Abstract

When a newborn is hospitalized in the Neonatal Intensive Care Unit (NICU), families often have limited opportunities for physical contact, which may lead to difficulties in the formation of healthy attachment and increase the risk of postpartum depression. We propose an Embodied Online Visitation System to support embodied bonding between babies and their families across physical distance. Unlike standard online visitation, which only provides visual access to the baby, our system delivers synchronized heartbeat vibrations—matched to the baby' s actual heart rate—through a chest-held device. This evokes the feeling of holding the baby while watching a live video. Our system offers a supplementary way for families to feel connected even when face-to-face visitation is not possible. By enhancing the sense of closeness and reassurance, it may help nurture emotional well-being and attachment. This technology offers a gentle way to maintain the parent-child bond beyond the limits of time and physical distance.

The importance of parent-child interaction

Hospitalization in the NICU often limits opportunities for physical interaction between parents and their babies, which has been associated with an elevated risk of postpartum depression and may disrupt the formation of healthy parent-child attachment.

To promote parent-infant bonding during hospitalization, NICUs actively implement practices that encourage skin-to-skin contact, such as touch care and kangaroo care.*

This involves placing the infant on the parent's bare chest to promote direct skin-to-skin contact and strengthen the parent-infant bond.

Limitations on direct physical interaction

Opportunities for family visits may be restricted due to a range of factors:

- Infection control for high-risk emerging diseases (e.g., COVID-19)
- · Family-related social factors (e.g., work, caring for older siblings)
- Geographical barriers (e.g., distance, transportation access)

Embodied Online Visitation System

We have devised an Embodied Online Visitation System that allows parents to feel as if they are holding their baby remotely.



Through a chest-held device, the family can experience heartbeat vibrations synchronized with the baby's heart rate and watch a live video of the baby. The family's voices are captured by a microphone and transmitted to the baby through a speaker mounted on top of the incubator.

Interviews with families of babies hospitalized in the NICU

Eleven family members (six mothers, four fathers, and one grandmother) experienced the Embodied Online Visitation System as well as two other types of online visitation, and were asked about their impressions of each.



What aspects did you find good?

Collaboration with Iwate Medical University

A was a standard online visitation, but it was nice to be able to clearly see my child's full-body movements. In A, I felt a bit of distance between myself and my child. B and C felt much closer, and I especially liked B because I could clearly see my child's face.

In C, I felt as if I was holding my child—not only through the tactile sensations in my hands but also visually. In A, my child felt somewhat distant, but in B and C, I

could feel their heartbeat. In C, I felt as if I was holding my child, which helped ease my sense of loneliness.

Feeling the heartbeat made me realize that my child's heart was truly beating. In C in particular, I could feel both my child's presence and heartbeat together, which gave me a sense of reassurance.

The Embodied Online Visitation System was preferred by many of the family members, and it appeared to help them feel closer to their baby and evoke the feeling of holding their baby, which in turn provided a sense of reassurance for the parents.

References

[1] A. Murata, Y. Toya, K. Komazaki, A. Matsumoto, G. Sotodate, J. Watanabe, M. Akasaka. "Exploring an embodied interaction system to support the bond between hospitalized newborns and parents in the NICU," in Proc. *the 29th Annual Conference of the Virtual Reality Society of Japan*, 2A1–12, 2024. (in Japanese)

[2] A. Murata, K. Komazaki, Y. Toya, A. Matsumoto, G. Sotodate, M. Akasaka, J. Watanabe. "Supporting family bonds with hospitalized NICU extremely preterm infants through an embodied online visitation system," in Proc. *the 24th International Conference on Interaction Design and Children*, 2024. (accepted)

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