WILEY

ARTICLE OPEN ACCESS

Synthesizing Public Health Preparedness Mechanisms for High-Impact Infectious Disease Threats: A Jurisdictional Scan

KM Saif-Ur-Rahman[1,2] 🆔 | Nikita N. Burke[1,2] | Lena Murphy[3] | Randal Parlour[4] | Máirín Boland[5] | Petek Eylul Taneri[1,2] | Bearach Reynolds[6] | Mary Horgan[7] | John N. Lavis[8] | Declan Devane[1,2,9] 🆔

[1]Evidence Synthesis Ireland and Cochrane Ireland, University of Galway, Galway, Ireland | [2]Centre for Health Research Methodology, School of Nursing and Midwifery, University of Galway, Galway, Ireland | [3]Faculty of Occupational Medicine, Royal College of Physicians of Ireland, Dublin, Ireland | [4]Research & Guideline Development Unit, National Health Protection Office (HSE), Dublin, Ireland | [5]Health Security Programme, National Health Protection Office, HSE, Dublin, Ireland | [6]General Medicine, St James's Hospital, Dublin, Ireland | [7]Department of Infectious Diseases, School of Medicine, University College Dublin, Dublin, Ireland | [8]McMaster Health Forum and Department of Health Research Methods, Evidence and Impact, McMaster University, Hamilton, Ontario, Canada | [9]HRB-Trials Methodology Research Network, University of Galway, Galway, Ireland

Correspondence: KM Saif-Ur-Rahman (kmsaif-ur.rahman@universityofgalway.ie)

ABSTRACT

Aim: High-impact infectious diseases pose major global health challenges, underscoring the urgent need for robust public health preparedness. Despite efforts to improve global health security, recent pandemics have revealed significant weaknesses in health systems' preparedness and response capabilities.

Methods: We reviewed and synthesized key strategies and lessons from existing public health preparedness plans for high-impact infectious diseases. This included examining national and global plans, focusing on strategic approaches, evidence integration, and real-world implementation lessons. A narrative synthesis, based on the Public Health Emergency Preparedness (PHEP) model, identified effective practices and areas needing improvement.

Results: We screened 1987 documents, selecting 38 for detailed analysis. Findings highlighted strategies for long-term health emergency preparedness, workforce development, enhancing global health frameworks, and investing in infrastructure. Challenges included maintaining laboratory detection, managing sentinel surveillance, and logistical issues. Effective approaches emphasized early threat detection, rapid response, healthcare capacity, medical supply management, and strategic communication.

Conclusions: Effective public health preparedness for high-impact infectious diseases requires a coordinated approach, including early threat detection, rapid response, robust healthcare systems, and strategic communication. Past outbreaks show the need for continuous investment, evidence-based policies, and adaptable health systems. Future research should assess ongoing preparedness efforts and implementation challenges.

1 | Introduction

High-impact infectious diseases have consistently posed significant health challenges globally, resulting in high rates of morbidity and mortality. Since the dawn of the twenty-first century, the world has witnessed several severe infectious disease outbreaks, beginning with the SARS coronavirus pandemic in 2002–2003. This pandemic highlighted the need for the robust international frameworks for pandemic preparedness to manage such health crises [1]. In response to the lessons learned from the SARS outbreak, the World Health Organization (WHO) significantly revised its International Health Regulations (IHR) in 2005. This revision aimed to provide a more effective global legal framework to respond to acute public health risks that could potentially cross borders and threaten people worldwide. A key feature of the revised regulations was the introduction of the mechanism for declaring a Public Health Emergency of International Concern (PHEIC), designed to bring a coordinated international response to such crises [2].

Since the amendment of these regulations, the WHO has declared PHEICs on several occasions: the H1N1 influenza (swine flu) pandemic in 2009; Ebola outbreaks in West Africa (2014) and the Democratic Republic of Congo (2018); the resurgence of polio in 2014; the Zika virus outbreak in 2015; the COVID-19 pandemic beginning in 2020 and the Mpox outbreaks in 2022 and 2024. These health emergencies presented unique challenges and necessitated globally coordinated responses to mitigate their impacts [2]. The COVID-19 pandemic, in particular, has underscored the devastating consequences of such diseases, not only on global health but also on society and the worldwide economy. It has highlighted the interconnectedness of countries and economies and the importance of global solidarity in responding to public health threats. The pandemic has led to unprecedented public health measures, including international travel restrictions, nationwide lockdowns, and massive vaccination campaigns, illustrating the critical role of international cooperation and preparedness in combating global health emergencies.

The recent outbreaks, culminating in the COVID-19 pandemic, have, however, exposed significant gaps in public health systems' preparedness to manage and contain infectious diseases. The pandemic revealed that many health systems were overwhelmed and lacked the infrastructure and protocols to respond effectively to such widespread health crises [3]. According to the Independent Panel for Pandemic Preparedness and Response, critical elements of successful public health interventions against COVID-19 have included prompt case identification and contact tracing, establishment of dedicated isolation facilities, fostering partnerships within government sectors and with external entities, maintaining clear and transparent communication, and actively engaging communities and the private sector. These components underscore the necessity for comprehensive planning, collaboration, and transparent strategies in strengthening public health responses to future infectious disease outbreaks [4].

The panel identifies several areas for improvement in public health responses in some countries, noting the depreciation of scientific evidence evolved and the pandemic's potential impact, procrastination in initiating measures, inadequately funded health systems, and poor coordination between national and local responses. A significant shortcoming was the failure of leadership in some countries to assume responsibility and implement strategies to limit community transmission effectively. These factors contributed to less effective management and control of the pandemic, underscoring the critical need for timely action, adequate funding, cohesive strategy, and accountable leadership in future public health crises [4]. Well-coordinated, evidence-based strategic planning, implemented by national authorities across jurisdictions, could have significantly enhanced pandemic responses in numerous countries.

Jurisdictional scans are strategic instruments employed by governments for informed decision-making. They entail an in-depth analysis of various jurisdictions' definitions, approaches, and strategies regarding specific issues. This process enables policymakers to identify, compare, and gauge the relevance of distinct policies and helps provide crucial insights for policy formulation. Moreover, jurisdictional scans may help identify practical considerations critical for implementing policies, leveraging insights from various regions' experiences [5]. This jurisdictional scan aims to review and synthesize key strategies and lessons from existing public health preparedness plans, specifically targeting high-impact infectious disease threats.

The objectives of the study are as follows: To review existing public health preparedness plans at both national and global levels, focusing specifically on high-impact infectious disease threats. The aim is to distill key strategies, best practices, and lessons learned from various national and global responses to high-impact infectious disease threats to public health. To synthesize the key strategies used in these plans in the face of high-impact infectious disease outbreaks following the Public Health Emergency Preparedness (PHEP) model. This involves understanding the systems and processes used in different jurisdictions. To describe how evidence support is integrated into these preparedness plans. This includes assessing the use of evidence in formulating and implementing the plans or strategies and the mechanism for timely demand-driven evidence support across all eight forms of evidence in decision-making as identified by the Global Evidence Commission Report [6], that is, data analytics, modeling, evaluation, behavioral/implementation research, qualitative insights, evidence synthesis, technology assessment/cost-effectiveness analysis, and guidelines. To identify and extract lessons learned and best practices from these plans, especially those tested in real-world scenarios. This will include analyzing successes and challenges faced during high-impact infectious disease crises.

2 | Methods

2.1 | Jurisdictional Scope

The jurisdictional scope of this review encompasses a dual focus, examining both national and global perspectives. National: This aspect of the review focused on examining the public health preparedness approaches used by individual countries. It examined how different nations have responded to and managed public health crises, especially those related to high-impact infectious diseases. We selected countries based on their similarity to Ireland

in terms of geographical profile, population size, and organization of health services. We also considered the magnitude of public health challenges, uniqueness of response strategies, and outcomes.

Selected countries are as follows: **New Zealand**: Similar island geography, effective COVID-19 response strategy. **Portugal**: Public healthcare similar to Ireland. **Denmark**: Similar healthcare system, effective in managing public health challenges. **Finland**: Comparable in terms of population and healthcare organization, known for its strong public health infrastructure. **Norway**: Similarities in the public health system, proactive in health crisis management. **Iceland**: Island nation with a population size smaller than Ireland, but with an effective public health response system. **Luxembourg**: Small population, high-quality healthcare system faced unique challenges during the pandemic. **Singapore**: Similar population and island geography, highly organized healthcare system, and innovative public health strategies, particularly during the COVID-19 pandemic. **Israel**: Different in size and geographical profile but highly organized healthcare system, innovative use of technology in public health, and notable response to the COVID-19 pandemic, especially in terms of rapid vaccination rollout and data-driven strategies. **Canada**: Although larger in both geography and population, Canada's healthcare system, which is publicly funded and administered on a provincial level, has parallels with Ireland's system. Canada's diverse population and its response to public health crises, including its strategies for managing the COVID-19 pandemic across different provinces, provide a useful comparison for Ireland. **UK**: We considered the United Kingdom as a whole, as well as England, Scotland, Wales, and Northern Ireland separately. **Global**: Any international report on country-level preparedness such as the Evidence Commission Report, the Pan American Health Organization (PAHO) report, the WHO report, the European Centre for Disease Prevention and Control (ECDC) report, the Centers for Disease Control and Prevention (CDC) report, and so forth. These reports were used to understand and compare national responses to public health crises as evaluated and presented by multilateral organizations rather than how multilateral organizations respond.

2.2 | Search Methodology

Data sources: Primary sources included government websites, including ministry of health websites, reports from international health organizations (such as WHO, CDC, ECDC, PAHO, and OECD, Independent Panel for Pandemic Preparedness and Response, Policy Commons), and documents from national commissions and multilateral organizations. Key online repositories for these organizations were systematically searched.

Search strategy: A targeted search strategy was developed, focusing on combinations of keywords like "public health emergencies," "preparedness," "crisis management," "emergency response," "evidence-based policy," "infectious disease response," and specific names of diseases or threats. This strategy was adapted to each specific source, including its interface for searching, to maximize the relevance and comprehensiveness of the search results. The details of the search strategies have been provided in the Supporting Information section.

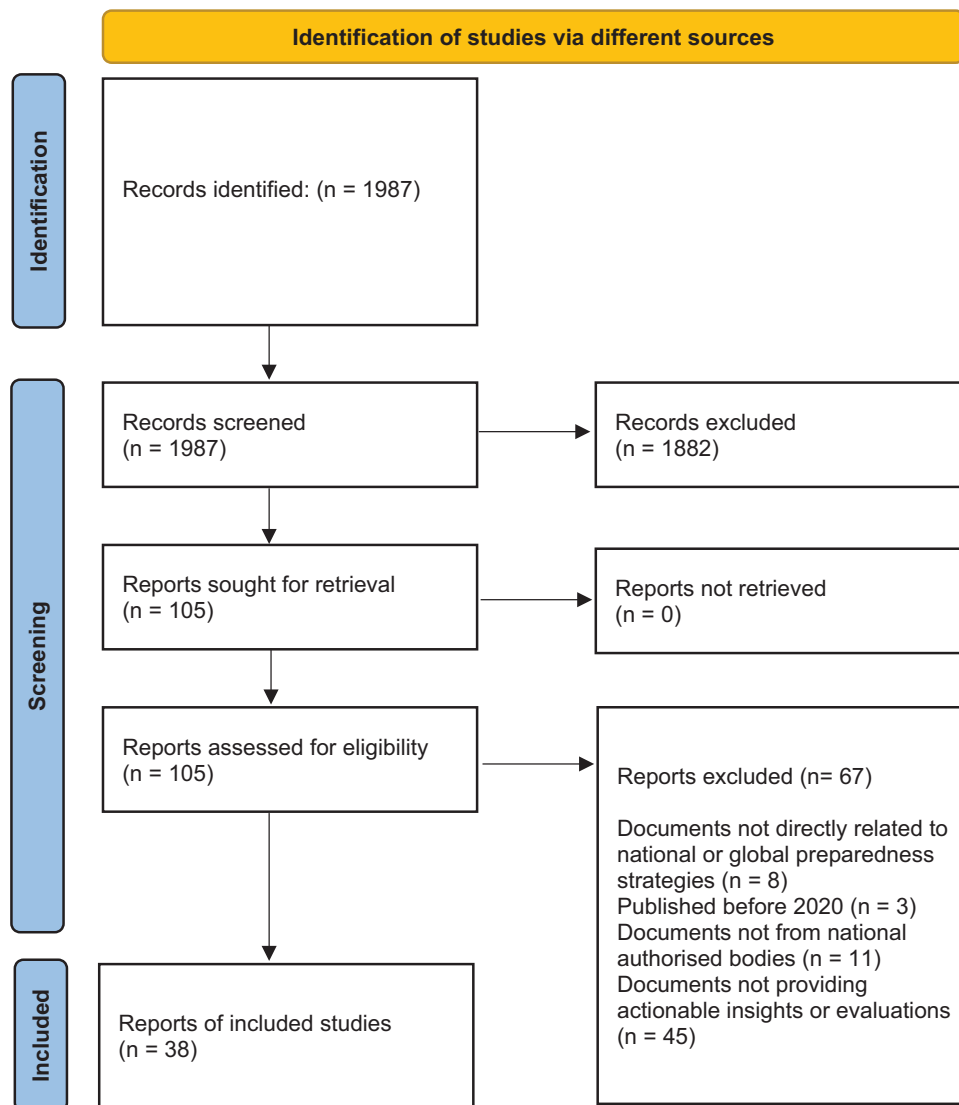## 2.3 | Screening and Selection

Inclusion/Exclusion criteria: Types of documents: The review included documents or reports of national advisory groups, review committees, assessment of high-level panels, national commissions, policy groups, monitoring boards, and reports of science task forces or academia. It also encompassed governmental policies, strategic plans, action reports, and guidelines that detail best practices in managing public health emergencies, particularly those related to high-impact infectious diseases. Health threats: The primary focus was on infectious diseases with actual or potential high impact. These include diseases with widespread infection rates and significant mortality, those causing considerable economic and social disruption, and rapid transmission rates leading to national, regional, or global outbreaks, including defined high-consequence infectious diseases [7]. Diseases declared global health emergencies by major organizations like ECDC and the WHO received substantial media and public attention or necessitated significant government and policy responses. Time frame: Documents that focus on infectious diseases, relevance to public health preparedness, and publication since 2020. Exclusion criteria include documents not directly related to national or global preparedness strategies or those not providing actionable insights or evaluations. Document assessment: Each document underwent a preliminary assessment to determine its relevance to the review's objectives. This involved evaluating the content for direct insights into public health preparedness strategies for high-impact infectious disease threats. Two independent review authors selected the documents through the full-text review, and any discrepancies were resolved through discussion with a third reviewer.

2.4 | Data Extraction

Key information was extracted from each selected document, including the nature of the public health strategy, measures of success or challenges, and evidence integration in the preparedness plans. We extracted data and synthesized it following the PHEP model [8, 9] and organized it by each objective. The PHEP framework was designed to assist EU member states in identifying areas where readiness planning is insufficient. The logic model focuses on three interconnected components: capacities, response capabilities, and objectives. In this model, "response capabilities," also referred to as "Public Health Preparedness Capabilities" are categorized into "detection and assessment," "policy development, adaptation and implementation," "health services," "coordination and communication," and "emergency risk communication" [9]. This approach can be broadly applied to categorize different facets of preparedness for various pandemic health threats. Data extraction was performed by one review author and was cross-checked by a second review author.

2.5 | Data Analysis and Synthesis

Comparative analysis: The extracted data were analyzed to compare and contrast different public health preparedness strategies. This analysis identified common themes, successful approaches, and areas of challenge across different national contexts. Evidence integration assessment: The use of evidence

Identification

Records identified: (n = 1987)

Screening

Records screened
(n = 1987)

Records excluded
(n = 1882)

Reports sought for retrieval
(n = 105)

Reports not retrieved
(n = 0)

Reports assessed for eligibility
(n = 105)

Reports excluded (n= 67)

Documents not directly related to national or global preparedness strategies (n = 8)
Published before 2020 (n = 3)
Documents not from national authorised bodies (n = 11)
Documents not providing actionable insights or evaluations (n = 45)

Included

Reports of included studies
(n = 38)

FIGURE 1 | Selection process of the related documents.

in formulating and implementing these strategies/decisions was assessed, including how various forms of evidence (data analytics, modeling, qualitative insights, etc.) are integrated. Synthesis of lessons learned: On the basis of the analysis, key strategies and lessons learned were identified to help highlight effective practices and areas where improvements are needed, particularly in the face of high-impact infectious disease outbreaks.

3 | Results

3.1 | Included Studies

We identified a total of 1987 documents, of which 105 were included in the full-text review (Figure 1). After the full-text review, 67 documents were excluded, and 38 included for data extraction. Exclusions were based on the following criteria: irrelevance to national or global preparedness strategies (*n* = 8), publication before 2020 (*n* = 3), origin from non-authorized national bodies (*n* = 11), and lack of actionable insights or evaluations (*n* = 45). Of the 38 records [10–47] included, 15

were published by the WHO (including its regional offices) [10–20, 27–29, 41], 6 by the ECDC [21–26], 5 by the OECD (the Organization for Economic Co-operation and Development) [30–34], and 2 each by the World Bank [36, 40], European Parliamentary Research Service [38, 39], and Public Health Agency of Canada [43, 44]. Additionally, one document each originated from the Independent Panel [35], the International Organization for Migration (IOM) [37], New Zealand Ministry of Health [42], NHS Scotland [45], the Government of Singapore [46], and the Health Information and Quality Authority (HIQA, Ireland) [47]. Our aim was to investigate the pandemic responses of specific countries, including New Zealand, Portugal, Denmark, Finland, Norway, Iceland, Luxembourg, Singapore, Israel, Canada, and the United Kingdom. However, we only managed to identify country-level reports for New Zealand, Singapore, Canada, and South Korea. The remainder of the documents comprised global or regional reports. The documents primarily addressed various public health emergencies, with COVID-19 being the most common (28 documents). Seven documents dealt with general public health emergencies, whereas two focused on Ebola. Other diseases, such as yellow fever, cholera, influenza, and arbovirus,

were the subject of one document. Additionally, single documents focused on the Middle East respiratory syndrome (MERS), polio, and Mpox. However, some reports encompassed more than one disease. Table 1 highlights the geographic location and settings, disease of concern, nature of the public health strategy, success measured, challenges, and types of evidence integrated into the preparedness plans in the reports.

3.2 | Synthesis of the Findings as per the Domains of the PHEP Model

We synthesized the extracted data and organized them as per the domains of PHEP model. The domains are detection and assessment, policy development, adaptation and implementation, health services, coordination and communication, and emergency risk communication.

3.2.1 | Detection and Assessment

The WHO reports [10–20] have consistently focused on enhancing epidemiologic investigations, risk characterization, and the monitoring and surveillance of health threats. Efforts have included developing community capacities for risk assessment, managing and evaluating surveillance of risk factors, and preparing laboratory capacities for large-scale testing. The region of Americas (PAHO) [27–29] highlighted systematic outbreak investigation, surveillance strategies, pandemic risk assessments, and enhancing laboratory testing and genomic surveillance. The ECDC [21–26] emphasized the establishment of clear triggers for incident recognition, including de-escalation and reescalation measures based on robust surveillance systems like sentinel and wastewater surveillance. It also underlines the importance of laboratory readiness and protocols to enhance response capabilities. Reports from OECD [30–34] mentioned enhanced public health monitoring and information systems, significant investments in capacities to detect and analyze health threats, removal of regulatory barriers for broader laboratory participation, emphasis on contact tracing and free testing.

3.2.2 | Policy Development, Adaptation, and Implementation

The WHO initiatives [10–20] have provided comprehensive infection control and treatment guidance. They have also focused on population-based disease control measures such as vaccination, nutrition, vector control, water sanitation, hygiene, service delivery, and enforcing laws and regulations to support public health workforce development. The PAHO [27–29] focused on updating infection control and treatment guidelines, reviewing laws and regulations relevant to pandemic management, and ensuring preparedness at points of entry and for mass gatherings. ECDC's main focus was developing policies that comprehend the characteristics of etiological agents, protect vulnerable populations, and prevent healthcare systems from collapsing. It includes drafting infection-control protocols and emergency plans to manage public health threats effectively [21–26]. OECD reports discussed the creation and adaptation of crisis response manuals, enforcement of laws and regulations, including travel restrictions

and quarantine measures, and implementation of fast-track or emergency legislation in several countries, including the United Kingdom, France, and Korea [30–34].

3.2.3 | Health Services

The WHO has emphasized preventive services, management of medical countermeasures, supplies and equipment, and a strategic shift toward ecosystem approaches to health emergencies. Additionally, there has been a focus on the care for healthcare workers and emergency responders, promoting prevention, early detection of diseases, and community protection [10–20]. The PAHO [27–29] highlighted the need for preventive services, infection prevention, workforce protection, and effective management of medical countermeasures, supplies, and equipment. ECDC reports discussed the necessity of maintaining structures, processes, and procedures established during the pandemic to ensure ongoing population protection. It stressed investing in the recovery of healthcare systems and developing next-generation vaccines and therapeutics [21–26]. OECD reports alluded to strengthening of healthcare infrastructure for infectious diseases and mass-casualty events, management of medical countermeasures, supplies, and equipment, support for healthcare workers through psychological support and protective measures, development of community care centers and home-based programs, and innovative roles for pharmacists and community health workers [30–34].

3.2.4 | Coordination and Communication

The WHO has focused on crisis management and emergency coordination, including communication with emergency management, public safety, and other sectors. This has been coupled with efforts toward designing local disaster risk reduction, resilience strategies, and engagement across various WHO regions [10–20]. The PAHO addressed crisis management mechanisms, communication with healthcare providers, and disseminating updated information to the health workforce [27–29]. ECDC underlined the importance of effective crisis management, including clear public communication regarding control measure adjustments. It emphasizes the role of cross-border communication and coordination with other public health agencies at all levels [21–26]. OECD mentioned a reduction in the number of emergency preparedness plans to adopt a more streamlined approach and an emphasis on interagency cooperation.

3.2.5 | Emergency Risk Communication

The WHO initiatives have aimed to communicate risk accurately, transparently, and timely. There has been an emphasis on fostering and maintaining trust within communities through evidence-based multichannel communication and addressing communication inequalities to improve trust and accountability in citizen-state relations [10–20]. Similarly, the PAHO stressed the importance of dynamic listening, managing rumors, engaging communities, and ensuring clear, transparent, and timely communication to build trust and address vaccine hesitancy [27–29].

TABLE 1 | Characteristics of the included reports.

Sl. no.	Publishing authority and year	Geographic location and settings	Disease of concern	Nature of the public health strategy	Success measured	Challenges	Types of evidence integrated in the preparedness plans
1	WHO, 2022 [9]	Global	COVID-19, Ebola	Global Strategic Preparedness and Response Plan, Incident management system	Vaccination strategy	Not specified	Guideline, data analytics
2	WHO, 2021 [10]	Global, Democratic Republic of the Congo, Bangladesh, the United Republic of Tanzania, Zambia, Somalia, Ethiopia, Kenya, Mozambique, South Sudan, and Zimbabwe	COVID-19, Ebola, yellow fever, cholera, influenza, and arbovirus	Longer term health emergency preparedness	Recovery from COVID-19, vaccine supply	Laboratory detection capacity, sentinel surveillance, laboratory quality assurance, and shipping of samples have been challenging due to emergence of SARS-CoV-2	Guideline, data analytics, evaluation
3	WHO, 2023 [11]	Global	Any health emergency	Health emergency preparedness, prevention, response and resilience (HEPR)	Not specified (mentioned minimizing the impacts of social, educational and economic disruptions)	Global governance, financing	Guideline
4	WHO, 2022 [12]	Global	Any health emergency	Public health workforce development	Not specified	Not specified (possible upcoming challenges might include climate change, rising noncommunicable disease burden, antimicrobial resistance and economic inflation)	Guideline, evaluation
5	WHO, 2023 [13]	Global	Any health emergency, influenza outbreak	Strengthening the global architecture for health emergency preparedness, response and resilience	Not specified	Global governance, financing	Guideline

(Continues)

TABLE 1 | (Continued)

Sl. no.	Publishing authority and year	Geographic location and settings	Disease of concern	Nature of the public health strategy	Success measured	Challenges	Types of evidence integrated in the preparedness plans
6	WHO, 2021 [14]	Global	Any health emergency, COVID-19	Effective policy and control strategies	Not specified	Not specified	Guideline
7	WHO, 2022 [15]	Global	Any health emergency	Strengthening preparedness for and response to health emergencies	Not specified	Not specified	Guideline
8	WHO, 2021 [16]	Global	COVID-19	Community-centred approaches to health emergencies	Collaboration with community, including teachers and students, midwives, and women's Unions, households	Epidemic response teams often have a limited understanding of how and where residents seek medical knowledge and help	Guideline
9	WHO, 2020 [17]	Global	COVID-19	Country-level coordination, planning, and monitoring	Not specified	Not specified	Guideline, evaluation
10	IFRC, UNICEF, WHO, 2020 [18]	Global	COVID-19	Risk communication and community engagement	Not specified	Some elements of the action plan guidance may differ between countries, depending upon their risk levels, people's perceptions, needs, local capacities and current situations	Data analytics, qualitative insights, evidence synthesis

(Continues)

TABLE 1 | (Continued)

Sl. no.	Publishing authority and year	Geographic location and settings	Disease of concern	Nature of the public health strategy	Success measured	Challenges	Types of evidence integrated in the preparedness plans
11	WHO SEAR, 2021 [19]	Regional, Southeast Asia	COVID-19	Strengthening emergency preparedness and response	Considerable regional progress has been reported in the areas of legislation and financing, IHR (international health regulation) coordination and National IHR Focal Points functions, zoonotic events and the human-animal interface, food safety, laboratory, surveillance, human resources, national health emergency frameworks and health service provision	Countries are not completely prepared to face pandemics and severe emergencies	Evaluation, qualitative insights
12	ECDC, 2022 [20]	Regional, EU countries (Croatia, Denmark, France, Italy, Malta, Portugal, Spain, and the Netherlands)	COVID-19	Not specified	Not specified	Substantial uncertainties regarding the optimal public health strategies	Qualitative insights
13	ECDC, 2020 [21]	Regional, EU countries	COVID-19	ECDC's activities, organization and processes that were in place during the pandemic	Smaller member States relied heavily on the guidance of ECDC for public health response decision-making	ECDC's assessment and guidance on important topics was seen by many as coming too late	Evaluation, qualitative insights
14	ECDC, 2020 [22]	Regional, EU, and the United Kingdom	COVID-19	Public health planning response activities to the COVID-19 pandemic	Not specified	Not specified	Evaluation framework

(Continues)

TABLE 1 | (Continued)

Sl. no.	Publishing authority and year	Geographic location and settings	Disease of concern	Nature of the public health strategy	Success measured	Challenges	Types of evidence integrated in the preparedness plans
15	ECDC, 2023 [23]	Regional, EU countries	COVID-19	Investment in the public health workforce, Preparing for the next public health crisis, risk communication and community engagement, collection and analysis of data and evidence	Not specified	Not specified	Evaluation, qualitative insights
16	ECDC, 2022 [24]	Regional, EU countries (Croatia, Finland, Germany, Italy, and Spain)	COVID-19	Lessons learned from EU experience of COVID	Not specified	PHEP systems are multi-jurisdictional and multidisciplinary, and vary markedly from one EU country to another	Evaluation, qualitative analysis, evidence synthesis
17	ECDC, 2022 [25]	Regional, EU countries	COVID-19	Not specified	Not specified	Not specified	Guideline, evaluation
18	PAHO, 2020 [26]	Global	COVID-19	Preparation for an emergency, surveillance, outbreak investigation and risk assessments, health services, clinical management and infection prevention and control, maintaining essential services and recovery, preventing illness in the community	Not specified	Not specified	Guideline
19	PAHO, 2021 [27]	Regional, The Americas	COVID-19	Not specified	Not specified	Not specified	Guideline, evaluation

(Continues)

TABLE 1 | (Continued)

Sl. no.	Publishing authority and year	Geographic location and settings	Disease of concern	Nature of the public health strategy	Success measured	Challenges	Types of evidence integrated in the preparedness plans
20	PAHO, 2023 [28]	Regional, The Americas	COVID-19	Strengthen the pandemic response	Strengthening of leadership and governance; epidemic intelligence; health systems and service delivery networks; emergency operations response and supply chains; and support for the introduction of and access to COVID-19 vaccines	Financial difficulties, socioeconomic decline, and supply chain disruptions	Evaluation, qualitative analysis, evidence synthesis
21	OECD, 2020 [29]	National, Korea	Public health emergencies	Emergency preparedness and response capacities	Encouraging efforts have been made to change legal and institutional frameworks, centralizing and clarifying the chain of command during emergencies, and significant investments have been made in emergency preparedness capacities	Not specified	Evaluation
22	OECD, 2020 [30]	Regional, OECD countries	COVID-19	Approaches by governments in relation to regulatory tools during a pandemic	Not specified	Not specified	Qualitative analysis
23	OECD, 2020 [31]	Regional, OECD countries	COVID-19	Policies aimed at providing effective care and managing the pressure on health systems	Not specified	Health systems being overburdened	Evaluation

(Continues)

TABLE 1 | (Continued)

Sl. no.	Publishing authority and year	Geographic location and settings	Disease of concern	Nature of the public health strategy	Success measured	Challenges	Types of evidence integrated in the preparedness plans
24	OECD, 2021 [32]	Regional, OECD countries	COVID-19	Strengthening primary and community healthcare	Robust primary health care can delay the onset of chronic conditions and reduce mortality rates through greater prevention, hospitalizations and emergency department use, solid primary health care ensures access to vulnerable populations	Overburdened health systems, people with chronic conditions are at more risk	Qualitative insights
25	OECD, 2020 [33]	Regional, ASEAN countries	COVID-19	Strategies used to mitigate the impact of COVID-19 in Southeast Asia	Mitigating the socioeconomic impact of COVID-19	Disruptions to tourism, trade and production, strain on healthcare system, inadequate medical supplies, deaths of healthcare workers, limited testing	Evaluation, qualitative insights
26	The Independent Panel, 2021 [34]	Global	COVID-19	Not specified	Not specified	Delayed responses by governments to the pandemic, lack of supplies, stressed health systems, economic impact, vaccine nationalism	Evaluation, qualitative insights
27	The World Bank, 2023 [35]	National, Korea	COVID-19, MERS (Middle East respiratory syndrome)	Pandemic responses	Not specified	Not specified	Evaluation
28	IOM, 2020 [36]	Global	COVID-19	Not specified	Not specified	Stigma against migrants, economic disruption	Evaluation

(Continues)

TABLE 1 | (Continued)

Sl. no.	Publishing authority and year	Geographic location and settings	Disease of concern	Nature of the public health strategy	Success measured	Challenges	Types of evidence integrated in the preparedness plans
29	EPRS (European Parliamentary Research Service), 2023 [37]	Regional, Europe	COVID-19	Protection, prevention, preparedness, and response during the COVID-19 pandemic	Not specified	Not specified	Evidence synthesis, qualitative insights
30	EPRS (European Parliamentary Research Service), 2023 [38]	Regional, Europe	COVID-19	Resilience to cross-border health threats	Not specified	Optimal response from the countries	Guideline
31	The World Bank, 2022 [39]	Global	COVID-19	Risk reduction, detection, containment, and mitigation capabilities, advanced case management and surge response	Not specified	Not specified	Evaluation
32	WHO EMRO, 2021 [40]	Regional, Eastern Mediterranean Region	COVID-19	Not specified	Not specified	Diverse region, conflict, environmental disasters, political instability, resource limited, low income settings, vulnerable healthcare systems	Modelling, evaluation, qualitative insights, evidence synthesis

(Continues)

TABLE 1 | (Continued)

Sl. no.	Publishing authority and year	Geographic location and settings	Disease of concern	Nature of the public health strategy	Success measured	Challenges	Types of evidence integrated in the preparedness plans
33	New Zealand Ministry of Health, 2023 [41]	National, New Zeeland	Polio	Not specified	Not specified	Not specified	Guideline
34	Public Health Agency of Canada, 2022 [42]	National, Canada	Mpox (Monkeypox)	Public health response plan	Not specified	Not specified	Data analytics, evidence synthesis, guidelines
35	Public Health Agency of Canada, 2022 [43]	National, Canada	COVID-19	Public health response plan	Not specified	Diverse population	Data analytics, guidelines
36	NHS Scotland, 2023 [44]	National, Scotland	Public health emergency	Public health preparedness for emergencies	Not specified	Not specified	Guidelines
37	Government of Singapore, 2023 [45]	National, Singapore	COVID-19	Public health response plan	Not specified	Not specified	Evaluation
38	HIQA, 2020 [46]	National, Ireland	COVID-19	Public health response plan	Not specified	Not specified	Data analytics, qualitative insights

Abbreviations: ECDC, European Centre for Disease Prevention and Control; WHO, World Health Organization.

ECDC advocated for accurate, transparent, and timely communication, emphasizing the building and maintaining capacity in social and behavioral sciences for a comprehensive preparedness and response framework. It calls for dynamic listening, evaluation data gathering, and managing misinformation to foster and maintain public trust [21–26]. OECD countries focused on making risk information widely available and understandable, ensuring clear, transparent, and timely communication with the public, and maintaining trust through stakeholder engagement [30–34].

Overall, these strategies from global health organizations reflect a comprehensive approach toward improving global public health response systems. They underscore the importance of a cohesive response encompassing effective detection, strategic policy development, robust health services, coordinated communication efforts, and dynamic emergency risk communication to effectively manage health emergencies.

The ECDC has developed a framework for monitoring COVID-19 pandemic responses that incorporates eight pillars, aligning closely with the WHO COVID-19 Strategic Preparedness and Response Monitoring and Evaluation Framework. These pillars facilitate comprehensive and coherent pandemic management and include country-level coordination, planning, and monitoring; risk communication and community engagement; surveillance, rapid response teams, and case investigation; vaccine monitoring (policy, coverage, safety, effectiveness, and acceptance); testing policy and practice; infection prevention and control (IPC); case management; maintaining essential health services and systems.

Key lessons identified from country experiences and ECDC analysis emphasized the need for updated, scalable preparedness plans applicable to all hazards and the importance of formalizing the role of public health authorities in decision-making processes. Effective preparedness and response also require cross-sector collaboration, procedures for increased staff capacity prior to crises, updates in communicable disease legislation to address ethical and human rights issues, and enhanced international cooperation and coordination. These insights underscore the critical components necessary for effective PHEP and response. Findings are presented according to the response capabilities domains of the PHEP model in Table S1. Key strategies, evidence support, and lessons learned were synthesized and are summarized in Tables 2–4.

3.3 | Strategies for Public Health Preparedness

The strategies employed by various entities are categorized under the PHEP model domains. These include detection and assessment, policy development, adaptation and implementation, health services, coordination and communication, and emergency risk communication. Table 2 outlines detailed strategies.

The strategies span a wide range, encompassing long-term health emergency preparedness, development of the public health workforce, enhancement of global health emergency frameworks, community-centered approaches, and investment in

TABLE 2 | Synthesized strategies by Public Health Emergency Preparedness (PHEP) model domains.

PHEP model domain	Strategies
Detection and assessment	Enhancing epidemiologic investigations, risk characterization, surveillance systems, and laboratory capacities for large-scale testing
Policy development, adaptation, and implementation	Developing infection control and treatment guidelines, updating laws and regulations, and ensuring preparedness at points of entry Ensuring adaptive response mechanisms, population-based disease control measures, and integration of evidence into policy
Health services	Strengthening healthcare infrastructure, managing medical countermeasures, and supporting healthcare workers
Coordination and communication	Establishing crisis management structures, cross-border coordination, and clear public communication strategies
Emergency risk communication	Fostering trust through transparent communication, managing misinformation, and engaging communities

public health infrastructure. Additionally, they covered specific aspects such as risk communication, community involvement, and the fortification of emergency preparedness and response systems. The primary objectives of these strategies are to boost preparedness, response, and resilience against both existing and anticipated health emergencies through formulating effective policies and control measures, enhancement coordination and planning at the national level, and investment in the public health workforce.

3.4 | Integration of Evidence Support

The documents utilized various forms of evidence in formulating and implementing preparedness plans. The types of evidence considered include guidelines, data analytics, evaluations, qualitative insights, evidence synthesis, and modeling. Table 3 presents the detailed integration of evidence across different forms according to the rapid evidence-support system assessment (RESSA) tool [6].

Guidelines, evaluations, and data analytics are most commonly referenced. Although the documents mentioned various types of

TABLE 3 | Evidence support considerations by rapid evidence-support system assessment (RESSA) components.

RESSA component	Evidence support considerations
Data analytics	Utilizing real-time data for decision-making, predictive analytics for outbreak trends
Modeling	Scenario planning, resource allocation modeling, and impact assessment
Evaluation	Regular assessments of preparedness plans, performance metrics, and outcome evaluations
Behavioral/ Implementation research	Studying public adherence to health measures, evaluating intervention effectiveness.
Qualitative insights	Gathering community feedback, stakeholder interviews, and ethnographic studies
Evidence synthesis	Combining multiple sources of evidence to inform guidelines and best practices
Technology assessment/ Cost-effectiveness analysis	Evaluating the cost-effectiveness of interventions, technology deployment
Guidelines	Developing evidence-based guidelines, protocols, and standard operating procedures

TABLE 4 | Synthesized lessons learned.

Key lessons learned	Examples
Early threat detection	Importance of prompt case identification and surveillance systems
Rapid response capabilities	Necessity of scalable response mechanisms and rapid deployment of resources
Healthcare system strengthening	Investing in healthcare infrastructure and workforce training
Communication and coordination	Establishing clear communication channels and coordinated response frameworks
Evidence-based decision-making	Integrating scientific evidence into policymaking and response strategies
Community engagement and trust building	Engaging communities, managing misinformation, and maintaining transparency

evidence in their methodologies, they did not provide detailed insights into how evidence was directly applied in the preparedness and response plans.

3.5 | Lessons Learned

The review also identified numerous lessons learned from the implementation of public health preparedness plans. These lessons, particularly those tested in real-world scenarios, highlight both successes and challenges faced during high-impact infectious disease crises. For a comprehensive list of lessons learned, refer to Table 4.

Success criteria varied, with some documents not specifying the success measures. Where articulated, success includes recovery from COVID-19, vaccine supply restoration, enhanced regional cooperation, improved laboratory and healthcare system capacities, and greater public and community engagement. For instance, WHO Southeast Asia regional progress reports highlight legislative and financing improvements. The reports from PAHO emphasized strengthening of leadership and governance as key successes.

Various obstacles encountered by different countries in implementing public health strategies were reported, particularly in response to COVID-19 and other health emergencies. Common challenges include maintaining laboratory detection capacity, addressing sentinel surveillance issues, managing quality assurance, and overcoming shipping complications due to the emergence of SARS-CoV-2. Other reported difficulties to encompass global governance, financing, understanding community health-seeking behaviors, and responding to the pandemic amid economic inflation and noncommunicable disease burdens. Specific challenges noted include limited understanding of community medical knowledge and help-seeking, substantial uncertainties regarding optimal public health strategies, delayed government responses, lack of supplies, stressed health systems, economic impacts, vaccine nationalism, stigma against migrants, and disparities in response effectiveness among different countries. Additionally, the documents mention issues such as disruptions to tourism, trade, production, and healthcare systems, inadequate medical supplies, deaths of healthcare workers, and limited testing facilities.

In addition, we summarized reports as examples of case summaries from various regional or national perspectives.

PHEP and Response in the Southeast Asia Region: The Southeast Asia region has made significant progress in health emergency preparedness since 2014, particularly in implementing the IHR (2005), reinforced by the Delhi Declaration (2019) [20]. However, the COVID-19 pandemic exposed gaps in emergency governance, surveillance, and healthcare access. Although advancements in laboratory systems and workforce capacity have been achieved, challenges persist at points of entry and in managing severe health crises. Recommendations from the review committee on the functioning of IHR highlight the need for stronger compliance, financing, and multisectoral coordination, urging the development of a global pandemic treaty, enhanced health

security frameworks, and sustainable investment in preparedness and response systems.

Learning from COVID-19 response: The pandemic exposed weaknesses in health emergency governance and underscored the need for strong political leadership, multisectoral coordination, and equitable access to pandemic products. Key lessons include the importance of effective alert systems, fair vaccine distribution, and the challenges posed by public health measures. Efforts have strengthened IHR capacities, national action plans, zoonotic event management, food safety, and laboratory systems, alongside improvements in surveillance and workforce capacity. However, gaps remain in emergency management and border control. Recommendations focus on compliance, empowerment, financing, and establishing a global mechanism for equitable pandemic product access [20].

ASEAN's (Association of Southeast Asian Nations) Response to the COVID-19 and Health Sector Responses: As the COVID-19 pandemic evolved, ASEAN countries implemented context-specific measures while gradually adopting a unified regional approach. Strategies included travel restrictions, public health emergency measures, and enhanced cooperation [34]. Health sector responses focused on testing, contact tracing, and quarantine facilities, with Vietnam and Singapore excelling in early containment efforts. However, healthcare system overloads, supply shortages, and testing challenges persisted. Regional cooperation strengthened, fostering policy alignment, trade continuity, and international collaboration, leading to the COVID-19 ASEAN Response Fund for collective pandemic response and recovery. These efforts highlighted the need for regional solidarity and sustained global cooperation.

Response to COVID-19 in Singapore: Singapore's White Paper on COVID-19 provided a comprehensive assessment of the nation's pandemic response, highlighting healthcare system resilience, vaccination efforts, supply chain stability, and economic support. It acknowledged the need to adapt preexisting crisis plans to meet the pandemic's unique challenges [46]. The report emphasized the growing risk of pandemics due to population growth, wildlife interaction, and global travel, underscoring the importance of flexible crisis responses, national resilience, and transparent public communication. To strengthen future preparedness, it proposed prioritizing crisis management, enhancing resilience, and fostering public trust through clear communication.

Preparedness for Public Health Emergencies in South Korea: South Korea has prioritized PHEP, implementing policy reforms and institutional changes to enhance disaster management and infectious disease control [30, 36]. Following the 2014 Sewol Ferry accident and 2015 MERS-CoV outbreak, Korea strengthened its legal framework, updating the Framework Act on the Management of Disasters and Safety and the Infectious Disease Control and Prevention Act to improve interagency coordination, hospital regulations, and public health workforce capacity [30].

Despite advancements, challenges remain in local-level preparedness and interministerial coordination. Korea utilizes sophisticated risk analysis tools and information-sharing platforms but lacks a whole-of-government National Risk Assessment, limiting its ability to prioritize resources effectively. However, investments in healthcare infrastructure, monitoring systems, and technological innovations have strengthened early warning capabilities.

Korea's strategic preparedness following MERS enabled a swift COVID-19 response, avoiding strict lockdowns while maintaining low infection and mortality rates. Governance improvements, public–private partnerships, and health system resilience measures played a crucial role. These experiences offer valuable lessons for other countries in enhancing public health preparedness and crisis response [36].

COVID-19 Pandemic Response in the Eastern Mediterranean Region: The Eastern Mediterranean region prioritized equitable vaccine delivery, addressing disparities in access and distribution while enhancing health system capacities through genomic surveillance and IPC [41]. Key achievements included logistical support for life-saving supplies, expanded genomic surveillance, and sustained health service delivery. Successful case studies from Morocco and Jordan highlighted effective vaccine rollouts and testing innovations. The region emphasized evidence-based public health measures, strong data management, and enhanced regional collaboration. WHO, member states, and stakeholders played a crucial role, underscoring the need for continued support, resource mobilization, and strategic planning to strengthen future health emergency responses.

The National Polio Outbreak Preparedness and Response Framework for New Zealand: New Zealand's Polio Preparedness and Response Framework provides comprehensive guidelines for polio surveillance, detection, and strategic response measures [42]. It outlines environmental and individual poliovirus detection and suggests response components refined through risk assessments with relevant stakeholders. The country prioritizes polio eradication and strengthens surveillance systems, including acute flaccid paralysis (AFP) and wastewater surveillance. Enhanced microbiological, clinical, and immunization strategies aim to improve detection and response. The framework emphasizes high vaccination coverage, identifying at-risk populations, and ensuring equity-based responses while also stressing preparedness in neighboring Pacific countries to prevent poliovirus spread.

COVID-19 Pandemic Response in the Americas: The regional COVID-19 response strategy integrated lessons from past outbreaks into a comprehensive plan to mitigate the pandemic's impact, focusing on key priority areas. These included coordinated public health emergency management, risk communication, strengthened surveillance, and infection prevention measures [28]. Efforts also enhanced laboratory capacity, workforce protection, case management, logistics, and healthcare system resilience. A strong emphasis was placed on vaccination access, intersectoral coordination, and tailored public health interventions, aligning with WHO's global strategic plans. With an estimated $239 million funding requirement, the strategy aimed to suppress transmission, minimize health impacts, and ensure equitable access to essential diagnostics, therapeutics, and vaccines, highlighting donor support as critical for effective implementation.

Public Health Response Plan for the Management of COVID-19 in Canada: Canada's Pan-Canadian COVID-19 response strategy balanced jurisdictional autonomy with a collective responsibility to manage the pandemic. The transition phase focused on risk preparedness, response management, and recovery efforts, with an emphasis on equity-focused recovery due to the pandemic's unequal impact on societal groups [43]. The plan prioritized flexible, evidence-based public health actions, including ongoing surveillance, vaccination, and adaptability to new variants. Special attention was given to Indigenous communities, ensuring culturally appropriate, equity-driven approaches that addressed the unique needs of vulnerable populations during the pandemic's transition phase.

The European Public Health Response to the COVID-19 Pandemic: The COVID-19 pandemic exposed weaknesses in European health systems, prompting unified EU action to address socioeconomic disparities and strengthen public health preparedness. Recognizing the limitations of individual Member States, the European Health Union was established, enhancing the EU's global health leadership [38]. A report by the European Parliamentary Research Service assessed the EU's vaccine strategies, public health response, and future preparedness, advocating for coordinated health policies and recognizing health as a global public good. Key recommendations included greater transparency in vaccine procurement, joint procurement guidelines, improved pharmaceutical contracts, investment in advanced drug and vaccine technologies, and enhanced communication strategies. The report also emphasized the need for PHEP, vaccine hesitancy reduction, medical supply chain security, and strategic autonomy in essential medical supplies, alongside increased investments in resilient healthcare systems to strengthen the EU's overall public health infrastructure and response capabilities.

Preparation for Emergencies in Scotland: The Scottish Health Boards outlined comprehensive emergency preparedness guidelines focusing on preparation, response, and recovery. Effective management requires clear command, control, and coordination structures, adaptable to the scale of emergencies [45]. The guidance emphasized defined leadership, rapid decision-making, and efficient communication. Preestablished emergency response arrangements ensure swift action through multiagency coordination, trained personnel, and structured procedures. Mutual aid agreements facilitate resource-sharing with regular reviews. Communication strategies include staff, patient, and public engagement, ensuring timely updates across multiple channels while adhering to legal privacy obligations. In the recovery phase, health boards play a key role in community rebuilding, healthcare service restoration, and long-term resilience, with a focus on continuity and support for vulnerable groups.

IPC Preparedness for COVID-19 in Ireland: The National Public Health Emergency Team (NPHET) assessed IPC preparedness in Ireland's acute hospitals during COVID-19. Although significant advancements were made, particularly due to prior threats like multidrug-resistant bacteria, challenges remain in ensuring continuous access to personal protective equipment (PPE), testing kits, and critical supplies beyond 48 h [47]. Key issues included variations in medical microbiology services in medium-sized hospitals and supply chain vulnerabilities. The report emphasized ongoing vigilance, resource allocation, and contingency planning to prevent system overload. Although progress in IPC preparedness was evident, targeted support is needed for hospitals facing specific challenges, with a focus on continuous assessment, resource strengthening, and integration with community and non-acute healthcare settings to enhance future emergency preparedness.

Table 5 provides a comparative summary analysis of PHEP and response across different regions, structured according to the domains of the PHEP model.

In addition to these regional and country perspectives, we have summarized recommendations from the World Bank [40] and the Independent Panel [35]. The World Bank and the Independent Panel provided key recommendations for strengthening global health resilience. The World Bank emphasized evidence-based governance, legal framework updates, and strengthening national public health institutions. It advocated for cross-sectoral partnerships, inclusive financing, and strategic investments in early warning systems, primary healthcare, and medical supply chain autonomy to integrate service delivery and pandemic preparedness [40].

The Independent Panel argued that COVID-19 was a preventable disease, attributing failures to inadequate funding, slow alert systems, and weak WHO authority. It called for equitable vaccine distribution, enhanced international cooperation, and stronger WHO independence and funding. The panel also proposed a new global surveillance system, pre-negotiated emergency supply platforms, and innovative financing mechanisms. To prevent future crises, it stressed elevating pandemic response to the highest political level and reinforcing national preparedness measures [35].

4 | Discussion

In this jurisdictional scan, we examined online materials from various global and national organizations, focusing on public health preparedness plans for managing high-impact infectious diseases. Our findings revealed that these plans are, for the most part, aligned with the domains of the PHEP model, demonstrating a consistent strategy toward early threat detection, rapid response, and healthcare capacity enhancement, management of medical supplies, healthcare workforce communication, and risk communication with stakeholders. These elements are pivotal in enhancing preparedness, promoting transparency, establishing trust, and countering misinformation, thereby strengthening public health infrastructures globally and nationally against infectious disease threats.

A recent scoping review examined the state of PHEP in the context of infectious disease emergencies [48]. Echoing our findings, this review highlighted a strong alignment with the components of the All-Hazards Resilience Framework for PHEP [49, 50], which advocates for a comprehensive and adaptable approach to emergency planning. This framework underscores the importance of resilience across various health system capacities to enable effective response and recovery during emergencies.

TABLE 5 | Comparative summary analysis of public health emergency preparedness and response across different regions, structured according to the domains of the Public Health Emergency Preparedness (PHEP) model.

Country/Region	Detection and assessment	Policy development	Adaptation and implementation	Health services	Coordination and communication	Emergency risk communication
Southeast Asia	Enhancement of national laboratory systems, surveillance, and human resource capacities	Development of a global pandemic treaty and sustainable financing recommendations	Equitable vaccine distribution mechanisms and response adaptations	Addressing healthcare system overload and shortages	Call for intergovernmental and multisectoral cooperation	Public engagement and information dissemination strategies
Singapore	Strategic monitoring and risk analysis improvements	White Paper on COVID-19 response strategy and policy refinements	Real-time adaptation strategies for evolving pandemic challenges	Investment in healthcare infrastructure and workforce resilience	Enhanced coordination between health ministries and national agencies	Prioritization of clear, transparent public messaging
South Korea	Sophisticated risk analysis tools and real-time surveillance systems	Framework Act on Disaster Management updated post-MERS outbreak	Post-MERS reforms for emergency health system response	Hospital regulation improvements and health workforce training	Strengthened coordination under the Ministry of Health and Welfare	Risk communication improvements for public trust-building
Eastern Mediterranean	Expanded genomic surveillance and infection control measures	Regional pandemic preparedness and response policy	Health system capacity-building for pandemic resilience	Expansion of testing and vaccine rollout capacities	WHO-led coordination between countries for pandemic preparedness	Strategic communication for regional pandemic collaboration
New Zealand	Acute flaccid paralysis and wastewater surveillance for polio detection	Guidelines for polio preparedness and response	Implementation of enhanced immunization and infection control policies	Immunization strategy and national vaccine preparedness	Multistakeholder approach to vaccine preparedness	Public awareness campaigns for immunization

(Continues)

TABLE 5 | (Continued)

Country/Region	Detection and assessment	Policy development	Adaptation and implementation	Health services	Coordination and communication	Emergency risk communication
Canada	Equity-focused surveillance enhancements	Pan-Canadian strategy for pandemic recovery	Equity-focused health system adjustments	Planning with Indigenous communities for health equity	Collaborative public health response planning	Infodemic management and structured public messaging
European Union	Health system strain assessments and vaccine monitoring	European Health Union formation and public health policy unification	Integrated response mechanisms for health crises	Resilient healthcare system investment	Cross-border health policy coordination	Transparency in vaccine policy and procurement
Scotland	Emergency response framework updates	Health Board emergency coordination policies	Emergency preparedness tailored to specific crisis levels	Hospital capacity planning and response readiness	Legally structured emergency response communication strategies	Crisis communication through multichannel platforms
Ireland	Infection prevention and control preparedness in acute hospitals	Equity-focused pandemic recovery strategies	Resource allocation for acute hospital IPC	Targeted IPC measures for acute hospitals	Institutional IPC preparedness and response mechanisms	Legal obligations for information dissemination
Americas	Strengthening surveillance, epidemiological investigation, and contact tracing	WHO-aligned strategic health planning and financing	Risk-based public health measures and tailored interventions	Scaling up clinical operations, case management, and therapeutics	Multi-country collaboration in emergency planning and execution	Public education on pandemic response and safety measures

Abbreviations: MERS, Middle East respiratory syndrome; WHO, World Health Organization.

The scoping review pinpointed several key themes essential for reinforcing emergency preparedness actions: Evidence-based decision-making: utilizing the best available data to guide actions and policy formulation. Vaccination capacity: expanding as a primary defense mechanism against infectious disease outbreaks. Diagnostic capabilities: enhancing the overall laboratory system for timely and accurate identification of pathogens. IPC: emphasizing measures to prevent disease spread within healthcare settings and the broader community. Healthcare infrastructure: increasing investment to form the backbone of any robust emergency response. Legislation support: enabling swift and effective emergency responses and public health measures. These themes form a blueprint for enhancing PHEP, ensuring that systems are in place to mitigate the impact of infectious disease emergencies.

Another recent report [51] from the HIQA, Ireland, guided the Public Health Reform Expert Advisory Group by evaluating the functionality and structure of public health systems in selected countries, particularly in the context of the COVID-19 pandemic. The report benchmarks these systems against the WHO's 12 Essential Public Health Functions (EPHFs), revealing a balance between strategic national oversight and decentralized implementation. Notably, functions such as surveillance and governance are predominantly nationally coordinated, whereas emergency management and health promotion are largely executed at regional and local levels. Key observations from the pandemic response underline the indispensability of: Robust IT infrastructure: for data gathering and surveillance. Evidence synthesis: in shaping policy. Decentralized models: fostering local engagement but with limitations in achieving a cohesive national response. Holistic approach: merging health protection with health promotion, intelligence, and service improvement to mitigate health disparities. These insights advocate for the strategic orchestration of EPHFs across different governance layers, highlighting the significance of readiness and flexibility within the public health framework. These findings also align with the identified public health preparedness strategies highlighted in our jurisdictional scan. To make informed decisions about public health and social measures (PHSMs), it is essential to use the best available evidence, even though these measures are challenging to evaluate in controlled settings. Real-world studies, despite their complexity and potential biases, provide valuable insights [52]. We did not rule out economic and social responses; however, we did not obtain specific information on those aspects in this jurisdictional scan. The PHEP model provides a systematic framework for enhancing pandemic response strategies across countries and regions. By establishing national standards for preparedness planning, the model enables jurisdictions to assess and strengthen their response capabilities to public health emergencies. Adopting the PHEP model allows regions to build resilience, improve preparedness, and ensure a more effective and coordinated response to future pandemics.

Our objective was to analyze the pandemic response strategies of selected countries, including New Zealand, Portugal, Denmark, Finland, Norway, Iceland, Luxembourg, Singapore, Israel, Canada, and the United Kingdom. However, we could only obtain reports specific to New Zealand, Singapore, Canada, and South Korea, with the remaining analyses being of a global or regional nature. A possible explanation is the prevalence of documents in local languages on the health ministries' websites of these countries, which may have limited our access to reports detailing national strategies for pandemic or emergency preparedness. Although these documents incorporate various types of evidence in their methodologies, they do not elaborate on how this evidence was explicitly used in formulating their preparedness and response plans. Our aim was to understand the application of evidence in national pandemic preparedness plans, but specific details on this aspect were not discernible from the available information. We could not determine if individual countries employ a single agency or multiple entities to devise strategies against emerging health threats, a factor critical for enhancing future preparedness for health crises, such as infectious diseases and pandemics. However, insights from Scotland revealed that centralized planning, managed by a specific public health agency or health board, can enable a more synchronized response effort. In Canada, efforts at central coordination gradually decreased over time.

The main challenges stem from the implementation of current preparedness plans and policies. Increased health investment and an evidence-based approach to policymaking can markedly improve preparedness and responses to future infectious diseases. Urgent and decisive actions by governments and public health authorities are essential, highlighted by the rapid progression of the COVID-19 pandemic. Combatting misinformation, intensified during the pandemic, is equally critical. The simultaneous spread of misinformation, disinformation, or "infodemic," alongside the health crisis, necessitates that global and national health organizations counteract misinformation effectively by validating sources and guiding the public to reliable information. In Ireland, a fact-checking initiative has played a key role in refuting nonscientific claims, providing evidence-based rebuttals, and thus reinforcing public trust and comprehension of health guidelines [53, 54]. The intra-action review of the health protection response in Ireland gathered insights from Health Service Executive Health Protection staff on the pandemic response, leading to key recommendations in communication, governance, and staff well-being. Effective communication should be timely, clear, relevant, and trustworthy to guide decisions and influence behavior. Quality governance involves structures and standards to ensure safe and effective services. A positive organizational culture, marked by trust and alignment of values, is crucial for success [55].

Our research examined preparedness for public health emergencies driven by emerging or reemerging infectious disease threats. We highlighted the critical need for a unified national surveillance system that integrates with regional and global efforts, leverages technological advancements, and ensures data integrity. Strengthening the framework for disease prevention and management requires: ensuring access to essential supplies, equipment, medications, and vaccines; enhancing the capacity and skills of the public health workforce. Effective public health management relies on a well-coordinated system that enables swift national and global decision-making. Additionally, risk communication and community engagement are essential for transparent information sharing and building trust among stakeholders.

Tracking progress on pandemic preparedness at the national level is essential. Future research should explore ongoing preparedness

efforts by countries, regional bodies, and global organizations for potential public health emergencies. A qualitative investigation could provide insights into the challenges faced in implementing national pandemic preparedness plans, particularly in integrating evidence into the planning and execution stages. Combining quantitative surveys with qualitative methods could offer a comprehensive assessment of a country's readiness, focusing on the domains specified in the PHEP model.

This jurisdictional scan has some limitations. Our research involved navigating the websites of various international organizations and health ministries across different countries. Keyword searches often yielded an overwhelming volume of documents, necessitating the establishment of a saturation point to maintain search feasibility. We also encountered country-level documents on various health ministry websites in local languages. Documents not available in English were excluded from our consideration, potentially omitting valuable insights from the analysis.

In conclusion, this jurisdictional scan highlights that global and national public health preparedness plans align with the PHEP model, emphasizing early threat detection, rapid response, healthcare capacity building, medical supply management, and effective risk communication. Although evidence-based policymaking and investments in healthcare infrastructure are crucial, challenges remain in implementation, misinformation management, and sustained health funding. Strengthening national surveillance systems, coordinated disease prevention frameworks, and robust risk communication strategies is essential for enhancing preparedness against infectious disease threats. Addressing these challenges through evidence-driven approaches and sustained investments will strengthen public health infrastructure and improve readiness for future health emergencies.

References

1. R. Baker, A. Mahmud, I. Miller, et al., "Infectious Disease in an Era of Global Change," *Nature Reviews Microbiology* 20 (2022): 193–205.

2. M. Jit, A. Ananthakrishnan, M. McKee, O. Wouters, P. Beutels, and Y. Teerawattananon, "Multi-Country Collaboration in Responding to Global Infectious Disease Threats: Lessons for Europe From the COVID-19 Pandemic," *Lancet Regional Health – Europe* 9 (2021): 100221.

3. M. Khan, O. Dar, N. Erondu, et al., "Using Critical Information to Strengthen Pandemic Preparedness: The Role of National Public Health Agencies," *BMJ Global Health* 5, no. 9 (2020): e002830.

4. E. Sirleaf and H. Clarke, "Report of the Independent Panel for Pandemic Preparedness and Response: Making COVID-19 the Last Pandemic," *Lancet* 398, no. 10295 (2021): 101–103.

5. A. Kilian, A. Nidumolu, and J. Lavis, "Jurisdictional Scans in Policy Making: A Critical Interpretive Synthesis," in *Emerging Health Policy Research Conference* (Menzies Center for Health Policy, 2016), https://ses.library.usyd.edu.au/bitstream/handle/2123/15695/bhsc_kilian_ehpr-presentation-2016-06-21final.pdf?sequence=1&isAllowed=y.

6. Global Commission on Evidence to Address Societal Challenges, *The Evidence Commission Report: A Wake-Up Call and Path Forward for Decision-Makers, Evidence Intermediaries, and Impact-Oriented Evidence Producers* (McMaster Health Forum, 2022).

7. ECDC. *Health Emergency Preparedness for Imported Cases of High-Consequence Infectious Diseases* (ECDC, 2019).

8. M. A. Stoto, C. Nelson, E. Savoia, I. Ljungqvist, and M. Ciotti, "A Public Health Preparedness Logic Model: Assessing Preparedness for Cross-Border Threats in the European Region," *Health Security* 15, no. 5 (2017): 473–482.

9. D. Eerens, R. Hrzic, and T. Clemens, "The Architecture of the European Union's Pandemic Preparedness and Response Policy Framework," *European Journal of Public Health* 33, no. 1 (2023): 42–48.

10. WHO, *Public Health Emergencies: Preparedness and Response* (World Health Organization, 2022), https://apps.who.int/gb/ebwha/pdf_files/EB150/B150_18-en.pdf.

11. WHO, *Public Health Emergencies: Preparedness and Response* (World Health Organization, 2022), https://apps.who.int/gb/ebwha/pdf_files/EB148/B148_17-en.pdf.

12. WHO, *Strengthening Health Emergency Prevention, Preparedness, Response and Resilience* (World Health Organization, 2023).

13. WHO, *National Workforce Capacity to Implement the Essential Public Health Functions Including a Focus on Emergency Preparedness and Response: Roadmap for Aligning WHO and Partner Contributions* (World Health Organization, 2022).

14. WHO, *Strengthening WHO Preparedness for and Response to Health Emergencies* (World Health Organization, 2023), https://apps.who.int/gb/ebwha/pdf_files/WHA76/A76_10-en.pdf.

15. WHO, *WHO's Work in Health Emergencies* (World Health Organization, 2021), https://apps.who.int/gb/ebwha/pdf_files/EB148/B148_18-en.pdf.

16. WHO, *Strengthening WHO Preparedness for and Response to Health Emergencies* (World Health Organization, 2022), https://apps.who.int/gb/ebwha/pdf_files/WHA75/A75_17-en.pdf.

17. WHO, *Community-Centred Approaches to Health Emergencies: Progress, Gaps and Research Priorities* (World Health Organization, 2021), https://cdn.who.int/media/docs/default-source/blue-print/who-covid-19-social-science-in-outbreak-report_15.08.21.pdf.

18. WHO, *Operational Planning Guidance to Support Country Preparedness and Response* (World Health Organization, 2020), https://www.who.int/docs/default-source/coronaviruse/covid-19-sprp-operational-planning-guidelines-to-support-country-preparedness-and-response-(22may20).pdf.

19. IFRC, UNICEF, WHO, *Risk Communication and Community Engagement (RCCE) Action Plan Guidance COVID-19 Preparedness and Response* (World Health Organization, 2020), https://hlh.who.int/docs/librariesprovider4/hlh-documents/rcce-action-plan-guidance-covid-19-preparedness-and-response.pdf?Status=Master&sfvrsn=e72a9be1_9.

20. WHO SEAR, *Strengthening Public Health Emergency Preparedness and Response in the South-East Asia Region* (World Health Organization, 2021), https://api.healthsecuritynet.org/get/file/sea-rc74-10-eng.pdf?id=3117.

21. ECDC, *Transitioning Beyond the Acute Phase of the COVID-19 Pandemic* (European Centre for Disease Prevention and Control, 2022).

22. ECDC, *Strategic and Performance Analysis of ECDC Response to the COVID-19 Pandemic* (European Centre for Disease Prevention and Control, 2020), https://www.ecdc.europa.eu/en/publications-data/strategic-and-performance-analysis-ecdc-response-covid-19-pandemic.

23. ECDC, *Monitoring and Evaluation Framework for COVID-19 Response Activities in the EU/EEA and the UK* (European Centre for Disease Prevention and Control, 2020).

24. ECDC, *Lessons From the COVID-19 Pandemic* (European Centre for Disease Prevention and Control, 2023).

25. ECDC, *The EU Experience in the First Phase of COVID-19: Implications for Measuring Preparedness* (European Centre for Disease Prevention and Control, 2022).

26. ECDC, *Long-Term Qualitative Scenarios and Considerations of Their Implications for Preparedness and Response to the COVID-19 Pandemic in the EU/EEA* (European Centre for Disease Prevention and Control, 2022).

27. PAHO, *A Checklist for COVID-2019 Pandemic Risk and Impact Management* (Pan American Health Organization, 2020), https://iris.paho.org/handle/10665.2/52274.

28. PAHO, *Response to the COVID-19 Pandemic in the Americas: Response Strategy and Donor Appeal* (Pan American Health Organization, 2021), https://iris.paho.org/handle/10665.2/53540.

29. PAHO, *Evaluation of the Pan American Health Organization Response to COVID-19 2020–2022* (Pan American Health Organization, 2023), https://iris.paho.org/handle/10665.2/57700.

30. OECD, *OECD Reviews of Public Health: Korea: A Healthier Tomorrow* (OECD, 2020), https://doi.org/10.1787/be2b7063-en.

31. OECD, *Regulatory Quality and COVID-19: The Use of Regulatory Management Tools in a Time of Crisis* (OECD, 2020), https://www.oecd.org/coronavirus/policy-responses/regulatory-quality-and-covid-19-the-use-of-regulatory-management-tools-in-a-time-of-crisis-b876d5dc/.

32. OECD, *Beyond Containment: Health Systems Responses to COVID-19 in the OECD* (OECD, 2020), https://www.oecd.org/coronavirus/policy-responses/beyond-containment-health-systems-responses-to-covid-19-in-the-oecd-6ab740c0/.

33. OECD, *Strengthening the Frontline: How Primary Health Care Helps Health Systems Adapt During the COVID-19 Pandemic* (OECD, 2021), https://www.oecd-ilibrary.org/social-issues-migration-health/strengthening-the-frontline-how-primary-health-care-helps-health-systems-adapt-during-the-covid-19-pandemic_9a5ae6da-en.

34. OECD, *COVID-19 Crisis Response in ASEAN Member States* (OECD, 2020), https://www.oecd.org/coronavirus/policy-responses/covid-19-crisis-response-in-asean-member-states-02f828a2/.

35. The Independent Panel, *COVID-19: Make It the Last Pandemic* (The Independent Panel, 2021), https://theindependentpanel.org/wp-content/uploads/2021/05/COVID-19-Make-it-the-Last-Pandemic_final.pdf.

36. The World Bank, *Learning From the Republic of Korea: Building Health System Resilience* (The World Bank, 2023), http://documents.worldbank.org/curated/en/099752108102328587/IDU0178c333307434042200a85b0d6bc5b4cf1fd.

37. IOM, *IOM's Covid-19 Preparedness and Response* (IOM, 2020), https://crisisresponse.iom.int/sites/g/files/tmzbdl1481/files/uploaded-files/IOM-COVID-19-preparedness-and-Response-Achievements-Report-2020.pdf.

38. M. Beke, L. Berenschot, S. Dutta, et al., *The European Public Health Response to the COVID-19 Pandemic: Lessons for Future Cross Border Health Threats* (European Parliamentary Research Service, 2023), https://www.europarl.europa.eu/RegData/etudes/STUD/2023/740218/EPRS_STU(2023)740218_EN.pdf.

39. L. Amand-Eeckhout, *Building Up Resilience to Cross-Border Health Threats* (European Parliamentary Research Service, 2023), https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/690565/EPRS_BRI(2021)690565_EN.pdf.

40. The World Bank, *Change Cannot Wait: Building Resilient Health Systems in the Shadow of COVID-19* (The World Bank, 2022), https://www.worldbank.org/en/topic/health/publication/change-cannot-wait-building-resilient-health-systems-in-the-shadow-of-covid-19.

41. WHO, *COVID-19 Pandemic Response in the Eastern Mediterranean Region* (World Health Organization, 2021), https://applications.emro.who.int/docs/9789292740344-eng.pdf?ua=1.

42. Ministry of Health, *National Polio Outbreak Preparedness and Response Framework for Aotearoa New Zealand* (Ministry of Health, 2023).

43. Public Health Agency of Canada, *Federal, Provincial and Territorial Public Health Response Plan for the Management of the Monkeypox Outbreak* (Public Health Agency of Canada, 2022), https://www.canada.ca/en/public-health/services/diseases/mpox/technical-documents/federal-provincial-territorial-public-health-response-plan-management.html.

44. Public Health Agency of Canada, *Federal, Provincial, Territorial Public Health Response Plan for Ongoing Management of COVID-19* (Public Health Agency of Canada, 2022), https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/guidance-documents/federal-provincial-territorial-public-health-response-plan-ongoing-management-covid-19.html.

45. NHS Scotland, *Preparing for Emergencies Guidance for Health Boards in Scotland* (NHS Scotland, 2023), https://www.gov.scot/publications/preparing-emergencies-guidance/documents/.

46. Government of Singapore, *White Paper on Singapore's Response to COVID-19: Lessons for the Next Pandemic* (Government of Singapore, 2023), https://www.gov.sg/article/covid-19-white-paper.

47. HIQA, *Desktop Analysis of Public Acute Hospital Infection Prevention and Control Preparedness for Covid-19* (HIQA, 2020), https://www.hiqa.ie/sites/default/files/2020-05/NPHET-Report_0.pdf.

48. J. M. Lee, R. Jansen, K. E. Sanderson, et al., "Public Health Emergency Preparedness for Infectious Disease Emergencies: A Scoping Review of Recent Evidence," *BMC Public Health* [Electronic Resource] 23, no. 1 (2023): 420.

49. Y. Khan, T. O'Sullivan, A. Brown, et al., "Public Health Emergency Preparedness: A Framework to Promote Resilience," *BMC Public Health* [Electronic Resource] 18, no. 1 (2018): 1344.

50. Y. Khan, A. D. Brown, A. R. Gagliardi, et al., "Are We Prepared? The Development of Performance Indicators for Public Health Emergency Preparedness Using a Modified Delphi Approach," *PLoS ONE* 14, no. 12 (2019): e0226489.

51. HIQA, *Report—High Level Review of Configuration and Reform of Public Health Systems in Selected Countries* (HIQA, 2022), https://www.hiqa.ie/sites/default/files/2022-06/Report-High-level-review-of-configuration-and-reform-of-Public-Health-systems-in-selected-countries.pdf.

52. C. M. Vélez, M. G. Wilson, X. Song, K. Waddell, P. DeMaio, and J. N. Lavis, *COVID-END PHSM LES Working Group. COVID-19 Living Evidence Synthesis 20.1: Effectiveness of Combinations of Public Health and Social Measures Over Time and Across Jurisdictions for Reducing Transmission of COVID-19 and Other Respiratory Infections in Non-Healthcare Community-Based Settings* (McMaster Health Forum, 2023).

53. Evidently Cochrane, *iHealthFacts Website: Fact-Check Things You Read and Hear About Health* (Evidently Cochrane, 2023), https://www.evidentlycochrane.net/ihealthfacts-website-fact-check-health-claims/.

54. M. Zaki, *Tackling the Infodemic: A New Digital Resource to Prevent the Spread of Misinformation* (HRB Open Research, 2021), https://blog.hrbopenresearch.org/2021/09/07/health-claims-and-a-digital-resource-to-check-their-reliability/.

55. M. Boland, M. C. Morrissey, E. O'Connor, et al., *Intra-Action Review of the HSE Health Protection Response to the COVID-19 Pandemic During 2021: Final Report and Recommendations* (Health Service Executive, 2022), http://hdl.handle.net/10147/632023.

Supporting Information

Additional supporting information can be found online in the Supporting Information section.