

Risk for adverse reaction to iodinated contrast media: a validation study

Risco de reação adversa ao meio de contraste iodado: um estudo de validação

Riesgo de reacciones adversas a los medios de contraste yodados: un estudio de validación

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ABSTRACT

Objectives: To validate the content of the nursing diagnosis, Risk for adverse reaction to iodinated contrast media, and its nursing interventions and outcomes according to standardized terminologies.

Method: Fehring's (1987) model of diagnosis content validation was used, with the participation of experts including registered nurses and physicians.

Results: Seventy-four experts validated the title and the definition of the diagnosis, and assessed 28 risk factors, five of which were validated as primary, 22 as secondary, and one was discarded. The inclusion of the diagnosis in the NANDA International Taxonomy II was evaluated by 41 registered nurses and validated for *Area II – Safety/Protection* and *Class 2 – Physical Injury*. Sixty-three experts validated seven nursing interventions as primary and one as secondary, and seven nursing outcomes as principal and one as minor.

Conclusion: The title, definition, and risk factors of the diagnosis were validated, in addition to eight interventions and eight nursing outcomes.

Keywords: Diagnostic imaging. Contrast media. Nursing diagnosis. Nursing process. Validation studies.

RESUMO

Objetivos: Realizar a validação de conteúdo do diagnóstico de enfermagem *Risco de reação adversa ao contraste iodado*, bem como de suas intervenções e resultados de enfermagem segundo terminologias padronizadas.

Métodos: Foi utilizado o modelo de validação de conteúdo de Fehring, com a participação de peritos enfermeiros e médicos.

Resultados: Setenta e quatro peritos validaram o título, a definição do diagnóstico e avaliaram 28 fatores de risco, sendo cinco validados como principais, 22 como secundários e um descartado. A inserção do diagnóstico na taxonomia II da *NANDA International* foi avaliada por 41 enfermeiros e validada no *Domínio 11 – Segurança/proteção* e *Classe 2 – Lesão física*. Sessenta e três peritos validaram sete intervenções de enfermagem como principais e uma como secundária, sete resultados de enfermagem como principais e um como secundário.

Conclusões: Foram validados o título, definição e fatores de risco do diagnóstico, além de oito intervenções e oito resultados de enfermagem.

Palavras-chave: Diagnóstico por imagem. Meios de contraste. Diagnóstico de enfermagem. Processos de enfermagem. Estudos de validação.

RESUMEN

Objetivos: Validar el contenido del diagnóstico de enfermería *Riesgo de reacción adversa a los medios de contraste yodados*, así como sus intervenciones y resultados de enfermería de acuerdo con terminologías normalizadas.

Método: Se utilizó el método de validación de contenido de diagnóstico de Fehring, con la participación de expertos incluyendo enfermeros y médicos.

Resultados: Setenta y cuatro expertos validaron el título, la definición del diagnóstico y evaluaron 28 factores de riesgo. Cinco fueron validados como principales, 22 como secundarios y uno fue desechado. La inserción del diagnóstico en la taxonomía II de *NANDA International* fue evaluada por 41 enfermeros y validada en el *Dominio 11 – Seguridad / protección* y *Clase 2 – Lesiones físicas*. Sesenta y tres expertos validaron siete intervenciones de enfermería como principales y una como secundaria, siete resultados como principales y uno como secundario.

Conclusión: Se validaron el título, la definición y los factores de riesgo del diagnóstico, además de ocho intervenciones y ocho resultados de enfermería.

Palabras clave: Diagnóstico por imagen. Medios de contraste. Diagnóstico de enfermería. Procesos de enfermería. Estudios de validación.

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■ INTRODUCTION

Iodinated contrast media (ICM) is a substance used to improve the visibility of organs and tissue in radiographic imaging. Despite being extremely useful to identify a wide range of pathologies, its use is not free from risk and it can provoke adverse reactions, which vary from minor manifestations to life threatening situations⁽¹⁻²⁾.

Typical signs of anaphylactic reactions include urticaria, bronchospasm, facial and laryngeal edema, and hypotension with tachycardia, amongst others, representing a risk of death depending on the degree of severity. Chemotoxic reactions manifest as nausea, vomiting, cardiac arrhythmia, hypertension, seizures, renal failure, and vasovagal reactions, amongst others. Localized events such as phlebitis, thrombophlebitis or lesions caused by extravasation of the radiopaque media can also occur⁽¹⁻⁷⁾.

The nursing team that attends in Imaging Diagnostic Services (IDS) and associated areas plays a crucial role in the prevention of events related to iodinated contrast media since they participate in the preparation of patients, carry out tests, administer the radiopaque media, and manage post-procedure recovery. Therefore, the description and documentation of the provided care should include all the steps of the nursing process, which includes data collection, nursing diagnosis, care plan, interventions, and outcome evaluations⁽⁸⁾.

For the diagnosis, intervention and outcome, nurses generally use the diagnostic category of NANDA International, Inc (NANDA-I)⁽⁹⁾, the Nursing Intervention Classification (NIC)⁽¹⁰⁾, and the Nursing Outcomes Classification (NOC)⁽¹¹⁾, respectively. The pathways that join the diagnoses to the outcomes and interventions in nursing are called Connections NANDA-I-NOC-NIC or NNN, and the synthesize the care provided to patients according to specific clinical conditions^(8,12).

In the case of patients who are vulnerable to adverse reactions caused by iodinated contrast media, the nursing diagnosis (ND) Risk for adverse reaction to iodinated contrast^c, is used. This diagnosis was included in the diagnostic classification of NANDA-I-2012-2014. The level of evidence was established at 2.1, showing that it has references to support the title, definition and each one of the risk factors⁽⁹⁾. Given its recent inclusion in this taxonomy, there are still no validation studies for the terminology or for the pathways of this ND with interventions and outcomes of the specific nursing process, especially in Brazilian literature.

Therefore, the following research questions were raised: Is the content proposed for the elements that make up the indicated nursing diagnosis adequate? Are the nursing interventions and outcomes proposed by the authors suitable for the diagnosis?

Therefore, the aim of this paper was to validate the content of the ND *Risk for adverse reactions to iodinated contrast*, and the nursing intervention (NI) of the NIC and the nursing outcomes (NO) of the NOC for this diagnosis. Based on the validation of this terminology, we sought to describe the application of the nursing process in the area of imaging diagnosis and promote the production of knowledge in this field of endeavor.

■ METHOD

This study is derived from a thesis⁽¹³⁾ based on the Fehring's Diagnostic Content Validation (DCV) model. This method is used to obtain the opinion of expert nurses regarding the degree to which each defining characteristic (DC) is indicative of a given nursing diagnosis⁽¹⁴⁾. The model was adapted to validate other elements of the ND, and the interventions and outcomes of the nursing process.

The study included two stages. In the first stage, the content of the ND *Risk for adverse reaction to iodinated contrast* was validated, with its title, definition, 28 risk factors, and insertion in the taxonomic structure of the NANDA-I (Domain and Class). Data were collected between October 2012 and January 2013. In the second stage, eight nursing interventions were validated according to the NIC and eight nursing outcomes were validated according to the NOC, based prepared from the risk factors (RiF) that scored 0.70 or more. For this stage, data were collected between June 3 and September 6, 2013.

The research field included Brazilian imaging and hemodynamic diagnostic services. The experts were defined as nursing and medical professionals with five years or more of clinical practice with patients subjected to procedures involving iodinated contrast media. The sample consisted of professionals known to the author and personally invited to participate in the research, professionals indicated by other subjects (snowball strategy), e-mail contact with Brazilian university hospitals, professional searches on the Lattes website, contact with authors of scientific publications on the research topic, and invitations via online business networks, according to the inclusion criteria.

^c Author's translations. The diagnosis was submitted in English with the title, "Risk for adverse reaction to iodinated contrast media". The Portuguese edition of the NANDA-I handbook, translated as, "*Risco de resposta adversa ao meio de contraste com iodo*", was published after research for this study was initiated.

Data were collected using an electronic survey. The invitations to complete the survey were sent by e-mail with a message containing information on the research, the informed consent statement, inclusion criteria, and a link to access the survey. Once completed, the answers were submitted in real time to an online database. The researchers guaranteed the confidentiality of the subjects and their responses, and acceptance to participate was confirmed by returning the completed survey.

The proposed elements were prepared based on a literature review on the subject and on the content sent for assessment to the NANDA-I for the creation of this ND⁽¹⁵⁾. The items proposed for validation were judged by the experts using a five-point Likert scale, where 1 = Unsuitable; 2 = Slightly suitable; 3 = Moderately suitable; 4 = Highly suitable; and 5 = Totally suitable. In the case of the risk factors, a brief justification was presented for the inclusion of each factor, and the scores of the Likert scale ranged from 1 = Does not cause vulnerability to 5 = fully causes vulnerability. In addition to adding the ND to Domain II – Class 5 of Taxonomy II of the NANDA-I, the possibility of inserting the ND in Class 2 – Physical Injury of the same domain, was also ascertained, considering evidence that the adverse reaction to iodinated contrast is not a defense process associated with antigenic-antibody reactions.

Nursing interventions were presented together with their definitions and examples of activities based on the NIC handbook⁽¹⁰⁾. Nursing outcomes included their definitions and examples of constant indicators in the NOC handbook⁽¹¹⁾.

Subsequently, the weighted average (WA) of the scores attributed to each assessed element was calculated according to the following weights: 1 = 0; 2 = 0.25; 3 = 0.5; 4 = 0.75; and 5 = 1. The RiF with an average greater than or equal to 0.8 were validated as being “primary”. Those with an average less than or equal to 0.8 but greater than 0.5 were validated as “secondary”, and those with an average less than or equal to 0.5 were discarded. Finally, we calculated the total score for diagnostic content (DCV total) by way of the sum of the individual scores of each RiF, divided by the total number of validated RiF was calculated, whereby the factors with a WA equal to or less than 0.5 being excluded from the calculation. According to Fehring, an ND is considered validated when it scores more than 0.6⁽¹⁴⁾. The WA criterion of above 0.6 was also adopted to validate the title, definition, and Domain and Class of the diagnosis under consideration. The primary NI and NO were those with a WA equal to or greater than 0.8 and the

secondary NI and NO obtained a WA of less than 0.8 and greater than 0.5.

This study was approved in 2008 by the Healthcare Ethics Committee of the institution (number 08-539) and the confidentiality of the subjects was guaranteed according to Resolution 466/12 of the National Health Council (“NCH”)⁽¹⁶⁾.

■ RESULTS

In the first stage of the study, 236 invitations were sent out, and 74 (31.4%) surveys were completed and returned to the authors. Amongst the respondents, 41 (55.4%) were nurses and 33 (44.6%) were physicians.

The title of the ND *Risk for adverse reaction to iodinated contrast* was validated with a weighted average of 0.83. An alternative statement for the ND was suggested, namely “*Risk for adverse reaction to iodinated contrast media*”. The statement that included the expression “contrast media” was judged to be more suitable by 41 expert professionals (56.2%), representing the majority of nurses as well as physicians.

The definition, “At risk for any harmful or undesirable reaction associated with the use of iodinated contrast, which can occur during or up to seven days after the injection of contrast agent” was validated with a weighted average of 0.79.

Amongst the 28 risk factors (RiF) proposed, five were validated as primary, 22 as secondary and one was not validated, as shown on Table 1.

Taking into account the validated risk factors, the total validation score for the ND was calculated, obtaining a total DCV = 0.70.

The inclusion of the diagnosis in the structure of the Taxonomy II of the NANDA-I was assessed by 31 nurses. They validated the inclusion of the ND in Domain II – Safety/Protection with a weighted average of 0.84, and in Class 5 – Defensive Processes with a score of 0.56. However, Class 2 – Physical Injury was considered more suitable for the proposal of the ND, attaining a score of 0.88. There was no suggestion for the introduction of the ND in another Domain and/or Class of the taxonomy. In the second stage, 323 expert professionals were invited and 63 (19.5%) questionnaires were returned by 40 (63.5%) nurses and 23 (36.5%) physicians.

Eight nursing interventions were proposed for the NIC, of which seven (87.5%) were validated as primary and one as secondary, as shown in Table 2.

Eight nursing outcomes from the NOC were presented for validation by expert professionals. Seven were validated as primary and one as secondary (Table 3).

Table 1 – Validation of risk factors proposed for the nursing diagnosis Risk for adverse reaction to iodinated contrast media. Porto Alegre, RS, Brazil, 2013

Risk Factors	Weighted average (n = 74)
Validated as primary	
History of previous adverse reaction to iodinated contrast media	0.92
Renal disease	0.91
Dehydration	0.86
Concurrent use of nephrotoxic medications	0.82
Intravascular injection of iodinated contrast media	0.81
Validated as secondary	
Physical and chemical properties of iodinated contrast media (concentration, viscosity, high osmolality and ion toxicity)	0.79
Extremes of age	0.77
Pulmonary disease	0.75
Concurrent use of metformin	0.75
Prior or actual chemotherapy treatment	0.71
Generalized debilitation	0.71
Previous axillary lymph node dissection in the limb to be injected	0.70
Endocrine disease	0.69
Pheochromocytoma	0.69
Distal intravenous access sites: hand, wrist, foot, ankle	0.67
Use of pump injector with high flow rates	0.66
Multiple attempts to obtain intravenous access	0.65
History of allergies	0.64
Prior or actual radiation in the limb to be injected	0.64
Sensory limitation	0.64
Blood dyscrasias	0.63
Autoimmune disease	0.62
Indwelling intravenous lines in place for more than 24 hours	0.58
Heart disease	0.57
Concurrent use of interleukin-2	0.56
Concurrent use of beta-blockers	0.55
Anxiety	0.52
Not validated	
Female sex	0.31

Source: Research data, 2013.

DISCUSSION

Regarding the title of the ND, some of the experts suggested the inclusion of the term “increased risk” for the

adverse reactions to ICM. This aspect is highlighted by an author⁽¹⁷⁾ who refers to a risk and “high risk” nursing diagnosis for given outcomes. Specific articles about the use of contrast also include the expression “increased risks” for

Table 2 – Validation of nursing intervention content for the nursing diagnosis Risk for adverse reaction to iodinated contrast media. Porto Alegre, RS, Brazil, 2013

Nursing interventions	Weighted average (n = 63)
Validated as primary	
Examination assistance	0.93
Documentation	0.92
Allergy management	0.91
Intravenous (IV) insertion	0.89
Vital signs monitoring	0.87
Respiratory monitoring	0.87
Decision-making support	0.86
Validated as secondary	
Fluid management	0.74

Source: Research data, 2013.

adverse reactions, considering that any patient can develop an adverse event, even in the absence of RiF^(1-2,6). This finding warrants a reassessment of the statements of this and other ND of risk. Additionally, the use of this diagnostic title in the following edition of the handbook for the NANDA-I in Portuguese was suggested.

The risk factors validated as primary reveal concerns related to the onset of a recurrent anaphylactic adverse reaction and renal complications. In this sense, the opinion of the experts agrees with literature, which also refers to these two outcomes as the most preoccupying^(1-2,4-7). It is notable that a previous history of adverse reaction to iodinated contrast increases the chance of a new event up to seven times, in comparison with non-reactive individuals⁽⁴⁾.

Regarding the RiF *History of allergies*, it was expected that this would be validated with scores closer to *Pulmonary disease* and *History of previous adverse reaction to iodinated contrast media*, since there is a consensus in literature that the presence of allergic diseases can increase risk^(1-2,6). This may reveal the need to clarify the characteristics and seriousness of events reported by patients. According to literature, the risk of administering iodinated contrast in allergic patients is more preoccupying in cases of multiple allergies or serious events that require treatment⁽⁷⁾.

The validation of *Renal disease*, *Dehydration*, *Concurrent use of nephrotoxic medications* and *Intravascular injection of iodinated contrast media* as primary RiF showed the importance of the identifying these factors due to the potential harm ICM can cause to renal function. Furthermore, the

Table 3 – Validation of nursing outcome content for the nursing diagnosis Risk for adverse reaction to iodinated contrast media. Porto Alegre, RS, Brazil, 2013

Nursing outcomes	Weighted average (n = 63)
Validated as primary	
Respiratory status: airway patency	0.88
Knowledge: medication	0.88
Allergic response: systemic	0.86
Allergic response: localized	0.84
Kidney function	0.82
Hydration	0.81
Knowledge: treatment procedure	0.80
Validated as secondary	
Tissue perfusion: peripheral	0.79

Source: Research data, 2013.

secondary RiF *Physical and chemical properties of the contrast media*, *Extremes of age* and *Generalized debilitation* were added, which aggravate the risk of these and other types of adverse effects. *Pulmonary disease* and *Concurrent use of metformin* make the situation more serious in the presence of anaphylactic reaction and renal dysfunction, respectively^(1,6,18). Therefore, it was not surprising that these were precisely the RiF validated with the highest score.

The risk of extravasation of iodinated contrast was attributed mainly to the RiF *Prior or actual chemotherapy treatment* and *Previous axillary lymph node dissection in the limb to be injected*. The other factors that indicate venous fragility were also assessed as secondary. Of these factors, *Indwelling intravenous lines in place for more than 24 hours* obtained the lowest scoring, possibly due to the importance of verifying the puncture site on the part of nurses.

The RiF *Heart disease* was expected to receive a higher score due to the risk of chemotoxic reactions in general. Considering the need to assess the severity of the situation prior to the procedure, the experts possibly judged the RiF assuming that any heart disorders of the patient were stable which shows, once again, the importance of a prior assessment of the patient.

The other elements validated as secondary were reflected in literature, appearing as risk factors that can increase the incidence or gravity of the adverse reactions to ICM, or provoke exacerbation of the clinical condition of

concomitant pathologies. *Female sex* was the only RiF not to be validated, which can be justified by controversial findings in literature⁽³⁾.

These results enable the proposal of a new form of presenting the ND and promote the prominence of more significant RiF. Currently, the risk factors in the diagnostic classification of the NANDA-I⁽⁹⁾ are listed in alphabetical order. However, it was considered that the grouping into primary and secondary RiF supports diagnostic accuracy and the selection of more appropriate results and interventions for the clinical condition of patients. This proposal includes the reallocation of the ND from Class 5 to Class 2 within the Domain II (Chart 1).

In the validation of nursing interventions and outcomes, it was possible to observe the relevance of these elements in terms of their applicability for the ND *Risk for adverse reaction to iodinated contrast media*, and the pertinence of the judgment of the experts, who established the prevention of anaphylactic reactions, renal complications, and extravasation of contrast as priorities.

The two NI with the highest scores are routinely carried out for at risk individuals and for apparently exempt individuals, and they are important to obtain the best care outcomes possible for all patients. The NI *Examination assistance* includes the admission, preparation, implementation, and assessment procedures for the patient during

Title: Risk of adverse reaction to iodinated contrast media

Domain II: Safety/protection
Class 2: Physical Injury

Definition: At risk for any harmful or undesirable reaction associated with the use of iodinated contrast, which can occur during or up to seven days after the injection of contrast agent.

Primary risk factors

- History of previous adverse reaction to iodinated contrast media
- Renal disease
- Dehydration
- Concurrent use of nephrotoxic medications
- Intravascular injection of iodinated contrast media

Secondary risk factors

- Risk of any harmful or undesirable reaction associated with the use of iodinated contrast, which can occur during or up to seven days after the injection of contrast agent
- Extremes of age
- Asthma
- Concomitant use of metformin
- Fragile veins (e.g. prior or actual chemotherapy treatment; previous lymph node dissection in the limb to be injected; distal intravenous access sites: hand, wrist, foot, ankle; multiple attempts to obtain intravenous access; prior or actual radiation in the limb to be injected; indwelling intravenous lines in place for more than 24 hours)
- Generalized debilitation
- Diabetes mellitus
- Use of pump injector with high flow rates
- History of multiple allergies with need for treatment
- Sensory limitation
- Other concomitant pathologies (e.g.: pheochromocytoma, multiple myeloma, sickle cell disease, autoimmune disease, cardiac disorders)
- Use of other concomitant medications (e.g.: interleukin-2, betablockers)
- Anxiety

Chart 1 – Suggestion of the presentation of the nursing diagnosis *Risk for adverse reaction to iodinated contrast media* after validation of content by experts. Porto Alegre, RS, Brazil, 2013

Source: Adapted from NANDA International, 2013.

care. The other elements with higher scores refer to the risk of an anaphylactic reaction to ICM consisting of the NO *Respiratory status: airway patency*, *Allergic response: systemic* and *Allergic response: localized*, as well as *Knowledge: medication* which needs to include knowledge regarding the properties and risks of iodinated contrast, interactions with regularly used medications, such as nephrotoxic drugs and metformin, as well as allergies to other pharmaceuticals. To achieve these results, NI validated as primary, which include *Allergy management*, *Intravenous (IV) insertion*, *Vital signs monitoring* and *Respiratory monitoring* are significant, even though a secure venous access and the control of vital signs are dealt with in terms of ascertaining any established targets. The importance of the NI *Intravenous (IV) insertion* in the prevention of lesions by

extravasation in medicated treatment of other adverse events should be highlighted.

The NO *Kidney function* and *Hydration* are relevant in the presence of vulnerability to contrast induced nephropathy, given that hydration is a condition linked to the prevention of extravasation and assists in the treatment of anaphylactic reactions. To achieve these results, NI such as *Intravenous (IV) insertion* and *Fluid management*, the only NI validated as secondary, can be implemented.

The NO *Knowledge: treatment procedure* is applicable to all patients who are received a ND in the study, whatever the RiF, and it is inherent to the role of nursing professionals. This is connected to the NI *Decision-making support* that implies detailed guidelines regarding the procedures, risks, and benefits of iodinated contrast, help-

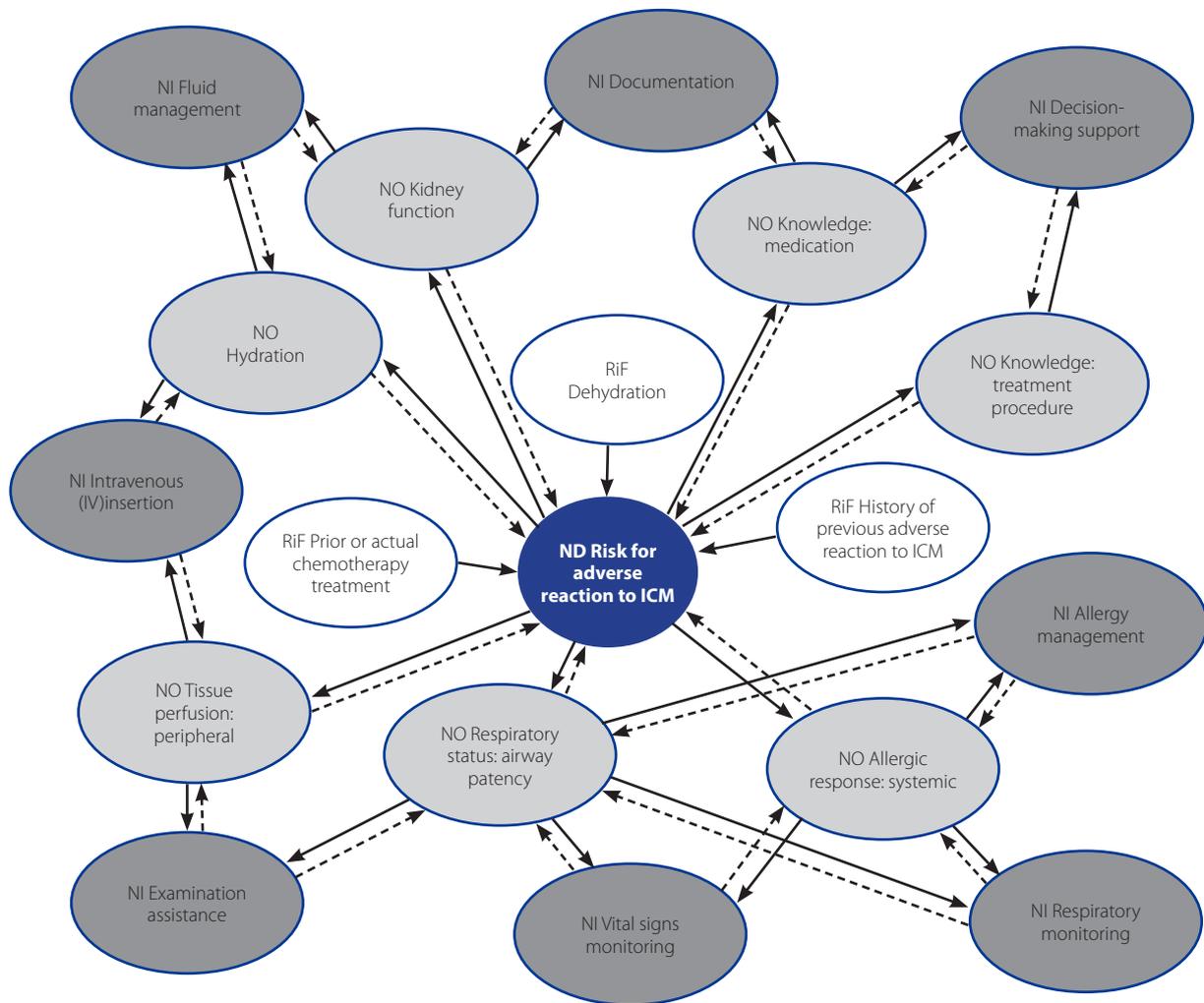


Figure 1 – Line of clinical reasoning: examples of pathways NNN for the ND *Risk of adverse reaction to iodinated contrast media*. Porto Alegre, RS, Brazil, 2013.

Source: Adapted from Johnson, Moorhead, Bulechek, Butcher, Maas, Swanson, 2013.

ing the patient to make the most adequate decision. The guidance given regarding the risks of ICM should be included in the NI *Documentation* when obtaining the free and informed consent from the patient to carry out the procedure. Further, it is important that they be informed regarding the importance of measures such as hydration, administration or suspension of medication, and detection of signs of renal dysfunction, amongst other educational measures⁽¹⁸⁾.

The NO *Tissue perfusion: peripheral* is specific in the presence of RiF for extravasation, and is also linked to the NI *Intravenous (IV) insertion and Examination assistance*.

In clinical practice, we can say that the pathways that connect the clinical conditions of the patient to the ND, NI and NO constitute “lines of clinical reasoning”, and represent the realization of the nursing process across all of its steps. In Figure 1, examples of these pathways are found, considering the ND and some of the RiF, NI, and NO validated in the study.

During patient evaluation, risk factors are identified, which leads to the establishment of the nursing diagnosis. Consequently, nursing outcomes are selected and, to attain these, the relevant nursing interventions must be implemented. After the implementation of the interventions, the outcomes are once again evaluated for decision making in terms of the ND situation. The arrows represent the course of the nursing process, with the use of connections NNN, which, in clinical practice are carried out in the sequence NANDA-I–NOC–NIC–NOC. During the development of the study, the lack of terminology related to diagnostic procedures was noted, since many nursing outcomes or interventions are only associated with treatment procedures. This fact can be exemplified with the availability of the NO *Knowledge: treatment procedures*, which was proposed for validation, suggesting its inclusion in the taxonomy of the NO *Knowledge: diagnostic procedure*.

In terms of the NIC and NOC taxonomies, the research findings also suggested the inclusion in the chapter “essential interventions” for “radiological nursing” the NI *Documentation* and *Decision-making support*⁽¹⁰⁾. Additionally, in the NOC handbook, *Respiratory status: airway patency*, *Kidney function*, *Tissue perfusion: peripheral* and *Knowledge: treatment procedure* should be included as NO quantifiable in the occurrence of ND, and the NO *Respiratory status: airway patency*, *Allergic response: systemic*, *Allergic response: localized*, *Kidney function*, *Knowledge: medication*, *Tissue perfusion: peripheral*, and *Knowledge: treatment procedure*⁽¹¹⁾ should be added in the NOC chapter related to the specialization of radiology.

■ CONCLUSION

Considering the results of this research, the title *Risk for adverse reaction to iodinated contrast media* is recommended for the ND, maintaining the definition proposed and its reallocation of the *Domain II – Safety/Protection for Class 2 – Physical Injury*.

Of the 28 risk factors proposed, five were validated as primary, 22 were validated as secondary, and one was discarded. The ND was validated with a diagnostic content validation score of 0.70.

Eight nursing interventions were suggested, of which seven were considered primary and one was considered secondary. In terms of nursing outcomes, eight were also proposed, with seven validated as primary and one as secondary.

This study permits the elevation of the level of evidence for this ND, originally established at 2.1 to 2.3, which includes the consensus of experts regarding the relevance of the ND and its elements, also adding the validation of the pathways NANDA-I–NOC–NIC to the case.

The participation of physicians as experts showed the support and valorization of the working systems of nurses, contributing to the refinement of the specific classifications NANDA-I–NOC–NIC for the theme in question and highlighting the possibility of including professionals with different academic training in studies that involve professional consensus, adding understanding and experience to reach of objectives.

In terms of research limitations, we can cite the possible blocking of electronic messages by some servers during data collection with the use of the electronic survey. Additionally, considering the ND under consideration and its recent inclusion in the diagnostic classification handbook of the NANDA-I, with a Portuguese language version made available only at the end of 2012⁽⁹⁾, the expert nurses could not be expected to apply it in the clinical practice since it could be unknown to these professionals. In the same way, we can presume that the physicians were unaware of knowledge related to the taxonomies and development of nursing processes.

The research results contributed to the education of professionals by stimulating critical thinking and clinical judgment with a focus on this specialty. Further research is important given the scarcity of production regarding the role of nursing in the area of diagnostic imaging, especially scientific production that promote the application of the PE in this specialization.

This research can be continued with further studies, including the validation of the content of the other nursing

interventions and nursing outcomes not included in the second stage of the study and validated as secondary. Additionally, a clinical validation by the expert professionals can offer a more solid foundation for the adequacy of this diagnosis and its application in clinical practice.

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