SYSTEMATIC REVIEW

Nontechnical Competency Framework for Health Professionals in All-Hazard Emergency Environment: A Systematic Review

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ABSTRACT

Objectives: To summarize characteristics and commonalities of non-technical competency frameworks for health professionals in emergency and disaster.

Methods: An electronic literature search was conducted in PubMed, MEDLINE, ERIC, Scopus, Cochrane database, and Google Scholar to identify original English-language articles related to development, evaluation or application of the nontechnical competency frameworks. Reviewers assessed identified articles for exclusion/inclusion criteria and abstracted data on study design, framework characteristics, and reliability/validity evidence.

Results: Of the 9627 abstracts screened, 65 frameworks were identified from 94 studies that were eligible for result extraction. Sixty (63.8%) studies concentrated on clinical settings. Common scenarios of the studies were acute critical events in hospitals (44;46.8%) and nonspecified disasters (39;41.5%). Most of the participants (76; 80.9%) were clinical practitioners, and participants in 36 (38.3%) studies were multispecialty. Thirty-three (50.8%) and 42 (64.6%) frameworks had not reported evidence on reliability and validity, respectively. Fourteen of the most commonly involved domains were identified from the frameworks.

Conclusions: Nontechnical competency frameworks applied to multidisciplinary emergency health professionals are heterogeneous in construct and application. A fundamental framework with standardized terminology for the articulation of competency should be developed and validated so as to be accepted and adapted universally by health professionals in all-hazard emergency environment.

Key Words: disaster medicine, health emergency, nontechnical competency

Although there are numerous, varied, and inconsistent definitions of the term "competency" throughout the literature, it usually refers to a kind of skill, capacity, ability, and knowledge as well as their combinations.[1,2] Nontechnical competency are the cognitive, social, and personal resource skills that complement technical skills.[3,4] Examples include leadership, communication, team interaction processes, and decision-making.

Nontechnical competency is important for emergency health professionals performing urgent and critical tasks under complex, high-risk, time-pressured, dynamic conditions,[1,5-7] including in-facility emergency situations (eg, emergency department,[8-10] intensive care unit [ICU],[11-14] operating room[15-17]) and out-of-facility incident responses (prehospital emergency medical services,[2] medical evacuation,[18,19] and on-site rescue,[20-22] as well as public health emergency[6]). With respect to the disciplines and professions, it has been emphasized for physicians,[27-29] surgeons,[30-32] nurses,[29,33,34] anaethetists,[32,35] public

health workers,[24,26,36] response administration staff,[37,38] and so on.

A common fundamental competency framework would benefit the ongoing standardization process in education, certification, and accreditation in the field of emergency health. Such nontechnical framework must first consider the wide audience because education and training programs for emergency health professionals should be multidisciplinary and transdisciplinary.[39]

Numerous studies have tried to figure out the construct and structure of task-related or profession-specific nontechnical competency for health workers,[39-42] which could provide a better understanding of the nontechnical competency but also establish guidance for the education and training programs. Previous reviews are also available on the competences related to disaster health-care providers[1] and health-care action teams[5]; however, they failed to focus nontechnical competency,[1,43,44] and partially targeted a specific profession or setting.[5,40-42,45-47]

FIGURE 1

Selection Process Used in A Systematic Review of Non-Technical Competency Frameworks for Health Professionals in All-Hazard Emergency Environment Published through March 2018.
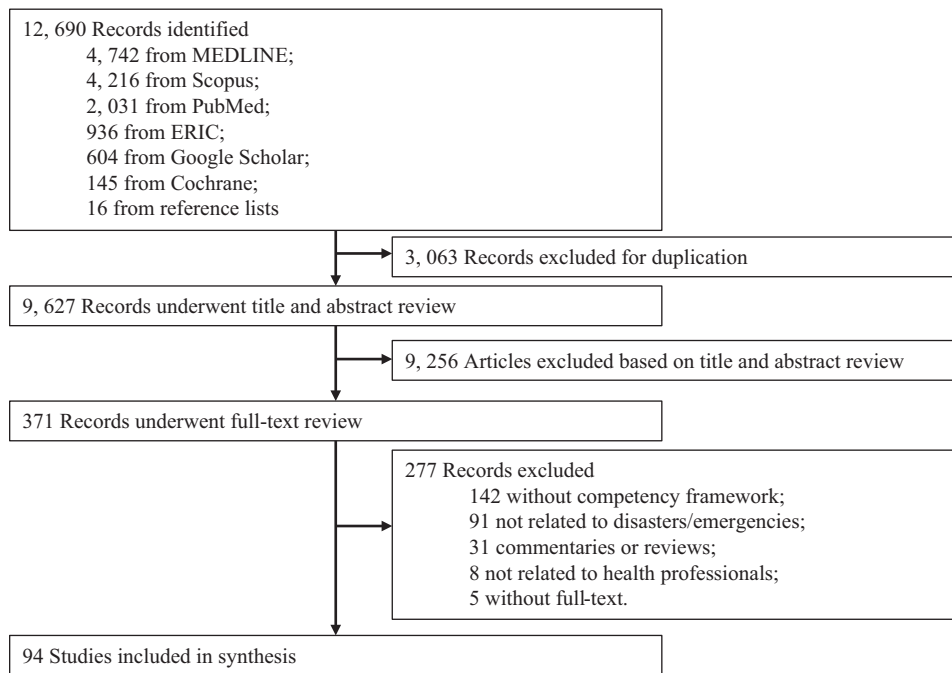
Despite the crucial link between nontechnical competency and performance of emergency health professionals, the general fundamental components of nontechnical competencies applied to all professions working in emergency remains poorly understood. To address this gap, a systematic review was undertaken to summarize the characteristics of nontechnical competency frameworks designed to various health professionals in all-hazard emergency environment. By examining the domains of nontechnical competency frameworks, the framework structure and application, this review focuses on 2 research questions: (1) what are the common nontechnical competencies of the health professionals in all-hazard emergency environment? (2) How are these nontechnical competencies developed, structured, and applied?

METHODS

The present review was conducted in adherence with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) standards for systematic review.[5,48]

Data Sources

Relevant English-language studies were systematically searched in the following databases from inception through March 2018: PubMed, MEDLINE, ERIC, Scopus, Cochrane and Google Scholar. The search was carried out using a combination of keywords unique to each database (detailed in Appendix 1, which is available in the Supplementary Material). The major keywords were divided into 4 groups: nontechnical/ social/ cognitive, emergency/ disaster/ crisis/ incident, health/ medicine and competency/ skill/ ability/ knowledge. Finally, reference lists of all included articles were also searched.

Study Selection

Papers were included if they described nontechnical, social or cognitive competency frameworks, abilities, knowledge, skills, or attitudes for disaster medical team leaders. Papers were excluded that described competency frameworks: (1) limited to clinical skills, (2) not dealing with disasters or emergency environment; (3) not specific to health professionals; (4) case studies; (4) without a full-text available, such as abstracts and citations; and (5) that were not available in English. No publication date or status restrictions were imposed (see Figure 1 and Table 1).

The initial search identified 9627 unique records. Eligibility assessment was performed independently by 2 reviewers (Xuejun Hu & Changnan He) and disagreements between reviewers were resolved by consensus.

Data Abstraction

A data abstraction form was developed based on previous relevant systematic review.[1,5,39,41,47] Coding metrics of this

TABLE 1

Inclusion and Exclusion Criterion for Studies		
Criterion	**Inclusion**	**Exclusion**
Study focus	Competency framework of disaster medicine/ emergency health.	All studies without competency framework, or focusing on technical/clinical competency, or focus on nondisaster/ emergency themes.
Target population	All health-care providers.	Responders in nonhealth field.
Settings	Health related sectors, including hospitals, public health sectors, health departments of government, and so on.	Nil.
Article type	Original research published in peer-review journal or in the gray literature.	Lesson learned report, or thesis.
Publication time period	From database inception to march 2018.	Nil.
Language and length of article	English; full article.	Non-English; abstract or citations.

form were discussed and revised several times by the reviewers. Each of the included articles were independently reviewed by 2 authors using the final data abstraction form. The 2 involved authors discussed and reached consensus on each code metric before a final score was assigned.

Information was abstracted on study characteristics (publication year, study objectives and methods, study settings, and study scenario) and study participant characteristics (professions, types, and specialties). Studies were also reviewed for detailed data on competency frameworks: (1) framework name, (2) scoring system, (3) comprehensive scoring, (4) behavior anchor, (5) assessment level (team or individual), (6) raters (external and self-assessment), and (7) reliability and validity.

A competency framework would be considered modified if its structure (format or item numbers) or anchors were changed. When a framework was modified from an existing instrument, it would be involved as a new one and information of it would be captured separately.

Data Analysis

Meta-analyses were infeasible because of study heterogeneity. Descriptive statistical analyses were performed to summarize characteristics of the studies and frameworks. Competency domains were abstracted from all the included frameworks and synthesized. Representative descriptions of those domains were reported.

RESULTS

Search Results and Study Characteristics

Of the 9627 studies initially identified, 94 met inclusion criteria (see Table 2 and detailed in Appendix 2).

Table 2 presented the characteristics of the included studies. Studies dated as far back as 1999, although the majority (38; 40.4%) were published during the period from 2011 to 2015. Studies usually intended to develop new competency framework (43;45.7%) or apply existing framework (42;44.7%), while only 16 (17.0%) studies aimed to evaluate the framework. Most (60; 63.8%) of the studies concentrated on hospitals as study settings. Acute critical events in hospital (44;46.8%) or nonspecified disasters (39;41.5%) were the common scenarios. Over 8 methods were applied in these studies, and simulation (36; 38.3%), interview (26; 27.6%), along with questionnaire survey (21;22.3%) were more frequently used. Many studies targeted nurses (31;33.0%), administration staff (20; 21.3%), and residents (17;18.1%) as participants. Most of the participants (76; 80.9%) are practitioners such as nurses, doctors, and other clinical personnel. With regarding to the targeted specialties, the majority (36; 38.3%) were multispecialty, and nurse and public health accounted for 22.3% and 11.7%, respectively.

Competency Framework Characteristics

The 94 included studies described 65 unique competency frameworks (see Table 3 and detailed in Appendix 3). Several commonly used frameworks underwent minor modifications resulting in novel, but closely related, frameworks. The most frequently studied competency frameworks were "Anaesthesia Non-Technical Skills (ANTS)" (13; 13.8%),[3,13,17,32,35,49-56] "Ottawa Global Rating Scale (GRS)" (5;5.3%),[3,14,57-59] "Competencies For All Public Workers-1" (4;4.3%),[33,36,60,61] and " Non-Technical Skills for Surgeons" (4;4.3%).[15,31,32,62]

Of the 65 frameworks, more than half (33;50.8%) reported scoring system, such as 5-point scale, but only 40% presented how to calculate the overall score as a comprehensive result. A little more than 1/3 (26; 40%) of the frameworks described the behavior anchor to the competency domain.

In the aspect of the framework application, most (59; 90.8%) of them were intended to individual. Almost 1/3 of frameworks were used for rating by raters themselves (19; 29.2%) and external raters (19; 29.2%).

Many of the 65 frameworks included multiple forms of validity and reliability evidence. Information on the reliability was

TABLE 2

Characteristics of 94 Studies Included in a Systematic Review of Frameworks Used to Describe Nontechnical Competencies for Health Profession Workers in Emergency Environment Published Through August 2018

Characteristic	N	(%)
Publication year		
-2005	12	(12.8)
2006-2010	22	(23.4)
2011-2015	38	(40.4)
2016-	22	(23.4)
Objective		
To develop framework	43	(45.7)
To apply framework	42	(44.7)
To evaluate framework	16	(17)
Settings		
Hospitals	60	(63.8)
Public health sectors	12	(12.8)
911 emergency medical services systems	8	(8.5)
Cross-sectors	7	(7.4)
Others	7	(7.4)
Emergency categories		
Acute critical events in hospital	44	(46.8)
Nonspecified disasters	39	(41.5)
Public health emergency	11	(11.7)
Methods		
Simulation	36	(38.3)
Interview	26	(27.6)
Questionnaire survey	21	(22.3)
Literature	12	(12.8)
Thematical analysis	8	(8.5)
Delphi	7	(7.4)
Field observation	6	(6.3)
Principal component analysis or factor analysis	6	(6.3)
Others	8	(8.5)
Participant professions		
Nurses	31	(33)
Administration staff	20	(21.3)
Residents	17	(18.1)
Students	8	(8.5)
Public health technicians	6	(6.4)
All health professionals	4	(4.3)
Profession-others	30	(31.9)
Participant types		
Practitioner	76	(80.9)
Leader	26	(27.7)
Informed worker/student	12	(12.8)
Participant specialties		
Multispecialty	36	(38.3)
Nurse	21	(22.3)
Public health	11	(11.7)
Anesthesia	9	(9.6)
Emergency medicine	8	(8.5)
Surgeon	4	(4.3)
Administration	3	(3.2)
Others	2	(2.1)

TABLE 3

Characteristics of 65 Frameworks Used to Describe Nontechnical Competencies for Health Profession Workers in Emergency Environment Published Through August 2018

Characteristic	N	(%)
Scoring system		
Yes	33	(50.8)
Non-report	32	(49.2)
Comprehensive scoring		
Yes	26	(40)
Non-report	39	(60)
Behavior anchor		
Yes	26	(40)
Non-report	39	(60)
Assessment level		
Team	6	(9.2)
Individual	59	(90.8)
Non-report	1	(1.5)
Raters		
Self-assessment	19	(29.2)
External ratings	19	(29.2)
Non-report	31	(47.7)
Reliability		
Yes	32	(49.2)
Non-report	33	(50.8)
Validity		
Yes	24	(36.9)
Non-report	42	(64.6)

reported for less than half of frameworks (32; 49.2%). Most (42; 64.6%) of the frameworks did not see the specific data on validity.

Nontechnical Competency Targeted

When provided, nontechnical competency themes, behaviors and descriptors were diverse. The 14 most commonly involved domains were identified and summarized based on the primary themes of the frameworks: (1) communication skills (60; 92.3%); (2) situation awareness ability (40; 61.5%); (3) collaborate, coordinate, and teamwork ability (37; 56.9%); (4) problem solving/decision-making skills (24; 36.9%); (5) incident command/disaster knowledge (23; 35.4%); (6) resource management skills (23; 35.4%); (7) personal character (19; 29.2%); (8) leadership (21; 32.3%); (9) task management skills (20; 30.8%); (10) performing one's role (18; 27.7%); (11) planning skills (18; 27.7%); (12) cultural, ethnic, and legal knowledge (14; 21.5%); (13) adaptability/flexibility (12; 18.5%); and (14) personal protection skills (11; 16.9%) (see Table 4). Some other themes were also reported, although not that frequently, such as knowledge of short- and long-term considerations for recovery, skills of budgeting and finance, and the ability to organize education and training.

TABLE 4

Domains, Descriptions, and Frequency of Competencies Included in 65 Frameworks Used to Describe Nontechnical Skills for All Health Professionals in Emergence Response

Domains	Descriptions	References	No	(%)
Communication	Demonstrate correct use of all communication equipment; be persuasive; negotiate; receives, processes, verifies, prioritizes, transmit and share information; listen to the public's specific concerns; meet the needs of the media; use the media and other forums to inform, educate, and empower people; breaking bad news; writing medicolegal reports and references; active listening.	[2,3,8-12,14-16,18,20-27,29-34,36-38,54,57-62,66-100]	60	(92.3)
Situation awareness	Recognize a potential critical event; routine re-evaluation of situation; estimate the impact of emergencies that have occurred or may occur; identify limits to own knowledge/skill/authority; gathering and understanding information, projecting and anticipating future state; recognize deviations from the norm that might indicate an emergency and describe appropriate action; risk assessment.	[3,4,8,14-17,19,22-24,29,31-33,35,36,49-52,54,55, 57-62,66-72,78,79,84-88,90-92,95-97,100-104]	40	(61.5)
Collaborate, coordinate, and teamwork	Build and engage in respectful, supportive relationships with disaster affected individuals and groups; working hand-in-hand and mutual support; establishing a shared understanding\coordinating team; coordinate diverse participants across very different disciplines.	[3,4,8,9,15-17,19-22,26,30-32,35,37,38,49-52,54,55, 60,62,67-72,76,77,80,82,84-86,88,91,93,94,99, 100,102,103,105]	37	(56.9)
Problem solving/decision-making	Problem identification, generation of solutions, and sharing them with the team; considering options/ implementing and reviewing decisions.	[3,4,10,11,14,16-20,27,30-33,35,37,38,49-52, 54,55,57-60,62,80,82-85,96,102,105]	24	(36.9)
Incident command/disaster knowledge	Describe the chain of command in emergency response; knowledge about duties and organizational hierarchy; describe the fundamentals of terrorism; understand the incident command and support system; knowledge of the environment and disaster context.	[22,23,33,36-38,60,61,73,74,77-79,83, 87-91,95,96,99,101,106,107]	23	(35.4)
Resource management	Predict, mobilize, integrate resources; awareness and utilization of all available resources.	[18,21,23,29,57-59,66,73-79,83,85,86,88,91,93,96,99, 100,102,108]	23	(35.4)
Personal character	Staying calm and cool under stress; demonstrates confidence, compassion, maturity, command presence, and trustworthiness; be honest, frank, and open.	[2,8,20,22,26,29,30,37,38,68-72, 75,78,83,92,99,101,104,105,107]	19	(29.2)
Leadership	Motivation to lead; leadership traits; assertiveness.	[3,8,12,15,16,18,21,25,30-32,57,58,62,66, 68-71,75,78,82,83,88,93,98,102,103]	21	(32.3)
Task management	Demonstrate knowledge of principles and practices for the clinical management, patient triage /prioritization, public health science, communicable disease control and prevention, surveillance and epidemiology, emergency and trauma care; maintenance of standards and guidelines.	[9,10,19,21,23-25,29,54,66-69,72-76,99-101,105,108]	20	(30.8)

TABLE 4

Continued				
Domains	**Descriptions**	**References**	**No**	**(%)**
Performing one's role	Understand, describe, identify, and perform his or her functional role(s) and responsibilities in emergency response.	[21-23,33,36-38,60,77-79,84,87-92,96,105]	18	(27.7)
Planning	Be able to establish and carry out proactive policies; develop specific disaster management plans in different situations and implement them effectively; understand the institutional emergency operations plan; identify necessary changes to the plan; identify and locate the agency emergency response plan.	[2,19,22,26,27,31,34,60,66,77-79,81,87,88,91,95,96,98,105]	18	(27.7)
Cultural, ethnic and legal	Deal with cultural, ethnic and legal issues in the context of emergence.	[20-23,26,79,81,83,86,91,95,99,100]	14	(21.5)
Adaptability/flexibility	Dealing with changing; effective coping with disruptions/distractions; surge capacity/capability critical thinking.	[8,12,20,29,30,33,37,38,60,66-72,86,100]	12	(18.5)
Personal protection	Apply safe work practices and avoid unnecessary risk; physical self-care/survival skills; demonstrate critical event safety principles; follow and enforce health-care system's safety rules, regulations, and policies during emergency response and recovery; use of equipment (including personal protective equipment); safety conscious and advocates for safety at all times.	[2,20,23,29,30,61,67,79,87,90,95,96,98]	11	(16.9)
Others	Demonstrate knowledge of short- and long-term considerations for recovery. [79,95] Budgeting and finance.[27] Education and training.[22,77,81]		6	(9.2)

DISCUSSION

Despite general agreement that nontechnical competency is an essential component of health professionals in all-hazard emergency environment, defining and measuring the universally applicable and fundamental nontechnical competencies remains a challenge, which is, however, significant to strengthen future nontechnical competency research and to provide foundations to educational programs for emergency healthcare professionals and students. This scoping review highlights 65 existing frameworks that articulated the critical constructs of nontechnical competency required for multispecialty health professionals working in crisis environment, and 14 common competency domains were identified from those frameworks.

Targeted Application Level

Included competency frameworks applied to either individual or team. The results of this review showed 90% of those frameworks focused on individuals. However, it is necessary to demonstrate the competency of the whole team which form is common in response to emergency and disaster situations. In some cases, it did not define the targeted audience level of the framework,[61] or some frameworks were used to both individual and team.[50,55] More studies are in need to specify the nontechnical competency contents for various specialty team as a whole, and the frameworks should note the targeted level to ensure originally intended application.[5]

Validity and Reliability Evidence

There is no doubt validity and reliability are the key indicators for a good framework. Among the 94 studies, however, few (17.0%) were aimed to evaluate the frameworks. Also, more than half of the identified frameworks did not see validity (64.6%) and reliability (50.8%) evidence in those studies. Several frameworks ($n = 12$) were repeatedly used across at least 2 studies, thus potentially providing the chance to build robust validity evidence. Nevertheless, those repeatedly applied frameworks usually underwent behavior anchor or/and even structural modifications with no detailed justifications for the changes. Moreover, the majority of the frameworks ($n = 54$) emerged in 1 study without reporting validation. In addition, numbers of competencies were proposed using qualitative methods such as focus group, thematic analysis, and Delphi, which is a consensus-building process and relies predominantly on the opinions of nominal experts.[1,63] Above all, a more systematic approach to framework test would help establish more robust and comparable validity and reliability evidence.

Targeted Application Audience

The majority of the included studies (63.8%) were performed in clinical settings (eg, emergency department and ICU) and based on a series of scenarios of acute and critical events (eg, acute shock, hypoxemic respiratory failure, and cardiac arrest). In contrast, there were relatively limited studies involved public health backgrounds. Also, much more included frameworks were designed to nurses, surgeons, physician residents, or other clinical practitioners than public health relevant staff. This may due to it is more practical to make access to the study environment and emergency events inside the hospitals than incident fields (eg, hurricanes and explosions) outside the facilities.[1] For example, simulation, which are the most common methods used in the 94 studies, were generally in-hospital clinical scenarios, rather than disasters that infrequently occur in disparate settings and conditions. Future studies should pay more attention to fundamental competency factors that could generalize to multidisciplinary health professionals in all-hazard emergency environment, including in-hospital clinical and out-of-hospital health emergencies.

Application Feasibility

Scoring system and behavior anchor determine the operability of competency frameworks that were designed for ability evaluation. Although half of the included frameworks had a scoring system, most (39; 60%) did not describe the behavior anchor. Another factor that could reduce the framework feasibility is 31(47.7%) frameworks did not specify the assessor (self- /external assessment). To help assessors precisely capture the competency nature, each domain should be defined clearly and the assessor type should also be originally taken into consideration.

Competency Domains

A total of 14 domains were identified. There was broad agreement on 3 domains: communication, situation awareness, collaboration/coordination and teamwork, among the reviewed frameworks. Little agreement was found, however, on the rest of 11 domains. This is possibly due to lack of standard terminology, clear definitions, and detailed articulation, which could lead to missing to precisely capture the domains and impede the comparison and integration of competencies among the frameworks reviewed.[1,39,64] Also, it may be related to an incomplete understanding of the a competency hierarchical structure composed by a systematically grouped competency domain, which is further broken down into subcompetencies or specified with behavioral indicators.[1,65]

Additionally, some competencies are obviously more significant or essential than others for a particular profession, organization, and emergency environment. But it does not mean it is needless to build up a common fundamental competency framework applicable to all levels and functions among various emergency health workers in all-hazards environments. To resolve this issue, proficiency levels for the various behavioral descriptors of the fundamental competencies should be clarified and differentiated according to various targeted groups and specified context. In addition to the fundamental competencies, additional competencies should be figured out, as a

supplement package, to meet special requirements related to specific profession, task, discipline, and context.

Despite of the lack of terminology standardization, the variability of competency structures, and diversity in targeted groups, previous works have provided a valuable groundwork for the development of a common framework for cross-cutting competencies applied to all emergency health professionals.

STRENGTHS AND LIMITATIONS

Several limitations to this review should be considered. First, frameworks were limitedly sourced from published literature available in English, thus possibility of publication bias cannot be excluded. Also, while disaster- and emergency-related terms were used for record searching, alternate terms (eg, hurricanes and earthquake) in otherwise relevant papers could not identify them for inclusion. Moreover, this study is restricted to the field of health. Although many of the nontechnical competencies required of other emergency professionals are applicable to health professionals, these were not within the purview of this review. In addition, heterogeneity of the included studies' designs and the variability in their data reporting make it limited to draw more extensive comparisons across the studies. Accordingly, it leads to being impossible to rate the methodological study quality.

There are several strengths in the present review. A total of 9627 records were widely collected from 6 major data sources as well as the reference lists of the included studies. Search strategy and inclusion/exclusion criteria were developed to reflect the multidisciplinary and cross-sector nature of health professionals, which helped maximize result applicability.

IMPLICATIONS FOR FUTURE RESEARCH AND PRACTICE

This review provides a comprehensive look at competency frameworks for health professionals working in various disaster/emergency environment regardless of their professional sector, discipline, role, or category, and it highlights several important considerations for future research and competency cultivation. The vast majority of competency frameworks reviewed are still directed to specific target groups. Due to imprecise, insufficient, and inconsistent articulation of the competency domain and its corresponding behaviors, reaching consensus on the common fundamental nontechnical competencies for all emergency health professionals is challenging but essential. For universal acceptance and application, further efforts should be directed to setting up standard terminology, clarified definitions, and detailed behavior anchors as well as supplementary competencies for particular targeted groups. Also, methodical collection of validity evidence is required when originally developing or modifying frameworks, which is significant to make comparisons in validity across studies.

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Xuejun Hu and Changnan He are co-primary authors.

Conflicts of Interest

The authors have no conflict of interests to declare.

Supplementary Material

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