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Original Article

Construction and validity of a checklist for assessing nurses' skills in external jugular vein puncture

Construção e validação de checklist para avaliação das habilidades de enfermeiros na punção da jugular externa

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ABSTRACT

Objectives: to construct and validate a checklist for assessing nurses' skills in puncturing the external jugular vein. **Methods:** this is a methodological study that was carried out using three stages: bibliographic survey, checklist elaboration, and checklist appearance and content validity. Validity took place with 20 expert judges. A minimum Content Validity Index of 0.90 was used to consider an item valid. **Results:** the checklist comprises 38 items, divided into four parts: pre-puncture, puncture, post-puncture, and post-procedure surveillance. The checklist demonstrated a Content Validity Index of 1.00 for content, 0.99 for language, and 0.99 for layout, with an overall mean Content Validity Index of 0.99. **Conclusion:** the checklist was developed and constructed by expert nurses, and it was shown to be a suitable educational technology to assess nurses' skills in the teaching-learning process for puncturing the external jugular vein. **Contributions for practice:** the checklist constructed and validated in this study allows nurses to assess their technical skills for puncturing the external jugular vein. Moreover, it supports interventions aiming to increase care safety and quality through evidence-based care and standardized instruments.

Descriptors: Validation Study; Jugular Veins; Catheterization, Peripheral; Checklist; Nurses, Male.

RESUMO

Objetivos: construir e validar *checklist* para avaliação das habilidades de enfermeiros na punção da veia jugular externa. **Métodos:** estudo metodológico, realizado em três etapas: levantamento bibliográfico, elaboração do *checklist*, e validação do conteúdo e da aparência do *checklist*. A validação ocorreu com 20 juízes especialistas. Utilizou-se o Índice de Validade de Conteúdo mínimo de 0,90 para considerar o item válido. **Resultados:** o *checklist* tem 38 itens, divididos em quatro partes: pré-punção, punção, pós-punção e vigilância pós-procedimento. O *checklist* apresentou Índice de Validade de Conteúdo de 1,00 para conteúdo, 0,99 para linguagem e 0,99 para *layout*, com Índice de Validade de Conteúdo médio de 0,99. **Conclusão:** o *checklist* elaborado foi construído e validado por juízes especialistas, demonstrando-se como uma tecnologia educacional adequada para avaliar habilidade dos enfermeiros no processo de ensino-aprendizagem na punção da veia jugular externa. **Contribuições para a prática:** o *checklist* construído e validado neste estudo possibilita aos enfermeiros avaliar a habilidade técnica na punção de jugular externa. Além disso, subsidia intervenções que visam aumentar a segurança e a qualidade da assistência, por meio de cuidado baseado em evidências e instrumentos padronizados.

Descritores: Estudo de Validação; Veias Jugulares; Cateterismo Periférico; Lista de Checagem; Enfermeiros.

*Extracted from the dissertation "Construção e validação de checklist para avaliação de habilidades do enfermeiro na punção de jugular externa", Universidade de Fortaleza, 2022.

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Introduction

Peripheral venous puncture is a procedure performed routinely by nursing professionals for the intravenous administration of solutions[1]. A meta-analysis shows that up to 59% of intravenous accesses performed in the limbs are hard to obtain due to patients' anthropometric characteristics and health conditions[2]. In this context, nursing professionals face greater difficulty during peripheral venous access in patients that are older adults, obese, undergoing chemotherapy, and dehydrated[3]. In such cases, the external jugular vein is a viable and timely option as it presents larger caliber and easier site, being a common option for venous access in emergency situations[4].

External jugular vein puncture is used when peripheral venous access in the limbs is not feasible. In Brazil, it is a procedure performed exclusively by nurses, as it requires a high level of expertise in physiology, vascular anatomy, decision-making ability, and specific technical knowledge[5]. Thus, nurses need to be properly trained and have the necessary tools that allow them to perform external jugular vein puncture.

The use of technology in health education has been increasing as an efficient strategy to help performing nursing duties. As a tool for recording and verifying the stages, the checklist is relevant for ensuring the successful functionality and purpose of the procedure to be performed[6].

Nurses can use checklists as part of the care process to contribute to a more reliable care based on best practices. They are built to create a systematic method for actions to be followed, based on the combination of knowledge that should culminate in items to be sequenced. This technological resource can promote a better healthcare quality, assist in the education assessment process, during decision-making, and in the conduct to be adopted, in addition to collaborating with interaction and communication among healthcare professionals[7].

Among the applications of checklists, their use in the assessment of nursing's technical skills stands out. Technical skills are a professional's ability to perform clinical procedures correctly, safely, and efficiently, integrating scientific knowledge, psychomotor skills, and the application of evidence-based protocols and practices[8].

The assessment of a nurse's skills when puncturing the external jugular vein occurs in general through direct observation, without standardized criteria or validated instruments. The absence of standardization favors differences when teaching, performing, or assessing the procedure among healthcare institutions and services, which can compromise professional training and patient safety[9].

In this context, going beyond empirical practice, it is relevant to use instruments submitted to a thorough scientific assessment. Thus, research on checklist construction and validity is relevant and necessary to help with nursing's professional practice[10].

It is expected that the material produced contribute to standardize the external jugular puncture technique, according to nurses' clinical qualification, favor patient safety, and adopt evidence-based practices in the different healthcare settings.

In this regard, this study aimed to construct and validate a checklist for assessing nurses' skills in puncturing the external jugular vein.

Methods

Study design and period

This methodological study was performed between April and August 2022, following three stages: bibliographic survey, checklist development, and checklist content and appearance validity by nursing faculty and nurses with experience in external jugular puncture. The Consensus-based Standards for the Selection of Health Measurement Instruments was used because it is an international framework for measure instrument validity and development studies. Its use contributed to ensuring methodological rigor and obtaining evidence of validity.

Sample, inclusion and exclusion criteria

Inclusion criteria for expert judges comprised professional expertise based on their knowledge and skills in a particular field[10]. Thus, nurses with experience in external jugular vein puncture, teaching and/or carrying out research on the topic, considering aspects such as academic background, clinical practice, scientific production, and teaching experience, were included. The exclusion criterion considered the unavailability to fill out the research instruments due to vacation, leave or absence.

Professionals received an invitation based on recommendation of faculty members at *Universidade de Fortaleza*. The invitation was sent by email and WhatsApp for 50 people. Upon acceptance, a validity kit was sent with an invitation letter, a characterization form, an Informed Consent Form, the checklist assessment instrument, and initial version of the checklist.

The sample size was set based on the criterion in which the number of experts can vary between six and 20[11]. And a total sample of 20 experts was chosen.

To assess the checklist's content and appearance, an adapted instrument was used[12], comprising 24 variables, 13 of which refer to patient characterization and 11 to agreement on the checklist items (four on content, three on language, and three on layout). The response options were "agree", "totally agree", "neither agree nor disagree", "disagree", and "totally disagree". The document was created using *Google Forms*®, and a 15-day deadline was established to fill out the form.

A field for recording experts' suggestions was created. The observations presented were analyzed and, when relevant, incorporated into the instrument. The suggestions were summarized into a chart, in which all judges were identified with letter "J", followed by a sequential number corresponding to the answers registered in the form.

Study design and period

In the first stage (bibliographic survey), evidence for developing the checklist was obtained through the search, in grey literature, for the opinions of Nursing Regional Councils, the Centers for Disease Control recommendations and guidelines, and the Brazilian Health Regulatory Agency (ANVISA - *Agência Nacional de Vigilância Sanitária*) manuals[5,13].

In the second stage (instrument development), the checklist comprised 38 items, divided into pre-puncture care, puncture care, post-puncture care, and post-procedure surveillance. Every item has the following response options for each type of care: performed, partially performed, or not performed. There was also a field to be used for possible comments. In the third stage (content and appearance validity), the content was validated by external jugular puncture nurses.

Analysis of results and statistics

Data were analyzed using the R version 3.2.1 software. Based on the Content Validity Index (CVI), the item-level CVI (I-CVI) was calculated, which correspond to the agreement proportion among evaluators for Every instrument item, in addition to the Overall CVI, which consist of the mean of the I-CVIs. The minimum agreement proportion for an item to be considered valid was 90%[14]. The binomial test was used to verify if the items reached separately an agreement statistically equal to or above 0.90. The significance level adopted was 5%.

Ethical aspects

This study was approved by the Research Ethics Committee of *Universidade de Fortaleza*, under Certificate of Presentation for Ethical Consideration 60253422.5.0000.5052 and Opinion 5.562.916/2022. The expert judges participating in the research received information on the objective of the study and the nature of the collected data, and they signed an Informed Consent Form.

Results

Considering the chronological sequence of the stages necessary for carrying out properly the procedure, the checklist was divided into four topics: pre--puncture care, consisting of 15 items; puncture care, consisting of nine items; post-puncture care, consisting of eight items; and post-procedure surveillance, consisting of six items. In total, 38 items were arranged considering the behavior/technical skills assessed (Figure 1).

Behavior and/or technical skills
Pre-puncture care
Organizes the materials on the tray.
Uses personal protective equipment correctly.
Performs hand hygiene in accordance with the Infection Control Protocol.
Prepares the syringe with 10 mL of 0.9% normal saline.
Labels the syringe to be used.
Takes the tray to the patient's bedside.
Identifies oneself to the patient and/or accompanying person.
Verifies the patient's name using the identification wristband.
Explains the procedure to the patient.
Puts on procedure gloves.
Places the patient in a supine position up to 15° with lateral hyperextension of the head.
Locates the vessel to be punctured via inspection and palpation.
Performs site antisepsis (chlorhexidine gluconate >0.5%, 10% alcoholic povidone-iodine, or 70% alcohol).
Applies downward traction to the skin with the thumb below the puncture site, moving in a distal-to-proximal direction.
Selects the device type and gauge, considering the condition of the venous system.
Puncture care
Uses aseptic technique for the puncture.
Inserts the venous catheter into the skin, with the bevel facing upwards, at an approximate angle of 10°, and maintain this angle or a smaller angle as the catheter is inserted.
Guides the catheter into the vein using the stylet and removes the stylet after the catheter is inserted.
Observes for blood reflux in the hub of the intravenous catheter.
Aspirates using a 10 mL syringe if there is no venous return in the catheter.
Connects the catheter to the extension set.
Flushes the line with a maintenance solution or saline.
Secures the device using a sterile, semi-occlusive dressing (gauze and sterile tape) or a transparent semi-permeable membrane.
Applies firm pressure for at least 10 minutes in the event of accidental carotid artery puncture and immediately notifies the physician.
Post-puncture care
Removes procedure gloves.
Labels the dressing with the date, time, catheter gauge, and nurse's name.
Instructs the patient/companion on catheter maintenance.
Ensures the patient is comfortable in bed.
Disposes of used materials in the appropriate receptacle and sanitize hands.
Makes entries in the patient's medical record.
Cleans the access port/connector with 70% alcohol or alcoholic chlorhexidine.
Connects the port only to sterile devices.
Post-procedure surveillance
Performs a new puncture after a minimum of 96 hours, or sooner based on clinical judgment if the puncture site shows signs of inflammation or catheter obstruction.
Monitors catheter sites visually or by palpating the dressing.
Monitors patients for tenderness at the insertion site, fever of unknown origin, or other manifestations and/or local or bloodstream infections.
Encourages patients to report any changes or discomfort at the catheter site.
Documents the procedure in a standardized form or medical record.
Documents dressing changes in a standardized form or medical record.

Figure 1 – Checklist for assessing nurses' skills in external jugular vein puncture. Fortaleza, CE, Brazil, 2022

The professionals that participated in the checklist validity process were on average 38.6 ± 10.4 years old, with a median of 35 (32 – 41) years old. The most common areas of expertise were emergency care and intensive therapy. All professionals had experience teaching jugular vein puncture and performing it in care practice. Most judges (13; 65%) reported having previous experience developing checklists; half of them held a master's degree (10; 50%); and one judge held a doctoral degree (Table 1).

Table 1 – Characterization of expert judges. Fortaleza, CE, Brazil, 2022

Variables	n (%)
Age: Mean 38.6 ± 10.4; Median 35 (32–41)	
University where they obtained their undergraduate degree	
Universidade de Fortaleza	6 (30.0)
Centro Universitário Fametro	3 (15.0)
Centro Universitário Inta	2 (10.0)
Universidade Estadual do Ceará	2 (10.0)
Centro Universitário Estácio do Ceará	2 (10.0)
Others*	5 (25.0)
Year of graduation	
Before 2000	2 (10.0)
2000-2010	6 (30.0)
2010-2020	12 (60.0)
Workplace	
Hospital	9 (47.4)
Emergency care unit	3 (15.8)
Mobile emergency service	5 (26.3)
University/college	2 (10.5)
Area of expertise	
Emergency care	8 (40.0)
Intensive care	6 (30.0)
Teaching	2 (10.0)
General nursing	2 (10.0)
Other†	2 (10.0)
Years of experience in jugular puncture	
0-4	15 (75.0)
5-10	3 (15.0)
>10	2 (10.0)
Checklist creation experience	
Yes	13 (65.0)
No	7 (35.0)
Specialization 1	
Intensive care	7 (36.8)
Emergency care	3 (15.8)
Medical-surgical	2 (10.5)
Administration	2 (10.5)
Other‡	6 (26.4)
Year of conclusion	
Before 2000	2 (12.5)
2000-2010	0 (0)
2011-2020	12 (75.0)
After 2020	2 (12.5)
Specialization 2	
Intensive care	3 (25.0)
Emergency care	3 (2.50)
Management/administration	2 (16.7)
Other§	4 (33.3)
Year of conclusion	
2011-2020	10 (90.9)
After 2020	1 (9.1)

**Unichristus, Faculdade do Piauí, Faculdade de Ensino e Cultura do Ceará, Universidade do Vale do Rio dos Sinos, Universidade Regional do Cariri, Centro Universitário Unigrande* (n=1); †Obstetrics, transplantation (n=1); ‡Cardiology and hemodynamics, family health, obstetrics, transplantation, oncology (n=1); §Cardiology and hemodynamics, family health, transplantation, medical-surgical (n=1)

All items were considered valid, because two presented CVI=0.95, and the others presented CVI=1.0. Concerning the checklist domains, the content presented CVI=1.00, and language and layout presented CVI=0.99. All domains were valid with at least 96% of agreement among judges (p>0.05). Finally, the whole checklist presented CVI=0.99, with a minimum of 98% agreement among judges (p=0.144) (Table 2).

Table 2 – Content validity of the checklist. Fortaleza, CE, Brazil, 2022

Item	95%CI*	I-CVI†	p-value
Content	0.95 – 1.00	1.00	0.062
Is relevant for the checklist	0.83 – 1.00	1.00	0.122
Helps those performing the simulation	0.83 – 1.00	1.00	0.122
Is scientifically accurate	0.83 – 1.00	1.00	0.122
Is presented in an understandable way	0.83 – 1.00	1.00	0.122
Language	0.93 – 1.00	0.99	0.166
Is adequate for the target audience	0.83 – 1.00	1.00	0.122
The phrasing is engaging	0.75 – 1.00	0.95	0.392
The information presented is scientifically accurate	0.83 – 1.00	1.00	0.122
Is clear and concise	0.83 – 1.00	1.00	0.122
Layout	0.93 – 1.00	0.99	0.166
Font size facilitates reading	0.83 – 1.00	1.00	0.122
Colors make reading feasible	0.83 – 1.00	1.00	0.122
The layout of items is organized	0.83 – 1.00	1.00	0.122
The number of pages is appropriate	0.75 – 1.00	0.95	0.392
S-CVI/Ave‡	0.97 – 1.00	0.99	0.144

*Confidence interval; †I-CVI: Item-level Content Validity Index; ‡S-CVI: Scale-Level Content Validity Index, Average

Expert judges' suggestions on the categories of pre-puncture care, puncture care, post-puncture care, post-procedure surveillance, and general checklist structure focused on adjusting the writing of the acronyms used, specifying the alcoholic solutions used, and including information on the transparent dressing. Most recommendations were incorporated into the final version of the instrument. Suggestions that were not accepted were analyzed and justified based on scientific evidence and on the checklist's methodological proposal. Figure 2 shows expert judges' suggestions regarding the categories of pre-puncture care, puncture care, post-puncture care, post-procedure surveillance, and general checklist structure.

Category	Suggestion	Observation
Pre-puncture care	*Describe the acronym CCIRAS* and state the volume of 0.9% saline to be aspirated into the syringe* (J4).	The suggestion was accepted. The meaning of the acronym and the volume of 0.9% normal saline to be aspirated (10 mL) have been added.
	Regarding your checklist, I recommend that, among the possible products to be used in skin antisepsis, you use the term "alcoholic chlorhexidine" instead of 2% chlorhexidine, since there are also 2% degerming chlorhexidines, which would lead to confusion regarding the correct product. Furthermore, there are also alcoholic chlorhexidines at 0.5% (J14).	The suggestion was accepted. The remaining alcohol-based solutions for pre-puncture use were included: chlorhexidine gluconate >0.5%, 10% alcoholic povidone-iodine, or 70% alcohol. Additionally, information regarding 70% alcohol solutions and 0.5% alcoholic chlorhexidine solutions was added to the post-puncture care section.
Puncture care	*During puncture care, I suggest modifying the item concerning the catheter fixation because of ANVISA's protocol, as it states that fixation should be sterile* (J20).	The suggestion was accepted, which states that the device should be secured with a semi-occlusive sterile dressing (gauze + sterile adhesive tape) when the expected access time is less than 48 hours, or a semi-permeable transparent membrane for longer maintenance periods.
Post-puncture care	Regarding post-puncture care: *In addition to recording the date, time, and nurse name, it is also recommended to record the number of the catheter used for puncture* (J4).	The suggestion was accepted. The gauge of the catheter used for puncture was included.
Post-procedure surveillance	Regarding the device replacement interval, ANVISA recommends: *Routine replacement of peripheral catheters should not occur within less than 96 hours. The decision to extend the frequency of replacement to longer periods or when clinically indicated will depend on the institution's adherence to the best practices recommended in this document, such as routine and frequent assessment of patients' conditions, insertion site, skin and vessel integrity, duration and type of prescribed therapy, care site, device integrity and patency, sterile dressing integrity, and sterile stabilization* (J14).	The suggestion was accepted. There was a change in the term from: *Repeat the procedure within 96 hours if the puncture site shows signs of inflammation or based on clinical judgment to Perform a new puncture within a period of not less than 96 hours or if the puncture site shows signs of inflammation or catheter obstruction, based on clinical judgment* (J14). The other items mentioned were not accepted, as they had already been included in the initial version of the checklist.
General checklist structure	*I understand that preparation issues and infection management measures are inherent to any procedure. I hoped to see a technical checklist. The checklist is too long the way it is* (J15).	The suggestion was not accepted, as guidance regarding the pre-, during, and post-procedure phases of external jugular vein puncture is important in order to prevent adverse events and infections.
	This is a very well developed checklist, but I suggest to include images/figures to call professionals' attention (J3).	The suggestion was not accepted because it is a technology of a technical nature. In other words, a person who will perform the procedure would already have a basic understanding of how to execute it.

*CCIRAS: Healthcare-Associated Infection Control Commission (*Comissão de Controle de Infecções Relacionadas à Assistência à Saúde*)

Figure 2 – Suggestions from clinical experts to validate the external jugular vein puncture checklist. Fortaleza, CE, Brazil, 2022

Discussion

The checklist construction and validity to assess nurses' technical performance in external jugular vein puncture is a strategy to standardize its assessment and qualify teaching, training, and clinical practice processes. In addition to supporting professional training, this checklist contributes to patient safety as it provides an objective assessment based on previous established criteria.

In care settings of oncology, we identified that the nursing staff faced challenges related to difficult peripheral venous puncture, evidencing different perceptions between nurses and nursing technicians on this procedure. Among the main challenges, the ones that stood out were the necessary technical skills and clinical factors that must be considered during difficult peripheral venous puncture performance and assessment[3]. Moreover, higher educational and knowledge levels are associated with enhancement of te-

chnical skills and the adoption of best practices when handling peripheral venous catheter[15]. Thus, educational technologies can subsidize the implementation of new handling techniques, contributing to mitigating risks and strengthening patient safety.

External jugular puncture assessment requires a thorough and structured approach. The technology must be concise and easy to use so that nurses can use it efficiently in clinical practice. Structure must include items to check the technical performance, such as correct antisepsis, patient assessment, and communication between nursing staff and patient, which guarantees security and comfort[16]. Nurses can use the checklist as part of care coordination, with technologies and tools to support them for a safe care grounded in best practices. Therefore, creating this technology can contribute to reducing errors due to irregularities and enhance communication[17].

Appearance and content validity is a process that examines accurately an instrument developed. It is fundamental to ensure validity and reliability, in addition to providing care practice safety, because it analyzes the objectives proposed and reliably achieves what is intended[18-20]. In this study, all judges met all the requirements, and the selection of these qualified experts provided a better instrument assessment.

The checklist assessed is now an educational technology validated by health experts regarding content, language, and layout. The validity obtained from content and language supports the findings, which validated a checklist for assessing pressure injury prevention and obtained approval from the evaluators regarding content and language[21]. These assessed items deserve to be highlighted given the importance of health education technologies having correct, up-to-date, relevant, and pertinent content so that they are not verbose and/or composed of unnecessary or incorrect items. Furthermore, it is important that the checklist uses language adapted to the target audience, being clear, accessible, and appropriate to professionals' knowledge and skill levels.

Another aspect valued by judges concerns the layout, which must be clear, organized, and easy to understand, ensuring that information is accessible and that users can perform actions correctly. As for nurses, who developed and validated a tool to assess the NANDA International diagnostic classification, it was confirmed that a well-designed instrument with an appropriate layout can improve institutional regulations in a structured and systematic way[22].

Intensive care nurses' skills in preventing ventilator-associated pneumonia and catheter-related bacteremia support the usefulness and validity of this technological resource in healthcare to enhance their knowledge and skills[23].

Validating checklists in technical procedures improves the accuracy of assessing professionals' skills and enhances teaching and training[24-25]. In relation to external jugular vein puncture, it can therefore contribute significantly to the development of educational strategies, in addition to being a useful tool for nursing managers and coordinators to monitor nurses' technical skills in this specific procedure.

On the international stage, there is a growing use of checklists to assess technical performance in nursing, particularly in simulation, training, and continuing education activities. Unlike their use in healthcare, where they aim to standardize the execution of procedures and promote patient safety, performance assessment documents aim to objectively assess technical performance during the execution of clinical procedures. In this context, the developed instrument expands the strategies for assessing nurses' technical skill in external jugular vein puncture, which contributes to teaching and qualification of clinical practice[26-27].

The high level of agreement among judges may be related to the relatively homogeneous composition of the expert panel, as homogeneous panels tend to reach greater consensus, whereas the inclusion of experts from diverse backgrounds broadens the range of perspectives and strengthens the instrument's validity evidence[28]. Thus, it is recommended that future studies include evaluators from different regions of the country.

Study limitations

A limitation of this study is that all judges were from the state of Ceará, which limits the generalizability of the research findings to other regions of the country. Moreover, the instrument was not submitted to clinical validity with the target population, nor have reliability studies been conducted, aspects that could be addressed in future research to broaden the checklist's validity and reliability evidence.

Contributions to practice

The checklist developed and validated in this study enables nurses to assess technical proficiency in external jugular vein puncture. Furthermore, they can support initiatives aimed at improving the safety and quality of healthcare through evidence-based practices and standardized tools. Therefore, it is expected that using new technologies, such as care checklists, will contribute to a systematic approach to care based on best practices.

Conclusion

The developed checklist was created and validated by expert judges, showing to be adequate for guiding nurses in the teaching-learning process. Its development and validity process encompassed all planned methodological stages, allowing for the incorporation of experts' suggestions and the achievement of consensus regarding the proposed items. Thus, the technology was considered validated in terms of content, language, and layout criteria.

Authors' contributions

Conception and design or data analysis and interpretation; drafting the manuscript or critical revision of the intellectual content; final approval of the version to be published; agreement to be accountable for all aspects of the manuscript related to the accuracy or integrity of any part, ensuring that issues are appropriately investigated and resolved: **Santos CD, Maia ICVL, Freitas JG**. Drafting the manuscript or critical revision of the intellectual content; final approval of the version to be published; agreement to be accountable for all aspects of the manuscript related to the accuracy or integrity of any part, ensuring that issues are appropriately investigated and resolved: **Galindo Neto NM, Pereira JCN, Alexandre ACS, Pimentel JC**.

Data availability

The authors declare that the data are fully available within the body of the article. The research dataset may be requested from the corresponding author.

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