



## Promotion of Neonatal Pain Management in Neonatal Intensive Care Unit: A participatory Action Research

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### Abstract

**Introduction:** Pain management is especially important for infants who are not able to verbally express their pain. The objective of this study was to promote pain management in Neonatal Intensive Care Unit (NICU).

**Methods:** The present study was conducted using an action research based on Kemmis and McTaggart's action research cycle on 35 participants including nurses, physicians, and center managers involved in the care of neonates. Four qualitative methods including interviews, focus group discussions, strategic meetings, and field notes were used for data collection. The content analysis approach was also used to analyze the data. Two action cycles were designed, with four stages of "identification, planning, implementation, and observation and reflection".

**Results:** Based on the results of this study, the source of the challenges was categorized into four areas of human resources management, pain control policy, workplace conditions, and management factors. The steps for the follow-up and implementation of the proposed solutions and strategies included training workshops, preparation of pain control policy, provision of facilities and equipment, and participation of senior managers in the implementation of neonatal pain management. The results of data analysis in the final evaluation revealed two themes of "comfort" and "improvement" in pain management in the NICU.

**Conclusion:** The results of this study showed positive experiences of the participants on implementation of pain management in the NICU. The results also demonstrated that pain management problems in NICU can be reduced, without imposing high costs, by forming multidisciplinary teams and engaging various disciplines in the process of neonatal pain management.

**Keywords:** Pain management, Neonate, NICU, Qualitative study

### Introduction

Over the past decade, advances in infant care have contributed significantly to the survival of high-risk infants, including premature infants. These vulnerable infants admitted to the Neonatal Intensive Care Unit

(NICU) are often exposed to multiple invasive procedures as part of their care and experience an average of 10 to 16 hours of painful procedures daily during their hospital stay (1). Studies have shown



that infants born between 25 and 42 weeks of gestation who require intensive care may experience, on average, 14 hours of painful procedures daily in the first 2 weeks of hospitalization (2).

Proper treatment of pain in infants is particularly important as the sensory area of the brain in infants is the most active area of the brain and the pathway of pain transmission has been fully developed while its inhibitory systems have not well developed. Preventing pain in infants should be the goal of all health care providers, as exposure to the pain may have potentially harmful consequences. Therefore, effective and safe interventions should be considered and provided if painful procedures are needed (3). The main function of any health care provider is to identify and evaluate the pain and assess and treat it following national and international guidelines (3,4). Pain and stress assessment is recognized as one of the five core measures of developmental care. Over the years, the concept of developmental care has been described in detail. Recently, core measure sets for evidence-based developmental care have been identified: (1) protected sleep, (2) pain and stress assessment and management, (3) developmental activities of daily living, (4) family-centered care, and (5) the healing environment (5).

Pharmacological interventions are rarely prescribed before painful procedures are taken, regardless of the severity of the pain (6). Scientific evidence suggests that despite advances in neonatal pain management and increased awareness among health care providers about the primary complications of neonatal pain, nurses and physicians confirm that pain remains untreated in this vulnerable community (7). This indicates that the importance of neonatal pain management has not been shown in its clinical practice, and this gap between knowledge and practice is the reason for further research on neonatal pain management (6).

Despite growing knowledge about pain assessment and intervention, as infants cannot speak and defend themselves when they experience pain, neonatal pain management is still a challenge for infant care providers. Nurses are constant caregivers for infants, and nursing assessments of their pain and pain-related function are extremely valuable to this vulnerable population (8). A survey study involving US nurses and physicians found that although it is believed that infants feel pain and usually experience several painful procedures, pharmacological or non-pharmacological measures are rarely used (1).

The results of some studies indicate that there is still a gap between the scientific knowledge of

neonatal pain, its consequences, and the use of different techniques to assess and manage pain. These conditions are related to the lack of protocols for the evaluation and management of pain in health services and the absence of theoretical knowledge about its physiopathology, as well as the lack of assessment methods and treatment options for providing services to at-risk infants (9).

Action research is the bridge between theory and practice that leads to knowledge production and change in the research environment. It connects thinking with action and thus achieves both research and clinical goals (10). This kind of research seeks to empower those who are part of a process and with the help of individuals, seek to discover and solve problems. Action research allows them to actively engage and work together to design, direct, and report research results (11).

Various studies have so far suggested several strategies for controlling neonatal pain, mainly experimental and quasi-experimental studies on pharmacological and non-pharmacological interventions and their effects (12,13). Previous studies were researcher-centered, changes were dictated from the outside, organizations were not involved in identifying, explaining, confirming, solving, implementing, and evaluating issues, and interventions were transient and unstable. Therefore, in this study, the participation of all involved groups is needed to improve neonatal pain management, to deeply understand pain management in neonatal intensive care units, and to make a lasting change in neonatal pain management in a specialized setting. To this end, participatory action research was used to promote pain management in the neonatal intensive care unit of Alavi Medical and Training Center in Ardabil.

## Methods

This study was action research with a cooperation approach. In this approach, the researcher and the participants together design and make decisions for the research process (14). This study was performed in the neonatal intensive care unit of the Alavi Medical and Training Center in Ardabil in 2018. The data were collected through open-ended interviews, focus group discussions, and strategic meetings with the researcher, the nursing director, the educational supervisor, the head of the department, and the head nurse. Different locations were also noted to collect the data.

Two action cycles were designed in the present study, each with four stages of "identification, planning, implementation, and observation and reflection" based on Kemmis and McTaggart's action research cycle (Figure 1). This paper aims to share the

findings of the final evaluation steps in the second cycle of this action research.

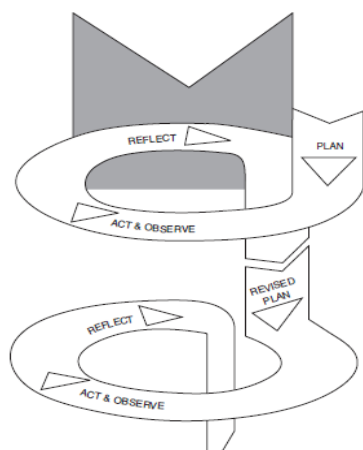


**Figure 1.** action research cycle, Kemmis and McTaggart (2007)

### Participants

All those involved in the process of assessment and management of neonatal pain in the neonatal intensive care unit were selected as members of the research team and participated in the study and all their views and opinions were considered. The participants were all 35 nurses and physicians working in the neonatal intensive care unit and the managers of the center.

Participation in the study was completely voluntary so that participants could stop participation at any stage they wished. Written informed consent was obtained from the participants and they were assured that not participating in the project would have no negative consequences for their occupation and that the findings would be published anonymously. At the end of each cycle, a summary of the findings was provided as feedback to the participants.

### Data Analysis

Data analysis was performed simultaneously with data collection using a technique proposed by Graneheim and Lundman, which has five steps for analyzing qualitative data: (1) Word-by-word transcription of interviews and repeated reading to understand their content, (2) Splitting the text into shorter units, (3) Abstracting and coding the summarized semantic units, (4) Comparing the codes based on their similarities and differences and categorizing them into classes and subclasses (representing the overt content of the text), and (5) Extracting the themes from the classes (representing the covert content of the text).

### Robustness of the data

The trustworthiness of the qualitative findings was assessed based on four criteria including credibility, transferability, dependability, and confirmability proposed by Lincoln and Guba (15). The credibility of the data was ensured by communicating appropriately with participants and checking the obtained codes (by other research team members and the participants themselves). Besides, an audit technique was used to increase the dependability and confirmability of the data. The interview text was reviewed by two raters who were serving as faculty members and they also confirmed the accuracy of the data analysis. To ensure transferability, detailed explanations were provided by the researcher so that the research findings can be applied and assessed by others.

### A. Identification

In the first stage, to identify and explain the current status of neonatal pain management in the NICU, a qualitative study was conducted with a content analysis approach based on focus group discussions with nurses and individual interviews with physicians and managers. Four focus group discussion sessions were held with nurses and 10 interviews were conducted with physicians and center managers. The problems extracted from the interviews and focus group discussions were reviewed at strategic group meetings. The problems were then prioritized based on urgency, feasibility, budget, and preparedness of the research team. Thus, the need for human resources empowerment, development of neonatal pain management policy, improvement of workplace conditions, and managerial factors in implementing neonatal pain management were identified as the top priority factors.

The factors identified in the qualitative data analysis were classified into two themes: "individual factors" and "organizational factors" that were effective in implementing neonatal pain management. The first theme includes "staff's knowledge" and "staff's attitude and commitment", and the second theme was subdivided into "pain control policy", "workplace conditions", and "management factors". According to the results, the source of the challenges was categorized into four areas of human resources management, pain control policy, workplace conditions, and management factors. Then, possible solutions were discussed. The steps for the follow-up and implementation of the proposed solutions and strategies included training workshops, preparation of pain control policy, provision of facilities and equipment, and participation of senior managers in the implementation of neonatal pain management.

## B. Planning

In the second stage, designing change plans after the identification stage (collecting initial data and reviewing the current position), the solutions proposed by the participants were reviewed in focus group discussions and strategic group meetings, and the change plan was designed by the involved group (Table 1). Therefore, for all change plans, an overall action plan was designed by the participants' involvement in the focus group discussions and the strategic group meetings. The strengths and weaknesses of the developed plan were identified after each implementation, observation, and reflection followed by the next cycle.

## C. Implementation

In the third stage, the designed plan was implemented

in the neonatal intensive care unit for 6 months. At this point, the change plan was identified. All stages were designed based on the functional plan and a Gantt chart and changes were made based on administrative hierarchy and coordination with managers.

## D. Observation and Reflection

At this stage, the results were given to the involved group via continuous control and monitoring, and implementation strategies were determined by discussing emerging challenges. At this point, the strengths and weaknesses of the plan were summarized and the issues that needed to be addressed were identified as shown in Table 2. The second cycle began based on the same framework.

**Table 1. Design and strategies of the change plan in neonatal pain management**

| Change plan design                             | Strategies                                                             |
|------------------------------------------------|------------------------------------------------------------------------|
| Human resources empowerment                    | Holding pain management workshops                                      |
|                                                | Holding neonatal pain management conferences                           |
|                                                | Preparing training pamphlets and booklets for neonatal pain management |
|                                                | Visiting advanced centers in neonatal pain management                  |
| Development of neonatal pain management policy | Providing guidelines for neonatal pain management                      |
|                                                | Providing pain assessment tools                                        |
|                                                | Neonatal pain control recording                                        |
|                                                | Pain management monitoring                                             |
| Improvement of workplace conditions            | Providing 24% sucrose for use in the ward                              |
|                                                | Providing blankets to position the baby                                |
|                                                | Providing incubator cover to reduce light                              |
| Managerial factors                             | Restructuring the ward                                                 |
|                                                | Involving top managers                                                 |
|                                                | Encouraging active personnel                                           |

**Table 2. Evaluation of the plan implemented in the first cycle**

| Evaluation of the plan | Items                                                                                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------------|
| Strengths              | Nurses' satisfaction with the quality of the pain management workshop                                                |
|                        | Cooperation of the nursing office in implementing the necessary changes and reforms                                  |
|                        | Nurses' satisfaction with the 24% sucrose effect in reducing neonatal pain and calming the baby                      |
|                        | Nurses' control of sound and light in the ward                                                                       |
|                        | Appropriate interaction between physicians and nurses in neonatal pain management                                    |
| Weaknesses             | The workload and crowdedness of the ward                                                                             |
|                        | Failure to complete the painful procedure form                                                                       |
|                        | Inadequate knowledge of pain assessment tools                                                                        |
|                        | Failure to record the neonatal pain assessment score                                                                 |
|                        | Not using other non-pharmacological methods                                                                          |
|                        | Resident physicians' failure to use pharmacological methods                                                          |
| Reforms                | Nurses' failure to prepare medications before doing the procedure                                                    |
|                        | Removing the painful procedure form                                                                                  |
|                        | Changing the NICU chart and adding pain assessment tool and infant's vital signs form to the chart                   |
|                        | Training the staff how to use infant pain tool using face-to-face and practical training in different working shifts |
|                        | Training the staff to use other non-pharmacological methods                                                          |
|                        | Emphasizing the use of pharmacological methods by resident physicians                                                |
|                        | Preparing painkillers by nurses before doing the procedures                                                          |
|                        | Checking the NICU chart to complete the pain section by the manager and the researcher                               |

## Second cycle: Implementing the first revised plan

This stage started after proposing the plan to the strategy group and upon their approval. Besides, the NICU chart was changed and the pain-related items including the type of procedure, pharmacological and non-pharmacological interventions, and pain assessment scores were recorded in the chart. After these changes, the staff members were trained by the researcher. To do so, the researcher attended the NICU in different working shifts every day and provided training to nurses about painful procedures such as blood sampling, venipuncture, endotracheal suctioning, as well as non-pharmacological interventions such as giving sucrose 24%, swaddling, etc. Furthermore, neonatal pain scores were assessed.

## Second cycle: Observation and reflection

At this stage, again the process of implementing neonatal pain management was observed and reflected and underwent developmental assessment.

## Evaluating or collecting data after change

The evaluation was performed after the end of the operational cycles with the participation of the members involved in the study in each cycle and data were collected after the change. As in the first stage, qualitative data were collected after the changes were made with the participation of the involved group. The data were then analyzed using qualitative content analysis.

## Results

The results of data analysis at the final evaluation stage revealed two themes of “comfort” and “improvement” in pain management implementation in the neonatal intensive care unit (Table 3).

### 1. Comfort

“Comfort” was the first theme extracted in this study. Comfort was subdivided into two categories: “Neonatal pain control” and “staff satisfaction”.

#### 1.1 Neonatal pain control

Most of the participants in this study agreed on the need for pain control in neonates and were well aware of the pain control measures performed in the procedures. Moreover, they used certain pain control measures in the procedures including “sucrose administration”, “non-pharmacological measures”, and “pharmacological measures”.

The use of sucrose was particularly popular among the participants, and most participants were very satisfied with its effect on neonatal pain control, especially in painful procedures such as venipuncture

and blood sampling, and they believed it had considerable effects on neonates, especially premature neonates. One of the participants stated: “*Sucrose is very effective. Sucrose calms the baby even when we are going to do venipuncture or other things. You can give some sucrose to calm the baby and then you can do your work very easily. Its effect is great*” (A nurse with 3 years of experience).

In addition to sucrose, some participants stated that they used other non-pharmacological methods to control neonatal pain including a pacifier, swaddle, and cuddling care. Concerning the effects of the sucrose-impregnated pacifier in painful procedures such as exchange transfusion, a participant stated: “*We put sucrose on the pacifier’s head or drop it into the baby’s mouth. The baby sucks the pacifier and calms down and we can do exchange transfusion more effectively. The baby does not struggle or recoil and the exchange transfusion is done more easily. It is a miracle when you soak the pacifier on the sucrose and pour it into the baby mouth*” (A nurse with 5 years of experience).

Most physicians use midazolam and fentanyl in infants as pharmacological measures. One of the participants stated: “*We use midazolam and fentanyl. For example, we always use midazolam to loosen the baby’s larynx with no pain or side effects. We use fentanyl too*” (A physician with 24 years of experience).

### 1.2 Staff satisfaction

Most study participants expressed satisfaction with the implementation of pain management as well as the developmental care for infants in the NICU, believing that pain management in the ward would comfort the nurses and lead to the nurses’ and physicians’ satisfaction.

Most study participants acknowledged that infant developmental care calms down infants and this also makes the nurses relaxed. According to one participant, “*Well, as we see, it silences the noise. Once a baby calms down and stops crying, other babies calm down too. This turns the ward into a quiet environment. The nurses must have at least some peace of mind*” (A nurse with 10 years of experience).

Most participants were satisfied with the impact of pain control and developmental care on infants, and in this regard, one participant stated: “*I personally enjoy when I feel that the baby is not crying. We feel that we have done something helpful so that the baby does not feel pain, and this makes us satisfied. That would be 100% satisfying*” (A nurse with 9 years of experience).

**Table 3. Themes, categories, and subcategories extracted from focus group discussions and interviews with participants**

| Themes      | Categories                         | Subcategories                                                                                                                                                |
|-------------|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Comfort     | Neonatal pain control              | Sucrose administration<br>Non-pharmacological measures<br>Pharmacological measures<br>Nurses' relaxation<br>Nurses' satisfaction<br>Physicians' satisfaction |
|             | Staff satisfaction                 | Implementing the pain policy<br>Changing the attitudes of the staff<br>Staff training<br>Employing qualified staff<br>Restructuring the NICU                 |
| Improvement | Institutionalizing pain management |                                                                                                                                                              |
|             | Workplace conditions               |                                                                                                                                                              |

Another participant stated: *"I feel happy and tell my coworkers it worked. When we give sucrose to a baby and they stop crying and it has no side effects, so it is best to use sucrose to calm the baby"* (A physician with 24 years of experience).

## 2. Improvement

The second theme identified in this study was "improvement" which was divided into two categories: "Institutionalizing pain management" and "workplace conditions".

### 2.1 Institutionalizing pain management

Most participants acknowledged that their attitudes toward pain had changed and emphasized the need and importance of pain control in the NICU. Accordingly, one participant stated, *"There is a great change in the attitudes towards pain control by nurses. I can say that 70% of nurses changed their view of pain management compared to the time when babies felt pain"* (A nurse with 9 years of experience).

One participating manager stated: *"An important issue is to foster pain management culture among the staff. Fortunately, our staff made considerable progress and came to the belief that they must control pain, and their attitude changed a lot because they saw the impact"* (A manager with 12 years of experience).

Most participants believed that pain management in the ward was institutionalized, and the pain policy was being implemented in the ward, and attitudes toward pain management changed. However, more training is needed.

Concerning the institutionalization of the use of sucrose in the ward, one of the participants stated: *"We take sucrose with ourselves when doing venipuncture and record the pain scores. Believe me; I take sucrose before using angiocaths. It is a common practice for venipuncture. I even administered*

*sucrose and did venipuncture on my own. Of course, the baby got a good vein"* (A nurse with 5 years of experience).

### 2.2 Workplace conditions

Most participants identified workplace conditions as an important factor in improving pain management which was further categorized into "hiring effective staffs" and "restructuring the NICU".

One of the participants also commented on the incompatibility between the number of nurses and newborns and the demand for more workforce: *"One of our main problems is the workload. Well, I can handle 3 babies much easier than 10 babies because I have enough time to provide care to all babies. When there are a huge number of patients to be cared for by a small number of nurses, some things are missed and supportive actions get unnoticed while they are a part of treatment. There are also lots of writing tasks and they take a lot of time. When we record everything on a computer, there is no need to write them again"* (A nurse with 9 years of experience).

The design of the NICU and the need to design night and day episodes for the developmental care of infants are very important. Accordingly, one of the participants stated: *"One of our ideals is designing a standard NICU with low noise, controlled light, and a standard physical environment in the long run. This helps the infants and their parents who come to see the infants, and the staff feel comfortable"* (A physician with 20 years of experience).

## Discussion

The findings of this study at the final evaluation stage showed that empowering the staff, improving the nurses' access to pain management policy and care standards and providing them based on neonatal need have promoted neonatal pain management leading to comfort, staff satisfaction,

institutionalization of pain management, and improvement of working conditions in the NICU. As a result, the nurses provided infant care with higher self-confidence.

Most participants were satisfied with the impact of pain management interventions, especially sucrose, on neonatal pain control and described it as miraculous in terms of its effect on reducing neonatal pain and relieving infants. There have been a great number studies on the effect of sucrose on neonatal pain control. The results of a review study by Campbell et al. on the safety and effectiveness of sucrose as an analgesic for neonates showed that oral sucrose with and without pacifier in preterm and term neonates was effective in reducing neonatal pain responses up to the first month of life. Sucrose is accepted as a non-pharmacological intervention for procedural acute pain management and its administration is associated with sedation and a reduction in pain behaviors observed in term and preterm infants (15).

According to the findings of the present study, some participants suggested that sucrose could be effective in combination with other methods. There have been many studies on the common use of sucrose and pacifier (16-18). It is clear from these studies that a normal sucking action by an infant may cause a sedative response and appears to be analgesic when combined with sucrose.

In line with the present study, similar results have been reported on the impact of non-pharmacologic pain management interventions including kangaroo care (19) and skin-to-skin contact (20) on neonatal pain relief in different procedures. Kangaroo care is an easy, non-pharmacological intervention that involves parents and can be performed as a pain management procedure for physiological and behavioral stability in preterm infants.

The majority of participants in the present study were satisfied with the implementation of neonatal pain management and stated that their attitudes toward pain had changed and that pain management was institutionalized and implemented in the ward. However, more training and supervision is needed in the ward.

The results of a study by Diemar et al. showed that at the beginning of the study, most of the research units did not receive any training in pain management, whereas after the educational intervention most of the participants in training courses changed

their attitudes about neonatal pain control and management, indicating the importance of education in this area (9). In another study, Deindl et al. implemented the neonatal pain and sedation protocol in two neonatal intensive care units in Australia. This protocol included strategies defined for both pharmacological and non-pharmacological interventions based on a systematic evaluation on the N-PASS scale. The staff members were trained using video and clinical training materials, and reassessment, re-training, and random quality control were performed. The results showed that the implementation of the neonatal pain and sedation protocol in the two NICUs resulted in increased opiate dose, pharmacological interventions, and staff satisfaction without affecting mechanical ventilation time, length of stay in the NICU, and the consequences of complications (21). Using a three-stage action research study in Brazil, Diemar et al. assessed the perception of neonatal intensive care team about pain assessment and management before and after educational intervention and its implementation in the ward, and the results showed that the staff who participated in the training intervention observed changes in pain management in the ward and considered them to be associated with strategies defined and implemented by the operative group (9). Similar findings were obtained in a study by Lago et al. They evaluated the hospital's current performance on analgesia in neonatal intensive care units 5 years after the release of the National Guideline in Italy, and the results showed that most Italian NICUs implemented some analgesic and sedative procedures for aggressive procedures under the Guideline. However, routine adherence to pain control and monitoring is still less than desirable (21).

A study by Shen and El-Chaar using a three-stage quality improvement project on the effect of training on the use of oral sucrose on pain from heel blood sampling suggested 84% increase in sucrose use after the training intervention (the third stage). Most importantly, there was 11.2% decrease in the score of neonatal pain from heel blood sampling, and no adverse effects were observed with sucrose. The results also showed that despite the availability of sucrose and nursing and staff awareness, this treatment was not used regularly. However, the training program was effective in the use of sucrose and led to reduced pain due to heel blood sampling in infants (22). These findings are in line with the results of the present study.

## Conclusion

The results of the content analysis of the participants' experiences indicated their positive experiences of performing pain management in neonatal intensive care units. It was shown that by forming a multidisciplinary team and engaging different disciplines in the process of neonatal pain management and collaborating among different therapeutic groups, without imposing a high cost, some of the challenges related to neonatal pain management implementation can be mitigated. Besides, the involvement of all stakeholders in the planning and implementation of neonatal pain management is effective in reducing the problems in the ward, reducing the gap between theory and practice of neonatal pain management, and increasing staff satisfaction and responsibility.

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