

SUPPLEMENTARY FILE 2

Reproducible search, screening, appraisal, scoring and curriculum-synthesis methods

Companion methods for the proposed generic Public Health Emergency Management curriculum

5 October 2026

1. Purpose and scope

This file records the methods used to build the 81-source analytic library and to convert it into a four-layer, 22-domain proposed curriculum. It supports audit and replication. It does not convert a documentary synthesis into a review of intervention effects.

The review question was: which common competencies, curriculum layers, role pathways, learning domains and workplace products should form an adaptable Public Health Emergency Management curriculum?

2. Study design

The curriculum was developed with the six-step curriculum model, and the main article reports the first four steps: problem identification, targeted needs assessment, goals and objectives, and educational strategies. Implementation and evaluation belong to companion work and to the validation studies listed in the main article.

The documentary review is the evidence-gathering component inside that design. It is not a scoping review, a narrative review or a systematic review of effects. The Scale for the Assessment of Narrative Review Articles was retrieved during the search and examined. It appraises the quality of a published narrative review and does not govern the reporting of search, extraction or synthesis, so it was not adopted as the reporting standard. It remains in the analytic library as a retrieved methodological source.

3. Reporting standard: PRISMA-ScR item table

No EQUATOR reporting guideline covers curriculum-development studies. The review component is reported against the items of the PRISMA extension for scoping reviews that apply to a synthesis of documents. The table below records where each item is addressed. Use of the checklist supports transparent reporting and does not make the study a scoping review.

#	PRISMA-ScR item	Reported in
1	Title	Article type line identifies the design: a generic curriculum developed from a structured documentary review
2	Structured summary	Abstract: background, methods, results, conclusion
3	Rationale	Introduction, paragraphs 1 to 5
4	Objectives	Introduction, final paragraph: review question and product
5	Protocol and registration	No protocol was registered. Stated here; scoping-review registries do not accept curriculum-development studies
6	Eligibility criteria	Methods, Eligibility and screening; section 7 of this file
7	Information sources	Methods, Search period, information sources and language scope; section 5 of this file
8	Search	Methods, Search strategy; section 6 of this file, including backward citation searching
9	Selection of sources of evidence	Methods, Eligibility and screening; section 8 of this file
10	Data charting process	Methods, Competency normalization and outcome derivation; sections 11 and 12 of this file
11	Data items	Section 11 of this file: extraction framework
12	Critical appraisal of individual sources (optional)	Methods, Source appraisal and evidence families; section 9 of this file
13	Synthesis of results	Methods, Decision rules and Curriculum development; sections 12 and 13 of this file

#	PRISMA-ScR item	Reported in
14	Selection of sources of evidence	Methods, Eligibility and screening: 157 candidates, 13 removed, 144 assessed, 81 included
15	Characteristics of sources of evidence	Results, Source profile and evidence families; Table 1; Supplementary File 3
16	Critical appraisal within sources (optional)	Results, Source profile: 72 high and 9 moderate; Supplementary File 3
17	Results of individual sources of evidence	Supplementary File 3 (per-source appraisal) and Supplementary File 4 (per-outcome anchors)
18	Synthesis of results	Results, Curriculum layers to Traceability and audit findings; Tables 2 and 4; Figure 1
19	Summary of evidence	Discussion, What the evidence establishes and what the authors designed
20	Limitations	Discussion, Strengths, limitations and validation pathway
21	Conclusions	Conclusion
22	Funding	Declarations: no specific grant

4. Review design and date boundary

The search ran in three rounds. The first closed on 19 July 2026 and covered PubMed and named institutional repositories in four languages. The second closed on 31 August 2026 and covered peer-reviewed and institutional sources across all six World Health Organization regions, targeting consensus competency frameworks, national education standards, regional training curricula and program evaluations. It assessed 45 candidate records and included 19. The third closed on 5 October 2026. It covered training-provider and agency sites, a general web search engine used for review, education, nursing and psychosocial literature, and articles identified by the authors. It assessed 39 candidate records and included 12. No lower publication-date limit was applied in any round.

Sources from the second round and what each contributes: a consensus educational framework with seven learning domains and three performance levels (North America); a national disaster health education framework and higher-education provider standards (Australia); an in-service curriculum development study for health emergency response offices (China); a scoping review of incident-management leader education (North America); an evaluation of a leadership in emergencies training program (Eastern Mediterranean); a national undergraduate disaster medicine curriculum using blended learning and simulation (Europe); a conceptual framework for incident management systems (North America); and two Spanish-language regional resources on health emergency risk management training and on competencies for workers in emergency preparedness and response (Latin America and the Caribbean); a regional health emergency workforce strategy and a regional strategic roadmap on health security and health system resilience, together with a strategic action framework for community engagement and resilience (South-East Asia); a perspective on regional public health coordination by the West African Health Organization and a regional assessment of field epidemiology workforce capacity across its fifteen member states, a decadal assessment of its national public health institutes and an account of how its training programs supported the COVID-19 response; a narrative review of the roll-out of a continental emergency responder initiative across fifteen African countries; and a French-language account of that initiative training national responders in Burkina Faso (francophone West Africa). Exclusions in that round were dominated by profession-specific competency sets, single-course descriptions, facility-level incident-command studies and institutional news items.

Sources from the third round and what each contributes: a six-module technical diploma with learning outcomes and module outlines (Eastern Mediterranean); a twelve-month executive master's program of three subprograms and a supervised capstone (Eastern Mediterranean); a facilitator's guide for a three-module disaster epidemiology course with exercises and knowledge checks (North America); an empirically derived framework of eleven elements of a resilient preparedness system (North America); a mixed-methods study of emergency management capacity and capability in a national public health agency (Africa); a scoping review of 67 studies of field epidemiology and rapid response team training (Europe); a review of a regional training centre for emergency medical teams (Africa); a scoping review of doctoral curricula in disaster health management (Eastern Mediterranean); a scoping review of 38

articles on training programs for pandemic preparedness and response (North America); a scoping review of humanitarian health education and training (Europe); a scoping review of 319 studies of learning interventions in health emergencies (global); a competency-based emergency preparedness curriculum with participant assessment (Europe). Each was compared with the 22 domains in the coverage test reported in section 20. No outcome was added, removed or renumbered.

A post-synthesis update check was completed on 7 August 2026 against current hazard-classification and all-hazards strategic risk-assessment resources. Those later sources informed the adaptation crosswalk in Supplementary File 1. They did not add, remove or renumber any curriculum outcome, and they are not counted in the 81-source analytic library.

5. Information sources

- PubMed-indexed peer-reviewed literature. This was the only bibliographic database searched.
- World Health Organization publication pages, International Health Regulations resources and regional-office repositories.
- United Nations Office for Disaster Risk Reduction and other United Nations legal or policy repositories.
- Centers for Disease Control and Prevention, Africa Centres for Disease Control and Prevention, European Centre for Disease Prevention and Control and Federal Emergency Management Agency resources.
- Recognized emergency-management, curriculum, competency, exercise, One Health, laboratory, digital-governance and implementation-science sources.
- Backward citation searching from eligible reviews, competency studies and normative documents (section 6).
- Third round: training-provider and agency sites, namely iaph.org, emphnet.net, africacdc.org, cdc.gov, stacks.cdc.gov, openwho.org, aspher.org and the Kenya Ministry of Health Virtual Academy.
- Third round: a general web search engine, used for review, education, nursing and psychosocial literature (queries in section 6).
- Third round: articles identified by the authors.

Not searched systematically: Embase, Scopus, Web of Science, ERIC, CINAHL, PsycINFO, dissertation repositories, and university or ministry intranets. Search terms were English with French, Spanish and Portuguese equivalents in the first two waves, and third-wave queries were in English. No other language was searched.

5b. Records retrieved and screened by information source

First wave, closing 19 July 2026. PubMed 412 records retrieved, 38 candidates registered. WHO headquarters and regional office repositories 96 retrieved, 14 registered. United Nations Office for Disaster Risk Reduction 21 retrieved, 3 registered. Centers for Disease Control and Prevention 34 retrieved, 5 registered. Africa Centres for Disease Control and Prevention 18 retrieved, 3 registered. European Centre for Disease Prevention and Control 16 retrieved, 3 registered. Federal Emergency Management Agency 22 retrieved, 3 registered. Backward citation searching 47 cited works examined, 4 registered. First-wave totals: 666 records retrieved or examined and 73 candidate records registered.

Second wave, closing 31 August 2026. PubMed with regional and education terms 268 retrieved, 17 registered. WHO regional office and Pan American Health Organization repositories 143 retrieved, 16 registered. West African Health Organization and Economic Community of West African States sources 26 retrieved, 5 registered. National and professional education standards sites 58 retrieved, 4 registered. Backward citation searching from second-wave eligible sources 31 cited works examined, 3 registered. Second-wave totals: 526 records retrieved or examined and 45 candidate records registered.

Third wave, closing 5 October 2026. Training-provider and agency sites 20 pages and documents examined, 11 registered. Author-identified articles 9 examined, 9 registered. Web search engine 187

result titles screened across 20 queries, 19 registered. Third-wave totals: 216 records retrieved or examined and 39 candidate records registered.

Across the three waves 1,408 records were retrieved or examined and 157 candidate records were registered. Thirteen duplicate or superseded records were removed, 144 full documents were assessed and 81 entered the analytic library. Counts of records retrieved are counts of titles and landing pages screened, not counts of unique indexed citations, because official repositories return document pages rather than bibliographic records.

6. Search concepts, example strings and backward citation searching

Concept block	Illustrative terms
Core PHEM concept	("public health emergency management" OR "health emergency management" OR "health emergency and disaster risk management" OR "public health emergency preparedness")
Operational systems	("public health emergency operations center" OR PHEOC OR "incident management system" OR "incident command system" OR "rapid response team")
Education and workforce	(curriculum OR curricula OR competency OR competencies OR training OR fellowship OR simulation OR exercise OR assessment OR rubric OR mentor*)
Risk reduction and cycle	(prevention OR mitigation OR "disaster risk reduction" OR resilience OR recovery OR transition OR continuity)
Specialist functions	("public health intelligence" OR "risk communication" OR "community engagement" OR logistics OR "One Health" OR laboratory OR biosafety OR biosecurity)
Digital and emerging practice	("digital health" OR informatics OR "geographic information" OR modeling OR "artificial intelligence" OR cybersecurity)

Complete PubMed query, first wave, run 19 July 2026:

("public health emergency management"[tiab] OR "health emergency management"[tiab] OR "health emergency and disaster risk management"[tiab] OR "public health emergency preparedness"[tiab] OR "emergency operations cent*" [tiab] OR "incident management system"[tiab] OR "incident command system"[tiab]) AND (curricul*[tiab] OR competenc*[tiab] OR training[tiab] OR fellowship[tiab] OR simulation[tiab] OR exercise*[tiab] OR assessment[tiab] OR rubric*[tiab] OR mentor*[tiab] OR "learning outcome*" [tiab]) NOT (animal[mh] NOT human[mh])

Complete PubMed query, second wave, run 31 August 2026:

((("public health emergency management"[tiab] OR "health emergency and disaster risk management"[tiab] OR "disaster management"[tiab] OR "emergency preparedness"[tiab]) AND (curricul*[tiab] OR competenc*[tiab] OR "education standard*" [tiab] OR "training program*" [tiab] OR "programme evaluation" [tiab])) AND (Africa[tiab] OR "Latin America"[tiab] OR Caribbean[tiab] OR "South-East Asia"[tiab] OR "Western Pacific"[tiab] OR "Eastern Mediterranean"[tiab] OR Oceania[tiab] OR regional[tiab] OR national[tiab] OR "low- and middle-income" [tiab])

Institutional-site search log. Each official site was searched with the same four term sets, entered in the site search box and, where a site search was unavailable, through a Google site-restricted query of the form site:<domain> "<term>". The term sets were: "emergency management" curriculum; "emergency management" competency framework; "emergency management" training OR fellowship; "emergency operations centre" OR "emergency operations center" training. Sites searched were who.int and the six WHO regional-office domains, undrr.org, cdc.gov, africacdc.org, ecdc.europa.eu, fema.gov, paho.org, wahooas.org and ecowas.int. Landing pages and publication records returned by these queries were screened by title, and the counts appear in section 5b.

French, Spanish and Portuguese equivalents of the four term sets were used on regional and national sites in those languages: gestion des urgences, gestion du risque de catastrophe, formation, competences; gestion de emergencias, gestion del riesgo de desastres, formacion, competencias; gestao de emergencias, gestao do risco de desastres, formacao, competencias.

Third-wave web search log, run 5 October 2026. Eleven topic queries were entered in a general web search engine, and the first page of results for each was screened by title: scoping review public health emergency management training programmes curricula Africa 2000-2025 BMJ Public Health 2026;

Eric Nzirakaindi Ikoona et al., *A proposed generic open curriculum for public health emergency management: An evidence-informed synthesis for country adaptation. Journal of Interventional Epidemiology and Public Health.* 2026; 9(4):167. <https://doi.org/10.37432/jieph-d-26-00297> 4

knowledge mapping analysis public health emergency management research Web of Science 2007-2020 bibliometric; ASPHER core curriculum for public health update emergency preparedness pan-European; "public health emergency management" curriculum competencies training programme evaluation; "health emergency" workforce development competencies curricula scoping review; disaster preparedness competencies nursing education curriculum systematic review public health emergency; "public health emergency" preparedness higher education master's program curriculum competencies evaluation; "rapid response team" training curriculum evaluation public health emergency competencies; "emergency operations center" OR "emergency operations centre" public health training curriculum evaluation; mental health psychosocial support emergency responders training competency framework public health emergency; "emergency management" competency framework public health professionals Delphi consensus. Nine further known-item queries, each the title of a record found by a topic query or named by the authors, located the full records. The 20 queries returned 187 result titles. Training-provider and agency pages were opened directly from the sites listed in section 5.

Terms were combined with Boolean operators and adapted to each platform. Official-site searching also used document titles, program names and institutional abbreviations.

Backward citation searching ran as a separate step after database and institutional searching. The reference lists of every eligible systematic review, competency study and normative document were read in full. A cited work became a candidate when its title or citation indicated competencies, curricula, exercises, workplace assessment, program evaluation or emergency-management doctrine. Candidates then passed through the same eligibility criteria as database records and received a record identifier in the candidate register. Forward citation searching was not performed, and citation-tracking software was not used.

7. Eligibility criteria

Included	Excluded
International normative documents; official competency frameworks or manuals; government or regional training resources; peer-reviewed curriculum-development, competency or program-evaluation studies; curriculum-development textbooks. The source needed substantive content on competencies, objectives, modules, exercises, workplace products, assessment, mentorship, adaptation, monitoring or revision.	Recruitment advertisements without substantive content; promotional reports used as primary evidence; commercial courses without transparent methods; single clinical procedures; profession-specific packages without transferable PHEM content; inaccessible records; duplicate or superseded versions.

8. Screening flow and disposition

Stage	Round 1	Round 2	Round 3	Total
Candidate register	73	45	39	157
Duplicate or superseded records removed	7	0	6	13
Full documents assessed	66	45	33	144
Included in analytic library	50	19	12	81
Excluded after full-document review	16	26	21	63

Every candidate received a unique identifier. Supplementary File 3 gives the complete disposition and the recorded reason for each excluded, duplicate or superseded record.

9. Source-quality appraisal and evidence families

Official and grey literature received an adapted Authority, Accuracy, Coverage, Objectivity, Date and Significance appraisal, each dimension scoring 0, 1 or 2. Totals of 9 to 12 indicated high quality, 6 to 8 moderate and 0 to 5 low. Low-quality material could not establish a universal competency or a program standard. Among the 81 included sources, 72 scored high and nine moderate.

Dimension	Operational question
Authority	Is the issuing body, authorship, mandate and expertise identifiable and credible?
Accuracy	Are claims, methods, references and version information transparent and internally consistent?

Dimension	Operational question
Coverage	Does the document provide sufficient scope and depth for the curriculum decision?
Objectivity	Are purpose, interests, limitations and the line between evidence and promotion clear?
Date	Is the source current for its purpose, or a recognized foundational standard?
Significance	Does the source materially inform PHEM roles, outcomes, program design, assessment or adaptation?

The appraisal screens whether a document is usable for a curriculum decision. It does not measure empirical validity. Because authority, empirical validity, educational validity and normative status are different properties, every included source was also assigned to one of six evidence families, recorded in Supplementary File 3 and summarized in Table 1 of the main article: normative instruments (15); operational doctrine and manuals (14); educational program and curriculum-method sources (16); empirical studies and evaluations (19); competency frameworks (9); and conceptual or definitional scholarship (8). Two rules follow. Universal-core outcomes were not derived from empirical sources alone, and performance claims were not derived from normative sources alone.

10. Documentation completeness of public resource packages

Six major public resource packages received a 10-element documentation completeness score. The construct is the completeness of the public record: whether a ministry could obtain the components needed to run a program without redeveloping them. It is not implementation readiness, and it is not program quality. Public availability determines what could be scored rather than earning points, so material held internally scores as absent.

Resource types and interpretation. The six packages differ in purpose. The analysis is a descriptive mapping of publicly documented curriculum components across resource types, rather than a comparison of program completeness. Totals are interpreted within resource type. Table 2 of the main article gives the type of each package. The WHO public health emergency operations center resources are an operational manual set. The Africa CDC advanced fellowship is an educational program. The Health Emergency and Disaster Risk Management, Sendai and African disaster-risk work is a normative framework and competency set. The ECDC competencies and HEPSA are a competency framework and self-assessment tool. The CDC capabilities and fellowship are a capability standard and educational program. The WHO public health intelligence resources are a competency framework and curriculum.

Workplace products, assessment tools, facilitator guidance and mentor or supervisor guidance belong to training delivery. They are expected of educational packages, and a score of 0 on those elements records that the component is absent from the public package. Statements about missing components, and the finding that no package met the predefined criteria, therefore apply to the three packages that carry an educational program or curriculum: the Africa CDC advanced fellowship, the CDC capabilities and fellowship, and the WHO public health intelligence resources. The predefined criteria describe a complete training package: a full-cycle competency set, differentiated role pathways, teaching content, repeated simulation, standard workplace products, mentor guidance and calibration-ready assessment, held in one publicly available package. They were applied to the three educational packages.

Element anchors. Each element scores 0 when the public package contains nothing usable, 1 when the component is partial, implicit or present only as an example, and 2 when it is explicit, substantial and directly usable by a country adopting the package.

Element	Scored 2 when the public package provides
1 Competencies	Explicit competency or capability statements covering more than one emergency function
2 Learning objectives	Stated learning objectives tied to those competencies
3 Modules or session plans	A module structure or session plans a facilitator could teach from
4 Exercises or simulations	Exercise or simulation materials with objectives, scenario and evaluation
5 Workplace products	Named workplace deliverables with minimum content requirements or templates
6 Assessment tools	Assessment instruments, rubrics or standard-setting guidance
7 Facilitator guidance	Facilitator or instructor guidance beyond the content itself

Element	Scored 2 when the public package provides
8 Mentor or supervisor guidance	Guidance for workplace mentors or supervisors, with review arrangements
9 Adaptation guidance	Stated rules or procedures for national adaptation of the package
10 Monitoring, revision and version control	A monitoring, revision or version-control arrangement for the package itself

Thresholds. Totals of 15 to 20 indicate complete public documentation, 8 to 14 partial and 0 to 7 limited. The thresholds are investigator-defined. They capture what each package documents publicly. Program quality and implementation readiness require separate assessment.

Scoring procedure. All six packages were scored against these element definitions on 31 August 2026, using the current public version of each package. Two authors applied the anchors independently to all ten elements of every package. Exact agreement was 53 of 60 element scores, 88.3 percent, with a linear weighted kappa of 0.85 (95% CI 0.70 to 1.00). The seven disagreements were reconciled against the source document, one of them after a third author adjudicated.

Artefacts scored for each package. Scores describe the public documents listed here as they stood on 31 August 2026, and not the training an institution delivers. A reader who disputes a score can open the same documents and apply the anchors.

WHO public health emergency operations center resources: Framework for a Public Health Emergency Operations Centre (2015); Handbook for developing a public health emergency operations centre, Part A, policies, plans and procedures (2018); Handbook Part C, training and exercises (2018); WHO Regional Office for Africa handbook for public health emergency operations center operations and management (2021).

Africa CDC advanced fellowship: Eteng and colleagues, competency-based curriculum development for the advanced PHEM training program, with its published supplementary material (2024); Getaneh and colleagues, inaugural cohort account (2025).

Health Emergency and Disaster Risk Management, Sendai and African disaster-risk work: WHO Health Emergency and Disaster Risk Management Framework (2019); Sendai Framework for Disaster Risk Reduction 2015-2030; Olu and colleagues, proposed disaster competencies for the African health workforce (2018).

ECDC competencies and HEPSA: Public health emergency preparedness core competencies for European Union Member States (2017); HEPSA health emergency preparedness self-assessment tool user guide (2018).

CDC capabilities and fellowship: Public Health Emergency Preparedness and Response Capabilities, national standards for state, local, tribal and territorial public health (2018 update); the public pages of the international Public Health Emergency Management Fellowship; Brencic and colleagues on CDC support for global public health emergency management (2017); Krishnan and colleagues on fellowship graduates in the COVID-19 response (2022). The 2018 capability update states that it does not carry programmatic performance measures, which is the basis of the assessment-tools score for this package.

WHO public health intelligence resources: Public health intelligence competency framework (2025); Public health intelligence curriculum (2025).

Instrument status. The scale was built for this study. Its ten elements and written anchors were fixed before any package was scored and were then piloted on two packages outside the final six, after which the anchors for assessment tools and for monitoring, revision and version control were reworded. The elements carry equal weight, which is a design choice. Every element was scored independently by two authors and the agreement statistic is reported. External benchmarking against other instruments has not been done.

Worked example: WHO public health emergency operations center resources, total 12 of 20.

Element	Score	Basis for the score
1 Competencies	1	Functions and position descriptions are set out, but not as competency statements

Element	Score	Basis for the score
2 Learning objectives	1	Training guidance implies objectives without stating them as learning outcomes
3 Modules or session plans	2	The training and exercises handbook gives a usable training structure
4 Exercises or simulations	2	Full exercise guidance with objectives, scenario design and evaluation
5 Workplace products	2	Plans, procedures, rosters and action-plan formats are specified
6 Assessment tools	1	Exercise evaluation is provided; learner assessment instruments are not
7 Facilitator guidance	1	Guidance is addressed to program managers rather than to facilitators
8 Mentor or supervisor guidance	0	No public mentor or workplace supervisor guidance
9 Adaptation guidance	1	The package is written for national use without a stated adaptation procedure
10 Monitoring, revision and version control	1	Revision occurs across editions without a published version-control arrangement
Total	12	Partial public documentation

11. Extraction framework

- Issuing organization and year
- Geographic scope and intended workforce
- Emergency phases and hazards
- Roles and proficiency expectations
- Domains and competency statements
- Learning objectives and program sequence
- Exercises, simulations and operational practice
- Workplace or simulation products
- Assessment, certification and automatic-failure standards
- Mentorship and workplace supervision
- Implementation conditions, licensing and revision procedures

12. Competency normalization, with worked transformation examples

Each candidate competency was rewritten as an observable performance statement with four components: the action, the object acted on, the operational context and the expected standard. The format follows performance-objective conventions in instructional design. A terminal competency means the end-of-domain performance statement that the outcomes of that domain together support.

Semantic duplicates were merged when two statements described the same performance in different institutional vocabulary. Narrow tasks were nested under the terminal competency they serve. Every retained outcome was mapped to emergency phase, curriculum layer, role pathway, proficiency level and required evidence. The three examples below show the transformation. Source requirements are paraphrased rather than quoted.

Source requirement (paraphrased)	Transformation applied	Resulting outcome
European competency framework: preparedness personnel should be able to contribute to developing, testing and revising preparedness and response plans.	Action: write. Object: plan components. Context: national planning policy. Standard: triggers, roles, resources, annexes, continuity and a validation record. Testing and revision were nested under the domain terminal competency rather than kept as separate outcomes.	D06.3 Write objectives, assumptions, activation triggers, roles, procedures, resource arrangements and functional or hazard annexes.
Emergency operations center handbook: a center requires documented standard operating procedures, staffing plans, rosters and activation checklists.	Action: develop. Object: the four named artefacts. Context: an activated or activating center. Standard: usable at activation. Four separate source requirements were merged into one outcome because they describe one performance and are assessed through one product.	D12.4 Develop standard operating procedures, staffing plans, rosters, position aids and activation checklists.

Source requirement (paraphrased)	Transformation applied	Resulting outcome
Risk communication and infodemic competency frameworks: responders should monitor rumours, misinformation and community feedback during an emergency.	Action: operate. Object: feedback, listening and rumour monitoring systems. Context: an active response. Standard: continuous operation feeding response decisions. Two framework statements were merged because they describe one monitoring function.	D16.4 Operate community feedback, social-listening, rumour and misinformation monitoring systems.

The complete register of all 132 outcomes, with source anchors, cluster, curriculum layer, emergency phase, role pathways, terminal proficiency, required product and assessment context, is Supplementary File 4.

13. Translation from system capability to assessable competence

Most authoritative sources state system requirements rather than individual obligations. Outcomes were derived through a five-step chain: system capability, occupational function, individual competency, learning outcome and assessment evidence. Table 3 of the main article works the chain through one capability. A capability entered the universal core only when a named post holder performs part of it and the required performance is teachable and observable.

Assessment context was assigned by proficiency level. Outcomes at the understand and apply levels are individually assessable. Outcomes at the coordinate, lead and govern levels depend on a team, a mandate and institutional conditions, and for those the curriculum accepts observed simulation performance in place of workplace performance.

14. Decision rules for the curriculum layers

- Universal core: a defining PHEM function that applies across settings and carries concordant support from at least two authoritative sources issued by different bodies. Independence is judged at the level of the issuing organization and the parent document.
- Context-adaptable core: required in every program, but dependent on national law, institutions, hazards, languages or technology.
- Role pathways: applied to named emergency functions rather than to professions.
- Optional specializations: hazard-, sector- or technology-specific depth, dependent on national need.
- Graduation evidence: a workplace product, observed simulation performance or both. Knowledge tests and attendance may support that evidence and may not replace it.

15. Quality control and traceability

- Deduplicate by title, Digital Object Identifier and canonical address.
- Assess complete documents rather than search snippets.
- Second-pass audit of eligibility, citation accuracy and source-to-domain traceability for every included source.
- Automated checks for duplicate competencies, duplicate codes and unmapped outcomes.
- Reconcile domain numbering, role pathways, proficiency levels and products across the manuscript and Supplementary File 1.
- Where sources conflict, retain the narrower interpretation and preserve national legal authority.
- Version all changes to universal outcomes, role pathways and products.

Duplication and agreement: screening, full-document assessment, extraction, evidence-family assignment, source appraisal and completeness scoring were each performed independently by two authors, with a third settling residual disagreements. Cohen kappa 0.83 (95% CI 0.72 to 0.94) for full-document eligibility; kappa 0.86 (95% CI 0.77 to 0.95) for evidence-family assignment; two-way random-effects, absolute-agreement, single-rater intraclass correlation, ICC(2,1), 0.89 (95% CI 0.83 to 0.93) for the source appraisal total score; linear weighted kappa 0.85 (95% CI 0.70 to 1.00) and 53 of 60 exact agreements for completeness scoring. The ten completeness elements and their written anchors were

fixed before any package was scored and piloted on two packages outside the final six, after which two anchors were reworded. Totals are interpreted within resource type. Agreement statistics for screening, evidence-family assignment and source appraisal refer to the first two rounds. The same two authors screened and appraised the third-round records against the same eligibility criteria, evidence-family rules and appraisal anchors, and agreed on every disposition.

Intraclass correlation model. The unit of analysis was the total appraisal score, from 0 to 12, of each of the 69 sources included from the first two rounds. The same two authors scored every source, so a two-way model was used. Appraisers were treated as a random effect so that the estimate applies to other trained appraisers using the same anchors. Absolute agreement was specified because a systematic difference between appraisers would move a source across a quality band. The single-rater form is reported and is the more conservative estimate, since the average-rater form is higher. The specification follows the reporting guideline of Koo and Li, reference 57 of the main article.

16. Post-synthesis update check

After the analytic library closed, the curriculum was checked against the 2025 UNDRR-ISC Hazard Information Profiles and the WHO Strategic Toolkit for Assessing Risks. The check confirmed that domains D03 and D04 covered standard hazard identification, multi-hazard and cascading-risk terminology, participatory strategic risk assessment, prioritization, uncertainty, prevention and mitigation. No outcome changed. These sources appear as A25 and A26 in Supplementary File 1 and as post-synthesis alignment entries in Supplementary File 3. They are reported as an update check and not as part of the first round.

17. Excluded full documents (first round, 16 documents)

ID	Candidate	Reason for exclusion
E01	WHO Handbook for developing a PHEOC, Part B	Detailed infrastructure guide; no additional curriculum or workforce competency content beyond the included WHO package
E02	WHO systematic review of PHEOCs, 2013	Superseded by the 2015 framework and 2018 handbooks
E03	WHO Strategic Framework for Emergency Preparedness, 2017	Superseded for this synthesis by the 2019 Health EDRM framework and later capability frameworks
E04	WHO AFRO PHEOC Legal Framework Guide, 2021	Narrow legal guide; relevant concepts captured by the included PHEOC framework and the law domain
E05	IAEM poster on the CDC PHEM Fellowship, 2022	Promotional summary without a complete curriculum or assessment package
E06	Nurses as Leaders in Disaster Preparedness and Response, 2016	Profession-specific agenda rather than a generic PHEM curriculum
E07	Ensuring Doctor of Pharmacy Graduates Have Emergency Preparedness Competencies, 2023	Profession-specific educational recommendation
E08	Emergency Preparedness Academy Adds Public Health to Terrorism Training, 2005	Local educational intervention with limited transfer to a generic advanced curriculum
E09	Expanding the PHEP Competency Set to Meet Specialized Local Needs, 2007	Local needs assessment superseded by more current workforce competency evidence
E10	Improving Emergency Preparedness System Readiness Through Simulation, 2014	Single interprofessional intervention rather than a curriculum
E11	FEMA IS-100 course materials	Single introductory course; not a complete PHEM curriculum
E12	OpenWHO HEPR introductory course	Self-paced course without the role, product and assessment framework required for inclusion
E13	ECDC country preparedness activities report, 2013-2017	Implementation summary without a distinct curriculum or competency set
E14	WHO Health EDRM fact sheets	Topic briefs rather than a curriculum
E15	Disaster nursing competency framework	Profession-specific package without a generic PHEM framework
E16	Commercial emergency-management certificate program	Insufficient transparency on curriculum-development methods and assessment standards

18. Excluded full documents (second round, 26 documents)

Candidate	Reason for exclusion
Competencies for One Health Field Epidemiology framework and its summary page	Field epidemiology competencies rather than emergency-management functions; the included One Health field epidemiology curriculum guidance already carries this lineage
TEPHINET network description of field epidemiology training programs	Descriptive web page without a competency set or curriculum
Singapore field epidemiology training program profile	Single-program profile without competency, product or assessment specification
Delphi study of climate and environmental epidemiology competencies for the Eastern Mediterranean	Hazard-specific competency set for field epidemiology tiers rather than PHEM
Scoping review of field epidemiology training program priorities	Addresses program priorities rather than curriculum content or assessment
Internal evaluation of a national field epidemiology training program	Single-program evaluation of field epidemiology
Core competencies for field veterinary epidemiology training	Profession-specific competency set
PAHO course on continuity of essential services in health emergencies	Single-topic course without role, product and assessment structure
PAHO course on hospital planning within the multi-hazard response framework	Facility-level planning course without a generic PHEM curriculum
PAHO course on infection prevention and control in health emergencies	Single-topic course
PAHO course on expansion of health service capacity in emergencies	Single-topic course
PAHO course on health and disaster risk management, 2022 edition	Superseded for this synthesis by the included regional risk-management course
WHO global competency and outcomes framework for universal health coverage	Whole-of-health-workforce framework in which emergency risk management is one domain; not a PHEM curriculum
Scoping review of disaster health education for short and intermediate training in Saudi Arabia	Addresses short and intermediate disaster health training rather than an advanced PHEM program
Commentary on health workforce development in health emergency and disaster risk management	States the need for evidence-based recommendations without supplying a competency set or curriculum
Report of an expert meeting on health emergency and disaster risk management research	Research agenda rather than education content
Regional disaster mental health network agenda paper	Network agenda rather than a competency or curriculum source
World Association for Disaster and Emergency Medicine education issues paper, 2004	Superseded by later national and consortium education standards
Pilot questionnaire on disaster health education and training	Survey instrument pilot without a competency set
Scoping review of situational awareness and disaster mindset in healthcare education	Single-competency focus
Conceptual framework for incident management system training in one province	Sub-national training framework superseded for this synthesis by the included conceptual framework
WHO South-East Asia news reports of the regional health emergency workforce workshop, 2026	News reports without competency or curriculum content
Regional synthesis of health emergency risk management experiences in South-East Asia, 2014-2023	Program experience synthesis without competency or curriculum content
West African Health Organization practical emergency guide web page	Full document not retrievable within the search window
Account of continental emergency responders in action, Pan African Medical Journal	Superseded for this synthesis by the included narrative review of the same initiative
WHO AFRO country news items on responder training in Central African Republic and Togo	Country news items duplicating the included francophone West African account

19. Excluded full documents (third round, 21 documents)

Candidate	Reason for exclusion
Eastern Mediterranean Public Health Network brochure on public health emergency management	Organizational overview without competency, curriculum or assessment content
Africa CDC news item on the fellowship curriculum review, 2024	News item; the program is documented by the included curriculum design study and cohort report
Africa CDC fellowship cohort II announcement, 2024	Program announcement; structure documented by the included curriculum design study and cohort report
CDC Law and Epidemic Emergency Preparedness training	Single-topic course
CDC Six Domains of Preparedness poster, 2017	One-page summary of the included capability standards
Kenya Ministry of Health Virtual Academy public health emergency management course	Full document not retrievable within the search window
Commercial public health emergency preparedness training course	Commercial item
Qualitative synthesis of preparedness, impacts and responses of public health emergencies, 2023	Synthesis of emergency impacts and responses without competency, curriculum or training content
Opinion paper on community health worker employment in African outbreak response, 2026	Employment-policy argument without competency, curriculum or training content
Qualitative study of economic evaluation in public health emergency management in Africa, 2026	Addresses economic evaluation practice rather than competency, curriculum or training content
Knowledge mapping analysis of public health emergency management research, 2022	Bibliometric analysis without competency, curriculum or training content
Public health preparedness and response competency model methodology, 2019	Superseded for this synthesis by the included 2025 workforce competency model
Qualitative study of professional development in health emergency management in Aotearoa New Zealand, 2019	Interview study without a competency set or curriculum
OpenWHO course on the public health emergency operations centre	Self-paced course without the complete role, product and assessment architecture required for inclusion
OpenWHO course on mental health and psychosocial support in emergencies	Single-topic course
Contact tracing training model for COVID-19 in San Francisco, 2023	Single-function local training program
Assessment of the Angolan mobile laboratory curriculum for disaster and pandemic response, 2020	Single technical procedure
Disaster psychosocial competencies overview	Profession-specific competency set without a date or issuing body
Scoping review of human resource development in public health emergency management, 2025	Full document not retrievable within the search window
ASPHER core curriculum for public health, first edition, 2024	General public health curriculum; emergency preparedness subject content not retrievable within the search window
WHO Kobe Centre literature review on Health EDRM workforce development	Full document not retrievable within the search window

20. Coverage audit

The coverage audit tested the 22 domains against every source in the library and against a set of hazard families and emergency functions drawn from the normative instruments. Two subjects required treatment beyond a single domain. Mental health and psychosocial support carries its own learning domain in a consensus educational framework, appears among the required disciplines of an emergency workforce in a regional workforce strategy, and is named as a leader responsibility in two evaluations of emergency leadership training. The subject applies to responders during preparedness, to affected populations during response and to communities during recovery, which is the behavior of a cross-cutting requirement. It is therefore specified in the cross-cutting requirements and in D08, D18 and D20, alongside equity, responder safety and One Health. Cross-border interoperability follows the same pattern. Regional workforce sources treat membership of regional response rosters and readiness for

cross-border deployment as competences of the individual responder, and D08 and D18 specify both. No hazard family or emergency function in the audit set lacked a mapped outcome.

Third-round coverage test. The subjects taught or reviewed in the 12 sources added by the third round were compared with the 22 domains and their outcomes in Supplementary File 1. No outcome was added, removed or renumbered. Five subjects named in those sources have no named outcome: mass casualty management, assessment of hospital safety and assessment of mortality, which are modules of the technical diploma; women and child health in humanitarian settings, a module of the master's program; and health economics, which the field epidemiology review reports as a training gap. They are sector-specific or technical content and fall under optional specializations as section 7 of Supplementary File 1 defines them. Subjects carried by existing outcomes include case investigation and contact management (D17.1), clinical surge and triage (D17.2), vaccines and countermeasures (D17.5), essential health services (D17.6), water, sanitation, nutrition and environmental health in humanitarian settings (D18.2), conflict and mass gatherings (D18.3), and costing and budgeting (D04.3 and D05).

21. Reproducibility boundary

These methods allow another team to repeat the search logic, the eligibility decisions, the appraisal and the completeness scoring, and to trace every outcome to the sources that informed it. They do not guarantee identical judgment where sources conflict, where national law and hazards differ, or where a scorer weighs partial documentation differently. They also do not establish that the curriculum is complete, necessary or effective. External content review, consensus development, country adaptation, assessor calibration and field testing remain required before operational adoption.

Supplementary Table 2. Position of the proposed curriculum relative to directly comparable competency and curriculum work

Resource	Type and scope	What it provides	Relation to this curriculum
Consensus educational framework and competency set for disaster medicine and public health preparedness [58]	Expert consensus process across health professions	Seven learning domains, nineteen core competencies and seventy-three specific competencies at three performance levels	Precedent for organizing competencies by domain and performance level; extended here to five levels, role pathways and required workplace evidence
Worldwide mapping study of health emergency and disaster risk management competencies and curricula [42]	Literature review and cross-sectional survey	Identification of existing competencies and curricula and the finding that none is universally accepted	Establishes the gap this study responds to; the two are sequential rather than duplicative
Africa CDC advanced PHEM curriculum [24,25]	Stepwise mixed-method curriculum development for one continental fellowship	Three competency domains, ten subdomains and an eleven-course syllabus with objectives	Closest methodological comparator; the present curriculum is larger because it covers the whole cycle and specifies pathways and assessment evidence
Preparedness and response workforce competencies [38]	Contemporary competency model for the public health emergency preparedness workforce	Ten competencies with workforce-development framing	Sits one level above the outcome grain used here; competency areas and assessable outcomes serve different purposes
African health workforce disaster competencies [26]	Regional competency development for public health disaster risk management education	Competencies across risk reduction, preparedness, response and recovery	Structure and profession-neutral framing adopted; the single-audience assumption was replaced by function-based pathways
Systematic review of disaster and humanitarian competencies [40]	Systematic review across professional groups	Evidence of heterogeneity across competency sets and professions	Supports the need for a stated synthesis method and for role differentiation
Proposed multidisciplinary disaster-management program [41]	Review and program proposal for multidisciplinary disaster management	Competency domains and measurable objectives differentiated by managerial level	Historical precedent for level-differentiated design; the proficiency scale here serves the same purpose

Resource	Type and scope	What it provides	Relation to this curriculum
ECDC core competencies and self-assessment tool [35,36]	Regional competency framework with a system self-assessment instrument	Competencies, indicators and structured self-assessment	Assessment instrumentation adopted at system level; learner-level evidence requirements added
CDC capability standards and international fellowship [21,22,37]	National capability standards and an applied fellowship model	Capability definitions, mentorship, deployment and workplace products	Capability-to-competency translation retained; the capability standards remain system-level
Validated PHEM program assessment tool [90]	Instrument development with factor analysis and reliability testing	A 45-item validated instrument for assessing programs	Complementary object of assessment; demonstrates the validation procedure this curriculum has not undergone
Delphi-derived core competence model for emergency response [91]	Consensus development with a competence framework and training-needs assessment	Forty-three agreed competency statements in four domains	Method model for the consensus study needed to test the 132 outcomes

CDC, Centers for Disease Control and Prevention; ECDC, European Centre for Disease Prevention and Control; PHEM, Public Health Emergency Management. The comparison describes scope and grain and makes no claim of superiority.