of experts supports Canada's efforts to model and make predictions on the COVID-19 epidemic. Emerging evidence on COVID-19 is reviewed by PHAC to facilitate integration of the current understandings into decision-making, guidance and recommendations. At the federal level, the Public Health Agency of Canada collaborated with other departments to ensure Canada's pandemic response was nationally coordinated and supported. For example, the National Collaborating Centre for Methods and Tools provided evidence synthesis at the request of Public Health decision makers; Canadian Border Services Agency implemented and enforced border restrictions and mandatory quarantine measures; Health Canada expedited access to medical supplies; Innovation, Science and Economic Development Canada introduced measures to directly support businesses developing products to help with the efforts against COVID-19; while Indigenous Services Canada (ISC) worked with Indigenous partners to help communities implement customised public health emergency preparedness plans and responses.

- Prior to the COVID-19 pandemic, the Statens Serum Institute (SSI) provided advice to the Danish Health Authority. During the pandemic, the SSI also provided evidence-based advice to the Epidemics Commission (EC) and Danish Government, and performed risk assessments with respect to Public Health and the COVID-19 pandemic. The government also received advice from experts on other areas (for example, the economy), all of which they considered when making policy decisions. It has been noted that health sector-related advice was based on scientific evidence synthesis, while this was not the case for other sectors. In some instances, resultant policy decisions may not have been in accordance with the scientific evidence base, but instead reflected the priorities of the economy.
- The Finnish Institute for Health and Welfare set up an Expert Advisory Group for evidence synthesis. The Committee for the Future launched a three-step data acquisition initiative to ensure decisions related to COVID-19 were informed by the evidence base. This allowed the Committee for the Future to detach itself from day-to-day politics and instead consider the long-term effects of the pandemic and better detect critical risks.
- In the Netherlands, as reported under decision-making above, the Outbreak Management Team, convened by the director of the Centre Infectious Disease Control within the RIVM, considers the evidence and provides advice to the cabinet, after which, the cabinet make the final decision concerning the control policy.
- The director of Public Health in New Zealand was responsible for the evidence synthesis at the start of the pandemic. A Science and Insights team was set up within the COVID-19 Directorate in the Ministry of Health, and were responsible for delivering evidence briefs, literature searches and analyses. Findings provided from the Science and Insights team were used to inform policy decision making in relation to COVID-19. This is now a strong component of the Ministry of Health.
- The Norwegian Institute of Public Health established a rapid review team consisting of two to three reviewers and one information scientist to provide evidence-informed guidance to policymakers, health care providers and the public. Moreover, within the Norwegian Institute of Public Health, the Norwegian Science Programme on COVID-19 was established to address critical knowledge gaps relating to the COVID-19 pandemic, promote efficient research collaboration nationally and help prepare for a future pandemic.

- In terms of evidence synthesis, the Joint Biosecurity Centre provided this function to inform local and national decision-making, while effectiveness of the COVID-19 vaccination was monitored by the UK Health Security Agency.
- Public Health Wales (PHW) provided advice to the Welsh Government to address Public Health protection across the Welsh healthcare system. In the early stages the Welsh Government or CMO requested topics at meetings with a rapid turnaround time, (that is, less than one day). PHW also formulated advice for the CMO (and government) related to the evidence on household contacts, transmission limitation, education and care home settings. PHW also chaired technical advisory subgroups for the Welsh Government, such as the Care Home Cell established to provide advice for care homes. The technical advisory group met twice a week and included scientific and technical experts from across Welsh Government, NHS Wales and academia to provide advice and guidance to the Welsh Government in response to COVID-19.

### **Public health interventions**

In some countries to increase acute and critical care capacity to treat COVID-19 patients, dedicated facilities were set up:

- In some Australian territories, dedicated COVID-19 treatment facilities were set up, for example the Royal Adelaide Hospital was dedicated for treating adults with COVID-19 only.
- In Northern Ireland, two acute COVID-19 facilities were set up to treat COVID-19 patients, a 75 bed facility for critically ill patients and a 100 bed step-down facility to receive patients from intensive care units. Ten dedicated COVID-19 centres were also set up as separate facilities, created as an extension of primary care to help direct suspected COVID-19 cases for assessment.
- In Wales, field hospitals were built with space for 2,000 beds. The number of available critical care and invasively ventilated beds in Wales more than doubled and extra capacity was agreed with private partners such as sports centres and private hospitals.

The need to quickly and efficiently roll-out vaccines to the entire population led to many countries deviating in how vaccines were usually provided:

- In Australia, vaccination was facilitated in a wide range of settings including workplaces and government-operated pop up clinics.
- In Denmark, regional vaccination facilities were set-up, prior to COVID-19, vaccinations were administered at a local level by general practitioners.

- Finland deviated from normal protocols for national immunisation programmes by allowing mRNA vaccines to be delivered to the hospital pharmacies who then delivered them to the municipalities. The municipalities were responsible for deciding the best approach for organising vaccination of populations locally.
- In New Zealand, the COVID-19 Vaccination Immunisation Programme oversaw policy relating to, and purchasing of, COVID-19 vaccinations.
- Implementation of the Swedish vaccination programme was the responsibility of the regions, who set up vaccination hubs (mostly established in existing premises such as sports arenas) using private contractors, staffed by retired nurses and financed by the state.
- In England, the NHS established a centralised service to manage the COVID-19 vaccination programme and Scotland deployed armed forces personnel to support the vaccination roll out.

Generally, across all included countries, the vaccination roll-out was highlighted as a success and may have an impact on future practice.

- For example, in Denmark, due to the success of these vaccination centres it has been suggested that these could be used for administration of other vaccines such as influenza and pneumococcal vaccine. The continuation of vaccination centres has a number of advantages. For example, it reduces the number of staff who would require vaccination training, reduces the number of centre locations to which vaccines need to be transported, reduces wastage, improves patient access as centres were open weekends and evenings, and frees up GP time. However, it was noted that vaccination appointments with a GP gives patients an opportunity to discuss other health-related issues, and allows GPs to identify potential health issues opportunistically.

However, a number of challenges with the vaccine programmes were also acknowledged:

- The COVID-19 vaccination roll-out in the Netherlands encountered challenges due to individuals over 60 years of age and at-risk groups initially being prioritised by the Health Council. This faced some opposition from hospital organisations who insisted that frontline healthcare staff should be prioritised for vaccination. In addition, the procurement of vaccines was delayed. After these initial challenges, the vaccination rates in the Netherlands rose steadily surpassing the EU average in May 2021.



- In Scotland, although a major strength was the speed at which the vaccination programme went forth, there were issues related to inconsistent vaccine supply, staffing issues and changes to intervals between vaccine doses.
- In England, the success of the vaccination programme was the result of collaboration across a number of organisations and individuals with the right expertise at the right time. However, the advice from the scientific committee (the Joint Committee on Vaccination and Immunisation) to the UK Government to prioritise the immunising of groups based on age, exposure to the virus and clinical vulnerability was met with criticism from some in the scientific and policy communities.

COVID-19 testing and contact tracing were key strategies adopted in response to the pandemic in all countries. However, there was variation in how testing and contact tracing was implemented.

- In Australia, Indigenous populations were identified early in the pandemic as being at high risk of infection and severe illness; to address this, a strategy was developed in partnership with representatives from Indigenous populations which prescribed a collaborative partnership model be embedded in the central pandemic management team.
- Within provinces and territories across Canada, contact tracing was mainly the responsibility of local public health units. For example, Ontario's local public health units are responsible for COVID-19 contact tracing and case management. Public Health Ontario partnered with public health units, Ontario Ministry of Health and the federal government to provide additional support to public health units for following up with individuals identified as high risk contacts of a COVID-19 case. After several months, some partners needed to transition to other work and a new partnership was established with Statistics Canada.
- In Denmark, general practitioners (GP) would normally be the primary point of contact with respiratory symptom development. However, during the COVID-19 pandemic, patients were advised to go to community testing centres.
- Testing capacity in the Netherlands was limited during the early stages of the COVID-19 pandemic. Prior to the summer of 2020, COVID-19 tests required referral from a physician. From June 2020, a dedicated phone line was set up to allow those with symptoms to book a test without a referral. Additionally, contracts were set up with laboratories to allow for large scale testing and contact tracing.

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- In New Zealand, the Ministry of Health set up contact tracing. They were also responsible for implementation of restrictions on the country's borders and establishment of managed isolation and quarantine facilities, in conjunction with other government departments such as the Ministry of Foreign Affairs and Trade.
- Like other countries internationally, Public Health interventions in Norway included contact tracing and the roll out of a national vaccination programme. The first contact tracing app developed for COVID-19 in Norway was Smittestopp. However, in June 2020, Smittestopp was disbanded by the Norwegian Data Protection Authority due to privacy concerns. Subsequently, a new app (Smittestopp v2) was launched in December 2021. It was highlighted in a national review that the substantial municipal-level responsibility for infection control in Norway was a strength as the local authorities were familiar with the needs of the local population.
- In Sweden, the Track and Trace system was the responsibility of the regions via COVID-19 special units in each region. Sweden departed from usual practices by contracting private and academic enterprises to scale up the regional lab systems. Due to the success of the Track and Trace system developed during the pandemic, it will be continued and will be used to identify future infections and outbreaks.
- In England, the NHS Test, Track and Trace programme was used for COVID-19 contact tracing.
- In Northern Ireland, the Public Health agency (PHA) led on testing and contact tracing, in collaboration with other departments in Northern Ireland, such as the Department of Health and Department of Education. Testing in care homes with a suspected or confirmed outbreak was managed by the PHA and Health and Social Care Trusts. Contact tracing in schools was originally the responsibility of the Department of Education, but later moved to PHA. It was staffed by nurses and Environmental Health Officers with lead clinicians and health protection consultants advising on complex situations and local clusters or outbreaks.
- Contact tracing in Scotland was delivered by health protection professionals in teams in local NHS Boards, and by the National Contact Tracing Centre. Public Health Scotland led on the development of guidance, digital systems and training resources to support contact tracing. A Case Management System was introduced during the pandemic to replace the Simple Trace Tools system. The new system allows for management information on how contact tracing is progressing to be shared with Local Health Boards and the Scottish Government. This information includes the number of calls made, the number of people traced

and areas where tracing has shown a cluster of cases. In addition to personal information, GP details and additional medical information, there is also data on the case's Community Health Index, providing a more holistic approach to contact tracing.

- Due to the existence of an all-Wales technical platform, Digital Healthcare, the integration and interoperability needed to incorporate the Test and Trace system was already in place. As a result, Test and Trace was digital from the outset. Activities were managed regionally by a regional director who engaged with Public Health Wales. Community testing units were supported by investment in laboratory infrastructure which included a new laboratory and workforce for antigen and antibody testing, as well as increased investment in six hot labs in acute settings.

Challenges associated with COVID-19 testing and tracing systems experienced by some countries were noted:

- In New Zealand, contact tracing across the Public Health units experienced challenges as units vary in size and consequently resources. As such, some districts within New Zealand had the infrastructure to develop digital tools to support contact tracing, whereas others did not. Another challenge was the fact that the various tools were developed in isolation, resulting in systems that were not compatible. For example, contact tracing tools used in Auckland and Christchurch differed and were not compatible with each other.
- In Norway, in terms of testing, the high demand for testing and lack of testing capacity created delays and an audit on COVID-19 testing highlighted the fragmented laboratory infrastructure. The four main issues highlighted were: supply problems associated with international suppliers; the National Institute for Public Health and the Environment having limited insight into testing capacity, systems and material usage at laboratories; Municipal Public Health Services not being set up for the rapid increase in tests required; and test chain disruptions. In addition to laboratory testing disruptions, there were also challenges with contact tracing. The 25 regional Public Health services were responsible for contact tracing; this was achieved by deploying healthcare workers from other settings. When cases rose in September 2020, staff were deployed to clinical care causing a reduction in staff working in contact tracing. As a result, contact tracing had to be limited to individuals living in the same household.
- In Sweden, it was acknowledged that the Track and Trace system faced challenges in meeting the surge capacity at times. However, overall it was reported to work well.

- The NHS test and trace programme in England struggled to consistently match supply and demand. This has resulted in either substandard performance or surplus capacity. For example, poor performance of the system was noted when it significantly underestimated the increase in demand for testing when there was a return to schools and universities.

## **Public participation, public messaging and communication**

Early in the pandemic, Australia developed a strategy to effectively respond to the needs of Indigenous populations in partnership with representatives from Indigenous communities, as they were identified as a group at high risk of infection and severe illness. The strategy recommended a collaborative partnership model be embedded in the central pandemic management team. COVID-19 preparedness and outbreak plans at any level should take into account the overarching principles and factors specific to urban and regional Aboriginal and Torres Strait Islander communities.

Digital infrastructures set up in Denmark allowed for instant alerts to the public on information and guidance around the Public Health emergency (for example, relating to test and trace and vaccination programmes). This strengthened and increased the transparency of scientific communication to the public. Within Statens Serum Institut, communications officers acted as gatekeepers, meaning all correspondence from the media relating to the evidence base had to go through them. Throughout the pandemic, social scientists conducted surveys to gain insights into the behaviours and attitudes of Danish citizens towards Public Health and government responses to the pandemic; this informed subsequent Public Health messaging and communication.

Changes over the course of the pandemic occurred with the aim of diversifying the management approach of the pandemic in the Netherlands. This included generating panels consisting of citizens, ethics and behavioural professionals which provided outlooks on policies and decisions by government. In 2020, public opinion was gathered (n=60,000) on eight different possibilities for relaxing lockdown measures in the Netherlands. It has been reported that participants appreciated the opportunity to evaluate relaxation options and the consequences of each option; it also increased the public's awareness of the dilemmas the government faced. A COVID-19 and society programme was held during the first half of 2021. This involved 600 citizens, 123 companies and civic organisations, 50 scientists and 41 local administrators. Public discussions were conducted by the National Institute for Public Health and the Environment in order to obtain views and preferences of Dutch citizens. Perspectives of the impact of COVID-19 and moving forward post pandemic were gathered and some of these open dialogue discussions were provided to the Dutch Government. This improved dialogue between the government, Public Health

authorities and the public allowing citizens to present ideas and opinions that influence and benefit decision-making.

In Norway, the Corona Commission report highlighted that communication with immigrant populations was deficient and needed to be strengthened.

The Swedish Government selected one regional council to disseminate guidance to the 20 regional councils. This is usual practice during times of unexpected upheaval. The guidance first went out for consultation then one council coordinated dissemination via the coordinating body (that is, Swedish Association of Local Authorities and Regions), who in turn coordinated dissemination of the information to the rest of the healthcare system.

Behavioural science was integrated into UK policy through inclusion of the chief executive of the Behavioural Insights Team in the government's Scientific Advisory Group for Emergencies (SAGE) and development of a behavioural advisory group known as the Scientific Pandemic Influenza Group on Behaviours.

The Keep Wales Safe campaign was launched in order to communicate public health information across a variety of media platforms; it reached approximately 98% of the adult population. Communication of the COVID-19 vaccination roll-out was considered an imperative part of managing Public Health. As such, a microsite was launched in December 2020 before the large scale vaccine roll-out, as a preliminary tool for the public and healthcare professionals to provide up-to-date vaccine information. A dedicated COVID-19 website was also established to provide up to date information and guidance.

### **Continuation of healthcare services**

A number of countries noted that the continuation of care posed some challenges throughout the pandemic:

- During the peaks of the first and second waves of the COVID-19 pandemic in Denmark, elective surgeries were postponed. The second wave in Denmark saw hospitals co-operating to a larger extent than during the first wave, which helped to transfer non-COVID-19 patients from regions struggling to cope with high COVID-19 case numbers.
- Non-essential services and primary healthcare services in Finland suffered as staff were diverted or other resources were diverted. The contact tracing system was one of the main consumers of staff.

- Sweden is experiencing a backlog in health and medical services in general and coverage of screening programmes has declined as people did not attend during the pandemic.
- Screening and cancer diagnosis programmes in England were also paused. However, a decision was taken to prioritise continuation of some paediatric surgeries given their semi-elective nature.
- Overall, capacity in Northern Ireland, across many functions remained a challenge throughout the pandemic. Five screening programmes (namely, the Abdominal Aortic Aneurysm Screening Programme, Breast Screening Programme, Diabetic Eye Screening Programme, Bowel Cancer Screening Programme and Cervical Screening Programme) were either put on hold or operated at a significantly reduced capacity, mainly due to staff being redeployed to deal with the COVID-19 response.
- Scotland deployed armed forces personnel to support the Scottish Ambulance service.
- In Wales Breast Test Wales, Cervical Screening Wales, Bowel Screening Wales, Diabetic Eye Screening Wales and Wales Abdominal Aortic Aneurysm screening programs were paused. Ante-natal and newborn screening continued throughout the pandemic and the reactivation of services was guided by conducting risk assessments, with some services reactivated as early as June and July of 2020. At different stages throughout the pandemic services were paused or reactivated depending on risk assessments. During the first phase of the pandemic, the Welsh Government positioned mental health services as essential services within the NHS and invested £1.3 million in support of these services to reduce the pressures on local primary mental health services. Wales reported that one of the strengths of their response during the initial phase of the pandemic was the protection of the most vulnerable members of society. PHW have a WHO collaborating centre allowing some activity around population health to continue early in the pandemic, including exploring unemployment and longstanding illness which commenced in August 2020.

The delivery of care changed to facilitate continuity, with the wide adoption telephone and online platforms to carry out remote consultations.

- In Denmark, like other countries internationally, the GP was no longer the first point of contact for those who had COVID-19 symptoms. However, activity levels for primary care were maintained at regular levels, in part due to the rapid national rollout of teleconsultations. As a result, unmet healthcare needs during the first twelve months of the pandemic were among the lowest in Europe.

- The Netherlands implemented changes including online consultations with physicians and the use of remote monitoring for medical information such as heart rate and blood pressure. This enabled health care at a distance without the risk of spreading COVID-19.
- In England, clinical commissioning groups worked with GPs in primary care networks to implement a triage and remote consultation model during the pandemic to ensure that every patient was triaged before an appointment was made.
- Changes to primary and community care services in Wales occurred as a response to COVID-19. Substantial investment was made early on to implement widespread use of telephone assessment.

### **Workforce capacity and resilience**

In response to the COVID-19 pandemic many countries redeployed staff and or increased health workforce capacity, through recruitment as well as the use of retired health professional and students:

- Denmark increased its health workforce capacity during the initial stages of the pandemic. Regional health authorities (responsible for organising hospital services) established reserve lists of retired health professionals and medical and nursing students to be used if needed in the event of a surge. Healthcare staff were reallocated to COVID-19 roles as their tasks in original roles had been decreased.
- Sweden set-up COVID-19 Special Units, responsible for the Test and Trace system. These were staffed by retired nurses, rather than from existing facilities and hospital staff resources and freeing up attending physicians. Healthcare workers were deployed by regions to assist with contact tracing. When cases rose in September 2020, staff were redeployed back to clinical care reducing the number of staff working in contact tracing. Due to this reduced capacity contact tracing had to be limited to only contacting individuals living in the same household. Care of the elderly in Sweden is provided by multiple actors which made coordinating guidance, staffing capacity and resources challenging.
- Wales increased healthcare staffing numbers to tackle the rising case numbers and hospital admissions aided by the return of recently retired healthcare staff.
- In England, a range of existing and returning staff were rapidly deployed into new clinical roles and environments during the COVID-19 pandemic.

- The Antimicrobial Resistance team in Northern Ireland were redeployed to the COVID-19 response; consequently, the work programme was put on hold. Like many other countries, Northern Ireland experienced significant challenges attempting to return to pre-pandemic functioning with the emergence of new variants.
- Redeployment of staff in Scotland allowed for increased staffing in Public Health Scotland as it allowed for the collaboration of colleagues from multiple disciplines and as a result facilitated a combined unified approach to the Public Health response. Moreover, due to the increased focus on communicable disease during the pandemic, the challenge will be to ensure that Public Health is not reduced to just Health Protection, but retains its other functions.
- Public Health Wales received funding to recruit 120 staff into the Health Protection Team, which has facilitated activation of their core Public Health functions. There has been capacity to manage the COVID-19 surge so far, while reactivating core Public Health functions. It is acknowledged that as Wales move from a pandemic to epidemic scenario, a focus of Public Health should be horizon scanning and prevention.

The additional demands placed upon staff during the COVID-19 pandemic were recognised as well as its impact for the future:

- In Denmark, elective surgery staff were redeployed into COVID-19 related roles. This necessitated fast-track retraining in some cases, particularly for roles in intensive care units and ventilator facilities; this was particularly challenging.
- In England, staff were made aware during the COVID-19 pandemic that there may need to be increased presence of staff working nights and out of hours and that all staff, across all grades may be needed to contribute to on-site, on-call rotas. All rotas were designed with the recognition that it was likely a proportion of staff would be out due to sickness. Workforce supply in Public Health was noted to have been a problem for many years with the specialist training programme highly over-subscribed. It has been suggested that the number of people being trained should be increased and that the training is reviewed to ensure it is still fit for purpose. Other suggestions to combat this issue include diversifying the workforce so that it reflects the community it serves. The government made available emergency funding to support Public Health teams to tackle COVID-19. This helped to build capacity in Public Health teams. However, the short-term nature of the emergency funding provided leaves uncertainty about solutions for longstanding challenges in the Public Health system.



- The requirement for staff to work from home on new issues at high pace was identified as a challenge in Northern Ireland.
- Workforce fatigue due to the increased workload expected of staff and the personal sacrifices made has been highlighted in Scotland as impacting on motivation; it may be a factor in future staff engagement and Public Health reform. The magnitude of the structural changes involved means it will take time for current Public Health structures to adapt to the planned reforms.

### **3.2.2 Post-pandemic evaluation and reform**

#### **Planned reform in light of the COVID-19 pandemic**

Despite the efforts of the Canadian federal government to coordinate and develop consistent approaches, provinces and territories took different approaches in addressing similar responsibilities. As a result, decision-making differed among jurisdictions, resulting in the appearance of inconsistent management approaches. The Canadian National Collaboration Centre for Health Public Policy has acknowledged that the COVID-19 pandemic has highlighted the need to renew and reinforce the Public Health infrastructure in Canada.

In April 2021, the Office of the Chief Public Health Officer at the Public Health Agency of Canada started a discussion process with a broad range of key stakeholders to gather information and insights on key system-level elements of a future Public Health system. Although a reform strategy plan has not been finalised, it is agreed that there is an overall lack of understanding across stakeholders about what Public Health is; specifically, that Public Health is more than just Health Protection. It is also acknowledged that community engagement is key to ensuring collective responsibility in Public Health. The lack of resources in Public Health is a major challenge and adequate funding needs to be in place to ensure equity and quality of services both during and outside pandemics. There is a need to develop a foundational Public Health data system, the lack of which is a critical gap that needs to be addressed to allow for evidence-based decisions to be made. There needs to be an accountability structure in place to clearly define the role of the Public Health system and those who work in it. A research project known as the Platform to Monitor the Performance of Public Health Systems has since been established. This project is led by principal investigators from the University of Toronto and is currently in its first phase; that is, conducting an analysis of Public Health financing, governance, organisation and workforce capacity across each of the 13 Canadian provinces and territories. Following completion of the first phase, the next phase will involve conducting a set of comparative in-depth case studies examining implementation and outcomes of reforms, and their impacts on responses to the COVID-19 pandemic.

While there is discussion about reform in Denmark, the details have not been finalised, but any reform will include lessons learned from the COVID-19 pandemic. It is thought that any future reform in Denmark will focus on local healthcare provisions.

Political representatives on regional councils for health and social care will be the key players in bringing about reform in Finland. Public opinion will also be garnered through the election system and public meetings. There are significant power struggles in Finland between rural and urban actors which makes reform challenging. Further reform is planned with relevant bodies being responsible for collecting data from their region, if and how this will be collated into a national dataset, by for example the Finnish Institute for Health and Welfare (THL) is yet to be confirmed. A standardised approach to data collection is required and details regarding incentives and penalties for not reporting need to be agreed. It was highlighted in Finland that back-up supply systems need to be developed and existing systems improved, including emergency supplies, as highlighted by the pandemic. An evaluation by Finland's National Emergency Supply Agency (NESA), published on 28 May 2021, reported that due to changes in the operating environment, its regulation, structures and processes need to be reformed. It was also noted that preparedness can no longer take place in silos separate from each other.

In the Netherlands, discussion is ongoing regarding how to strengthen the Public Health structure in light of the COVID-19 pandemic. Important considerations are improved data sharing with necessary legislation for the same, centralised implementation of policies in the context of a pandemic and ensuring sufficient workforce capacity. Moreover, to inform future decision making in an emergency situation, experts are in the process of evaluating the effectiveness of public health interventions (that is, testing and contact tracing) with respect to their impact on morbidity and mortality.

In Norway, it has been reported that a reform of Public Health is expected in the near future. These reforms are likely to have a stronger emphasis on early interventions aimed at children and youths, prevention of loneliness in society, and reduction of social inequalities in health outcomes. Additionally, the current National Health and Hospital Plan, which was developed prior to the onset of the COVID-19 pandemic, is scheduled to end in 2023. The next plan will likely incorporate lessons learned during the COVID-19 pandemic.

There are a number of evaluations underway in Sweden. These include a committee to examine the communicable disease act and look at who has responsibility to enact quarantine (domestic and travel), border and international travel restrictions,

and how to make track and trace more flexible – that is, better adapted to specific challenges during a pandemic. It will also examine modernising the role of nurses. The committee will produce a report that will be available at the end of 2022 and will give detailed recommendations on how the law will be enacted. The final report will go to government and, subject to a positive response from a public consultation, will be enacted. A major weakness reported for Sweden was the variation in the size of regions across the country, and the limited availability of resources assigned to some regions under the Communicable Disease Act. For example, there is one director of Public Health in each region regardless of the size of the region. This was a major problem during the pandemic and has been identified as a weakness in the system for years. However, it is politically challenging to change.

In Northern Ireland, there are plans to develop an Integrated Care System (ICS) at a local level. This has been delayed as there was no government or Health Minister for a period of three years prior to 2020. This new ICS model will see organisations across the region use local knowledge to plan integrated and continuous health and social care services for their local communities. The key focus of the ICS is to address the wider determinants of health and wellbeing through a population health approach. This will address the whole life course from prevention, early intervention through to treatment and end of life care. Reform in Northern Ireland has been motivated by the need for integration, to reduce overlapping of functions and inefficiencies. Learnings from the COVID-19 pandemic will also be included in this planned reform. The Department of Health are also establishing a board to look at the functions of the Public Health Agency to ensure these functions are appropriate as a previous review highlighted that both Health Protection and Health Improvement in Northern Ireland need to be improved. Additionally, systems for reporting and supporting data intelligence, as well as data analysis skills, have been reported as sub-optimal and in need of improvement.

In 2018, “A healthier Wales: long term plan for health and social care Wales” was published. This plan was informed by the parliamentary review of health and social services. Like other countries included in this report, there are discussions around reform in light of the COVID-19 pandemic, but as yet nothing has been agreed.

### **Reform within the last five years**

From 1 July 2020, an addendum to the National Health Reform Agreement (NHRA) in Australia took effect and on 17 September 2021, all Health Ministers endorsed the NHRA Long Term Reforms Roadmap. The NHRA is an agreement between the Australian government and state and territory governments. It aims to improve health outcomes sustainably for all Australians through better coordination and integration of care in the community. Like many countries, the COVID-19 pandemic

was just one catalyst in reshaping Australia's health system and establishing new ways of working. Firstly, the Australian Academy of Science Rapid Research Information Forum was established to facilitate quick dissemination of policy-relevant information within Australia's innovation and research sector; it has been suggested that this should be continued post-pandemic. Secondly, the state of Queensland was able to rapidly transform its paper-based Public Health system into a digital consumer-centred one during COVID-19. This experience offers lessons for digitisation of Public Health systems going forward. Thirdly, the pandemic highlighted substantial inequality in terms of access to health services and health outcomes; this is something that will need to be addressed post-pandemic.

Prior to the COVID-19 pandemic, a health and disability reform process had begun in New Zealand and a subsequent 'Health and Disability System Review' was published. Both the pandemic and recommendations contained within the review signaled significant duplication in the New Zealand Public Health system. While there were some benefits to New Zealand's Public Health system working at a local level (for example understanding the local community and their needs), a more centralised approach was needed when responding to a national pandemic. Throughout the early stages of the pandemic, health service delivery was dispersed across the 20 District Health Boards (DHBs). However, from a Public Health perspective, there was a need to consolidate the response across the country and provide a single national response. Following the recognition of this issue, the Ministry of Health created a national response team. This issue of inequity across DHBs was identified prior to the pandemic, but the experience of the pandemic further highlighted the importance of have a more centralised health system. There will be a particular focus on addressing the range of factors which contribute to health and wellbeing, for example, housing, education and employment.

In New Zealand, planned health reforms will come into place on 1 July 2022. The 20 existing District Health Boards (DHBs) will be disestablished and their functions merged into Health NZ. Health NZ will manage the running of the system for the whole country and the operational functions of the Ministry of Health, such as managing national contracts. All health services (including hospital and specialist services, and primary and community care) will be managed by Health NZ. Health NZ will have four regional divisions that will plan and purchase primary and community-based services. Within each region there will be district offices located among local communities to understand the needs of the area and, as such, develop and implement services to improve the health and wellbeing of those local communities. Health NZ will work in partnership with the Māori Health Authority, to develop a New Zealand Health Plan ensuring that the needs and expectations of Māori communities are also centred in design and delivery. The goal is to make the

system simpler and more coordinated, allowing for better and more consistent care. The Ministry of Health will be able to refocus on stewarding the health system and providing advice to Ministers on health strategy and policy. A new Public Health Agency will be established within the Ministry of Health. It will provide national leadership on Public Health policy, strategy and intelligence; while the Public Health Units will be brought together into a national Public Health service within Health NZ. This will ensure the Public Health Units are well equipped to respond as one to threats like COVID-19. The Health Promotion Agency will be merged into Health NZ. In the future health system there will be a better balance of national consistency for hospital and specialist services and local tailoring of primary and community care.

In August 2020, England announced that the National Institute of Public Health would be established to bring together the NHS Test and Trace, the Joint Biosecurity Centre (whose role is to provide data and advice on COVID-19 infection outbreaks) and the resilience and health protection functions of Public Health England (PHE). In October 2021, the National Institute of Public Health was renamed as UK Health Security Agency (UKHSA), it became fully operational and the PHE was dissolved. The Office for Health Improvement and Disparities (OHID) in England also became fully operational in October 2021. Its responsibilities are national health improvement, prevention of poor health, and tackling health disparities. These changes were made due to an apparent lack of cohesion in the UK's pandemic response and it was thought that the new restructure would improve operational capacity and efficiency.

Post-pandemic, the UKHSA will continue to build on the 'local first' approach, working closely with councils and local directors of Public Health to ensure the service is responsive to the health needs of local communities. The government's next objective is to enable the country to manage other COVID-19 like respiratory illnesses, while maintaining an ability to respond to emerging variants and minimising mortality. It has been noted that while some elements of the COVID-19 response need to be delivered at a national level, for example, legislation and decision making, surveillance and evidence synthesis, there should be greater recognition of the role of local government since locally driven processes and responses are often more effective than those prescribed centrally.

Planned reform in Scotland included establishing Public Health Scotland (PHS) with the objective to develop a whole Public Health system working together as one to enable and support local strategic planning and the delivery of local services. Due to the COVID-19 pandemic, some aspects of the reform have been delayed. PHS took over functions previously under the remit of various bodies such as Health Protection Scotland (a division of NHS National Services Scotland (NSS)), Information Services Division (also a division of NSS) and NHS Health Scotland (a Special Health Board).

Due to the emergence of variants of concern and on-going waves of COVID-19, achieving a streamlined and consistent transition to the new structures has been difficult. Assessment of the execution of the reform in Scotland has also proven difficult due to the ever changing conditions of the pandemic. Currently officials are assessing the impact of the reform on existing structures.

The Scottish Government and the Convention of Scottish Local Authorities (COSLA) managed the reform by establishing the Public Health Reform Programme in 2017. The Scottish Government and COSLA recognised that if the needs of the population are to be met, both local and national needs must be addressed. This meant involving representatives from the local authorities in decision-making along with directors of Public Health, Government and the Department of Health. They also had patient representative groups as part of the consultation process, although not from the start. Additionally there was community engagement and partnerships with local authorities throughout the current reform.

The difficulty in deciding which structures to maintain in Scotland in the future has been acknowledged. Emergency funding provided by the Scottish Government is not recurring and therefore planning has proven difficult. It is recognised that funding for Public Health needs to be at a higher level than pre-pandemic times and future contracts for recruiting suitable personnel need to go beyond fixed term contracts. The Scottish Government is currently in discussion with directors of Public Health and others in PHS to identify local and national Public Health needs going forward.

## **4 Discussion**

### **4.1 Summary of RQ1 findings: Configuration of public health systems**

All 12 EPHFs were described as being configured, at least partly, at a national level for all countries. However, for some EPHFs, the sole adoption of a national configuration was more common than others. Those essential EPHFs that were predominantly described at a national level were:

- EPHF 1 – monitoring and evaluating populations’ health status, health service utilisation and surveillance of risk factors and threats to health
- EPHF 3 – assuring effective Public Health governance, regulation, and legislation
- EPHF 9 – ensuring adequate quantity and quality of Public Health workforce
- EPHF 10 – assuring quality of and access to health services
- EPHF 11 – advancing Public Health research
- EPHF 12 – ensuring equitable access to and rational use of essential medicines and other health technologies.

While all EPHF were described at either a regional or local level by at least one country, the following EPHFs had a well-defined presence at regional and or local levels:

- EPHF 2 – Public Health emergency management
- EPHF 4 – supporting efficient and effective health systems and multisectoral planning, financing, and management for population health
- EPHF 5 – protecting populations against health threats, including environment and occupational hazards, food safety, chemical and radiation hazards
- EPHF 6 – promoting prevention and early detection of diseases including non-communicable and communicable diseases
- EPHF 7 – promoting health and wellbeing and actions to address the wider determinants of health and inequity
- EPHF 8 – ensuring community engagement, participation and social mobilization for health and wellbeing.

From the data identified, it appears that there is national strategic oversight of all EPHF; this is where decisions are typically made. Within some countries, there is a single national body or agency with responsibility for several EPHFs, for example the Ministry of Health (New Zealand) and Public Health Wales. Then, for certain functions, there is regional and local level implementation. For some countries, typically those with decentralised systems, regions have a greater role in deciding how or if guidance will be implemented. Across all countries there was a lack of clarity on the mechanisms of communication between national, regional and local levels.

## **4.2 Summary of RQ2 findings: Structural changes in response to the pandemic, lessons learned and planned reform**

Following interviews with key representatives and data extraction from relevant identified documents, six broad themes were identified relating to the new structures implemented during the pandemic, their impact on existing structures and their strengths and weaknesses in light of the pandemic. These themes were: legislation and decision making; data collection, surveillance, evidence synthesis and collaboration; public health interventions; public participation, public messaging and communication; continuation of healthcare services; workforce capacity and resilience.

All countries included in this review moved to a more rapid decision-making model during the pandemic. In general, expert advisory groups or scientific committees were established to provide their respective governments with advice. In some cases, temporary legislation was put in place to allow the enactment of restrictive measures, or allow for temporary flexibilities across a range of policy areas to permit a quick response to the COVID-19 pandemic. The expert advisory groups and scientific committees formulated their advice based on evidence syntheses undertaken by a range of Public Health organisations (for example, the Public Health Agency of Sweden and Public Health Wales), research institutions (for example, the Statens Serum Institut in Denmark and the Finnish Institute for Health and Welfare), and Health Technology Assessment agencies (for example, the Finnish Coordinating Center for Health Technology Assessment and Swedish Agency for Health Technology Assessment and Assessment of Social Services); or in the case of New Zealand, a dedicated Science and Insights team was established within the Ministry of Health to conduct evidence syntheses to inform decision making. While it is evident that successful partnerships have been formed across different organisations as a result of the pandemic, it has been noted that such partnerships should have been established as part of pre-pandemic planning as forming these links took time at the outset of the pandemic.



Contact tracing was a key Public Health intervention introduced during the pandemic. Contact tracing staff were not always from a healthcare background, but they received intensive training to ensure they were able to carry out their roles and responsibilities accurately. Included countries reported difficulties in trying to meet the demand consistently throughout the pandemic with some establishing contracts with private industries to meet the demand. While addressing initial requirements, challenges arose for countries that relied on redeployment of existing healthcare staff for contact tracing as these staff had to revert to their clinical roles when case numbers rose. This then led to capacity issues in contact tracing resulting in changes to contact tracing policies. Despite these challenges, contact tracing was generally successful across all countries included and was paramount to managing transmission.

The COVID-19 vaccination programme was another key intervention. Typically, these programmes were rolled out at vaccination centres that were set-up within existing premises such as sports arenas or community centres. In some instances, it has been proposed that vaccination hubs should continue to be used for delivery of national immunisation programmes (for example, influenza and pneumococcal vaccinations) due to the efficiencies gained and to free-up GPs' time.

The success of contact tracing and the vaccination programmes was in large part due to public messaging and communication. It has been acknowledged that going forward, careful communication to the public of the scientific evidence is required not just in emergency situations, but also in relation to Public Health in general. Throughout the pandemic, some countries invested resources in assessing public opinion. For example, the Statens Serum Institut in Denmark worked with social scientists to conduct surveys on the behaviours and attitudes of Danish citizens towards government responses to the pandemic. Data gathered from these surveys was used to inform subsequent Public Health messaging and communication. A similar approach was used by the National Institute for Public Health and the Environment in the Netherlands.

In general, continuity of primary care services moved to online teleconferences. Ordinarily, GPs are the first point of contact for patients presenting with symptoms of any kind. However, during the pandemic, those with COVID-19 symptoms were diverted away from general practice to contact tracing centres and, if necessary, COVID-19 facilities in secondary care. During the first wave particularly, non-essential care was paused, for example, screening programmes, elective surgeries and some cancer treatment. This has created a backlog of patients who require medical attention. Moreover, non-essential services suffered a loss of staff and resources that were directed to COVID-19 specific care.

Internationally, workforce capacity was lacking and unable to cope with the surge during the pandemic. As such, staff working in non-essential services were redeployed and some retired staff returned to work. Similarly, it was reported that staff working in Public Health, Ministries of Health and research institutions, experienced excessive workloads, made huge personal sacrifices to complete this work and stepped up to undertake new tasks at rapid speed. It has been highlighted that staff wellbeing and resilience need to be prioritised to bolster the workforce going forward.

Of the countries included in this review, four have gone through reform within the last five years, namely Australia, New Zealand, England, and Scotland. In Australia, the Council of Australian Governments (COAG) agreed to the National Health Reform Agreement (2011).<sup>(70)</sup> This agreement detailed the shared intention of the Commonwealth, state and territory governments to work in partnership to improve health outcomes for all Australians and ensure the sustainability of the Australian health system. In light of the COVID-19 pandemic, an addendum to this agreement took effect in July 2020.<sup>(71)</sup> The addendum described a new pathway for long-term reform of the Australian health system and introduced six long-term goals. They were, empowering people through health literacy, prevention and wellbeing, paying for value and outcomes, joint planning and funding at a local level, enhanced health data and nationally cohesive health technology assessment. Subsequently, the new “National Health Reform Agreement (NHRA) – Long-term health reforms roadmap”,<sup>(72)</sup> was agreed in September 2021.

In New Zealand, the Government commissioned an independent review of the health system in 2018. The review published its final report in mid-2020 and reported that the health system was producing unequal outcomes, particularly for vulnerable populations. While plans to reform the health system in New Zealand had been initiated prior to the COVID-19 pandemic, they will not be executed until July 2022, when the new Health NZ will come into effect.<sup>(73)</sup>

In England, while a commitment to health and social care reform had long been declared by the government, this occurred after the pandemic struck;<sup>(74)</sup> by which stage the weaknesses of the current health and social care system were exacerbated.<sup>(75)</sup>

In Scotland, plans to reform Public Health in Scotland had been initiated by the 2015 Review of Public Health in Scotland. In 2018, six Public Health priorities were agreed between the Scottish Government and the Convention of Scottish Local Authorities (COSLA), and on 1 April 2020, the new Public Health Scotland was established; bringing together NHS Health Scotland, Health Protection Scotland and the Information Services Division.<sup>(76)</sup>

### 4.3 Lessons for Ireland

In light of these findings, key lessons for Ireland relate to IT infrastructure, evidence synthesis, centralised versus decentralised health care systems, public messaging and public opinion as well as communication with local authorities.

Having sufficient IT infrastructure in place to allow for data collection, surveillance and linkage to outcomes for notifiable diseases is paramount. To enable this, appropriate legislation, and cybersecurity, should be in place to allow for safe data sharing. In countries like Finland and Sweden, the IT infrastructure (National Infectious Diseases Register<sup>(77)</sup> and SmiNet,<sup>(78)</sup> respectively) for reporting and surveillance of infectious diseases was already in place and well-established and was supported by a well-resourced Public Health system to support contact tracing. As such, when COVID-19 emerged, it was a quick and smooth transition to include COVID-19 in the list of diseases being monitored. Establishing a strong IT infrastructure for monitoring infectious diseases and ensuring linkage to patient outcomes across all healthcare sectors is vital. For example, in Denmark,<sup>(79)</sup> the national Danish Microbiology Database contains test results from all Danish departments of clinical microbiology; this register can be accessed by all healthcare personnel in Denmark and it is linked to the Danish Civil Registration System (within which all Danish residents are registered) and the Danish National Patient Registry (which contains all hospital admissions and discharges). This IT infrastructure allowed for close surveillance of COVID-19 as well as detailed analysis on areas of increased transmission rates. The establishment and use of a robust IT infrastructure should be prioritised during “peace times” so that in emergency situations these systems, which are already in use, can be adapted to facilitate an emerging situation and are thus fit for purpose. Another example of “pre-pandemic planning” was the EAVE (Early Estimation of Vaccine and Anti-Viral Effectiveness) study in Scotland established in response to the H1N1 pandemic. The EAVE study<sup>(80)</sup> was an established cohort for seasonal and pandemic influenza vaccine and anti-viral assessment. The EAVE II (Early Pandemic Evaluation and Enhanced Surveillance of COVID-19) database (which was established based on the original EAVE study) is a national, real-time prospective cohort. It uses national health data to describe the epidemiology of COVID-19, healthcare use, patient outcomes, as well as effectiveness and safety of COVID-19 vaccines and treatments.<sup>(81)</sup>

Another trend identified across all the countries included in this report was the role of evidence synthesis in decision making. While policy decisions were made at government level, these decisions were informed by evidence syntheses undertaken by various organisations. For example, the Statens Serum Institut in Denmark,<sup>(82)</sup> the Finnish Institute for Health and Welfare in Finland,<sup>(31)</sup> the Swedish Agency for Health Technology Assessment and Assessment of Social Services<sup>(83)</sup> and in New

Zealand, the Science and Insights team established within the Ministry of Health to inform policy during the COVID-19 pandemic.<sup>(84)</sup> Having recognised the need for an established evidence synthesis function to inform decision making in the longer term, the Statens Serum Institut in Denmark are making plans to establish an Infectious Disease Research Centre which will include a multidisciplinary groups of researchers (for example, statisticians, social scientists and systematic reviewers). Similarly, in New Zealand, the newly established Science and Insights team is now an integral part of the Ministry of Health. It was noted that, in some countries (for example, Northern Ireland), the relevant Public Health agency did not have the required capacity or capabilities to conduct the level of data analysis required. Therefore, it was necessary to form collaborations with external partners, such as academia. It was recognised that had these relationships been in place, collaboration in a time of crisis would have been more straightforward. Similarly, due to the volume of testing required during the pandemic, some countries developed contracts with private industries to facilitate this increased demand. Agreements with private contractors were also used to support delivery of COVID-19 vaccinations through vaccination centres. It was noted that if the necessary mechanisms (required legislation, administrative and procurement systems) for these contracts been in place prior to the pandemic, this additional capacity could have been acquired immediately.

One of the main differences across the countries included in this report was the organisation of healthcare services, that is, centralised versus decentralised. In Sweden, Finland and New Zealand healthcare services are highly decentralised, while in Norway and Denmark they are centralised. There are advantages and disadvantages to both these forms of service configuration. Decentralisation means that regions and municipalities (or for example, District Health Boards in New Zealand), are responsible for the interpretation and implementation of national guidance in their respective areas. Local decision makers and authorities have a good understanding of the local population and available resources, and are therefore in a good position to ensure that the selection of priorities is compatible with local needs.<sup>(85)</sup> This configuration can also help enhance community participation in the decision-making process and address local healthcare needs. However, there are several disadvantages associated with decentralised healthcare services.<sup>(85)</sup> For example, it can lead to inequity in access to services if local governments do not provide adequate funding for specific services. Moreover, it can result in an increased workload for the workforce as there may be fewer resources in terms of workforce availability for specialised activities and or infrastructure development. This can particularly arise as an issue in smaller, less populous regions; this issue was exacerbated during the COVID-19 pandemic. Decentralised healthcare systems can also become very complex due to an increased number of

organisations and functions across national, regional and local levels. This growing complexity leads to duplication of functions and inefficiencies.<sup>(86)</sup>

While decentralised systems in the pandemic had the advantage of good communication with the local population, particularly in relation to communication of guidance and execution of track-and-trace systems, the main disadvantage can be the lack of a unified response. For example, in Finland, national guidance regarding restrictive measures were negotiated at the government level and disseminated to the regional level. Implementation of this guidance was decided upon at the regional level, and as such, differed significantly across the regions depending on, for example local incidence. While at times, this was considered appropriate, as restrictions could be made proportional to the local incidence, it contributed to confusion regarding the public health message and there were issues particularly in relation to advice regarding movement between regions and international travel. However, it should also be noted that some countries changed their approach to decision-making as the pandemic continued. For example, in the Netherlands, during the first COVID-19 outbreak in early 2020, the initial response was regional. Then, a national response co-ordinated by the National Institute of Public health and the Environment followed soon afterwards given the changing epidemiological situation.<sup>(87)</sup>

As Public Health systems internationally work towards “business as usual” there is a danger that Public Health will be viewed as health protection only. However, it is important that the other pillars of Public Health (that is, health promotion and well-being, health intelligence and health service improvement) are retained and strengthened. This is especially true if health inequalities are to be addressed.

#### **4.4 Strengths and limitations**

We conducted a systematic and exhaustive search that included electronic databases, grey literature and relevant organisational websites. However, most data sources were identified from the grey literature and it is inherently difficult to ensure a systematic approach is followed when repeating grey literature searching. In addition, we contacted key representatives from all 12 countries to verify and supplement the data extracted. However, a limitation was that we were unable to recruit participants for three of the eligible countries as such, data extracted for these countries were based solely on that available in the public domain. It is also possible that we did not identify all relevant data because some are not publically available. Additionally, there was no quantitative assessment of the quality and or standard of EPHF delivery undertaken as part of this report. Finally, thematic analysis is subject to researcher reflexivity. However, we endeavoured to avoid this by having multiple authors read and synthesise the data.

## **5 Conclusion**

The functioning of Public Health systems in countries included in this report were described according to the delivery of the 12 EPHFs at national, regional and local levels. These EPHFs can be mapped to the four pillars of Public Health (health protection, health promotion and wellbeing, health intelligence, and health service improvement), although it is recognised that there is considerable overlap; that is, one EPHF can be mapped to more than one pillar of Public Health. Across the included countries, there is typically national strategic oversight of all EPHFs, whereas, within some countries, there is a single national body or agency with responsibility for several EPHFs. For certain functions, there is regional and local level implementation in addition to national delivery. Across all countries, there was a lack of clarity on the mechanisms by which communication occurs between national, regional and local levels. When structuring Public Health functions, there is a need to carefully identify which functions, and or which elements of a function, should be delivered at a national, regional or local level to ensure a sustainable and comprehensive Public Health system. Where devolved, there should be clear governance and a strategy of clear communication mechanisms across the different agencies and levels to ensure consistent messaging.

Lessons learned from the COVID-19 pandemic, broadly related to the themes of legislation and decision making; data collection, surveillance, evidence synthesis and collaboration; public health interventions; public participation, public messaging and communication; continuation of healthcare services; and workforce capacity and resilience.

In considering these findings, it is evident that having an appropriate IT infrastructure and an established evidence synthesis function is key to timely and informed decision making. Ideally, these functions should be established during periods of relative stability to permit a faster response during a pandemic or emergency situation. Finally, as Public Health systems internationally work towards “business as usual”, it is important that Public Health is not viewed only as health protection; but that the other pillars of Public Health are strengthened.

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