

Prevention Decalogue for Dependency-Related Skin Lesions in Neonates: A Consensus-Based Delphi Study

Citation: Buck Sainz-Rozas P, Gros-Turpin A, Balaguer-López E, Mora Morillo IM, De Frutos Pecharroman J, González García L, Cristóbal Cañadas D, Cánovas Barcelona M, Fàbregas Mitjans M, García-Molina P. "Prevention Decalogue for Dependency-Related Skin Lesions in Neonates: A Consensus-Based Delphi Study" (2025) *International Journal of Wound Research* 1(1) 1(1): 33-45. DOI: 10.64115/ijwr-2025-2

Received: March 2, 2025

Revised: June 9, 2025

Just accepted online: June 30, 2025

Published: June 30, 2025

Correspondence: Evelin Balaguer López, Facultad de Enfermería y Podología, Universidad de Valencia, C. de Menéndez y Pelayo, 19, 46010 Valencia. Email: evelin.balaguer@uv.es

Copyright: Buck Sainz-Rozas P, Gros-Turpin A, Balaguer-López E, Mora Morillo IM, De Frutos Pecharroman J, González García L, Cristóbal Cañadas D, Cánovas Barcelona M, Fàbregas Mitjans M, García-Molina P. This is an open access, peer-reviewed article published by iEditore and distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data Availability Statement: All relevant data are within the paper and its Supporting Information files. This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination, and proofreading process, which may lead to differences between this version and the Version of Record.

Pablo Buck Sainz-Rozas^{1,2}, **Anna Gros-Turpin**^{1,2}, **Evelin Balaguer López**^{3,4,5}, **Isabel María Mora Morillo**⁶, **Julia De Frutos Pecharroman**¹, **Laura González García**¹, **Delia Cristóbal Cañadas**⁷, **Mireia Cánovas Barcelona**¹, **Montserrat Fàbregas Mitjans**⁸, **Pablo García Molina**^{3,4,5}

¹ Hospital Universitario Vall d'Hebron, Barcelona, Spain

² Universidad Autónoma de Barcelona, Barcelona, Spain

³ Hospital Clínico Universitario de Valencia, Valencia, Spain

⁴ Facultad de Enfermería y Podología, Universidad de Valencia, Valencia, Spain

⁵ Care Research Group. INVESTENF-INCLIVA, Valencia, Spain

⁶ Hospital Regional Universitario de Málaga, Málaga, Spain

⁷ Hospital Universitario Torrecárdenas, Almería, Spain

⁸ Hospital del Mar, Consorci Mar Parc de Salut de Barcelona, Barcelona, Spain

Abstract

Introduction. The extreme fragility of neonatal skin, particularly in extremely preterm infants, underscores the need for effective preventive measures. This study aims to validate and design a decalogue for the prevention of dependency-related skin lesions (DRSL) in the neonatal population, based on existing consensus documents.

Methods. The Delphi method was employed to validate the content of the decalogue through expert consultation across Spain. Key criteria—including relevance, clarity, ambiguity, simplicity, satisfaction, and applicability—were assessed using a 4-point Likert scale and a 10-point scale, with a 75% agreement threshold for validation. Descriptive statistics were used to analyze responses. Items not meeting the threshold were revised based on qualitative feedback and re-evaluated. The final list of interventions was established through consensus in the second round.

Results. A total of 23 experts participated in the first round, and 20 in the second. Across both rounds, all items were validated with a high level of agreement. In the second round, all items exceeded 85% agreement for relevance, clarity, ambiguity, and

Competing Interests: The author(s) declare(s) no conflict of interest.

simplicity. The average satisfaction (9.36–9.47) and applicability (9.09–9.42) revealed a high level of agreement concerning the clinical applicability of the Decalogue. The decalogue outlines essential measures for preventing DRSL in neonates, including risk assessment, postural changes, the use of specialized pressure-relieving surfaces, and monitoring of device-related pressure points. It also highlights the importance of tailored skin care based on neonatal maturity and the need for thorough documentation of preventive interventions.

Discussion. Consensus achieved via the Delphi process substantiates the Decalogue's capacity to effectively articulate key preventive strategies with clarity and brevity. Moreover, its implementation will foster evidence-based care practices, ultimately enhancing the quality of care in neonatal units. However, ongoing efforts are required to further improve DRSL prevention and continuously update strategies in light of emerging evidence.

Keyword: Pressure Injuries, Prevalence, Risk Factors, Neonatal Nursing, Infant, Newborn

Introduction

The prevention of dependency-related skin lesion (DRSL) in neonates is a critical challenge in neonatal care, given the unique vulnerability of this population. These injuries result from factors such as prolonged pressure, shear, friction, and moisture, which compromise tissue perfusion and lead to cellular damage.^{1,2} Despite advancements in neonatal care and technology, pressure injuries remain a significant concern, with reported incidence rates of approximately 3% in neonates^{1,2} and as high as 25–43% in neonatal intensive care units (NICUs).^{3–5}

The anatomical and physiological characteristics of neonates heighten their susceptibility to these injuries. The skin of newborns, particularly preterm infants, is immature, featuring a thin epidermal barrier and limited cohesion between dermal and epidermal layers. As the first line of defense against pathogens, the skin plays a crucial role in maintaining homeostasis by minimizing unnecessary fluid losses and preventing electrolyte imbalances.^{1,6}

Moreover, the use of medical devices such as endotracheal tubes, catheters, and oximetry sensors are associated with 50–70% of DRSL cases in neonatology.^{2,3,7} This issue not only affects the quality of life of neonates—causing

pain, stress, infections, long-term scarring, and prolonged hospitalization—but also presents challenges for healthcare systems due to the associated costs and complications. These include neurodevelopmental impairments, as exposure to pain and stressful conditions can disrupt brain maturation and connectivity, particularly in the white and grey matter, as well as in thalamic regions. This underscores the urgent need for effective preventive strategies.^{3,8}

The lack of consensus on best practices for preventing these injuries is reflected in the variability of current strategies. Although risk assessment tools such as the Neonatal Skin Risk Assessment Scale (NSRAS) and the Braden Q Scale exist, their implementation and impact remain inconsistent.^{9,10} Similarly, preventive strategies such as mobilization, kangaroo care, the use of pressure-redistributing surfaces, and moisture control have demonstrated effectiveness, yet their application does not always follow a standardized, evidence-based approach.^{3,9–12} This heterogeneity impacts the quality of care provided and has consequences on health outcomes; therefore, this study employs the Delphi process to identify and prioritize the recommendations.

Given the vulnerability of neonates and the importance of establishing specific, evidence-based care measures, it is essential not only to

identify current practices for the prevention of dependency-related skin injuries but also to consolidate them into a clear and accessible set of recommendations. The primary objective of this study was to design and validate a decalogue for the prevention of dependency-related skin lesions in the neonatal population, based on existing consensus documents developed by the skin care working group of the Spanish Society of Neonatal Nursing and the Upppediatria scientific group, as well as on the most recent literature. This decalogue aims not only to standardize best practices but also to serve as an easy-to-read reference tool, synthesizing the evidence into a concise format for healthcare professionals. By promoting safe and effective care that minimizes the risk of injury, it seeks to improve the quality of life of hospitalized neonates. Given the relevance of this issue, the study focused on validating and designing a decalogue for the prevention of dependency-related skin lesions (DRSL) in the neonatal population based on existing consensus documents.

Methods

The Delphi methodology was employed through an expert consultation process to validate the content of the decalogue. The ACCurate Consensus Reporting Document (ACCORD) guidelines for reporting consensus methods in biomedicine were followed. The study was structured into three distinct phases: development of the initial questionnaire, composition of the expert panel, and an electronic survey using the e-Delphi panel.¹³

Development of the Initial Questionnaire

The initial questionnaire was designed following a comprehensive review of up-to-date clinical guidelines, consensus statements, systematic reviews, and original research focused on neonatal skin care and prevention of DRSL. A systematic search was conducted in databases (PubMed, TripDatabase, and GuíaSalud), institutional repositories (GuíaSalud, NICE), and scientific society libraries. A thematic synthesis of key preventive strategies was conducted, with inclusion criteria based on clinical relevance, recurrence in the literature, and alignment with current neonatal care standards. Terminology was standardized using internationally recognized nomenclature (e.g., “medical adhesive-related

skin injury,” “moisture-associated skin damage,” “family-centered care”). The preliminary items were grouped into three conceptual domains—assessment, prevention, and management—based on an integrated approach to neonatal care. This classification was informed by theoretical models of clinical risk management and the prevention of adverse events, ensuring coherence with established frameworks in neonatal practice. Organizing the items in this way enhanced the applicability of the decalogue in clinical protocols and facilitated its structured inclusion in the Delphi questionnaire, supporting its practical adoption in neonatal units.

Sample and Participants

A multidisciplinary panel of 20 experts, including neonatal nurses, university professors, and clinical researchers, was invited to participate. All panellists were members of the Upppediatria Group and/or the skin care working group of the Spanish Society of Neonatal Nursing. Experts were selected based on their experience in neonatal care and their knowledge of dependency-related skin lesions (DRSL). The inclusion criteria required more than 10 years of experience in neonatal care or at least 5 years of experience as a specialist paediatric nurse. In line with methodological considerations described by Hasson et al.¹⁴, a sample of 20 participants was deemed sufficient to ensure representativeness while maintaining manageability of data analysis. Additionally, a pilot test of the initial questionnaire was conducted with four neonatal care professionals to assess item clarity, terminology, and technical operability before initiating the Delphi rounds.

Delphi Rounds

The electronic survey was distributed via email, and responses were collected using a LimeSurvey database. Panellists were given two weeks per round to complete the survey. Intermediate results were analysed within one week, and aggregated, anonymised feedback (including median scores and interquartile ranges) was shared with participants. To maximise response rates, reminders were sent to non-respondents.

The study was conducted over four weeks, from December 2023 to January 2024. In both rounds, the objective was to establish content validity for each item. Participants independently evaluated relevance, clarity, ambiguity, and simplicity using a 4-point Likert scale:

- 1 = Not simple, unclear, irrelevant, or ambiguous
- 2 = Requires revision
- 3 = Requires minor revision
- 4 = Very relevant, clear, concise, and simple

Items achieving $\geq 75\%$ agreement advanced to the next round, while those below this threshold were revised or eliminated. To facilitate a confidential exchange of opinions, an open-ended section was included at the end of each question set.

Additionally, satisfaction and applicability of the decalogue were assessed in each round using a Likert scale (1 = worst, 10 = best). Consensus was defined as $\geq 75\%$ agreement across all items. Following recommendations from the scientific literature¹⁵⁻¹⁷, the expert panel also evaluated the content of the decalogue for subsequent calculation of the Content Validity Index (CVI) using Aiken's V statistic.¹⁸

Data Analysis

A descriptive analysis was performed to characterise the expert panel. The percentage of agreement (PA%) was used to determine the inclusion of items in the decalogue, defined as the proportion of responses rated as 3 (minor revision) or 4 (strongly agree). Consensus was established if PA% was $\geq 75\%$.

Mean and standard deviation (SD) were used to describe the central tendency and data dispersion. Data analysis was conducted using IBM SPSS Statistics 28.0.1.1. Qualitative comments were categorised thematically to identify recurring suggestions and areas of disagreement.

A freely available software developed by Merino et al. using Visual Basic 6.0 (Microsoft®, Washington)¹⁸ was used to calculate Aiken's V and confidence intervals.

Ethical Considerations

All participants provided informed consent for the processing of their personal data, and the confidentiality of their responses was maintained throughout the study.

Results

A total of nineteen scientific papers were reviewed, including two clinical practice guidelines, four consensus documents, six systematic reviews, and seven original research

papers. As a result of this literature review, a decalogue of recommendations covering ten key domains was developed.

The identification of the ten key domains comprising the clinical decalogue was based on a synthesis of recommendations derived from a comprehensive review of the scientific literature, including clinical practice guidelines, consensus statements, systematic reviews, and original research articles. These recommendations were thematically categorized and organized into an initial framework of functional domains. To minimize potential bias from a priori assumptions, domain validation was conducted through a Delphi consensus process involving clinical experts. Each item was independently evaluated, with participants invited to suggest modifications or propose additional perspectives through open commentary. This methodological approach ensured that the final domains reflected a consensus-driven and evidence-based framework, rather than solely the initial perspective of the research team.

Two rounds of consultation were conducted, involving 23 experts, of whom 20 participated in both rounds. The expert panel included professionals with extensive experience in neonatal care. Table 1 presents the background and experience of the expert panel. Of the total number of participants who met the inclusion criteria, 73.9% had more than 10 years of experience in neonatology, 26.1% held a master's degree in neonatology, and 87% were pediatric specialists. Additional qualifications included doctoral degrees, expertise in skin lesions, and more than 15 years of clinical experience in neonatology.

Table 1. Characteristics of the expert panel (n = 23).

Characteristic	n, (%)
Master's degree in Neonatology	6 (26,1)
Expert in Neonatology	3 (13)
Specialist in Paediatric Nursing	20 (87)
Continuing education in Neonatology	13 (56,5)
PhD in Neonatology	1 (4,3)
Master's Degree in Skin Lesions	2 (8,7)
Continuing Education in Skin Lesions	10 (43,5)
PhD in Skin Lesions	1 (4,3)
Experience in Neonatology (>15 years)	13 (56,5)
University teaching (>10 years)	3 (13)

In the first round, the mean validation score across all criteria was 3.821 (SD = 0.031), increasing to 3.95 (SD = 0.058) in the second round. Table 2 illustrates the evolution of validation scores across the four criteria between both consultation rounds.

Table 2. Evolution of Validation Criteria over Consultation Rounds.

Criteria	Round 1	Round 2
Relevance	3,827	4
Clarity	3,827	4
Ambiguity	3,779	3,9
Simplicity	3,852	3,9

The percentage of agreement for each criterion and item is detailed in the Table 3, as shown on the right-hand side of the table. All items exceeded 85% agreement in terms of relevance, clarity, ambiguity, and simplicity, with scores ranging between 3 (requires minor revision) and 4 (do not modify).

The first-round assessment of the Content Validity Index (CVI) for the Decalogue demonstrated high validity across all evaluated dimensions. The total CVI scores indicated strong expert agreement on the relevance (0.94), clarity (0.94), ambiguity (0.92), and simplicity (0.95) of the proposed recommendations. Among the individual items, the highest CVI scores were observed for recommendations related to protecting the skin from clinical devices and adhesives (relevance: 1.00) and ensuring regular postural changes (simplicity: 1.00), reflecting a consensus on their critical importance.

Table 3. Content validity index (CVI) Round 1 and Percentage of Agreement (Score 3 or 4) for Each Item and Round (R1 and R2)

1. Age and Care Plans					
	Content validity index (CVI) Round 1			Percentage of Agreement	
	M [SD]	CVI	CI 95%	R1	R2
Relevance	3.91 [0.29]	0.97	0.89 - 0.99	100%	100%
Clarity	3.78 [0.52]	0.92	0.84 - 0.96	95,6%	90%
Ambiguity	3.87 [0.46]	0.95	0.87 - 0.98	95,6%	85%
Simplicity	3.78 [0.52]	0.92	0.84 - 0.96	95,6%	90%
2. Regular Assessment					
	Content validity index (CVI) Round 1			Percentage of Agreement	
	M [SD]	CVI	CI 95%	R1	R2
Relevance	3.70 [0.70]	0.90	0.80 - 0.95	86,9%	100%
Clarity	3.83 [0.58]	0.94	0.86 - 0.97	91,3%	100%
Ambiguity	3.65 [0.83]	0.88	0.78 - 0.93	86,9%	95%
Simplicity	3.78 [0.60]	0.92	0.84 - 0.96	91,3%	95%
3. Postural Changes					
	Content validity index (CVI) Round 1			Percentage of Agreement	
	M [SD]	CVI	CI 95%	R1	R2
Relevance	3.87 [0.34]	0.95	0.87 - 0.99	100%	100%
Clarity	3.87 [0.46]	0.95	0.87 - 0.99	95,6%	100%
Ambiguity	3.87 [0.46]	0.95	0.87 - 0.99	95,6%	100%
Simplicity	4 [0]	1	0.94 - 1	100%	100%
4. Skin-to-Skin and FCC/DC					
	Content validity index (CVI) Round 1			Percentage of Agreement	
	M [SD]	CVI	CI 95%	R1	R2
Relevance	3.83 [0.39]	0.94	0.86 - 0.97	100%	100%
Clarity	3.91 [0.29]	0.97	0.89 - 0.99	100%	100%
Ambiguity	3.87 [0.46]	0.95	0.87 - 0.99	95,6%	100%
Simplicity	3.87 [0.63]	0.95	0.87 - 0.99	95,6%	100%

5. Special support surfaces					
	Content validity index (CVI) Round 1			Percentage of Agreement	
	M [SD]	CVI	CI 95%	R1	R2
Relevance	3.52 [0.67]	0.84	0.73 - 0.90	91,3%	100%
Clarity	3.83 [0.39]	0.94	0.86 - 0.97	100%	100%
Ambiguity	3.70 [0.76]	0.90	0.80 - 0.95	91,3%	100%
Simplicity	3.91 [0.42]	0.97	0.89 - 0.99	95,7%	100%

6. Skincare and moisturisation					
	Content validity index (CVI) Round 1			Percentage of Agreement	
	M [SD]	CVI	CI 95%	R1	R2
Relevance	3.74 [0.62]	0.91	0.82 - 0.95	91,3%	100%
Clarity	3.83 [0.49]	0.94	0.86 - 0.97	95,7%	100%
Ambiguity	3.74 [0.69]	0.91	0.82 - 0.95	95,7%	95%
Simplicity	3.96 [0.21]	0.98	0.92 - 0.99	100%	95%

7. Humidity Control					
	Content validity index (CVI) Round 1			Percentage of Agreement	
	M [SD]	CVI	CI 95%	R1	R2
Relevance	3.87 [0.46]	0.95	0.87 - 0.99	95,7%	100%
Clarity	3.78 [0.60]	0.92	0.84 - 0.96	91,3%	100%
Ambiguity	3.61 [0.78]	0.86	0.77 - 0.93	91,3%	100%
Simplicity	3.74 [0.75]	0.91	0.82 - 0.95	91,3%	95%

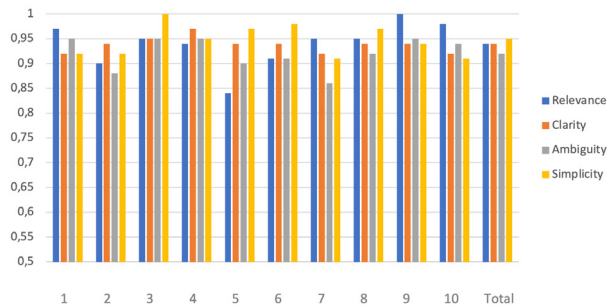
8. Nutritional Assessment and Breastfeeding					
	Content validity index (CVI) Round 1			Percentage of Agreement	
	M [SD]	CVI	CI 95%	R1	R2
Relevance	3.87 [0.34]	0.95	0.87 - 0.99	100%	95%
Clarity	3.83 [0.49]	0.94	0.86 - 0.97	95,7%	100%
Ambiguity	3.78 [0.67]	0.92	0.84 - 0.96	95,7%	95%
Simplicity	3.91 [0.29]	0.97	0.89 - 0.99	100%	100%

9. Device Protection					
	Content validity index (CVI) Round 1			Percentage of Agreement	
	M [SD]	CVI	CI 95%	R1	R2
Relevance	4 [0]	1	0.94 - 1	100%	100%
Clarity	3.83 [0.49]	0.94	0.86 - 0.97	95,7%	100%
Ambiguity	3.87 [0.46]	0.95	0.87 - 0.99	95,7%	95%
Simplicity	3.83 [0.49]	0.94	0.86 - 0.97	95,7%	95%

10. Documentation					
	Content validity index (CVI) Round 1			Percentage of Agreement	
	M [SD]	CVI	CI 95%	R1	R2
Relevance	3.96 [0.21]	0.98	0.92 - 0.99	100%	100%
Clarity	3.78 [0.52]	0.92	0.84 - 0.96	95,7%	100%
Ambiguity	3.83 [0.49]	0.94	0.86 - 0.97	95,7%	100%
Simplicity	3.74 [0.54]	0.91	0.82 - 0.95	95,7%	100%

CVI total of the Decalogue			
	M [SD]	CVI	CI 95%
Relevance	3.82 [0.14]	0.94	0.85 - 0.97
Clarity	3.82 [0.04]	0.94	0.85 - 0.97
Ambiguity	3.77 [0.10]	0.92	0.83 - 0.96
Simplicity	3.85 [0.09]	0.95	0.87 - 0.98

Conversely, the recommendation concerning the selection of special support surfaces received the lowest relevance score (0.84), highlighting the need for further refinement. (see Graphic 1 and Table 3).



Graph 1. Content Validity Index (V Aiken) for each item and the total of the decalogue in Round 1.

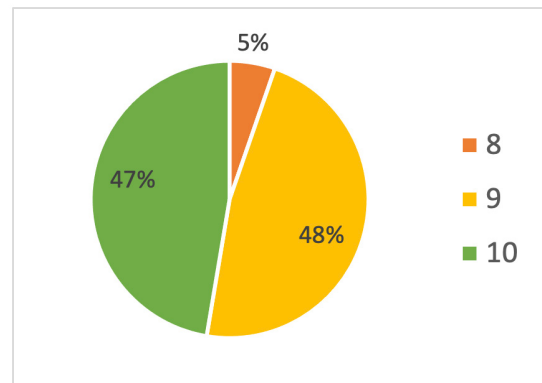
Although all items met the established consensus threshold, some were slightly reworded based on the qualitative feedback provided by the expert panel during the first Delphi round. Regarding overall satisfaction with the decalogue, the mean score was 9.35 (SD = 0.885) in the first round, increasing to 9.47 (SD = 0.679) in the second round (see Graphic 2). Similarly, the applicability score improved from 9.09 (SD = 1.083) to 9.42 (SD = 0.607) (see Graphic 3).

Table 4 presents the modifications made to the wording of certain items after the first round,

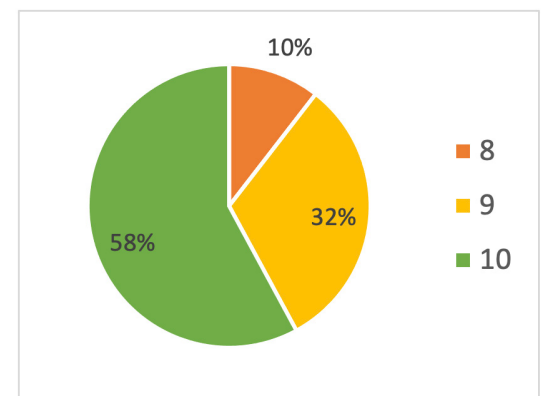
Table 4. Percentage of agreement (score 3 or 4) for each item and round (R1 or R2).

1 st Round (N 23)	Mean PA%	2 nd Round (N 20)	Mean PA%
DRSL does not depend on age but on the level of dependency. All vulnerable individuals may be at risk.	96,7	Design and implement standardised care plans to prevent DRSL, promoting continuous professional training. DRSL does not depend on age but on the level of dependency.	91,25
Regularly assess the risk of DRSL using validated and appropriate tools (e.g., e-NSRAS).	89,1	Regularly assess the risk of DRSL using validated and appropriate tools.	97,5
Ensure regular postural changes, monitoring skin condition and high-risk areas.	97,8	Ensure regular postural changes, monitoring skin condition and high-risk areas.	100
Encourage skin-to-skin contact and promote family-centered care (FCC) and developmental care (DC).	97,8	Encourage skin-to-skin contact and respect family-centered care (FCC) and developmental care (DC).	100
Select the appropriate Special support surfaces to redistribute pressure according to the pathology and risk level of neonatal patients.	94,58	Select the appropriate Special support surfaces to redistribute pressure according to the pathology and risk level of neonatal patients.	100
Provide appropriate skincare and moisturisation based on the corrected gestational age and skin maturity status.	95,68	Provide appropriate skincare and moisturisation based on the corrected gestational age and skin maturity status.	97,5
Controls excess humidity. Mixed incontinence, drains, and condensation in tubes contribute to skin damage. Nappy rash is the primary DRSL.	92,40	Controls excess humidity. Identify and manage excessive moisture sources affecting the skin: mixed incontinence, drains, condensation in tubes, etc. Nappy rash is the primary DRSL.	98,75
Assess nutritional status and promote breastfeeding, as adequate nutrition and breastfeeding reduce DRSL risk. A well-nourished neonate has a lower risk of developing new injuries.	100	Assess nutritional status and promote breastfeeding, as adequate nutrition and breastfeeding reduce DRSL risk.	100
Protect the skin from clinical devices and adhesives. Non-invasive ventilation (NIV), invasive mechanical ventilation (IMV), vascular access, and diagnostic sensors are major causes of medical adhesive-related skin injuries (MARSIs) and pressure injuries in neonatal patients.	96,78	Protect the skin from clinical devices and adhesives. Non-invasive ventilation (NIV), invasive mechanical ventilation (IMV), vascular access, and diagnostic sensors are major causes of MARSIs and pressure injuries in neonatal patients.	97,50
Record all injuries, assessments, risk factors, and preventive measures to generate epidemiological indicators and scientific evidence. Include paediatric and neonatal patients in epidemiological studies in all hospitals where they are treated. Ignoring this is not an option.	96,78	Record all injuries, assessments, risk factors, and preventive measures to generate epidemiological indicators and scientific evidence, as well as for cost-effective management.	100

based on the qualitative feedback provided by the panel, with the aim of enhancing the precision, clarity, or applicability of the recommendations.



Graph 2. Applicability of the Decalogue (N = 20) Rating from 1 to 10.



Graph 3. Satisfaction with the Decalogue (N = 20). Rating from 1 to 10.

After the literature review and two rounds of expert consultation, the final decalogue for the prevention of dependency-related skin lesions (DRSL) in neonates was established:

- Design and implement standardised care plans to prevent DRSL, promoting continuous professional training. DRSL does not depend on age but on the level of dependency.
- Regularly assess the risk of DRSL using validated and appropriate tools.
- Ensure regular postural changes, monitoring skin condition and high-risk areas.
- Encourage skin-to-skin contact and promote family-centered care (FCC) and developmental care (DC).
- Select the appropriate Special support surfaces to redistribute pressure according to the pathology and risk level of neonatal patients.
- Provide appropriate skincare and moisturisation based on the corrected gestational age and skin maturity status.
- Controls excess humidity. Mixed incontinence, drains, and condensation in tubes contribute to skin damage. Nappy rash is the primary DRSL.
- Assess nutritional status and promote breastfeeding, as adequate nutrition and breastfeeding reduce DRSL risk.
- Protect the skin from clinical devices and adhesives. Non-invasive ventilation (NIV), invasive mechanical ventilation (IMV), vascular access, and diagnostic sensors are major causes of medical adhesive-related skin injuries (MARSI) and pressure injuries in neonatal patients.
- Record all injuries, assessments, risk factors, and preventive measures to generate epidemiological indicators and scientific evidence, as well as for cost-effective management.

Discussion

With the participation of a group of healthcare professionals with expertise in skin care in the neonatal population, this study selected the ten main domains to be considered in the prevention of dependency-related skin lesions (DRSL). After two Delphi rounds, in which

experts blindly assessed each other, high validity values were obtained, demonstrating a strong level of consensus. Until this study, prevention had been approached as separate interventions depending on the type of skin lesion (pressure injuries, friction injuries, or humidity-related injuries). However, this project has designed and validated a decalogue of recommendations for the prevention of DRSL.^{19–21}

When designing a comprehensive skin care plan for hospitalized neonatal patients, it is necessary to rely on validated tools, guidelines, and protocols, agreed upon by experts in neonatal skin care, to prevent the occurrence of skin lesions.^{19–21} In neonatal care, multiple skin care practices have been identified without solid scientific evidence, often depending on the cultural, social, or healthcare context in which clinical care is provided. To ensure that essential knowledge on neonatal skin care reaches healthcare professionals, recommendations should be clearly formulated to facilitate understanding, emphasizing the main guidelines and instructions to be followed.^{22–24}

A neonatal patient is exposed to multiple interventions aimed at diagnosis and treatment. Not all procedures necessarily place the neonate at high risk of developing skin lesions. It is therefore essential to identify the key risk factors. The use of assessment tools, whether risk prediction tools—such as scales for assessing pressure injury risk^{19,20,22,25–27}—or diagnostic tools—such as scales for evaluating diaper dermatitis²⁸—can help to reduce both the incidence and severity of skin lesions.²⁹

Different authors argue that, to reduce DRSL rates, healthcare teams trained in prevention should be in place, with specific roles dedicated to identifying, reporting, and monitoring skin lesions associated with risk factors, such as clinical devices.^{19,20,30} However, the presence of specialized teams or protocols alone does not necessarily reduce the incidence of injuries without intensive and continuous training. Visscher³¹ concluded that the establishment of a specialized lesion detection team resulted in a slight decrease in incidence, although the impact was limited due to the number of factors involved in skin lesion development.

For the reduction of DRSL to be significant and sustainable, the scientific literature suggests that, in addition to having an action guide, it is essential to prioritize key interventions that have proven

effective. Jani²¹ supports the implementation of a local care guide, as suggested by other authors, but emphasizes the need to assess skin condition every four hours to prevent skin lesions.

The acquisition, availability, and use of medical devices, and inappropriate use may increase the risk of skin damage in neonates. Munson³² highlights that while these medical devices are widely utilized in neonatal units, there are no standardized protocols governing their application frequency or removal, which poses a potential risk to neonatal skin integrity. Similarly, Lund³³ reinforce the need for evidence-based, standardized protocols for neonatal skincare.

Since scientific evidence on the use of topical medical products (dressings, biological adhesives, solutions, creams, or sprays) in neonates is very scarce, with low potency and significant limitations^{34,35}, it is essential to recognize and investigate both the characteristics of these products and the preferences of healthcare professionals, depending on the care context (critical or intermediate care).³⁶ Boswell³⁷ observed that, anecdotally, neonatal nurses prefer transparent polyurethane dressings instead of hydrocolloid dressings for tube and probe fixation. However, the study found no significant differences in effectiveness between the two dressings in reducing skin lesions of the MARS type.

If we analyze one of the devices most frequently associated with skin lesions in hospitalized neonatal patients, such as non-invasive mechanical ventilation (NIV), we observe uncertainties in skin care and a need to adapt recommendations to the specific context of each center. Healthcare professionals must recognize that neonates on NIV are at high risk of pressure injuries, friction injuries, and humidity-related injuries.^{24,38–40} Therefore, they must receive consistent training in the main prevention measures, which include individualized selection of the interface^{38,41}, rotation of interfaces^{39,42}, correct fixation techniques⁴³, and selection of appropriate protective dressings.⁴⁴

Nie⁴⁵ propose a set of recommendations for the prevention of pressure injuries in pediatric patients. While their work aligns with our study in its focus on preventive measures, key methodological differences set the two apart. Our decalogue extends beyond pressure injuries to encompass all DRSL in neonates, addressing a broader spectrum of skin damage associated

with neonatal care. Additionally, unlike Nie⁴⁵, our study employs a rigorous validation process through expert consensus using the Delphi methodology, ensuring a high level of agreement on each recommendation. Furthermore, our analysis incorporates the Content Validity Index (CVI) to assess the clarity, relevance, ambiguity, and simplicity of each item, providing a quantitative measure of the decalogue's robustness. Another notable distinction is our strong emphasis on family-centered care and skin-to-skin contact as key preventive strategies, which are not as prominently discussed in the compared study. These differences highlight the need for validated, consensus-based guidelines tailored to neonatal care, ensuring their clinical applicability and effectiveness in preventing DRSL.

Various scientific societies, both in the wound care field (SEHER, GNEAUPP, EPUAP, EWMA, Upppediatria) and in neonatal care (Sociedad Española de Enfermería Neonatal, Association of Women's Health, Obstetric and Neonatal Nursing, Società Italiana di Neonatologia Infermieristica), are making significant efforts to compile and disseminate the most current scientific evidence on the prevention of neonatal skin lesions. However, this information is often scattered across guidelines and consensus documents, which hinders rapid and effective access to key recommendations. The creation of simplified compilations, such as the prevention decalogue validated by experts, could facilitate intensive and continuous training of healthcare professionals in neonatal skin care. As supported by the scientific community, such resources would allow professionals to recognize, understand, and correctly implement prevention strategies, ultimately reducing the incidence of skin lesions.^{6,46–50}

This study presents certain limitations that should be considered when interpreting the results. First, the expert panel was composed primarily of professionals affiliated with scientific societies and working groups specializing in neonatal care, which may have biased responses towards recommendations with stronger consensus within these groups. Additionally, although robust in reaching a consensus, the Delphi methodology relies heavily on active participation, and a reduction in the number of experts across rounds could limit the diversity of opinions.

Another important limitation is that the

decatalogue's validation was based exclusively on expert opinions, without preliminary clinical trials to assess its real impact on DRSL prevention. Furthermore, as August highlighted in his review, terminology inconsistencies regarding neonatal skin lesions complicate unified diagnoses and treatment approaches, representing another challenge in achieving consensus.

Despite these limitations, the decatalogue offers a practical and applicable guide for healthcare professionals working in neonatal care units. Its high scores in relevance, clarity, ambiguity, and simplicity criteria support its implementation in different clinical contexts. The recommendations provided align with current evidence and are designed to be adaptable according to the specific needs of each neonatal center. Additionally, the decatalogue serves as an educational tool for training new professionals and promoting standardized neonatal skin care practices at a national level.

This study establishes a foundation for future research in several areas. First, multicenter clinical studies are necessary to assess whether the integration of the decatalogue into continuous education programs and its dissemination among healthcare professionals contribute to a reduction in neonatal DRSL incidence. These studies should incorporate clinical indicators, such as skin lesion prevalence, as well as patient- and family-centered outcomes, including pain levels and length of hospitalization.

Furthermore, the economic impact of implementing the decatalogue in neonatal units could be investigated. Finally, the development of digital tools to facilitate the application, monitoring, and documentation of the decatalogue's recommendations could represent a promising area for further research.

Clinical Implications

This validated decatalogue will facilitate that training interventions to prevent dependency-related skin lesions in newborns aimed at health professionals contain the ten basic key points validated by a panel of experts.

Conclusions

This study facilitated the design and validation of a decatalogue for the prevention of dependency-related skin lesions (DRSL) in neonates through a Delphi process with experts. The results

show a high level of consensus regarding the relevance, clarity, applicability, and simplicity of the included recommendations. The decatalogue serves as a practical guide that can support healthcare professionals in enhancing neonatal care quality and reducing the incidence of DRSL.

Despite its limitations, the decatalogue is presented as a valuable tool for standardizing best practices across neonatal units, whether critical, intermediate, or basic care settings. Its implementation and assessment in real clinical environments are strongly recommended, alongside further studies to validate its effectiveness and long-term applicability.

References

1. García-Fernández FP, Agreda JJS, Verdú J, Pancorbo-Hidalgo PL. A new theoretical model for the development of pressure ulcers and other dependence-related lesions. *J Nurs Scholarsh*. 2014;46(1):28–38. <https://doi.org/10.1111/jnu.12051>
2. Nieva-Sausa C, López-Medina IM. Eficacia de las medidas de prevención de úlceras por presión en neonatos y niños: revisión sistemática. *Gerokomos*. 2022;33(2):127–132. Accessed Feb 7, 2025. http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1134-928X2022000200012&lng=es&nrm=iso&tlng=es
3. García-Molina P, Balaguer-López E, García-Fernández FP, Ferrera-Fernández MÁ, Blasco JM, Verdú J. Pressure ulcers' incidence, preventive measures, and risk factors in neonatal intensive care and intermediate care units. *Int Wound J*. 2018;15(4):571–579. <https://doi.org/10.1111/iwj.12900>
4. Boyd SM, Tapawan SJ, Badawi N, Popat H. Protecting the brain of the micropreemie. *Semin Fetal Neonatal Med*. 2022;27(3):101370. <https://doi.org/10.1016/j.siny.2022.101370>
5. McPherson C, Miller SP, El-Dib M, Massaro AN, Inder TE. The influence of pain, agitation, and their management on the immature brain. *Pediatr Res*. 2020;88(2):168–175. <https://doi.org/10.1038/s41390-019-0744-6>
6. Mora-Morillo IM, Avilés-Avilés JM, Balaguer-López E, Ferrera-Fernández MÁ, García-Molina P. *Prevención de lesiones por presión en neonatos*. 2021:0-94. https://www.seenenfermeria.com/sites/default/files/documentos/prevencion-de-lesiones-por-presion_0.pdf
7. Nicolosi B, Parente E, Marilli I, Prisco R, Gregorini M, Ciofi D. Investigation of the prevalence of skin injuries in hospitalized newborns and main reports: an observational, cross-sectional, and monocentric pilot study. *Infermieristica J*. 2024;3(1):63–70. <https://doi.org/10.36253/if-2412>
8. Alfaro López A, Balaguer López E, Pérez Paredes A, et al. Efectividad de las medidas y estrategias de prevención de úlceras por presión en neonatos. *Gerokomos*. 2020;31(3):193–197. <https://doi.org/10.4321/s1134-928x2020000300011>
9. Gray M. Context for practice: pressure injury prevention in the neonatal intensive care unit, stoma and peristomal complications, post-prostatectomy incontinence, and best practice amongst foot & nail care providers. *J Wound Ostomy Continence Nurs*. 2021;48(5):379. <https://doi.org/10.1097/WON.0000000000000808>
10. Razmus IS, Keep SM. Neonatal intensive care nursing pressure injury prevention practices: a descriptive survey. *J Wound Ostomy Continence Nurs*. 2021;48(5):394–402. <https://doi.org/10.1097/WON.0000000000000805>
11. Schlüer AB, Müller AY, Fromme NP, et al. Use of a novel pressure distribution system for severely ill neonates: a clinical pilot study carried out by the PREPICare consortium. *BMC Pediatr*. 2023;23(1):42. <https://doi.org/10.1186/s12887-023-04252-2>
12. Cummins KA, Watters R, Leming-Lee TS. Reducing pressure injuries in the pediatric intensive care unit. *Nurs Clin North Am*. 2019;54(1):127–140. <https://doi.org/10.1016/j.cnur.2018.10.005>
13. Gattrell WT, Logullo P, van Zuuren EJ, et al. ACCORD (Accurate Consensus Reporting Document): A reporting guideline for consensus methods in biomedicine developed via a modified Delphi. *PLoS Med*. 2024;21(1):e1004326. <https://doi.org/10.1371/journal.pmed.1004326>
14. Hasson F, Keeney S, McKenna H. Research guidelines for the Delphi survey technique. *J Adv Nurs*. 2000;32(4):1008–1015. <https://doi.org/10.1046/j.1365-2648.2000.t01-1-01567.x>
15. Lynn MR. Determination and quantification of content validity. *Nurs Res*. 1986;35(6):382–386. <https://doi.org/10.1097/00006199-198611000-00017>
16. Polit DF, Beck CT. The content validity index: Are you sure what's being reported? Critique and recommendations. *Res Nurs Health*. 2006;29(5):489–497. <https://doi.org/10.1002/nur.20147>
17. Yaghmaie F. Content validity and its estimation. *J Med Edu*. 2003;3(1):e105015. <https://doi.org/10.22037/jme.v3i1.870>
18. Merino Soto C, Livia Segovia J. Intervalos de confianza asimétricos para el índice la validez de contenido: un programa Visual Basic para la V de Aiken. *Anales Psicol*. 2009;25:161–71. <https://doi.org/10.6018/analesps.25.1.50551>
19. Pittman J, Beeson T, Kitterman J, Lancaster S, Shelly A. Medical device-related hospital-acquired pressure ulcers: development of an evidence-based position statement. *J Wound Ostomy Continence Nurs*. 2015;42(2):151–154. <https://doi.org/10.1097/WON.0000000000000113>
20. Squires AJ, Hyndman M. Prevention of nasal injuries secondary to NCPAP application in the ELBW infant. *Neonatal Netw*. 2009;28(1):13–27. <https://doi.org/10.1891/0730-0832.28.1.13>
21. Jani P, Mishra U, Buchmayer J, et al. Global variation in skin injuries and skincare practices in extremely preterm infants. *World J Pediatr*. 2023;19(2):139–157. <https://doi.org/10.1007/s12519-022-00625-2>
22. Broom M, Dunk AM, E Mohamed AL. Predicting neonatal skin injury: the first step to reducing skin injuries in neonates. *Health Serv Insights*. 2019;12:1178632919845630. <https://doi.org/10.1177/1178632919845630>
23. Milligan PS, Goldstein MR. Implementation of an evidence-based non-invasive respiratory support (NIRS)

- bundle in the NICU to decrease nasal injury complications. *J Neonatal Nurs*. 2017;23(2):89–98. <https://doi.org/10.1016/j.jnn.2016.05.003>
24. Csoma ZR, Meszes A, Ábrahám R, Kemény L, Tálosi G, Doró P. Iatrogenic skin disorders and related factors in newborn infants. *Pediatr Dermatol*. 2016;33(5):543–548. <https://doi.org/10.1111/pde.12960>
 25. Curcio F, Abellán MV, Dioni E, de Lima MM, Saldaña MR. Validity and reliability of the Italian–Neonatal Skin Risk Assessment Scale (i-NSRAS). *Intensive Crit Care Nurs*. 2024;80:103561. <https://doi.org/10.1016/j.iccn.2023.103561>
 26. Curcio F, Vaquero-Abellán M, Zicchi M, Romero-Saldaña M. Translation and cross-cultural adaptation of the Neonatal Skin Risk Assessment Scale (NSRAS) to Italian. *J Tissue Viability*. 2022;31(4):693–698. <https://doi.org/10.1016/j.jtv.2022.07.004>
 27. Nicolosi B, Curcio F, Gheorghe MA, Ranieri P, Parente E. Risk assessment of pressure injuries in newborns. Appropriateness of Glamorgan and NSRAS scales: a scoping review. *Infermieristica J*. 2024;3(1):45–60. <https://doi.org/10.36253/if-2403>
 28. Balaguer-López E, Estañ-Capell J, Rodríguez Dolz MC, Barberá Ventura MC, Ruescas López M, García-Molina P. Incidencia de dermatitis asociada a la incontinencia en neonatos hospitalizados. *Adaptación y validación de una escala de gravedad*. *An Pediatr (Engl Ed)*. 2024;100(6):420–427. <https://doi.org/10.1016/j.anpedi.2024.04.004>
 29. August DL, Edmonds L, Brown DK, Murphy M, Kandasamy Y. Pressure injuries to the skin in a neonatal unit: fact or fiction. *J Neonatal Nurs*. 2014;20(3):129–137. <https://doi.org/10.1016/j.jnn.2013.08.006>
 30. Javaheri Abkenar M, Khanali Mojen L, Shakeri F, Varzeshnejad M. Skin injuries and its related factors in the neonatal intensive care unit. *Iran J Neonatol*. 2020;11(4). <https://doi.org/10.22038/ijn.2020.45342.1756>
 31. Visscher M, King A, Nie AM, Schaffer P, Taylor T, Pruitt D, Giaccone MJ, Ashby M, Keswani S. A quality-improvement collaborative project to reduce pressure ulcers in PICUs. *Pediatrics*. 2013;131(6):e1950–e1960. <https://doi.org/10.1542/peds.2012-1626>
 32. Munson KA, Bare DE, Hoath SB, Visscher MO. A survey of skin care practices for premature low birth weight infants. *Neonatal Netw*. 1999;18(3):25–31. <https://doi.org/10.1891/0730-0832.18.3.25>
 33. Lund C. Medical adhesives in the NICU. *Newborn Infant Nurs Rev*. 2014;14(4):160–165. <https://doi.org/10.1053/j.nainr.2014.10.001>
 34. de Souza S, Takashima M, Silva TL, et al. Use of tissue adhesive for neonatal intravenous access devices: a scoping review. *Eur J Pediatr*. 2024;183(12):3687–3696. <https://doi.org/10.1007/s00431-024-05800-3>
 35. August DL, Kandasamy Y, Ray R, Lindsay D, New K. Fresh perspectives on hospital-acquired neonatal skin injury period prevalence from a multicenter study: length of stay, acuity, and incomplete course of antenatal steroids. *J Perinat Neonatal Nurs*. 2021;35(3):275–283. <https://doi.org/10.1097/JPN.0000000000000513>
 36. Brandon D, Hill CM, Heimal L, et al. *Neonatal skin care: evidence-based clinical practice guideline*. 4th ed. Association of Women's Health, Obstet and Neonatal Nurses; 2018.
 37. Boswell N, Waker CL. Comparing 2 adhesive methods on skin integrity in the high-risk neonate. *Adv Neonatal Care*. 2016;16(6):449–454. <https://doi.org/10.1097/ANC.0000000000000333>
 38. Mishra U, August D, Walker K, Jani PR, Tracy M. Thermoregulation, incubator humidity, and skincare practices in AGA ultra-low birth weight infants: need for more evidence. *World J Pediatr*. 2024;20(7):643–652. <https://doi.org/10.1007/s12519-024-00818-x>
 39. Newnam KM, McGrath JM, Salyer J, Estes T, Jallo N, Bass WT. A comparative effectiveness study of continuous positive airway pressure-related skin breakdown when using different nasal interfaces in the extremely low birth weight neonate. *Appl Nurs Res*. 2015;28(1):36–41. <https://doi.org/10.1016/j.apnr.2014.05.005>
 40. Fujii K, Sugama J, Okuwa M, Sanada H, Mizokami Y. Incidence and risk factors of pressure ulcers in seven neonatal intensive care units in Japan: a multisite prospective cohort study. *Int Wound J*. 2010;7(5):323–328. <https://doi.org/10.1111/j.1742-481x.2010.00688.x>
 41. Yong SC, Chen SJ, Boo NY. Incidence of nasal trauma associated with nasal prong versus nasal mask during continuous positive airway pressure treatment in very low birthweight infants: a randomized control study. *Arch Dis Child Fetal Neonatal Ed*. 2005;90(6):F480. <https://doi.org/10.1136/ad.2004.069351>
 42. Balaguer-Escutia P, García-Molina P, Balaguer-López E, Montal-Navarro MA. Análisis de la aparición de lesiones por presión en neonatos portadores de ventilación mecánica no invasiva. *Gerokomos*. 2023;34(1).
 43. Collins CL, Barfield C, Horne RSC, Davis PG. A comparison of nasal trauma in preterm infants extubated to either heated humidified high-flow nasal cannulae or nasal continuous positive airway pressure. *Eur J Pediatr*. 2014;173(2):181–186. <https://doi.org/10.1007/s00431-013-2139-8>
 44. Cubells Celda R, Montal Navarro M, Rodríguez Dolz M, et al. Prevención de úlceras por presión en neonatos con ventilación mecánica no invasiva. *Gerokomos*. 2020;31(2).
 45. Nie AM. Top ten tips: preventing pressure injuries in paediatric patients. *Wounds International*. 2024;15(4).
 46. Baharestani MM. An overview of neonatal and pediatric wound care knowledge and considerations. *Ostomy Wound Manage*. 2007;53(6):34–55. <https://doi.org/10.1097/01.AWM.0000260489.91727.0a>
 47. Barbera-Ventura M, Castaño-Pico M, Cervera Gasch A, Cortes-Zapatero E, Dolz-Alabau M. *Documento de Consenso INCATIV Pediátrico*. Ediciones CECOVA; 2023.

-
48. García Molina P, Bargos Munárriz M, Ferrera Fernández M, Balaguer López E, Mora Morillo I, Avilés Avilés J. *Qué no hacer en lesiones por presión en pediatría-neonatología*. In: Grupo Nacional para el Estudio y Asesoramiento en Úlceras por Presión y Heridas Crónicas, ed. Recomendaciones basadas en la evidencia. Logroño: Grupo Nacional; 2021:0-37.
 49. Quesada Ramos C, Pérez Acevedo G, García Molina P. Heridas en pediatría: úlceras por presión, dermatitis asociada a incontinencia y lesiones por extravasación. *Revista ROL de Enfermería*. 2018;41:11-12.
 50. Balaguer López E, García Molina P, Rodríguez Dolz M, Alonso C, Larburu I, Baquero Fernández C. *Cuidados de la piel en neonatos portadores de ventilación mecánica no invasiva*. 2019:0-109. https://www.seenenfermeria.com/sites/default/files/documentos/cuidados_de_la_piel_en_neonatos_portadores_del_vmni-13_05_19.pdf