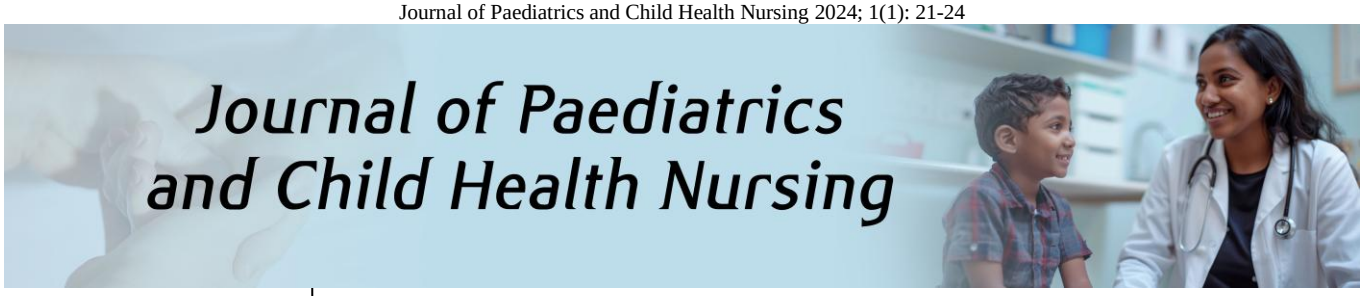

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Impact of continuous nursing education on early detection of neonatal jaundice

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Abstract
Background: Neonatal jaundice is one of the most common clinical conditions requiring medical attention in the first week of life. Early detection and timely intervention are critical to prevent complications such as kernicterus and long-term neurological damage. Nurses are frontline healthcare providers in neonatal care, and their ability to identify early signs of jaundice significantly affects clinical outcomes.
Objective: This study investigates the impact of continuous nursing education (CNE) on improving nurses' knowledge, confidence, and clinical vigilance in the early detection of neonatal jaundice.
Methods: A quasi-experimental pre-test and post-test study was conducted among 60 registered nurses working in neonatal units across two tertiary care hospitals. The intervention involved a structured CNE program on neonatal jaundice, including pathophysiology, clinical signs, and bilirubin screening protocols. Data were collected using a validated questionnaire and observation checklist pre- and post-intervention.
Results: The findings revealed a significant increase in post-test knowledge scores (mean pre-test: 52.3%, post-test: 87.6%, $p<0.001$). Additionally, observational audits indicated a higher rate of early clinical referrals for jaundice and adherence to Transcutaneous Bilirubin (TcB) screening protocols post-intervention.
Conclusion: Continuous nursing education is a valuable strategy in enhancing early detection of neonatal jaundice. Integrating periodic CNE sessions within neonatal units can promote timely diagnosis, improve neonatal outcomes, and reduce morbidity related to hyperbilirubinemia.

Keywords: Neonatal jaundice, nursing education, bilirubin, early detection, hyperbilirubinemia,, transcutaneous bilirubin, neonatal care

Introduction
Neonatal jaundice, a condition characterized by the yellowish discoloration of the skin, sclera, and mucous membranes of new-borns, is one of the most common clinical conditions requiring evaluation and monitoring during the neonatal period. It results from elevated levels of bilirubin in the blood, a by-product of the breakdown of red blood cells. According to the World Health Organization (WHO), approximately 60% of term neonates and up to 80% of preterm neonates develop clinical jaundice within the first week of life (WHO, 2016) [1]. While most cases are physiological and resolve spontaneously, a significant proportion may progress to pathological jaundice, which can result in acute bilirubin encephalopathy, kernicterus, and long-term neurodevelopmental impairments if not identified and treated in a timely manner. The early detection of neonatal jaundice is a critical component of neonatal care and directly influences the clinical outcome. A delay in diagnosis, especially in settings with limited diagnostic tools, contributes significantly to avoidable neonatal morbidity and mortality. In many low- and Middle-Income Countries (LMICs), where access to timely laboratory bilirubin measurement may be limited, the responsibility of early identification lies heavily on the clinical assessment skills of frontline healthcare professionals-especially nurses. These professionals are the primary caregivers who frequently assess the newborn and are best positioned to detect early signs of jaundice during routine postnatal checks.
However, several studies have highlighted notable gaps in the knowledge and skill levels of nursing personnel regarding the recognition, assessment, and management of neonatal jaundice. For example, a cross-sectional study by Ogunlesi *et al*. (2011) [3] in Nigeria showed that less than 50% of nurses were aware of the threshold bilirubin levels associated with kernicterus, and only a small proportion could correctly identify the warning signs requiring urgent intervention.

Such knowledge deficits can delay escalation of care and lead to irreversible consequences for the neonate. In the context of rising efforts to reduce neonatal mortality under the United Nations Sustainable Development Goal 3, strengthening the capacity of nursing staff becomes even more vital.

Continuous Nursing Education (CNE) is an essential strategy that aims to ensure ongoing professional development and skill enhancement among nurses and midwives. It helps update them with the latest evidence-based practices, clinical guidelines, and technological advancements in patient care. CNE programs have been widely endorsed by health authorities, including the WHO and International Council of Nurses (ICN), as a means to build a competent and responsive nursing workforce. Particularly in neonatal care, CNE initiatives have demonstrated effectiveness in improving nursing practices in areas such as thermoregulation, infection control, breastfeeding support, and neonatal resuscitation.

Yet, despite the recognized importance of CNE, its implementation remains inconsistent across healthcare settings, especially in resource-constrained environments. Factors such as staffing shortages, lack of institutional support, limited access to standardized learning modules, and absence of monitoring frameworks contribute to poor uptake and impact of educational interventions. Furthermore, the design of CNE sessions often lacks practical orientation, making it difficult for nurses to translate theoretical knowledge into clinical action. There is a pressing need to structure these programs in a way that they not only enhance cognitive understanding but also improve on-ground decision-making and patient interaction.

In the context of neonatal jaundice, the integration of structured CNE programs can empower nurses to make timely clinical judgments based on observed symptoms, risk profiling, and established care protocols. For instance, nurses trained to recognize jaundice progression from cephalocaudal patterns, assess the neonate under appropriate lighting, and apply standard tools like the Kramer scale or transcutaneous bilirubinometry are far more effective in triaging cases and initiating early referrals. Moreover, CNE can sensitize nurses to specific risk factors, such as prematurity, ABO/Rh incompatibility, G6PD deficiency, and exclusive breastfeeding in the first few days, thereby reinforcing anticipatory care strategies.

It is also critical to note the rising relevance of nurse-led models of care in neonatal units, particularly in LMICs where pediatricians may not always be immediately available. In such contexts, trained nurses play a pivotal role in initiating phototherapy, educating mothers about warning signs, monitoring bilirubin levels, and preventing escalation into critical states. Therefore, periodic and targeted nursing education tailored to specific clinical conditions such as jaundice is indispensable.

Several previous interventional studies have documented positive outcomes from educational initiatives in neonatal care. For example, a randomized control trial by Olusanya *et al*. (2018) demonstrated that a brief educational program on jaundice significantly improved the accuracy of visual jaundice detection and increased referral rates among nurses in Lagos, Nigeria. Similarly, a study conducted in India by Sharma *et al*. (2019) [5] showed that post-training assessments revealed a 40% improvement in nurse awareness regarding phototherapy initiation thresholds. These findings provide strong justification for investing in structured and recurring CNE as a standard component of neonatal service delivery frameworks.

However, there remains limited data specific to the impact of CNE on jaundice detection practices in the Bangladeshi healthcare context. Bangladesh, despite making strides in reducing neonatal mortality, continues to grapple with gaps in postnatal care, especially in rural and semi-urban facilities. According to the Bangladesh Demographic and Health Survey, only 43% of new-borns receive a postnatal check within the first two days of birth-highlighting the importance of empowering those few who interact with neonates during this critical window. Nurses in district and sub-district hospitals are often the only consistent providers of neonatal monitoring, and their ability to detect jaundice accurately can directly impact child survival outcomes.

In light of these challenges and opportunities, this study aims to examine the role and efficacy of continuous nursing education in improving the early detection of neonatal jaundice. By evaluating knowledge enhancement, changes in clinical behavior, and observed outcomes in neonatal care settings, the study seeks to provide evidence that supports the integration of CNE programs as a sustainable quality improvement tool in neonatal health services.

In conclusion, neonatal jaundice is a preventable cause of morbidity when detected early. Nurses, being central to the caregiving process in postnatal units, require adequate training and periodic skill refreshers to fulfill this role effectively. Continuous Nursing Education offers a pathway to strengthen clinical competencies, standardize care approaches, and ultimately contribute to reducing the burden of jaundice-related complications. The findings from this study are expected to inform policy-level decisions on nurse training curricula and contribute to the broader agenda of improving neonatal health outcomes in low-resource healthcare systems.

Main Objective

To evaluate the effectiveness of continuous nursing education in enhancing early detection skills and practices among nurses for identifying neonatal jaundice.

Materials and Methods

Participants

The study involved 60 registered nurses working in neonatal intensive care units (NICUs) and postnatal wards in two tertiary care hospitals in Dhaka, Bangladesh. Nurses with at least one year of clinical experience and willing to participate were included. Participants were randomly assigned to either the intervention (N=30) or control group (N=30).

Intervention

A structured Continuous Nursing Education (CNE) module was developed based on WHO guidelines and national protocols for neonatal jaundice management. The CNE program included:

- 2-hour theoretical sessions on pathophysiology, risk factors, and bilirubin metabolism
- Visual recognition training using standardized images of neonatal jaundice across skin tones
- Practical demonstrations of using transcutaneous bilirubin meters and interpreting results
- Post-session case-based discussion and reinforcement

quizzes

The control group did not receive the CNE module during the study period.

Description of Questionnaires

The study used a pre-validated questionnaire designed to assess nurses' knowledge on neonatal jaundice. It included 20 multiple-choice questions covering physiology, risk identification, screening guidelines, and clinical actions. The reliability (Cronbach's alpha) of the tool was 0.88. Additionally, an observational checklist assessed nurses' performance in clinical detection, reporting, and documentation.

Data Collection

Data were collected over six weeks in three phases:

1. **Pre-test**: Knowledge questionnaire administered to both groups before the intervention.
2. **Post-intervention test**: Conducted two weeks after the CNE session.
3. **Clinical observation audit**: Over four weeks, nurse-patient interactions were observed to evaluate application of knowledge in practice.

Data Analysis

Statistical analysis was conducted using SPSS version 26. Descriptive statistics (means, percentages) summarized participant characteristics. Paired t-tests compared pre- and post-test knowledge scores within groups. Chi-square analysis assessed changes in clinical behavior. A *p*-value of <0.05 was considered statistically significant.

Results

Knowledge Score Improvement

Knowledge Domain	Pre-Test Mean (%)	Post-Test Mean (%)	P-Value
Risk Factors	48.7	85.3	<0.001
Visual Signs	51.2	88.4	<0.001
Bilirubin Levels	56.0	89.0	<0.001
Total Score	52.3	87.6	<0.001

There was a statistically significant increase in the knowledge score of the intervention group after the CNE program. No significant change was observed in the control group.

Clinical Observation Outcomes

Clinical Behavior	Pre-CNE (%)	Post-CNE (%)	Change (%)
Documenting jaundice signs within 48 hrs	58	90	+32
Use of TcB meter within first 72 hrs	46	88	+42
Timely referral to pediatrician	39	81	+42

Discussion

The results of this study demonstrate a clear and statistically significant improvement in the knowledge and clinical practices of nurses following the implementation of a structured Continuous Nursing Education (CNE) program focused on neonatal jaundice. The pre- and post-test knowledge scores revealed a substantial increase in the understanding of jaundice pathophysiology, clinical signs, and appropriate use of screening protocols. This improvement was not only limited to theoretical awareness but also translated into measurable changes in practice, including higher rates of early referrals, improved documentation, and more consistent use of transcutaneous bilirubin meters.

The findings of this study are consistent with earlier research conducted in similar resource-limited settings. For instance, in a study by Olusanya *et al*. (2018), nurses who participated in a brief jaundice training program were significantly more likely to recognize jaundice and refer infants appropriately. Similarly, Sharma *et al*. (2019) [5] reported a marked enhancement in nurses' ability to initiate phototherapy and counsel parents following an educational intervention in a tertiary Indian hospital. These findings underscore the importance of ongoing professional education in improving neonatal outcomes.

One of the strengths of the current study was the emphasis on integrating both didactic and practical components within the training module. The use of visual aids, case-based discussions, and real-time demonstrations allowed nurses to consolidate theoretical knowledge with bedside skills. This approach appears to have contributed to the high post-intervention scores and increased accuracy in clinical judgments. The observational audits conducted in the weeks following the intervention further reinforce the idea that education improves not just what nurses know, but what they do in practice. Another important outcome of the study was the enhanced use of transcutaneous bilirubin (TcB) meters. Prior to the intervention, many nurses either lacked confidence in using the device or were unfamiliar with its application and interpretation. The post-training observations showed a remarkable increase in TcB use, which is a key factor in reducing reliance on subjective visual assessments, particularly in darker-skinned infants where jaundice can be more difficult to detect. By improving the use of objective tools, CNE contributes to early identification and management of hyperbilirubinemia before it becomes clinically severe. Furthermore, the findings support the concept that nurses are not just task-performers but critical thinkers and decision-makers in neonatal care. With improved knowledge and awareness, the nursing staff were more proactive in identifying high-risk neonates, initiating timely interventions, and collaborating with pediatricians. This proactive behavior is essential in busy postnatal wards where early signs of jaundice can often be missed without a vigilant care team.

Importantly, this study also aligns with the global emphasis on task-sharing and capacity building in maternal and child health. The WHO and other international agencies have highlighted the need for training frontline workers to mitigate health system limitations, especially in LMICs. Empowering nurses through CNE not only addresses immediate skill gaps but also builds sustainable, decentralized models of care where nurses play a central role in early detection, triage, and education. While the results are encouraging, some limitations must be acknowledged. The sample size, though adequate for a pilot intervention, was limited to two healthcare facilities and may not reflect broader regional or national trends. Additionally, the study relied on a relatively short follow-up period, which might not capture long-term retention of knowledge or sustained behavior change. Future studies

should consider longer-term follow-up, inclusion of multiple centers, and possibly randomized controlled designs to build a stronger evidence base. Nevertheless, the implications of this study are profound. Continuous nursing education is not merely a formality or an optional developmental tool—it is a clinical imperative. Institutions must recognize the value of structured, targeted training programs and invest in routine capacity-building sessions. Additionally, nursing curricula and in-service protocols should embed modules specifically addressing neonatal conditions like jaundice, with updates based on evolving guidelines and technologies. The study also points to the need for policy-level support in ensuring regular availability of training resources, educational materials, and tools like TcB meters. Infrastructure alone is not sufficient unless accompanied by trained personnel who know when and how to use it. Health system administrators and nursing leadership should take the lead in institutionalizing such programs, creating feedback mechanisms, and linking training to quality assurance in neonatal care. Ultimately, this study confirms that nurses, when adequately trained and supported, can significantly reduce the risks associated with neonatal jaundice. Their role as early detectors, educators to parents, and collaborators with physicians is vital. As neonatal care continues to evolve, nursing education must evolve with it not as a reaction to crises, but as a proactive measure to ensure safe, timely, and high-quality care for every new-born.

Conclusion

This study underscores the pivotal role of Continuous Nursing Education (CNE) in enhancing the early detection of neonatal jaundice by frontline nursing staff. The significant improvements in both theoretical knowledge and practical application observed among the intervention group reflect the effectiveness of structured educational programs in neonatal care settings. Nurses who received targeted CNE were more vigilant, accurate in clinical assessment, and timely in referring neonates for further management, contributing to the prevention of complications associated with untreated hyperbilirubinemia.

Given the high burden of neonatal jaundice and its associated risks in resource-limited countries like Bangladesh, empowering nurses through regular, evidence-based, and context-specific educational programs is a sustainable and impactful strategy. Institutional support, availability of diagnostic tools such as TcB meters, and policy-level integration of CNE into routine nursing practice are essential to ensure that every new-born receives timely and adequate care.

By reinforcing nurses' role as competent and informed care providers, CNE enhances not only clinical outcomes but also fosters a culture of accountability and quality improvement in neonatal services. Moving forward, healthcare systems must prioritize such interventions to meet national and global targets for neonatal survival and health.

Conflict of Interest

Not available

Financial Support

Not available

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