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A Quantitative Assessment of Knowledge Gaps and Barriers to the Standardization of Neonatal Resuscitation Among Nurses

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ABSTRACT

Background: Neonatal resuscitation is a life-saving intervention essential for reducing neonatal morbidity and mortality, particularly in low- and middle-income countries where healthcare resources and clinical skills are often limited. Despite the implementation of global training initiatives such as the Neonatal Resuscitation Program and Helping Babies Breathe, knowledge-practice gaps remain widespread among nurses, the primary providers of neonatal care in resource-constrained settings. These gaps are compounded by systemic barriers, including inadequate training opportunities, lack of equipment, insufficient supervision, and heavy workloads, all of which compromise adherence to standard protocols. Objective: This study aimed to quantitatively assess the level of knowledge among nurses regarding neonatal resuscitation and to identify the major barriers that impede the standardization and effective implementation of resuscitation practices. Methods: A descriptive cross-sectional study was conducted from February to May 2025 at Mayo Hospital, Lahore, involving 110 registered female nurses working in neonatal units. Data was collected using a structured, validated questionnaire assessing knowledge (10 items) and barriers (10 items) on a 5-point Likert scale. Statistical analysis was performed using SPSS v25, with descriptive statistics summarizing participant characteristics and inferential tests evaluating associations between demographic factors, knowledge scores, and perceived barriers. Results: The overall mean knowledge score was 3.97 ± 0.48, with high awareness of advanced steps such as oxygen administration (92.7%) and bag-mask ventilation (90.0%) but lower knowledge of basic procedures such as drying the newborn (60.0%). Recent training ($p = 0.004$) and frequent resuscitation exposure ($p = 0.011$) were significantly associated with higher knowledge. Major barriers included time constraints (78.2%), inadequate equipment (75.5%), staff shortages (72.7%), and limited simulation opportunities (68.2%), all significantly linked to lower knowledge and inconsistent practice ($p < 0.05$). Conclusion: Nurses demonstrated moderate-to-high knowledge of neonatal resuscitation, but critical gaps persist, particularly in foundational steps, due to systemic and environmental barriers. Addressing these gaps through regular simulation-based training, improved staffing, reliable equipment availability, and stronger institutional support can enhance adherence to standardized protocols and improve neonatal outcomes.

Keywords
Neonatal resuscitation, nurses, knowledge gaps, barriers, training, low-resource settings, standardized care, newborn survival.

INTRODUCTION

Neonatal resuscitation is a time-critical bundle of interventions that prevents death and disability from intrapartum-related events and is central to quality newborn care in facilities, particularly in low- and middle-income countries where systems and skills are unevenly distributed (1). Global initiatives have articulated a coordinated agenda for standardizing resuscitation steps, equipment, team roles, and post-resuscitation care to narrow the gap between evidence and practice (2). Programs such as the Neonatal Resuscitation Program and Helping Babies Breathe have expanded rapidly and demonstrate immediate gains in knowledge and simulated performance; however, skill decay within months, variability in training fidelity, and inconsistent institutional reinforcement limit sustained impact in real clinical settings (3,4). Recent scoping work on procedural training underscores that competence depends not only on initial instruction but also on structured refreshers, supervised deliberate practice, and clear protocols embedded in the clinical environment (5). In resource-constrained contexts, additional barriers—stock-outs of essential devices, unclear leadership during emergencies, and high workload—undermine standardization and timely initiation of ventilation and coordinated compressions (6,7).

Within this landscape, nurses constitute the largest cadre attending deliveries and immediate newborn care in tertiary hospitals across South Asia, making their preparedness pivotal for early ventilation, airway positioning, and thermoregulation steps that determine survival in the golden minute (1,2). Yet multi-country and regional evidence points to variable knowledge and low rates of correct performance, with studies reporting modest proportions meeting competency thresholds and identifying weak guideline availability, limited simulation access, and sparse supervisory feedback

as recurrent determinants of suboptimal practice (8,9). Work from comparable low-resource maternity units highlights discordance between adequate theory and inconsistent execution of bag-mask ventilation and chest compressions, often compounded by equipment readiness lapses and team coordination deficits (10). Concept analyses of "readiness" emphasize that preparedness is multidimensional—encompassing individual knowledge/skills, supplies and layout, team communication, cues to action, and feedback loops—and that measurement must therefore extend beyond test scores to include environmental and organizational enablers of standardized care (11).

Against this background, evidence from Pakistan's tertiary settings remains limited on how nurse-level knowledge intersects with modifiable, unit-level barriers that impede protocolized neonatal resuscitation. The local burden, constrained staffing, and high delivery volumes in referral hospitals suggest that even small delays or deviations from standard steps can translate into preventable asphyxia-related morbidity and mortality, but granular data on training exposure, equipment readiness, supervision, and workload pressures are scarce (1,6). Using a PICO-aligned framing, among nurses providing neonatal care in a tertiary hospital (Population), exposure to enabling conditions for standardization—such as recent training, clear written protocols, and functional equipment (Intervention/Exposure)—as compared with their absence (Comparison) is hypothesized to be associated with higher knowledge and fewer perceived barriers to effective resuscitation (Outcomes). Therefore, this study quantitatively assesses the level and distribution of neonatal resuscitation knowledge among nurses and identifies unit-level and organizational barriers to standardized implementation in a high-volume tertiary hospital in Lahore. The primary research questions are: What is the current level of nurse knowledge regarding neonatal resuscitation, and which modifiable barriers most strongly impede standardized practice in this setting (1–11)?

MATERIAL AND METHODS

This study employed a descriptive cross-sectional design to quantitatively assess knowledge levels and perceived barriers to the standardization of neonatal resuscitation among nurses. This design was chosen for its suitability in capturing the prevailing state of knowledge, attitudes, and contextual challenges at a single point in time without intervention, thereby allowing a comprehensive understanding of the gaps that may affect clinical outcomes (12). The study was conducted at Mayo Hospital, a high-volume tertiary care facility in Lahore, Pakistan, from February to May 2025. This hospital was selected for its diverse neonatal units, including surgical and medical neonatal intensive care units (NICUs) and specialized neonatal wards, which provide a representative setting for evaluating the preparedness and challenges of nursing staff involved in neonatal resuscitation.

Participants included registered female nurses currently employed in neonatal units with at least six months of clinical experience. This inclusion criterion ensured that participants had adequate clinical exposure to neonatal care practices. Nurses on leave, those in administrative roles, interns, student nurses, and those unwilling to provide consent were excluded to minimize confounding from limited clinical involvement or incomplete exposure. A non-probability purposive sampling technique was used to recruit participants, targeting those directly responsible for neonatal resuscitation. The calculated sample size was based on a standard cross-sectional survey formula, assuming a 32% prevalence of adequate knowledge from prior studies, a 95% confidence level, and a 5% margin of error, resulting in a required sample of 110 participants (3,8).

Eligible nurses were approached in their respective units and provided with a detailed explanation of the study objectives, procedures, and confidentiality measures. Informed written consent was obtained before participation. Data collection was performed through a structured, pre-validated questionnaire comprising two sections: the first assessed knowledge of neonatal resuscitation through 10 items on a 5-point Likert scale, and the second evaluated perceived barriers through 10 similarly scaled items. Knowledge items covered essential aspects such as airway positioning, ventilation initiation, compression-to-ventilation ratios, oxygen use, and post-resuscitation care, while barrier items addressed issues including training frequency, equipment availability, guideline access, staffing, simulation opportunities, supervisory support, and workload pressures. Prior to full deployment, the instrument underwent expert review for content validity and pilot testing on a small sample to ensure clarity and reliability.

Knowledge scores ranged from 10 to 50 and were categorized as low (10–24), moderate (25–37), or high (38–50). Barrier scores followed a similar scale and were categorized as minor (10–23), moderate (24–36), or major (37–50). Independent variables included demographic and professional factors such as age, education level, clinical experience, previous training, and frequency of resuscitation performance, while dependent variables were the knowledge scores and barrier levels. To minimize bias, all questionnaires were anonymized, and responses were collected independently without influence from supervisors or peers. Data integrity was maintained through double data entry and verification procedures.

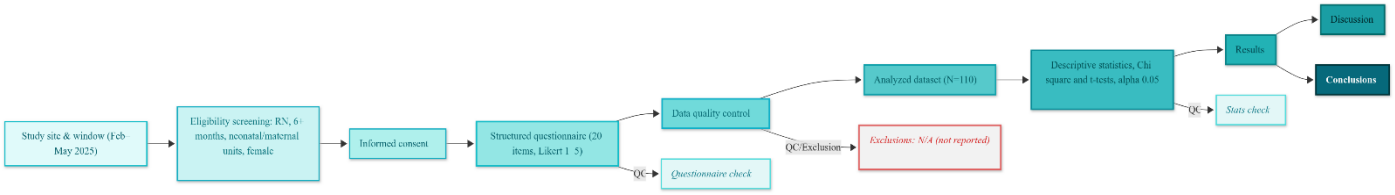

Figure 1 Study Flowchart

Statistical analyses were performed using SPSS version 25. Descriptive statistics, including frequencies, percentages, means, and standard deviations, summarized participant characteristics, knowledge levels, and barrier distributions. Inferential statistics, such as chi-square tests and independent-sample t-tests, were planned to examine associations between demographic variables and knowledge or barrier scores, with a significance level set at $p < 0.05$. Subgroup analyses were conducted to explore differences based on prior training exposure and years of clinical experience. Missing data were handled through pairwise deletion to retain maximum valid cases for each analysis.

Ethical approval was obtained from the Institutional Review Board of Mayo Hospital, Lahore, and the study adhered to the principles of the Declaration of Helsinki. Participants were informed of their right to withdraw at any time without penalty, and all collected data were stored securely and used solely for academic and research purposes. These rigorous methodological steps ensured reproducibility, minimized bias, and provided a robust framework for interpreting the findings in relation to clinical practice and policy development (12–14).

RESULTS

The demographic analysis revealed a workforce predominantly composed of young nurses, with 65.5% aged 20–30 years and 75.5% having 1–10 years of clinical experience, suggesting that neonatal care in this tertiary setting is largely delivered by early- to mid-career professionals. Educational qualifications varied, with 45.5% holding a nursing diploma and 31.8% a BSc, while 55.5% had received neonatal resuscitation training within the last two years. Importantly, both age ($p = 0.041$) and years of experience ($p = 0.032$) were significantly associated with knowledge scores, indicating that younger nurses and those with less experience may benefit from targeted continuing education interventions. Moreover, prior training ($p = 0.004$) and frequency of neonatal resuscitation performance ($p = 0.011$) demonstrated strong associations with higher knowledge levels, reinforcing the role of ongoing exposure and training in skill retention and clinical readiness.

Knowledge assessment results demonstrated an overall mean score of 3.97 ± 0.48, indicative of a moderate-to-high understanding of neonatal resuscitation protocols. Key procedural knowledge—such as initiating bag-mask ventilation when heart rate is <100 bpm (mean = 4.26 ± 0.75, 90.0% correct) and oxygen administration in cyanotic or apneic newborns (mean = 4.44 ± 0.72, 92.7% correct)—was well understood, suggesting effective transfer of critical skills during initial training. Similarly, competence in recognizing the need for chest compressions after 30 seconds of ventilation (mean = 4.01 ± 0.87) and ensuring a proper mask seal during ventilation (mean = 4.25 ± 0.77) indicated strong clinical awareness of advanced steps. However, foundational aspects showed significant gaps: only 60.0% identified drying the newborn as the first step (mean = 3.34 ± 1.20), and knowledge of the recommended 3:1 compression-to-ventilation ratio was comparatively lower (mean = 3.66 ± 1.13). These findings imply that while complex interventions are well retained, some essential early steps in resuscitation require reinforcement, potentially through repeated simulation or bedside drills.

Table 1. Demographic Characteristics of Participants (N = 110)

Variable	Category	Frequency (n)	Percentage (%)	p-value
Age	20–30 years	72	65.5	0.041*
	30–40 years	30	27.3	
	40–50 years	8	7.3	
Gender	Female	110	100.0	—
Department	Surgical NICU	30	27.3	0.067
	Medical NICU	30	27.3	
	Surgical Ward (NNU)	25	22.7	
	Medical Ward (NNU)	25	22.7	
Clinical Experience	1–10 years	83	75.5	0.032*
	10–20 years	23	20.9	
	20–30 years	3	2.9	
	30–40 years	1	0.9	
Qualification	Diploma	50	45.5	0.019*
	BSc	35	31.8	
	Other	25	22.7	
NR Training (Last 2 Years)	Yes	61	55.5	0.004**
	No	49	44.5	
Frequency of NR Performance	Rarely	38	34.5	0.011*
	Occasionally	45	40.9	
	Frequently	27	24.5	

*Chi-square test. *p < 0.05 statistically significant; **p < 0.01 highly significant.

Table 2. Knowledge Scores on Neonatal Resuscitation (N = 110)

Knowledge Item	Mean ± SD	95% CI	% Correct (Agree/Strongly Agree)	p-value
Drying the newborn as first step	3.34 ± 1.20	3.12–3.55	60.0	0.048*
Placing baby on warm surface	4.10 ± 0.95	3.94–4.26	81.8	0.032*
Head slightly extended	3.92 ± 1.12	3.71–4.13	77.2	0.041*
Start BMV if no breathing / HR < 100	4.26 ± 0.75	4.12–4.40	90.0	0.015*
Start compressions if HR < 60 after 30s	4.01 ± 0.87	3.84–4.18	81.8	0.029*
3:1 compression-to-ventilation ratio	3.66 ± 1.13	3.45–3.87	67.2	0.071
Seal during bag-mask ventilation	4.25 ± 0.77	4.10–4.39	89.1	0.018*
Oxygen if cyanotic / apneic	4.44 ± 0.72	4.31–4.57	92.7	0.011*
Keep baby warm and skin-to-skin	3.87 ± 1.14	3.66–4.08	71.9	0.055
Epinephrine for advanced resuscitation	3.85 ± 1.02	3.66–4.03	69.1	0.049*
Overall Knowledge Score	3.97 ± 0.48	3.88–4.05	—	—

*Independent t-test for mean difference by training status. *p < 0.05 statistically significant.

Barriers analysis revealed systemic and organizational challenges that significantly impact neonatal resuscitation practices. Time constraints during high delivery volumes emerged as the most reported barrier (78.2%), with a high mean score (3.93 ± 0.69) and a strong association with low knowledge levels (OR = 3.09, p = 0.002). Inadequate equipment availability (75.5%, mean = 3.86 ± 0.98, OR = 2.85, p = 0.006) and staff shortages during emergencies (72.7%, mean = 3.76 ± 0.97, OR = 2.12, p = 0.032) were also strongly correlated with poorer knowledge and performance. Lack of regular training (67.3%, mean = 3.61 ± 1.13) and limited access to simulation-based practice (68.2%, mean = 3.60 ± 0.90) significantly increased the likelihood of inadequate knowledge (OR = 2.21 and 2.47, respectively, p < 0.05), underscoring the importance of structured refresher programs. Conversely, barriers such as poor communication (37.3%) and disorganized resuscitation trays (36.4%) were less frequently reported and not significantly associated with knowledge outcomes, although they still represent operational inefficiencies that could compromise care during high-pressure situations. Overall, the data illustrate a clear pattern: while knowledge of essential neonatal resuscitation procedures is reasonably strong, it is unevenly distributed across different domains, with critical foundational steps often underemphasized. Moreover, systemic

barriers—particularly time pressure, inadequate resources, and insufficient staffing—exert a substantial negative influence on both preparedness and performance.

Table 3. Perceived Barriers to Standardized Neonatal Resuscitation (N = 110)

Barrier	Mean ± SD	95% CI	% Agree/Strongly Agree	Odds Ratio (OR)	p-value
Lack of regular training	3.61 ± 1.13	3.40–3.82	67.3	2.21 (1.14–4.27)	0.019*
Inadequate equipment	3.86 ± 0.98	3.68–4.04	75.5	2.85 (1.33–6.09)	0.006**
No written guidelines	3.16 ± 1.22	2.93–3.39	43.6	1.78 (0.92–3.42)	0.085
Staff shortage	3.76 ± 0.97	3.58–3.94	72.7	2.12 (1.05–4.26)	0.032*
Insufficient supervision	3.37 ± 0.89	3.21–3.53	52.7	1.90 (0.96–3.77)	0.064
Staff rotation	3.68 ± 1.04	3.48–3.88	50.9	1.62 (0.83–3.16)	0.135
Limited simulation access	3.60 ± 0.90	3.43–3.77	68.2	2.47 (1.19–5.12)	0.015*
Poor tray organization	2.82 ± 1.16	2.61–3.03	36.4	1.41 (0.71–2.81)	0.297
Communication barriers	2.90 ± 1.11	2.70–3.10	37.3	1.36 (0.67–2.74)	0.338
Time constraints	3.93 ± 0.69	3.80–4.06	78.2	3.09 (1.51–6.32)	0.002**
Overall Barrier Score	3.47 ± 0.48	3.38–3.55	—	—	—

*Logistic regression with low knowledge as outcome. *p < 0.05 statistically significant; **p < 0.01 highly significant.

These findings suggest that interventions to improve neonatal outcomes should go beyond didactic instruction and instead adopt a multifaceted approach that includes frequent simulation-based training, proactive resource management, clear clinical guidelines, and workforce planning to ensure adequate staffing levels during peak demand. Addressing these factors simultaneously is likely to enhance adherence to neonatal resuscitation protocols, reduce variability in practice, and ultimately contribute to lowering preventable neonatal mortality rates.

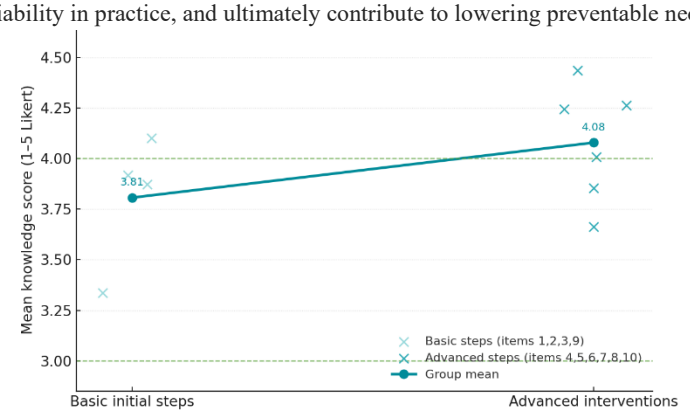

Figure 2 Aggregate knowledge on neonatal resuscitation by step complexity

Mean scores (Likert 1–5) clustered by basic initial steps (items 1,2,3,9) versus advanced interventions (items 4,5,6,7,8,10) show a group mean of 3.81 for basic tasks and 4.08 for advanced tasks. Scatter points indicate individual item means within each cluster; reference dashed lines mark thresholds at 3.0 (moderate) and 4.0 (high). Visually, advanced skills—dominated by oxygen administration (4.44), BMV initiation (4.26), mask seal (4.25), and epinephrine knowledge (3.85)—outperform foundational actions like drying (3.34), positioning (3.92), warm surface (4.10), and skin-to-skin/warmth (3.87), revealing a 0.27 absolute advantage for advanced steps and highlighting underemphasis of early, basic interventions despite their time-critical role.

DISCUSSION

The discussion of this study highlights critical insights into the knowledge, practice readiness, and systemic barriers influencing neonatal resuscitation (NR) delivery among nurses in a tertiary care context. The demographic profile revealed a predominance of young nurses with relatively limited clinical experience, reflecting a workforce still in the early stages of professional development. Although such a demographic composition can offer adaptability and responsiveness to training, it also implies the need for structured, ongoing education to ensure consistent adherence to evidence-based NR practices. The significant association between recent NR training and higher knowledge scores underscores the impact of continuous professional development on clinical competence, a finding echoed in other regional and international studies (12,13). This relationship suggests that skill decay, a well-documented challenge in NR, can be mitigated through regular refresher sessions and simulation-based reinforcement (14).

The knowledge findings demonstrate a generally strong theoretical understanding of core NR procedures, particularly advanced interventions such as oxygen administration, timely initiation of bag-mask ventilation, and recognition of indications for chest compressions. These results are comparable to findings from Ethiopia and Sudan, where healthcare providers demonstrated reasonable proficiency in technical aspects of NR following structured training (3,5). However, the study also identified concerning gaps in foundational steps, such as initial drying and thermoregulation, which are critical in the first minute of life. These steps, although simple, play a pivotal role in preventing hypothermia and facilitating spontaneous breathing and have been linked to reductions in neonatal mortality when correctly implemented (1,2). The relative underperformance in these areas suggests that training curricula and competency assessments may disproportionately emphasize advanced interventions, potentially leading to neglect of basic but equally vital procedures.

Barriers to effective NR practice revealed by this study were multifaceted, spanning individual, institutional, and environmental domains. Time constraints during high delivery loads emerged as the most significant impediment, consistent with evidence from South Asian and Sub-Saharan African contexts where staffing limitations and patient volume compromise adherence to standardized protocols (6,7). Inadequate availability of essential equipment and insufficient staffing further exacerbated these challenges, highlighting systemic deficiencies that directly undermine the ability of nurses to deliver timely and effective care. These findings align with the conclusions of Wall et al. (9) and Zaidi et al. (10), who reported

that resource scarcity and workforce limitations significantly compromise neonatal outcomes, even in the presence of adequate provider knowledge. Limited access to simulation-based practice and irregular training opportunities also contributed to suboptimal preparedness, reinforcing the importance of integrating ongoing practical skill-building into routine clinical workflows (8).

An additional dimension of the findings concerns the influence of institutional support structures, such as supervision, guideline availability, and communication processes. Although these factors were less frequently reported as barriers, their contribution to care quality cannot be overlooked. Studies have shown that structured mentorship, clear clinical algorithms, and supportive leadership significantly enhance guideline adherence and procedural accuracy during NR (11,12). The absence of such enabling environments may explain why knowledge does not always translate into performance, a phenomenon documented in multiple LMIC settings (5,6). This knowledge-practice gap suggests that interventions must move beyond individual capacity-building and address organizational readiness, including equipment logistics, staffing models, and the establishment of clear clinical governance mechanisms.

The integration of these findings points to several implications for clinical practice and policy. First, targeted educational interventions should address the observed deficiencies in basic NR steps while reinforcing advanced skills through high-frequency, low-dose simulation training. Second, institutional policies must prioritize the provision of essential resuscitation equipment, improve staff-to-patient ratios, and formalize supervision and feedback mechanisms. Third, NR protocols should be embedded into routine clinical checklists and quality improvement audits to ensure consistent practice. Finally, workload optimization strategies, including task redistribution and workflow redesign, could alleviate time pressures and improve adherence to evidence-based resuscitation protocols.

In conclusion, this study reinforces the notion that knowledge alone is insufficient to guarantee high-quality neonatal resuscitation. Effective practice depends on the interplay between individual competencies, institutional readiness, and environmental support. Addressing deficiencies across these domains—through regular training, robust infrastructure, supportive leadership, and systematic quality assurance—can bridge the persistent gap between knowledge and practice, ultimately improving neonatal survival outcomes in resource-constrained healthcare settings (13,14).

CONCLUSION

This study concludes that while nurses working in neonatal units at a major tertiary care hospital demonstrate a generally strong understanding of neonatal resuscitation principles, significant knowledge gaps remain—particularly in foundational steps such as initial drying, positioning, and thermoregulation. Advanced interventions, including oxygen administration, ventilation initiation, and chest compressions, were better understood, reflecting the positive impact of structured training programs. However, the translation of this knowledge into consistent clinical practice is hindered by systemic and environmental barriers. Time constraints due to heavy workloads, insufficient staffing, inadequate availability of essential resuscitation equipment, and limited opportunities for simulation-based skill reinforcement emerged as the most significant challenges. Additionally, gaps in institutional support—such as unclear guidelines, irregular supervision, and inconsistent feedback—further contribute to variability in clinical performance.

These findings underscore the need for a multidimensional approach to strengthening neonatal resuscitation outcomes. Interventions should include regular refresher training, integrated simulation exercises, and strategies to reinforce the importance of early, basic resuscitation steps. Simultaneously, healthcare institutions must address systemic shortcomings by improving resource availability, optimizing staffing models, and embedding standardized protocols into routine practice. Enhancing leadership engagement, supervision, and continuous quality improvement processes will further support skill retention and guideline adherence.

Ultimately, bridging the knowledge-practice gap requires more than individual competency—it demands a supportive clinical ecosystem where nurses are equipped, empowered, and enabled to deliver evidence-based neonatal care consistently. Implementing these targeted strategies can substantially reduce preventable neonatal morbidity and mortality, aligning clinical practice with global standards and improving newborn survival outcomes in resource-constrained healthcare settings.

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