

Global Competency of Hyperbaric Nurses: An Integrative Literature Review

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This study aimed to review and synthesize related studies on global competency in hyperbaric nursing through integrative literature review (ILR) guided by the Joanna Briggs Institute (JBI) systematic review framework combined with Whittemore and Knaff's (2005) five-stage integrative review to ensure rigorous and systematic approach. Synthesizing findings from the twenty reviewed research studies, identified key competency areas focusing on advanced technical proficiency in hyperbaric chamber operation, knowledge of hyperbaric physiology, patient assessment, safety protocols, and effective patient education which served as a foundation for developing a proposed Global Competency Framework for Hyperbaric nurses. Across countries, the reviewed studies revealed similarities and differences in recognizing the need for specialized knowledge and clinical expertise to ensure safety in hyperbaric environments.

However, differences emerged in educational requirements, certification processes, and access to continuous training influenced by local healthcare systems, resource availability, and cultural factors. Some countries reported challenges related to language barriers, limited mentorship, and inconsistent implementation of standardized training programs, which affected nurses' competencies. The study highlighted the need for globally aligned competency standards and expanded professional development opportunities to strengthen the capabilities of hyperbaric nurses.

The findings provide valuable insights that could guide educational institutions, healthcare organizations, and policymakers in enhancing hyperbaric nursing practices and promoting quality and safe patient care in diverse global settings.

Keywords: Global competency, hyperbaric nurse, integrative literature review, qualitative exploration

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Introduction

Hyperbaric nurses are essential in delivering specialized care, requiring distinct competencies to ensure patient safety and optimal outcomes.

As healthcare becomes increasingly globalized, global competency of hyperbaric nurses must align with international competency standards to maintain high-quality care (Smith et al., 2021).

The World Health Organization (WHO) has been highlighting the importance of a global competency framework in enhancing patient care across diverse healthcare settings, ensuring that healthcare professionals can meet the evolving demands of modern medicines (WHO, 2020).

Hyperbaric oxygen therapy (HBOT) has been widely recognized as an effective treatment modality that enhances oxygen supply and facilitates tissue healing through exposure to 100% oxygen under increased atmospheric pressure (Jain, 2017). Over the past four decades, HBOT has gained global recognition for its applications in treating decompression sickness, carbon monoxide poisoning, gas embolism, and chronic non-healing wounds (Mathieu et.al., 2017; Moon, 2019). The therapy's ability to promote oxygen diffusion and cellular recovery has positioned it as essential component in managing various neurological and physiological conditions worldwide (Grim, 1990; Leach et.al.,1998).

As hyperbaric oxygen therapy continues to expand in scope, addressing a broader range of medical conditions, the demand for highly skilled hyperbaric nurses is steadily increasing. However, recruiting registered nurses for this specialized setting is challenging, as these professionals must be capable of managing patient care from outpatient treatment to critical care while working independently within the hyperbaric chamber. Given the strictly regulated and potentially hazardous environment created by administering 100% oxygen in a confined space, hyperbaric nurses must possess specialized technical expertise and maintain a calm, composed demeanor during prolonged treatment sessions (Gray, 2008). Healthcare institutions should prioritize structured training programs for both theoretical knowledge and practical applications. Nurses must be proficient in the principles of HBOT including safety protocols, patient assessment and management of HBOT-related complications. Building on this foundational expertise, effective collaboration with multi-disciplinary teams, adherence to ethical standards and engagement in ongoing professional development are significant

components of competency-building in this specialized field. Furthermore, integrating local case studies and evidence-based practices into training programs will enhance nurses' ability to navigate specific challenges (Thompson & Green, 2023).

Healthcare providers use hyperbaric oxygen alone or with other medical treatments such as medication or surgery. Most people receive hyperbaric oxygen on an outpatient basis for one to two hours every session. The patient may sit or lie down during the procedure, depending on the type of treatment (<https://my.clevelandclinic.org/health/treatments/17811-hyperbaric-oxygen-therapy>).

As the scope of nursing continued to expand within an increasingly interconnected world, it became significant to consider the global context in which the hyperbaric nurses operated. Global competency frameworks in nursing emphasize adaptability, cultural competence, and adherence to national standards (Garcia & Thompson, 2020). The Global Health Workers Alliance advocates for standardized competencies to ensure quality healthcare worldwide (GHWAA, 2021). Hyperbaric nursing requires specific skills to function effectively in diverse, effective environments (Harrison, et.al., 2023). Research highlighted the need for structured competency development programs to meet global standards (Miller & Edwards, 2021).

International standards for hyperbaric nursing stressed continuous education, hands-on training, and adherence to safety protocols (Johnson, et.al., 2022). The European Society of Hyperbaric Medicine has established essential competency guidelines (ESHM, 2022). Prior qualitative studies provide insights into competency development in specialized nursing (Rodriguez & Patel, 2020). Furthermore, the Association of Diving Contractors International also advocates competency assessments to maintain high-quality hyperbaric nursing care (ADCI, 2021).

Considering the increasing global relevance of hyperbaric nursing and the need for a competency framework that reflected

international standards and local practice contexts, this integrative literature review aimed to determine the alignment of global hyperbaric competencies with local healthcare practices, identifying key factors that influence their implementation. By analyzing existing literature, the study sought to provide insights that would support the development of context-specific training programs and competency frameworks, ultimately enhancing patient care and professional growth in hyperbaric nursing.

Statement of the Problem

Generally, this study aimed to synthesize findings from integrative literature review to develop a framework for the global competency in hyperbaric nursing.

Specifically, it sought to answer the following questions:

1. What are the core competencies required for hyperbaric nurses worldwide?
2. What are the educational and training needs of hyperbaric nurses in the global context?
3. What global competency framework be proposed to guide hyperbaric nursing education?

Research Paradigm

The study utilized the input-process-output model to systematically examine global hyperbaric nursing competencies through an integrative literature review.

The input phase involved an extensive review of existing literature focusing on global competency

frameworks, international guidelines and training methodologies relevant to hyperbaric nursing. Data were sourced from credible academic journals, systematic reviews, regulatory standards and professional guidelines. This phase established a knowledge base, identified recurring themes and exposed gaps that require further exploration in hyperbaric nursing competencies.

In the process phase, the gathered literature, underwent rigorous evaluation, thematic synthesis and analysis. The integrative approach enabled the identification of common themes, key competency elements and patterns across reviewed studies. These were categorized into core areas including technical knowledge, patient management skills, risk assessment and alignment with global standards. The process ensured a comprehensive and systematic extraction of essential competencies required for hyperbaric nurses, contributing to an evidence-based understanding of global expectations.

The output phase generated a comprehensive competency framework for hyperbaric nurses. This framework includes recommendations for developing training programs, competency assessment tools and policy enhancements aimed at improving hyperbaric nursing competencies with global standards while considering local healthcare contexts. Ultimately, the framework supported the delivery of effective hyperbaric oxygen therapy services in diverse healthcare settings.

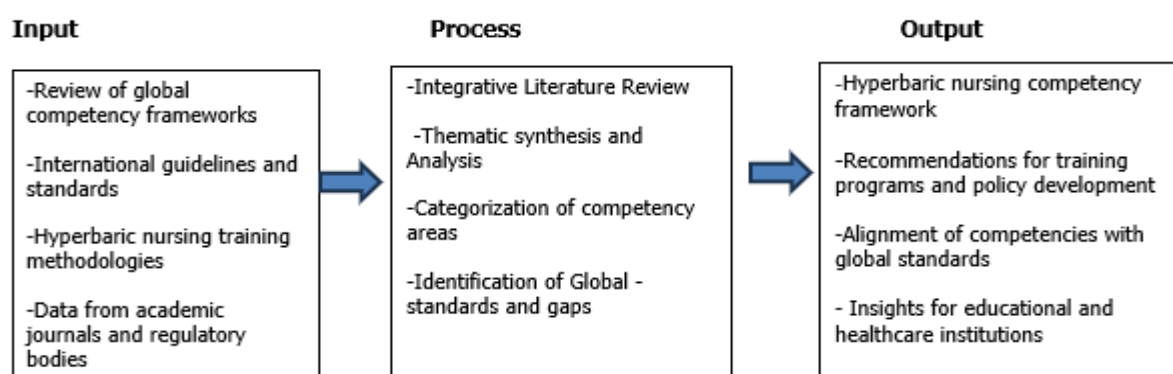


Figure 1: Paradigm of the Study

Methodology

The review followed Whittemore and Knafl's (2005) integrative review process: problem identification, literature search, data evaluation, data analysis, and presentation. Research studies published from 2010 to 2023 were included. Databases search included Scopus, Pub-Med, Science Direct, Google Scholar, and CINAHL using keywords such as "hyperbaric nursing competencies", "hyperbaric education", and hyperbaric certification".

Integrative Literature Review Process

The researcher employed the Joanna Briggs Institute (JBI) model combined with Whittemore and Knafl's (2005) five stage integrative review process to ensure rigorous and systematic approach to synthesizing literature on global competency of hyperbaric nurses.

The five stages of the review included problem identification, literature search, data evaluation, data analysis and presentation.

Guided by the JBI framework, the review began with a clear articulation of the research problem focusing on the identification of the global competencies required for hyperbaric nurses. A comprehensive literature search was conducted across recognized databases.

The JBI systematic was utilized as a process of synthesizing the literature in this integrative review. The JBI approach offers a structured and comprehensive method for gathering, appraising and synthesizing evidence to ensure rigor and reliability in the review process.

The process began with the identification of the review objective and eligibility criteria, which guided the selection of studies. The inclusion criteria covered the population, concept, context, study, types, language and publication years to ensure that only relevant studies on hyperbaric nurses' global competencies were included.

The next stage involved the systematic search and retrieval of literature from electronic databases such as Scopus, PubMed, Science Direct and CINAHL. Boolean operators and carefully chosen keywords were used to optimize the

search results. The search process followed the JBI's three-step strategy: an initial limited search, an analysis of the text words and index terms and a comprehensive search across all databases using refined terms.

After gathering the studies, critical appraisal was conducted using JBI Critical Appraisal tools designed for various study designs, such as qualitative, quantitative and mixed methods research. This ensured that only studies of acceptable quality and relevance were included. Each study was assessed based on its credibility, dependability and transferability.

For data extraction, the researcher utilized the standardized JBI data form. This included essential information such as authors, year, country, study purpose, population, methodology, key findings (similarities and differences), and recommendations. The data were transferred into a coding sheet as a matrix in Microsoft Word to ensure systematic extraction and facilitate comparison.

The data synthesis followed a narrative and thematic approach as recommended by the JBI framework. Studies were compared and synthesized item by item. Similar data were grouped into categories and sub-categories based on emerging themes such as knowledge, skills, safety protocols, cultural competence, and global standards in hyperbaric nursing. This process helped identify patterns, relationships, and differences across the studies.

The review adopted thematic derivation, allowing the classification of literature into distinct themes that described the core competencies required of hyperbaric professionals worldwide. This method supported the integration of theoretical, empirical, and conceptual studies, making it most appropriate for this research.

Furthermore, the findings were synthesized into a cohesive summary that highlighted the essential global competencies of hyperbaric nurses. Emerging themes informed the conceptualization of a proposed global competency framework. This operational framework can guide future research, curriculum

development, and policymaking in standardizing hyperbaric nursing competencies worldwide.

Problem Identification

The study systematically examined global hyperbaric nursing competencies to identify prevailing gaps and challenges. The review of existing literature, international guidelines and competency frameworks revealed inconsistencies across different countries and healthcare systems.

One significant problem identified was the limited standardization of hyperbaric nursing competencies, leading to varied interpretation of essential skills, knowledge areas and professional attitudes required for safe hyperbaric oxygen therapy practice. Existing competency models often lack specific guidelines designed to the unique demands of hyperbaric settings such as technical operation of hyperbaric chambers, risk management protocols and patient education specific to hyperbaric medicine.

The analysis also highlighted gaps in training methodologies and assessment tools, with some programs failing to comprehensively address specialized competencies, particularly in regions with limited resources and institutional support. This gap affects the capacity of hyperbaric nurses to meet global competency expectations and hindered the consistent delivery of quality patient care.

Moreover, it was found that while several international frameworks exist, their adaptability to diverse healthcare contexts remained a challenge, particularly in providing equitable access to specialized training and professional development opportunities.

Data Collection Methods

To effectively gather relevant literature and ensure comprehensive review, the researcher employed a systematic approach guided by the objectives of the study. A set of clearly defined inclusion and exclusion criteria was established to maintain the quality and relevance of the sources. Priority was given to studies that directly addressed hyperbaric nursing competencies, training programs, professional development, and global standards within the field of

hyperbaric medicine. The researcher carefully screened potential sources by reviewing titles, abstracts and full texts to determine their alignment with the scope of the study. Only peer-reviewed journal articles, systematic reviews, and expert guidelines that offered empirical data and substantial discussions on hyperbaric nursing competencies were considered for inclusion. Studies lacking empirical evidence, those focused on unrelated fields, or articles with limited relevance to the competency framework were excluded from the review.

Each selected study underwent quality appraisal using the Joanna Briggs Institute (JBI) checklist to assess methodological soundness and credibility. Relevant data were extracted focusing on competency elements, recommended skills, training methodologies and international standards essential to hyperbaric nursing practice. The extracted information was organized and categorized to aid in the synthesis process, contributing to the development of an evidence-based competency framework.

Through this structured data collection process, the researcher ensured that the literature review was both comprehensive and reflective of current trends, challenges, and best practices in hyperbaric nursing competencies at the global level. The process provided a solid foundation for the analysis and formulation of strategies to enhance competency development in hyperbaric nursing practice.

Data Evaluation

The researcher conducted a systematic evaluation of the selected studies to ensure their relevance, credibility, and alignment with the study's objectives of developing global competency framework for hyperbaric nurses. Each research article was critically appraised based on methodological rigor, research design, sampling techniques clarity of findings, and relevance to hyperbaric nursing competencies, training, and professional development. The JBI critical appraisal tool guided the evaluation process, allowing the researcher to identify studies with empirical foundations and practical relevance to hyperbaric nursing. Studies that demonstrated

clear definitions of competencies, appropriate data collection methods and comprehensive analysis were prioritized.

Additionally, the researcher cross-examined the findings from various sources to identify recurring themes, competency elements, and existing gaps in literature. This comparative analysis ensured consistency and strengthened the reliability of the data used in synthesizing the framework. By filtering out the studies with methodological weaknesses or limited applicability, the researcher ensured that the evaluation process produced high-quality evidence essential for framing a comprehensive and globally responsive hyperbaric nursing competency model.

Data Analysis

The researcher conducted a comparative analysis of the selected literature to identify the core

competencies, educational and training needs, and existing competency frameworks relevant to hyperbaric nurses across global contexts. This analysis allowed for the identification of shared standards and region-specific requirements that influence competency development. By synthesizing these findings, the study contributed insights that support the formulation of structured, context-responsive approaches to hyperbaric nursing education, ultimately promoting professional growth and enhancing the quality of patient care in this specialized field.

Presentation

The review of 20 studies on hyperbaric nurses' competencies reveals a comprehensive exploration of knowledge, skills and specialized practices needed in hyperbaric oxygen therapy.

Table 1 Reviewed Related Studies on Global Competency of Hyperbaric Nurses

Authors/Y ear	Country	Study Purpose	Population	Methodolo gy	Key Findings (Similarities & Differences)	Recommendatio ns
Komtae & Prachusilpa (2016)	Thailand	To develop competencies for hyperbaric oxygen nurses	Thai hyperbaric nurses	Mixed methods (survey and expert validation)	Identified core competencies (nursing care, education, communication, risk management, quality improvement) that align with global safety and competency standards; however, the framework is designed to Thai healthcare contexts	Integrate these competencies into national HBOT curricula and use the framework for local competency development
Smith et al. (2015)	USA	To review staffing ratio guidelines to ensure patient safety in HBOT	Studies on hyperbaric staffing	Systematic review	Emphasizes safe staffing and risk assessment, which is a common global need; however, the focus is more on staffing ratios rather	Establish global standardized staffing guidelines to enhance patient safety

Cooper et al. (2021)	Australia	To analyze workforce characteristics of HBOT nurses	Australian hyperbaric nurses	Descriptive survey	than individual nurse competencies Highlights the need for critical care backgrounds and professional capability—similar to global trends; differences emerge in workforce demographics unique to Australia	Standardize recruitment and training practices based on critical care competencies
Cheng et al. (2017)	Singapore	To investigate continuous education practices among nurses	Singaporean nurses	Quantitative survey	Confirms the importance of continuous education for maintaining competencies, aligning with global lifelong learning requirements; specific to Singapore's education framework	Strengthen continuous professional development programs tailored to hyperbaric nursing
Hampson et al. (2012)	USA	To establish HBOT nursing standards of practice	U.S. hyperbaric nurses	Expert panel and guideline development	Sets comprehensive competency standards (patient safety, psychological support) that reflect global best practices; detailed U.S.-specific protocols may differ from other regions	Implement and periodically update HBOT nursing standards based on international guidelines
Mensah-Kane & Sumien (2020)	France	To explore the application of HBOT in neurodegenerative diseases	Review of HBOT literature	Literature review	Highlights emerging competencies required for specialized applications (neurodegenerative conditions) which are consistent with global trends; focus	Incorporate specialized training modules for emerging HBOT applications in neurodegenerative diseases

					is narrow compared to broader HBOT practices	
Yuan et al. (2015)	China	To assess knowledge and practices regarding HBOT among nurses	Chinese hyperbaric nurses	Cross-sectional survey	Identifies a significant knowledge-practice gap similar to global findings; highlights unique training challenges within the Chinese healthcare system	Provide regular competency training to bridge knowledge-practice gaps
Wu et al. (2018)	Taiwan	To examine perceptions of HBOT safety among nurses	Taiwanese hyperbaric nurses	Quantitative survey	Reinforces the universal need for risk management and safety protocols; differences noted in cultural perceptions of safety specific to Taiwan	Enhance safety training and risk management practices tailored to local needs
Davenport et al. (2013)	USA	To describe HBOT nursing roles for radiation-induced tissue damage	HBOT nurses caring for radiation patients	Literature synthesis	Demonstrates the need for specialized pathophysiology knowledge—a competency recognized globally; however, focus is exclusively on radiation-related conditions	Develop targeted training for radiation-induced injury management in HBOT
Smit et al. (2016)	South Africa	To design an education curriculum for HBOT nurses	South African HBOT nurses	Curriculum design study	Emphasizes formal education and structured training needs, aligning with global demands; curriculum is specifically adapted to South Africa's healthcare context	Implement HBOT-specific educational programs and formal training curricula
Dan Christopher (2023)	USA	To define the role of RNs in hyperbaric medicine	U.S. hyperbaric RNs	Qualitative review	Highlights the importance of certifications, documentation, and leadership; aligns with global	Reinforce leadership and documentation skills in HBOT nurse training

					competency needs yet emphasizes U.S.-specific documentation practices	
Torem et al. (2011)	Israel	To examine research competencies among hyperbaric nurses	Israeli hyperbaric nurses	Mixed methods	Identifies a need for evidence-based practice and research skills common to global competency standards; focused on the Israeli context which emphasizes academic research	Integrate research skill development into HBOT nurse education and practice
Lindfors et al. (2013)	Sweden	To analyze holistic care practices in HBOT nursing	Swedish hyperbaric nurses	Descriptive study	Highlights the importance of wound care, psychological support, and holistic care consistent with global practices; Swedish model emphasizes a comprehensive holistic approach	Promote holistic care training and patient-centered approaches in HBOT nursing globally
Gerlichová et al. (2017)	Slovakia	To explore the role of hyperbaric nurses in Slovakia	Slovak hyperbaric nurses	Qualitative interviews	Identifies strong technical skills and psychosocial care competencies, reflecting global requirements; emphasizes holistic care tailored to the Slovak context	Adapt holistic and technical competency models to meet both global and local needs
Griffin et al. (2019)	USA	To develop a competency tool for transplant nurses adaptable to HBOT	Transplant nurses (adaptable for HBOT)	Tool development study	Structured assessment tools enhance competency measurement globally; originally designed for transplant nursing,	Modify and adopt structured competency tools for HBOT assessment

Fitzpatrick et al. (2018)	USA	To evaluate interprofessional collaboration in HBOT settings	HBOT healthcare teams	Mixed methods	requiring adaptation for HBOT	
					Emphasizes the universal need for effective communication, collaboration, and teamwork in hyperbaric care; specific focus on interprofessional practice in HBOT	Enhance interprofessional education and teamwork training in HBOT programs
Baines & Sykes (2020)	Australia	To assess clinical competencies, including medical and hearing assessments, in hyperbaric nurses	Australian hyperbaric nurses	Descriptive study	Demonstrates clinical competency needs consistent with global standards; includes unique elements like hearing assessments pertinent to the Australian context	Incorporate auditory assessment training in HBOT competency programs
					Identifies core competencies such as teamwork, communication, and decision-making that are transferable to HBOT; focused primarily on emergency care	Integrate emergency care competencies into hyperbaric nursing training modules
Gerlach & Volk (2021)	USA	To determine critical care nurses' competencies in emergency settings applicable to HBOT	Critical care nurses (transferable to HBOT)	Literature review	Confirms that simulation-based training effectively enhances clinical skills and emergency preparedness globally; simulation focus on advanced practice is distinct	Expand simulation training for HBOT nurses, especially in managing critical scenarios
Joubert et al. (2022)	South Africa	To evaluate simulation-based training for advanced nursing practice in HBOT	Advanced practice nurses	Simulation-based experimental study		
Gerlach & Schenk (2021)	USA	To develop an ECMO nursing competency framework	ECMO nurses (adaptable for HBOT)	Framework development study	Establishes technical and team competencies that are adaptable to	Adapt the ECMO competency framework to specifically address

adaptable HBOT	to	hyperbaric settings; ECMO framework provides insights transferable to HBOT but requires contextual adaptation	hyperbaric nursing competencies
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The reviewed studies emphasized the growing importance of establishing global competencies among hyperbaric nurses focusing on patient safety, technical skills, continuous education and specialized knowledge. Several studies including those of Komtae and Prashusilpa (2016), Smith, et.al (2015) and Hampson et al. (2012) highlighted the need for hyperbaric nurses to possess strong risk management skills, psychological support capabilities and quality care standards aligned with international best practices. Similarly, Copper,et al. (2021) and Baines and Sykes (2020) also highlighted the relevance of clinical experience and critical care backgrounds, particularly in Australian setting, which reflects a global demand for highly skilled and experienced nurses in hyperbaric environments. Studies from Asia such as those Yu An et al.(2015), Wu et al. (2018) and Cheng et al. (2017) reinforced the significance of closing the gap between knowledge and practice emphasizing the role of continuous professional education to enhance competencies and ensure patients safety.

Moreover, several studies also examined the need for specialized competencies when dealing with complex condition and emerging applications of hyperbaric oxygen therapy (HBOT). Mensah-Kane and Sumien (2020) focused on neurodegenerative diseases, highlighting the necessity of specialized knowledge in this field. Davenport et.al. (2013) also demonstrated that nursing care for radiation induced tissue damage requires a deeper understanding of pathophysiology and patient-specific interventions. Studies by Smith et al. (2016) and Dan Christopher (2023) further stressed the importance of standardized educational professional capability of hyperbaric nurses.

Additionally, Torem et al. (2011) and Linfors et al. (2013) expanded the global competency framework by incorporating research skills and holistic approaches to care while considering country-specific healthcare systems.

Thus, the importance of interprofessional collaboration and competency assessment tools is recognized as integral to global hyperbaric nursing competencies. Fitzpatrick et al. (2018) and Joubert et al. (2022) emphasized teamwork as a strategy to strengthen communication and decision-making skills for HBOT nurses working in complex environments. Griffin et al. (2019) and Gerlach et al. (2021) provided adaptable competency models, originally designed for transplant but applicable to HBOT which focused on structural assessment, technical proficiency, and critical care competencies. Studies from Slovakia and Sweden by Gerlichova et al. (2017) and Linfors et al. (2013) respectively, mirrored these global competencies by incorporating technical, psychological, and holistic care in their practice. Collectively, these studies highlighted the shared global priorities of safety specialized training, collaboration, and adaptability in developing the hyperbaric nursing workforce.

Results and Findings

The integrative review of the 20 studies revealed comprehensive insights into educational needs, core competencies, and framework development essential to hyperbaric practice globally. This review was guided by Joanna Briggs Institute Methodology.

The JBI model guided the establishment of clear inclusion and exclusion criteria. For this review, only peer-reviewed research papers published from 2010- 2024 were considered. Articles that

did not include the terms “hyperbaric nursing competency” or “hyperbaric nurses” or “hyperbaric oxygen therapy nursing” or “competency framework” or “nursing skills” or “specialized nursing” or global or international or worldwide or universal in their titles or abstracts, were excluded even relevant keywords were present.

The filtering process ensured that the reviewed material focused solely on studies addressing the

global competencies required in hyperbaric nursing practice. Studies centered on technical operations, diving medicine, or hyperbaric medicine unrelated to nursing competencies were also excluded.

The search covered multiple academic databases including Scopus, ScienceDirect, PubMed, and Google Scholar.

Search Number	Search Terms
S1	"hyperbaric nursing competency" OR "hyperbaric nurses" OR "hyperbaric oxygen therapy nursing" OR "nursing skills" OR "competency framework"
S2	S1 AND ("global" OR "international" OR "worldwide" OR "universal")
S3	S2 AND ("2010-2024")

The search strategy for this integrative review involved a systematic and structured process to ensure relevant studies addressing global competencies in hyperbaric nursing were identified. The initial search terms included combinations of keywords such as “hyperbaric nursing competency” or “hyperbaric nurses” or “hyperbaric oxygen therapy nursing” or “competency framework” to cover the core focus of the review. These were combined with search 1(S1). To narrow the scope towards global perspectives, Search Set 2 (S2) was created by adding keywords like “global”, “international” “worldwide” and universal to the initial search. Furthermore, to ensure the relevance and currency of the studies, Search Set 3 (S3) applied to publication date filter covering the years 2010 to 2024.

From this search, **62** records were initially identified through database searches. After removing **4** duplicate records, a total of **58** studies remained for screening. During the screening phase, **33** records were excluded due to such as focusing on general nursing without hyperbaric specialization, lacking discussions on global

competencies or concentrating solely on technical hyperbaric operations rather than nursing competencies. Out of the remaining articles, **25** full-text studies were assessed for eligibility. However, **5** of these were excluded as they did not provide sufficient discussion on global competencies in hyperbaric nursing. Ultimately, **20 studies** met all the criteria and were included in the integrative review for analysis. This rigorous search process ensured that the review captured only the most relevant studies addressing global competence necessary for hyperbaric nursing practice.

The included studies were critically appraised following the JBI approach, considering their methodological rigor, relevance, and contributions to the field of hyperbaric nursing competencies. Data extraction focused on key elements such as study purpose, population, methodology, major findings, and recommendations. This structured approach ensured consistency and facilitated the identification of recurring themes across the studies.

The synthesis of findings revealed that the reviewed studies consistently emphasized the importance of core global competencies required in hyperbaric nursing. These competencies included patient safety management, risk assessment, quality care standards, and psychological support, along with the need for critical care experience in handling hyperbaric patients. Several studies highlighted specialized knowledge areas such as managing neurodegenerative diseases, radiation-induced tissue damage, and other emerging applications of hyperbaric oxygen therapy (HBOT). Moreover, the review underscored the necessity of continuous professional education to bridge the gap between theoretical knowledge and practical application, particularly in Asian countries where hyperbaric nursing practice is still evolving.

Interprofessional collaboration, effective communication, and sound decision-making skills were also identified as essential global competencies. Some studies proposed competency assessment models that integrate technical expertise with psychological and holistic care approaches, reflecting the complex nature of hyperbaric nursing.

Anchored on the JBI integrative review model, this review presents strong evidence that hyperbaric nurses must possess a unique set of global competencies to deliver safe and effective care. The findings advocate for the development of standardized competency frameworks

adaptable to various healthcare systems worldwide. Furthermore, the review highlights the need for continuous global education and training programs to equip hyperbaric nurses with the necessary knowledge, skills, and attitudes, thereby strengthening the global hyperbaric nursing workforce.

Global Core Competencies for Hyperbaric Nurses

The integrative review of the 20 studies revealed that nurses must possess a distinct set of core competencies essential to ensure patient safety and quality care on hyperbaric settings. These competencies included technical expertise in operating hyperbaric chambers, managing patient care before, during and after hyperbaric oxygen therapy and apply knowledge on wound care and decompression illness. Studies from Australia (Baines and Sykes, 2015), Slovakia (Gerlichova et al. 2017) and Sweden (Linfors, et al. 2013) consistently emphasized technical proficiency and safety protocols as significant competencies. Additionally, communication, psychological support, interprofessional collaboration and research engagement were identified as necessary skills. Studies from US, Canada and Israel highlighted the importance of teamwork and providing psychological support to patients undergoing treatment. Risk management and ethical considerations were also emphasized, requiring hyperbaric nurses to balance technical performance with compassionate care and adherence to safety standards.

Table 2 Global Core Competency Themes of Hyperbaric Nurses

Core Competency Themes	Associated Authors/Years
Nursing Care & Patient Safety	Komtae & Prachusilpa (2016); Hampson et al. (2012); Smith et al. (2015)
Education & Continuous Professional Development	Cheng et al. (2017); Smit et al. (2016)
Risk Management & Staffing	Smith et al. (2015); Wu et al. (2018)
Workforce Characteristics & Critical Care Competency	Cooper et al. (2021); Gerlach & Volk (2021)

Specialized Clinical Knowledge	Mensah-Kane & Sumien (2020); Davenport et al. (2013)
Knowledge-Practice Gap	Yuan et al. (2015)
Professional Leadership & Documentation	Dan Christopher (2023)
Evidence-Based Practice & Research Competence	Torem et al. (2011)
Holistic & Psychosocial Care	Lindfors et al. (2013); Gerlichová et al. (2017)
Competency Assessment & Tools	Griffin et al. (2019)
Interprofessional Collaboration & Communication	Fitzpatrick et al. (2018)
Clinical Competencies & Auditory Assessment	Baines & Sykes (2020)
Simulation-Based Training & Advanced Practice	Joubert et al. (2022)
Technical & Team Competencies Adaptable to HBOT	Gerlach & Schenk (2021)

The review highlighted a multi-dimensional development of hyperbaric nursing competencies. The key themes included a strong emphasis on nursing care and patient safety, where studies by Komtae & Prachusilpa (2016), Hampson et al. (2012), and Smith et al. (2015) outlined essential core competencies that ensure high-quality care and safe staffing. Continuous education and professional development were highlighted by research from Cheng et al. (2017) and Smit et al. (2016), reinforced the need for ongoing learning and curriculum design tailored to hyperbaric settings. Risk management is another vital theme, with Wu et al. (2018) and Smith et al. (2015) advocated for rigorous safety protocols, while workforce characteristics and critical care competencies, as indicated by Cooper et al. (2021) and Gerlach & Volk (2021), pointed to the importance of specialized skills in emergency care environments. Moreover, specialized clinical knowledge for treating unique conditions, addressing the knowledge-practice gap, fostering interprofessional collaboration and integrating evidence-based practices and research skills were all significant in developing a strong competency framework. Additional themes emphasized holistic, psychosocial care approaches; the utility of structured competency assessment tools; and the advancement of simulation-based training, culminating in

technical and team competencies adaptable to HBOT settings as demonstrated by Gerlach & Schenk (2021).

Educational Needs of Hyperbaric Nurses

The review further revealed that significant educational needs essential for preparing hyperbaric nurses for global practice. Several studies highlighted the importance of formal training programs and structured competency-based education. In particular, studies from South Africa (Smit et al. 2016), the UK (Cooper et al. 2021), Thailand (Komtae & Prachusilpa 2016) and Singapore (Cheng et al. 2017) emphasized the need for continuous professional development programs, which include ethics, patient care, simulation-based emergency training, and certification specific to hyperbaric practice. Knowledge gaps were noted in specialized care areas such as diabetic foot ulcers (Hassan, 2017), radiation-induced tissue damage (Davenport et al., 2013), and management of neurodegenerative diseases (Mensah-Kane & Sumien, 2020). Studies from China (Yuan et al., 2015) and India (Savaganve & Sanadi, 2021) also reported insufficient knowledge among nurses and nursing students, highlighting the global need to strengthen curricula and validate competencies in hyperbaric nursing.

Authors/Year	Identified Educational Need
Komtae & Prachusilpa (2016)	Integration of core competencies (nursing care, education, communication, risk management, quality improvement)
Smith et al. (2015)	Training on safe staffing practices and risk assessment specific to HBOT environments
Cooper et al. (2021)	Enhancement of critical care background and professional capability in HBOT
Cheng et al. (2017)	Emphasis on continuous education and lifelong learning among HBOT nurses
Hampson et al. (2012)	Familiarization with comprehensive HBOT standards including patient safety and psychological support
Mensah-Kane & Sumien (2020)	Specialized training for HBOT applications in neurodegenerative diseases
Yuan et al. (2015)	Addressing the knowledge-practice gap in HBOT
Wu et al. (2018)	Enhanced safety training tailored to local cultural and risk management needs in HBOT
Davenport et al. (2013)	Targeted training in specialized pathophysiology for radiation-induced tissue damage
Smit et al. (2016)	Formal education and structured training curricula specifically for HBOT
Dan Christopher (2023)	Strengthening leadership, documentation, and certification competencies in hyperbaric nursing
Torem et al. (2011)	Development of research skills and evidence-based practice competencies in HBOT
Lindfors et al. (2013)	Promotion of holistic care and patient-centered approaches
Gerlichová et al. (2017)	Adapting technical and psychosocial care competencies to meet local needs
Griffin et al. (2019)	Implementation of structured assessment tools for competency measurement in HBOT
Fitzpatrick et al. (2018)	Enhancement of interprofessional collaboration and communication skills in HBOT settings
Baines & Sykes (2020)	Training on clinical competencies, including medical and hearing assessments in hyperbaric care
Gerlach & Volk (2021)	Development of emergency care competencies transferable to hyperbaric settings
Joubert et al. (2022)	Enhancement of simulation-based training for advanced clinical practice and emergency preparedness

Authors/Year	Identified Educational Need
Gerlach & Schenk (2021)	Adaptation of an ECMO nursing competency framework specifically for hyperbaric nursing

The table 2 highlights the identified educational needs for a comprehensive and multi-dimensional approach to hyperbaric nursing education. The different studies emphasized integrating core competencies—such as nursing care, communication, risk management, and quality improvement—with rigid training on continuous professional development and specialized subject areas like neurodegenerative diseases and radiation-induced injuries. Some significant areas included safe staffing practices, bridging the knowledge-practice gap and enhancing technical, psychosocial, and holistic care skills tailored to both global standards and local contexts.

Additionally, there is a strong call for improved leadership, documentation, and interprofessional collaboration, as well as the adoption of innovative educational strategies such as simulation-based training and adapted frameworks (e.g., ECMO competency models) that collectively foster a safe, effective, and responsive hyperbaric care environment.

Proposed Global Competency Framework for Hyperbaric Nurses

Anchored in the synthesized themes and educational needs derived from twenty international studies, the Global Competency Framework for Hyperbaric Nurses provided an operational structure to guide the standardization of hyperbaric nursing practice across diverse clinical settings.

This framework categorized core competencies into six key domains: (1) Technical and Clinical Expertise, (2) Holistic and Psychological Care, (3) Ethical and Professional Practice, (4) Risk Management and Safety (5) Interprofessional Collaboration, and (6) Research and Lifelong

Learning. Each domain is linked to clearly defined knowledge and skills expected for globally competent hyperbaric nurses. The framework emphasized continuous professional development and curriculum to address identified gaps such as the need formal education, specialized training and updated practice standards. By translating research findings into actionable educational strategies and clinical outcomes, the framework contributed a unified, adaptable guide for hyperbaric nurse preparation and development—thereby strengthening the global delivery of hyperbaric care.

The synthesis of findings across the 20 studies guided the development of a Global Competency Framework for Hyperbaric Nurses (GCFHN). Drawing from the distinct but complementary findings of international research, the framework was developed to standardize the knowledge, skills, and attitudes required for hyperbaric nursing practice worldwide. The framework centered on safety, risk management, and quality care, recurrent themes across the studies.

It composed of technical skills, psychological care, ethical practice, and continuous learning. The framework promoted standardizing core competencies globally, having an assurance that hyperbaric nurses are well-equipped to manage the complexities of hyperbaric environments regardless of location. It also encouraged interprofessional collaboration, patient education, and engagement in research and quality initiatives.

Thus, the GCFHN served as strategic guide for developing globally competent hyperbaric nurses who can adapt to diverse clinical settings while upholding the highest standards of care.

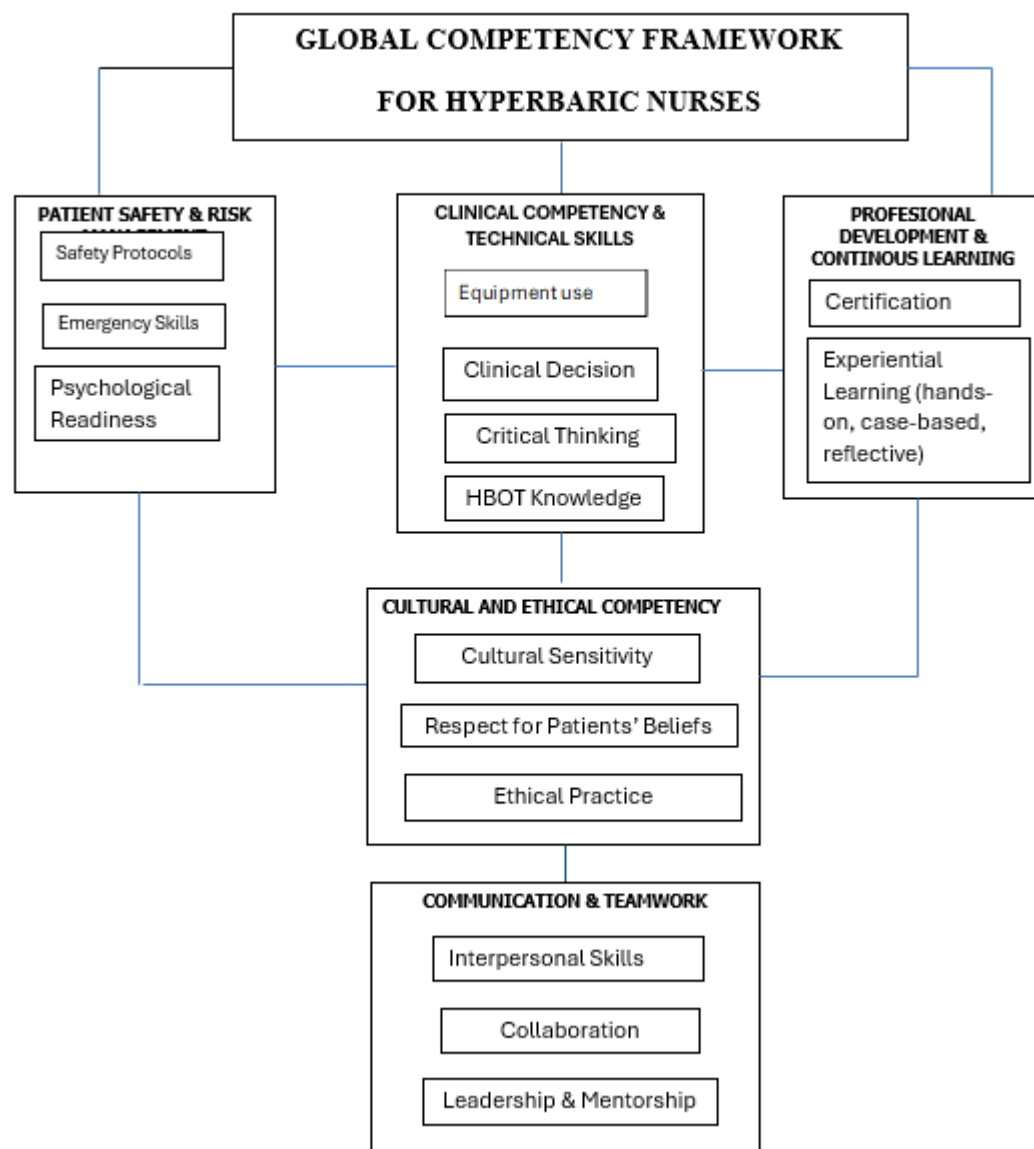


Figure 2: Global Competency Framework for Hyperbaric Nurses

Conclusion

Based on the integrative review of 20 research studies, the findings revealed that hyperbaric nursing requires specialized core competencies globally. These include proficiency in hyperbaric chamber, operations, patient monitoring, wound management, risk management, psychological support, communication, and interprofessional collaboration. Studies from Australia, Slovakia and Sweden consistently emphasized the critical role of technical expertise while others from Israel, US, and Canada highlighted the

significance of teamwork, research and psychological care.

The review also highlighted the pressing educational needs of hyperbaric nurses. Several studies identified the lack of structured educational programs and the necessity for continuous professional development (CPD) to strengthen hyperbaric nurses' knowledge and skills. Countries such as South Africa, Thailand, Singapore, and China emphasized competency-based orientation and importance of addressing knowledge gaps, particularly areas like diabetic

foot ulcer care and radiation-induced tissue damage.

Guided by the synthesis of findings, a proposed Global Competency Framework of hyperbaric nurses was developed. This framework focuses on standardizing knowledge, skills, and attitudes required in hyperbaric nursing practice. It emphasized patient safety and risk management. Ethical practice, continuous learning, and global competency alignment to guide hyperbaric nursing education, policy formulation, and professional practice.

Recommendations

Based on the findings of this integrative literature review, it is recommended that nursing education institutions integrate specialized hyperbaric nursing modules into their curricula to strengthen the core competencies of hyperbaric nurses. These include technical skills in hyperbaric chamber operations, patient safety, risk management, psychological support and effective interprofessional collaboration. Continuous professional development (CPD) program is also essential to enhance practical skills and address existing knowledge gaps, particularly in managing complex patient cases and emerging conditions in hyperbaric settings.

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For healthcare institutions and hyperbaric nursing practice, it is recommended to establish competency-based orientation programs and regular skills to ensure that nurses are equipped with necessary knowledge and expertise to deliver safe and effective care.

Encouraging teamwork, patient-centered care and involvement in quality improvement initiatives should be prioritized to uphold ethical standards and enhance patient outcomes. The proposed Global Competency Framework for hyperbaric nurses may be adopted to guide practice and

ensure alignment with international standards of hyperbaric nursing.

Furthermore, policymakers and regulatory bodies should recognize hyperbaric nursing as a specialized field requiring specific certification and continuous education. Policies supporting the implementation of the global competency framework must be developed to strengthen nursing practice, education, and research in hyperbaric care. Such measures will ensure that hyperbaric nurses are adequately prepared to address the unique demands of the field, promoting patient safety, professional growth, and global competency in hyperbaric nursing.

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