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Validation and classification of professional competencies of the hemodynamics nurse

Validação e classificação das competências profissionais do enfermeiro de hemodinâmica
Validación y clasificación de las competencias profesionales del enfermero de hemodinámica

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Abstract
Objective: To validate and classify the competencies of Hemodynamics nurses in collaboration with nurses working in this specialty. **Methods**: A methodological study aimed at validating the competencies of Hemodynamics nurses regarding relevance, appropriateness, clarity, and applicability, using a Likert scale, and classifying the competencies as basic, intermediate, or advanced by nurses working in Hemodynamics. Data were collected between January and June 2023, following approval by the Research Ethics Committee, and were analyzed based on the percentage of agreement and Cronbach's alpha. **Results**: Agreement exceeding 75% was observed for all evaluated competencies. Regarding competency classification, the User Education domain was classified as basic; Periprocedural Care included basic, intermediate, and advanced competencies; and all other domains were classified as advanced. **Conclusion**: The competencies of Hemodynamics nurses were validated and classified. Of these, 67.5% were classified as advanced, requiring specialized training and continuing education to support their monitoring, advancement, and development.

Descriptors: Nurses; Hemodynamics; Professional Competences.

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Whats is already known on this?
In 2023, due to the lack of instruments to determine the competencies of Hemodynamics nurses, a set of competencies for these professionals was developed and validated by specialists, encompassing care, teaching, management, and research. Based on this scope, which includes 74 competency items covering the expected knowledge, skills, and attitudes of Hemodynamics nurses, the need for the present study was established

What this study adds?
This study validates and classifies these competencies among clinical nurses. Consequently, it may contribute to supporting professional education, continuing education, and in-service training.

Resumo

Objetivo: *Realizar a validação e classificar as competências dos enfermeiros de Hemodinâmica, junto aos enfermeiros atuantes nessa área.* ***Método:*** *Estudo metodológico de validação das competências do enfermeiro de Hemodinâmica quanto à relevância, pertinência, clareza e aplicabilidade por meio de escala Likert e classificação das competências em básica, intermediária ou avançada pelos enfermeiros atuantes em Hemodinâmica. Os dados foram coletados entre janeiro e junho de 2023, após aprovação pelo Comitê de Ética em Pesquisa, sendo analisados a partir do percentual de concordância e pelo Alfa de Cronbach.* ***Resultados:*** *Houve concordância superior a 75% em todas as competências avaliadas. Quanto à classificação de competências, o eixo da Educação dos Usuários foi básico; na Assistência Peri-Procedimental foi básico, intermediário e avançado; e nas demais, foram avançados.* ***Conclusão:*** *As competências dos enfermeiros de Hemodinâmica foram validadas e classificadas. Destas, 67,5% foram classificadas como avançadas, requerendo formação especializada e educação permanente para o acompanhamento de seu avanço e desenvolvimento.*

Descritores: *Enfermeiros; Hemodinâmica; Competência Profissional.*

Resumén

Objetivo: *Realizar la validación y la clasificación de las competencias de los enfermeros de Hemodinámica junto a profesionales que actúan en esta área.* ***Métodos:*** *Estudio metodológico de validación de las competencias del enfermero de Hemodinámica en cuanto a relevancia, pertinencia, claridad y aplicabilidad, mediante una escala Likert, así como la clasificación de las competencias en básicas, intermedias o avanzadas por los enfermeros actuantes en Hemodinámica. Los datos fueron recolectados entre enero y junio de 2023, tras la aprobación por el Comité de Ética en Investigación, y se analizaron a partir del porcentaje de concordancia y del coeficiente Alfa de Cronbach.* ***Resultados:*** *Se observó una concordancia superior al 75 % en todas las competencias evaluadas. En cuanto a la clasificación de las competencias, el eje de Educación de los Usuarios fue considerado básico; en la Asistencia Periprocedimental se identificaron competencias básicas, intermedias y avanzadas; y en los demás ejes, las competencias fueron clasificadas como avanzadas.* ***Conclusión:*** *Las competencias de los enfermeros de Hemodinámica fueron validadas y clasificadas. De estas, el 67,5 % fue clasificado como avanzado, lo que requiere formación especializada y educación permanente para el seguimiento de su progreso y desarrollo.*

Descriptores*: Enfermeros; Hemodinámica; Competencia Profesional.*

INTRODUCTION

Cardiovascular interventions performed through catheters have undergone significant evolution since the first coronary angioplasty was performed in 1977,[1] requiring continuous improvement of the professionals working in Hemodynamics Units (HU).

With the aim of fostering such development, in 2013 the Brazilian Society of Cardiology (BSC) published the third edition of the Guidelines on Professional and Institutional Quality, Training Centers, and Professional Certification in Hemodynamics and Interventional Cardiology, which state that rigorous professional training focused on the management of complex situations and adverse events, with a high standard of patient safety, is essential.[2]

In 2020, the BSC, together with the Brazilian Society of Hemodynamics and Interventional Cardiology (BSHIC), published the Position Statement on Training Centers and Professional Certification in Hemodynamics and Interventional Cardiology, aiming to guide professionals, training centers, and institutions regarding percutaneous coronary intervention, structural and congenital heart diseases, among other topics.[3] However, when addressing competencies in the field of Nursing, this document referred to the 2013 guideline, which discusses the need for professional qualifications, participation in continuing education programs during the training process, management experience, and improvement in management skills.[2,3]

Given the scarcity of literature on the subject, in 2023, based on Pasquali's theoretical framework,[4] an instrument was developed containing seven professional competencies of nurses working in Hemodynamics across the domains of care, teaching, management, and research, comprising 74 items of knowledge, skills, or attitudes,[5] and its content validity was assessed by specialists.

To ensure continuity of this investigation, the need to validate and classify these competencies among clinical nurses was identified, assuming that the established set of competencies corresponds to those developed in the daily work of nurses in Hemodynamics Units.

This study may potentially contribute to supporting professional training in lato sensu postgraduate programs, continuing education, and in-service training, as well as to Human Resources management in this field of practice.

The objective of the present study is to validate and classify the professional competencies of Hemodynamics Unit nurses in collaboration with nurses working in this area.

METHODS

This is a methodological study aimed at validating the relevance, appropriateness, clarity, applicability, and classification of competencies by nurses working in Hemodynamics Units (HU). This instrument was developed based on a literature review, and its content was validated according to Pasquali's methodological framework,[4] in collaboration with experts. Content validation seeks to assess the degree of relevance and representativeness of a construct. It is considered fundamental in the process of developing and adapting measurement instruments and should follow stages that include identification of all domains, construction, and organization.[5,6]

Considering that this content validation was conducted in 2023, and aiming to update the literature, an integrative review was carried out using the framework proposed by Mendes (2008),[7] and the PICO strategy (Population, Intervention, Context). The guiding question was: "What are the competencies of nurses working in Hemodynamics?" MeSH and DeCS descriptors were used: {(nurse OR nursing) AND ("percutaneous coronary intervention" OR "cardiac catheterization" OR angioplasty OR angiography OR hemodynamics) AND ("clinical competence" OR "professional competence")}. These terms were freely combined and searched in the LILACS, SciELO, MEDLINE, PubMed, BDENF, and Scopus databases, including full-text articles published between 2007 and 2023, in English, Portuguese, and Spanish. Of the 52 articles initially identified, exclusions were made due to duplication (8), lack of relevance to the topic (7), lack of full-text access (17), failure to meet the defined time frame (9), and failure to meet the established language criteria (2), resulting in nine articles.

Including gray literature, searches were conducted in the Federal Nursing Council, the Brazilian Society of Cardiology, the Brazilian Society of Hemodynamics and Interventional Cardiology, and the American Heart Association. A document addressing Training Centers and Professional Certification in Hemodynamics and Interventional Cardiology, published in 2020, was identified.[3]

The evaluation of the studies was conducted by two reviewers, followed by categorization of objectives, methods, and results. For the classification of study types and determination of the origin of evidence, distributed across levels 1 to 7, the framework proposed by Melnyk and Fineout-Overholt was adopted.[8]

Considering that no new literature was identified after 2017, the present study was conducted based on the previously established set of competencies.[5]

The sample consisted of 82 nurses working in Hemodynamics Units (HU), who were invited to participate in the study online through WhatsApp groups of nurses, using the snowball sampling technique, a strategy in which initial participants indicate new subjects who meet the inclusion criteria. This technique has limitations related to selection bias and the indication of participants with similar viewpoints, particularly in small samples. Therefore, within the sampling universe, efforts were made to include participants who met the inclusion criterion of having at least six months of experience in Hemodynamics Units of institutions in Brazil.[9] Data collection was carried out between January and June 2023, and the sample was defined by convenience based on the pre-established data collection period.

This number of nurses allowed the estimation of response proportions on the Likert scale for judges' evaluations of relevance, appropriateness, clarity, and applicability, with a minimum precision of 11%, either above or below, within 95% confidence intervals.

The Informed Consent Form, as well as the questionnaire responses, were completed using the Research Electronic Data Capture software, accessed online. The questionnaire included questions regarding professional profile and requested the evaluation of each of the 74 competencies presented in terms of relevance (whether the assessed item is important for the professional practice of the hemodynamics nurse), appropriateness (whether it is consistent with professional practice), clarity (related to precision and ease of understanding of the text), and applicability (linked to the feasibility of use in professional practice). These were measured using the Likert scale categories "strongly disagree," "partially disagree," "partially agree," and "agree," according to the perception of hemodynamics nurses.

In addition, the competencies were classified by type as Basic, Intermediate, or Advanced, according to the degree of complexity of the activity as perceived by nurses in their daily practice and based on group consensus. This procedure was adopted because the definition of these levels of care complexity depends on specialized judgment, for which there are still no universally established objective criteria in the literature. Thus, classification was based on consensus among nurses, according to their practical reality in the field of practice.

In the statistical analysis, results were presented regarding the nurses' professional profile, the classification of competencies in terms of relevance, appropriateness, clarity, and applicability, as well as their classification as basic, intermediate or advanced.

Continuous variables were described using means and standard deviations, and categorical variables were described using absolute and relative frequencies. The distribution of participants' responses for each competency was presented in tables with their respective absolute and relative frequencies. Using Cronbach's alpha, it was assessed whether the responses from a given set of questions representative of the competencies were correlated,[10] and the percentage of agreement was used, as it is a simple measure of the level of consensus among nurses. The analyses were conducted using R software, version 4.1.2.

The research project was submitted to and approved by the Research Ethics Committee, in accordance with Resolution No. 466 of 2012, under approval number 5.678.718.

RESULTS

The sample consisted of 82 nurses working in Hemodynamics Units (HU), of whom 60 (73.2%) were women and 22 (26.8%) were men. The study included professionals from 11 Brazilian states, namely São Paulo (39, 47.6%), Pernambuco (11, 13.4%), the Federal District (9, 11%), Maranhão (8, 9.8%), and Bahia (7, 8.5%).

Regarding professional position, 69 (79.3%) were clinical nurses and 17 (20.7%) held leadership positions, with 53 (64.6%) earning up to five minimum wages. With respect to length of professional training, 47 (57.3%) had 10 years or more since graduation, and only 52 (63.4%) had specific training in hemodynamics. In terms of experience, 32 (39%) had worked for 10 years or more in Hemodynamics Units, and 25 (30.5%) had between one and three years of experience. Of the total sample, 62 (75.6%) reported having no prior experience in the area, and only 37 (45.1%) reported having completed admission training. Conversely, participation in continuing education courses was reported by 61 (74.4%) professionals, but only 24 (29.3%) reported being members of the Brazilian Society of Hemodynamics and Interventional Cardiology.

The competencies were presented according to the work processes of care, management, teaching, and research. Within the care–management work process (Table 1), the following domains were included: 1. Periprocedural Care, 2. Complications, 3. Care Management, and 4. Resource Management.

In the teaching work process (Table 2), the following domains were included: 5. User Education, 6. Professional Training and Continuing Education, and 7. Research.

The evaluations performed by the nurses showed that, for all competencies assessed, the mean level of agreement exceeded 75%. Regarding the classification of competencies, the Periprocedural Care domain comprised Basic (33.3%), Intermediate (27.8%), and Advanced (38.9%) competencies; the User Education domain was predominantly classified as Basic (38.9%); and the remaining domains were considered predominantly Advanced, as presented in Tables 1 and 2.

Table 1. Distribution of agreement percentages and competency classification in care-related work processes (Periprocedural and Complications domains) and management processes (Care Management and Resource Management domains). São Paulo, SP, Brazil, 2023.

Care – 1. Periprocedural: provide comprehensive and systematized care, from admission to discharge, related to clinical assessment, patient preparation, performance of therapeutic or diagnostic procedures, post-intervention care, and discharge from the hemodynamics unit, in collaboration with the multidisciplinary team.							
Competencies	**R**	**P**	**C**	**A**	**BC**	**IC**	**AC**
Supervise or prepare the patient for the procedure in the pre-procedure room, including measurement of weight and height, hair removal, and insertion of a large-bore venous access.	75 91.5%	75 91.5%	76 92.7%	71 86.6%	49 59.8%	17 20.7%	16 19.5%
Verify a minimum fasting period of 3 hours, history of allergic reaction to contrast media, suspended medications, and mandatory medications required for the procedure.	80 97.6%	79 96.3%	79 96.3%	78 95.1%	36 43.9%	28 34.1%	18 22%
Perform clinical assessment, monitoring vital signs and electrocardiographic tracing.	78 95.1%	78 95.1%	79 96.3%	77 93.9%	16 19.5%	32 39%	34 41.5%

Competency	R	P	C	A	BC	IC	AC
Supervise or prepare the procedure room, including assembly of the auxiliary table, arrangement of sterile drapes on the table, setup of the polygraph monitoring circuit, and contrast injector pump.	68 82.9%	67 81.7%	77 93.9%	64 78%	25 30.5%	38 46.3%	19 23.2%
Receive the patient in the procedure room.	66 80.5%	69 84.1%	74 90.2%	65 79.3%	60 73.2%	11 13.4%	11 13.4%
Supervise or receive the patient in the procedure room, performing monitoring, skin degerming and antisepsis, and placement of sterile drapes on the patient.	72 87.8%	70 85.4%	78 95.1%	66 80.5%	31 37.8%	37 45.1%	14 17.1%
Participate in all hemodynamic procedures alongside the multidisciplinary team, using appropriate Personal Protective Equipment.	68 82.9%	67 81.7%	76 92.7%	67 81.7%	33 40.2%	26 31.7%	23 28%
Support the medical team in the provision of material resources and address any patient complaints.	67 81.7%	66 80.5%	64 78%	63 76.8%	27 32.9%	31 37.8%	24 29.3%
Promote patient comfort by recognizing common discomforts and positioning the patient appropriately on the procedure table and subsequently in the bed.	73 89%	70 85.4%	77 93.9%	67 81.7%	50 61%	19 23.2%	13 15.9%
Measure frequency and record output and characteristics of spontaneous urine or urine via indwelling urinary catheter.	49 59.8%	50 61%	62 75.6%	50 61%	56 68.3%	17 20.7%	9 11%
Assist the patient with personal hygiene, feeding, elimination, and ambulation, encouraging self-care.	50 61%	48 58.5%	62 75.6%	51 62.2%	64 78%	10 12.2%	8 9.8%
Measure post-procedure bed rest time aiming at its reduction, while monitoring patient conditions, particularly ensuring full extension of the limb in which arterial or venous puncture was performed.	74 90.2%	74 90.2%	75 91.5%	70 85.4%	30 36.6%	30 36.6%	22 26.8%
Remove the arterial introducer after appropriate training or cardiology specialization, when this is part of the institutional protocol.	67 81.7%	66 80.5%	71 86.6%	60 73.2%	3 3.7%	16 19.5%	63 76.8%
Assist in analgesia or sedation, verification of activated clotting time, and measurement of blood pressure prior to introducer removal.	69 84.1%	69 84.1%	72 87.8%	64 78%	14 17.1%	35 42.7%	33 40.2%
Perform mechanical compression or use an appropriate device for compression, assessing signs of peripheral perfusion after introducer removal.	66 80.5%	67 81.7%	71 86.6%	60 73.2%	4 4.9%	25 30.5%	53 64.6%
After introducer removal, perform a compressive and occlusive dressing, assessing for the presence of bleeding and/or hematomas.	77 93.9%	76 92.7%	76 92.7%	72 87.8%	8 9.8%	36 43.9%	38 46.3%
Perform the Nursing Care Systematization and discharge planning, documenting planned and delivered care throughout all stages of the patient's stay in the unit.	78 95.1%	76 92.7%	81 98.8%	75 91.5%	17 20.7%	20 24.4%	45 54.9%
Analyze diagnostic tests related to the clinical context.	69 84.1%	67 81.7%	75 91.5%	65 79.3%	9 11%	28 34.1%	45 54.9%
Care – 2. Complications: provide nursing care for the prevention and/or management of complications during and after the procedure, communicating with the medical team.							
Competencies	**R**	**P**	**C**	**A**	**BC**	**IC**	**AC**
Ensure nursing care free from harm resulting from malpractice, negligence, or recklessness.	81 98.8%	82 100%	79 96.3%	77 93.9%	29 35.4%	19 23.2%	34 41.5%
Assess cardiovascular, neurological, and renal risk factors.	79 96.3%	79 96.3%	79 96.3%	76 92.7%	12 14.6%	26 31.7%	44 53.7%

Competencies	R	P	C	A	BC	IC	AC
Assess signs of neurological and renal complications, with emphasis on contrast-induced nephropathy.	79 96.3%	79 96.3%	79 96.3%	73 89%	10 12.2%	23 28%	49 59.8%
Communicate changes in pressure waveforms obtained during the procedure.	65 79.3%	61 74.4%	68 82.9%	57 69.5%	18 22%	28 34.1%	36 43.9%
Monitor signs of cardiac tamponade, myocardial ischemia, low cardiac output, and coronary occlusion after the procedure, giving due consideration to complaints of precordial pain and changes in the electrocardiographic tracing.	78 95.1%	79 96.3%	81 98.8%	75 91.5%	3 3.7%	17 20.7%	62 75.6%
Identify signs of vascular complications, such as bleeding, hematomas, pain at the puncture site, and reduced peripheral perfusion, warming the limb when necessary.	80 97.6%	77 93.9%	79 96.3%	80 97.6%	13 15.9%	35 42.7%	34 41.5%
Perform compression at the puncture site in cases of bleeding, requesting medical intervention when necessary.	77 93.9%	78 95.1%	79 96.3%	77 93.9%	11 13.4%	31 37.8%	40 48.8%
Act safely in emergency situations during the procedure, including cardiopulmonary resuscitation and life support.	82 100%	82 100%	82 100%	82 100%	7 8.5%	18 22%	57 69.5%
Assist safely during pericardiocentesis, temporary pacemaker implantation, and in potential complications associated with their use.	82 100%	82 100%	79 96.3%	80 97.6%	2 2.4%	19 23.2%	61 74.4%
Act in cases of retroperitoneal hematoma, pseudoaneurysm, vasovagal reactions, and allergic reactions to iodinated contrast.	80 97.6%	79 96.3%	78 95.1%	80 97.6%	3 3.7%	21 25.6%	58 70.7%

Management – 3. Care Management: implement the service and continuously monitor its infrastructure, work processes, and outcomes to ensure quality of care for users, managing indicators, risks, infections, and adverse events.

Competencies	R	P	C	A	BC	IC	AC
Develop and monitor specific indicators that support the quality of nursing care and represent the work unit in its entirety.	75 91.5%	73 89%	73 89%	65 79.3%	12 14.6%	23 28%	47 57.3%
Perform planning for service implementation, contributing to the development of the unit's physical layout and establishing routines for patient preparation, room setup, and circulation.	70 85.4%	69 84.1%	72 87.8%	63 76.8%	12 14.6%	21 25.6%	49 59.8%
Prepare monthly and weekly work schedules, as well as task schedules for duty shifts.	74 90.2%	74 90.2%	73 89%	71 86.6%	33 40.2%	21 25.6%	28 34.1%
Directly supervise the unit throughout its entire operating period.	75 91.5%	73 89%	74 90.2%	71 86.6%	24 29.3%	19 23.2%	39 47.6%
Monitor clinical outcomes.	71 86.6%	70 85.4%	70 85.4%	62 75.6%	14 17.1%	24 29.3%	44 53.7%
Refer patients to the cardiac rehabilitation sector after medical indication.	58 70.7%	53 64.6%	64 78%	54 65.9%	33 40.2%	23 28%	26 31.7%
Identify risks associated with ionizing radiation for patients and staff, supervising radiometric measures in collaboration with the hospital medical physicist.	68 82.9%	66 80.5%	71 86.6%	65 79.3%	14 17.1%	25 30.5%	43 52.4%
Map periprocedural adverse events.	76 92.7%	76 92.7%	76 92.7%	74 90.2%	18 22%	26 31.7%	38 46.3%
Understand the duration and importance of bed rest to prevent post-procedural complications.	78 95.1%	77 93.9%	80 97.6%	77 93.9%	33 40.2%	24 29.3%	25 30.5%

	R	P	C	A	BC	IC	AC
Manage risks, infections, and sentinel events.	78 95.1%	78 95.1%	80 97.6%	74 90.2%	20 24.4%	19 23.2%	43 52.4%

Management – 4. Resource Management: manage material, human, and financial resources with reallocative efficiency to reduce costs and waste.							
Competencies	**R**	**P**	**C**	**A**	**BC**	**IC**	**AC**
Conduct an inventory of the most frequently used materials and the need for surgical instruments.	69 84.1%	71 86.6%	74 90.2%	70 85.4%	29 35.4%	19 23.2%	34 41.5%
Develop material kits required for procedures according to the specific characteristics of different medical teams aiming to reorganize the surgical linen and instrument sets.	66 80.5%	61 74.4%	72 87.8%	58 70.7%	34 41.5%	18 22%	30 36.6%
Create spreadsheets and checklists for forecasting and provisioning materials and equipment, ensuring proper care of permanent assets and awareness of existing inventory conditions.	69 84.1%	69 84.1%	72 87.8%	68 82.9%	33 40.2%	16 19.5%	33 40.2%
Develop protocols for validation and reprocessing of materials, when necessary.	67 81.7%	64 78%	71 86.6%	60 73.2%	22 26.8%	23 28%	37 45.1%
Analyze costs to intervene in their reduction during procedures and the hospitalization period, guiding the team on the prevention of waste or improper use of materials.	67 81.7%	67 81.7%	72 87.8%	62 75.6%	22 26.8%	21 25.6%	39 47.6%
Reorganize and monitor staffing levels and clinical outcomes, considering the unit's technical safety index.	70 85.4%	68 82.9%	72 87.8%	64 78%	15 18.3%	24 29.3%	43 52.4%
Demonstrate familiarity and knowledge regarding hemodynamic monitoring, temporary pacemakers, intra-aortic balloon pumps, mechanical ventilation, transport ventilators, and the use of general anesthesia.	78 95.1%	79 96.3%	78 95.1%	77 93.9%	7 8.5%	11 13.4%	64 78%
Have experience in management, and procurement of materials and supplies.	52 63.4%	48 58.5%	62 75.6%	50 61%	17 20.7%	19 23.2%	46 56.1%
Have knowledge of the equipment that composes the hemodynamics suite, personal protective equipment, materials used for each procedure, and the principles of sterile technique for their preparation and opening.	81 98.8%	81 98.8%	80 97.6%	79 96.3%	23 28%	23 28%	36 43.9%

Legend: R: Relevance; P: Pertinence; C: Clarity; A: Applicability. BC: Basic Competency; IC: Intermediate Competency; AC: Advanced Competency.
Source: research data (2024).

Table 2. Distribution of agreement percentages and competency classification in teaching-related work processes (User Education and Professional Training and Continuing Education domains) and research. São Paulo, SP, Brazil, 2023.

Teaching – 5. User Education: to guide users and/or family members regarding care related to the procedure and actions for the prevention of complications, from admission through hospital discharge.							
Competencies	**R**	**P**	**C**	**A**	**CB**	**CI**	**CA**
Provide guidance to patients and family members before and after the procedure regarding general care, the introducer sheath removal procedure, bed rest and mobilization, as well as signs of complications at the puncture site, in alignment with the medical team and using clear, easily understandable language.	81 98.8%	81 98.8%	80 97.6%	77 93.9%	32 39%	31 37.8%	19 23.2%

Competencies							
Provide guidance on the importance of hydration after the procedure to ensure adequate elimination of the contrast agent.	76 92.7%	75 91.5%	77 93.9%	73 89%	50 61%	17 20.7%	15 18.3%
Provide health education for primary and secondary prevention in the cardiology field.	69 84.1%	65 79.3%	74 90.2%	63 76.8%	34 41.5%	26 31.7%	22 26.8%
Pay attention to social problems as determinants of the health–disease process, referring patients and family members to the professional responsible for this type of care as needed.	65 79.3%	61 74.4%	69 84.1%	59 72%	41 50%	26 31.7%	15 18.3%
Provide illustrated educational leaflets related to educational actions developed during the pre-, intra-, and post-procedural periods, aiming to facilitate communication among healthcare professionals, patients, and family members.	73 89%	69 84.1%	76 92.7%	65 79.3%	48 58.5%	17 20.7%	17 20.7%
Provide guidance to patients and/or family members at the time of hospital discharge.	77 93.9%	78 95.1%	80 97.6%	74 90.2%	40 48.8%	26 31.7%	16 19.5%

Teaching – 6. Professional Training and Continuing Education: to develop the competencies required for nurses to work in hemodynamics, as well as the continuous professional development of nursing to ensure updating and improvement in response to transformations in the labor market.

Competencies	R	P	C	A	BC	IC	AC
Be a registered nurse with specialization in cardiology or interventional cardiology or have passed the certification examination of the Brazilian Society of Cardiovascular Nursing (SOBENC) or have been awarded a professional title by the Federal Nursing Council (COFEN).	69 84.1%	67 81.7%	71 86.6%	63 76.8%	14 17.1%	16 19.5%	52 63.4%
Be trained in a hemodynamics laboratory and coronary care unit, with certification in basic life support, advanced life support, and, when required, pediatric advanced life support.	70 85.4%	71 86.6%	73 89%	65 79.3%	8 9.8%	14 17.1%	60 73.2%
Hold authorization to remove arterial or venous introducer sheaths.	61 74.4%	61 74.4%	72 87.8%	58 70.7%	8 9.8%	14 17.1%	60 73.2%
Knowledge of the procedures performed, their indications, contraindications, and most frequent complications.	80 97.6%	80 97.6%	80 97.6%	79 96.3%	17 20.7%	19 23.2%	46 56.1%
Knowledge of the main radioisotopes used in the unit, their risks, and the importance of using Personal Protective Equipment.	77 93.9%	75 91.5%	73 89%	70 85.4%	24 29.3%	21 25.6%	37 45.1%
Knowledge of the anatomical structure of the heart, aorta, great vessels, coronary arteries, cerebral vessels, and the main arterial or venous access routes used during procedures.	69 84.1%	71 86.6%	75 91.5%	69 84.1%	8 9.8%	24 29.3%	50 61%
Knowledge of the procedural workflow of right and left heart catheterization, coronary and peripheral arteries, and their implications.	76 92.7%	76 92.7%	77 93.9%	69 84.1%	10 12.2%	21 25.6%	51 62.2%
Knowledge of routine hemodynamic and oximetric measurements, including cardiac output calculation, vascular resistances, valve areas, and shunt quantification.	59 72%	58 70.7%	67 81.7%	50 61%	3 3.7%	15 18.3%	64 78%
Knowledge of the basic principles and indications for intracoronary ultrasound, Doppler, and pressure assessment.	63 76.8%	60 73.2%	74 90.2%	61 74.4%	4 4.9%	26 31.7%	52 63.4%

	R	P	C	A	BC	IC	AC
Knowledge of angiograms, ventriculograms, aortograms, pulmonary angiograms, and peripheral arteriographies under normal and pathological conditions.	52 63.4%	52 63.4%	67 81.7%	50 61%	4 4.9%	17 20.7%	61 74.4%
Maintain ongoing development in human resources management and in legislation relevant to the hemodynamics unit.	74 90.2%	74 90.2%	76 92.7%	71 86.6%	17 20.7%	25 30.5%	40 48.8%
Train the nursing team in the development of new technologies at the national and international levels, including participation in events within the field of practice.	77 93.9%	74 90.2%	77 93.9%	75 91.5%	14 17.1%	27 32.9%	41 50%
Prepare the team to participate in live procedural transmissions during professional events when the hospital institution has an educational purpose.	70 85.4%	69 84.1%	71 86.6%	63 76.8%	16 19.5%	28 34.1%	38 46.3%
Conduct continuous assessment of the team and of patient care needs, as well as institutional and community needs, correlating these with available human resources.	76 92.7%	75 91.5%	74 90.2%	70 85.4%	22 26.8%	29 35.4%	31 37.8%

7. Research: To develop research and evidence-based clinical practice, aiming at transforming professional practice							
Competencies	**R**	**P**	**C**	**A**	**BC**	**IC**	**AC**
Contribute to multiprofessional research within the field of practice.	76 92.7%	74 90.2%	77 93.9%	65 79.3%	22 26.8%	19 23.2%	41 50%
Conduct scientific research to improve care and modify risk factors after the procedure.	70 85.4%	71 86.6%	76 92.7%	61 74.4%	11 13.4%	24 29.3%	47 57.3%
Develop specific guidelines to improve clinical practice.	71 86.6%	69 84.1%	73 89%	67 81.7%	11 13.4%	19 23.2%	52 63.4%
Develop evidence-based practice using clinical studies.	76 92.7%	75 91.5%	78 95.1%	72 87.8%	13 15.9%	18 22%	51 62.2%
Analyze the feasibility of proposals for changing practices.	71 86.6%	68 82.9%	68 82.9%	66 80.5%	14 17.1%	27 32.9%	41 50%
Evaluate one's technical, scientific, and ethical competence.	77 93.9%	76 92.7%	75 91.5%	73 89%	25 30.5%	17 20.7%	40 48.8%
Use best practice protocols to ensure safety and standardization of procedure performance.	80 97.6%	77 93.9%	79 96.3%	74 90.2%	25 30.5%	26 31.7%	31 37.8%

Legend: R: Relevance; P: Pertinence; C: Clarity; A: Applicability. BC: Basic Competency; IC: Intermediate Competency; AC: Advanced Competency.
Source: research data (2024).

Table 3 describes Cronbach's alpha values, which assess the correlation among the evaluations; that is, the higher the value, the greater the consensus among professionals regarding a given assessment, whether agreement or disagreement. Lower values, in turn, indicate discrepancies among evaluators' responses. Thus, it can be observed that the Complications domain showed lower agreement, which is justified by the competency "Communicate changes in pressure waveforms obtained during the procedure," since this responsibility is performed by the interventional cardiologist during the procedure.

Table 3. Distribution of Cronbach's alpha values for each domain. São Paulo, SP, Brazil, 2023.

Domains	Relevance	Pertinence	Clarity	Applicability	Tipe of Competency
Periprocedimental	0.86 [0.78; 0.9]	0.83 [0.72; 0.89]	0.80 [0.67; 0.88]	0.89 [0.81; 0.92]	0.83 [0.73; 0.88]
Complications	0.22 [0.01; 0.39]	0.25 [0.01; 0.44]	0.31 [0.03; 0.51]	0.61 [0.39; 0.73]	0.84 [0.78; 0.88]
User Education	0.62 [0.42; 0.75]	0.68 [0.56; 0.77]	0.73 [0.51; 0.87]	0.71 [0.59; 0.79]	0.83 [0.70; 0.89]
Professional training and Continuing Education	0.85 [0.68; 0.93]	0.84 [0.58; 0.92]	0.90 [0.51; 0.96]	0.89 [0.78; 0.93]	0.88 [0.84; 0.91]
Care Management	0.62 [0.36; 0.77]	0.68 [0.52; 0.80]	0.77 [0.63; 0.85]	0.80 [0.64; 0.88]	0.87 [0.82; 0.91]
Resource Management	0.73 [0.53; 0.82]	0.75 [0.59; 0.83]	0.69 [0.52; 0.8]	0.77 [0.64; 0.85]	0.86 [0.81; 0.90]
Research	0.92 [0.71; 0.97]	0.91 [0.69; 0.96]	0.90 [0.53; 0.96]	0.88 [0.69; 0.94]	0.88 [0.82; 0.92]

Source: research data (2024).

DISCUSSION

Hemodynamics Units (HU) emerged in the context of scientific and technological advances as sectors responsible for performing minimally invasive procedures when compared with cardiac surgeries, for example. The state of São Paulo, as a center of innovation, hosts a large proportion of the country's hemodynamics centers, which justifies the fact that most of the nurses who responded to the questionnaire in the present study were from this state (39, 47.6%). In addition, the fact that more than 70% (60, 73.2%) of the evaluators were women is related to nursing being a predominantly female profession.[11]

Given the technological complexity of this sector, it is essential that the training of professionals working in it is also specialized, which corroborates the findings of the present study, in which more than 60% (52, 63.4%) of nurses had specialization to work in hemodynamics, meeting the qualification required for nursing professionals by the Brazilian Society of Cardiology.[2] However, it is noteworthy that more than 75% (62, 75.6%) had no prior experience in Hemodynamics Units and nearly 55% (45, 54.9%) did not receive admission training. These figures may represent the pursuit of specialization after entering this sector, aimed at addressing gaps in professional training in view of the responsibilities of a critical care unit.[12,13]

Regarding professional training, it is also important to emphasize that, historically, as this is a sector under constant development, nurses are required to undergo frequent updates regarding procedures and materials used. This is consistent with the data obtained, in which more than 74% (61, 74.4%) of nurses reported participating in continuing or ongoing education courses.[12,14]

Regarding the role of nurses in Periprocedural Care, the competency "Measuring frequency and recording volume and characteristics of spontaneous urine output or urine output via an indwelling urinary catheter" showed a low level of agreement, particularly with respect to Relevance (49, 59.8%) and Appropriateness (50, 61%). This was supported by the argument that this activity would be an exclusive responsibility of inpatient units. However, considering that contrast-induced acute kidney injury is one of the possible complications resulting from hemodynamic procedures, and is associated with increased morbidity and mortality, length of hospital stay, and hospital costs,[15] it becomes essential that monitoring of urine output frequency and characteristics be included among nursing responsibilities immediately after the procedure, since safe care is linked to continuous attention across different care settings.[16]

The same pattern was observed in the User Education domain, in which the competencies "Providing health education for primary and secondary prevention in the field of cardiology" and "Being attentive to social problems as determinants of the health–disease process, referring patients and their families to the professional responsible for this type of care when necessary"[5] showed lower values for Relevance (69, 84.1% and 65, 79.3%, respectively), Appropriateness (65, 79.3% and 61, 74.4%, respectively), and Applicability (63, 76.8% and 59, 72%, respectively), which contrasts with the literature describing shared responsibility for care among different sectors.[16] Thus, it is emphasized that, in order to ensure continuity of care, social aspects can and should be assessed in any healthcare setting.

About Complications, 9 (90%) of the competencies were classified as Advanced, and only 1 (10%) as Intermediate. This result was expected, considering that this is a critical care setting. It is noteworthy that although the competency "Identifying signs of vascular complications, such as bleeding, hematomas, pain at the puncture site, and decreased peripheral perfusion, warming the limb when necessary"[5] was classified as Intermediate by 35 (42.7%) nurses—possibly due to the perception that it is a routine and well-established professional practice—another 34 (41.5%) classified it as Advanced.

Still regarding Complications, this domain presented lower Cronbach's alpha values for Relevance, Appropriateness, and Clarity (0.22, 0.25, and 0.31, respectively). This result was obtained due to greater discrepancies in opinions among evaluators, particularly regarding the competency "Communicating changes in pressure waveforms obtained during the procedure." Although evaluations were predominantly divided between Agree and Partially Agree, this divergence is justified by the fact that pressure measurement is controlled by the interventional cardiologist during the procedure. Nevertheless, it is important to emphasize that pressure monitoring is directly related to the competency "Ensuring nursing care free from harm resulting from malpractice, negligence, or recklessness,"[5] which was considered appropriate by all nurses.

Regarding Care Management, 7 (70%) of the competencies were classified as Advanced, a result that qualifies nursing practice, as this is an exclusive responsibility and is directly related to patient safety and quality of care.[17] Similarly, in Resource Management, in which 7 (77%) competencies were classified as Advanced, it was observed that, in this domain, the competency "Having experience in management and procurement of materials and supplies" showed 63.4% Relevance and 58.6% Appropriateness. This may possibly be justified by the indirect participation of nurses in procurement processes, which require knowledge of bidding procedures and purchasing mechanisms.

With regard to the Professional Training and Continuing Education domain, all competencies were assessed as Advanced. The former can be justified by the difficulty of remaining up to date with the multiple knowledge demands and training requirements necessary to work in Hemodynamics Units, whereas the latter may be directly related to difficulties in interrupting daily activities to participate in training sessions, such as lack of time or lack of professional interest.[18,19]

Finally, the Research domain was considered Advanced by all evaluators, which may be explained by the scarcity of published studies in this area, since it represents a relatively new field of practice for nurses, making them pioneers in certain topics. In addition, a lack of incentives for the development of new projects was highlighted.[20] It is essential to emphasize that, because this is a sector undergoing constant transformation and requiring continuous updating, none of the nurses disagreed regarding the Relevance and Appropriateness of the competencies related to research.

The present study was conducted with a sample of nurses from 11 states, whose population agreed to participate, indicating an initial diagnostic result. Therefore, these professional competencies cannot be generalized to the entire country, considering the specificities of each state. Nevertheless, considering the findings, this study may contribute to the development of guidelines addressing the role of nurses in hemodynamics, as well as to professional training in this field.

CONCLUSION

This study achieved its objectives by validating and classifying the competencies of nurses working in Hemodynamics Units. The competencies were validated with a mean agreement above 75% and were predominantly classified as Advanced (50; 67.5%), corroborating the understanding of the complexity of nursing practice in this setting. Future studies may be conducted using factor analysis to strengthen construct validity.

CONTRIBUITIONS

Contributed to the conception or design of the study/research: Barros LM, Kobayashi RM, Silva EV. Contributed to data collection: Barros LM, Kobayashi RM, Silva EV. Contributed to the analysis and/or interpretation of data: Barros LM, Kobayashi RM, Silva EV. Contributed to article writing or critical review: Barros LM, Kobayashi RM. Final approval of the version to be published: Barros LM, Kobayashi RM.

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