Interfacility neonatal transfer for convalescent care — efforts toward achieving better regionalized care —

(The Institutional Review Board's approval Number 509-31-38)

Short running title: Interfacility neonatal transport

Yoshio Shima, Shohei Matsukawa, Kentaro Yashiro, Makoto Migita

Department of Neonatal Medicine, Nippon Medical School, Musashikosugi Hospital, Kanagawa, Japan

Correspondence to Yoshio Shima, MD

Department of Neonatal Medicine, Nippon Medical School, Musashikosugi Hospital, 211-8533, Kosugicho, 1-396, Nakahara-ku, Kawasaki City, Kanagawa, Japan

E-mail: shima-p@nms.ac.jp
Tel: +81-44-733-5181; Fax: +81-44-733-8824
Abstract

Background: Transfer of infants who no longer need intensive or specialized care from tertiary to community hospitals or clinics contributes to efficient bed utilization in neonatal intensive care units (NICUs).

Methods: A retrospective analysis of the records of all 1,503 infants admitted to our NICU during the past 6 years (from April 2013 to March 2019) was performed to evaluate the impact of interfacility neonatal transport for convalescent care.

Results: During the study period, our NICU accepted 33 infants from other tertiary NICUs and transferred 103 infants to other hospitals or clinics before their home discharge for convalescent care. Our NICU covered 39% of the total hospital days of infants accepted from other NICUs. Of the infants transferred to other facilities, 81% of infants born at our hospital were born to mothers transported to our obstetric department as imminent high-risk deliveries; 94% of infants born at other hospitals were moved back to the referring facility.

Conclusions: Interfacility neonatal transport for, both accepting and transferring infants for convalescent care has become an integral part of NICU practice to bridge the gaps between higher level care facility and home. Establishment of well-defined transfer criteria and appropriate allocation of medical and staff resources among relevant facilities is desirable.

Key Words: Neonatal transport; Regionalization; Convalescent care
Introduction

A recent sharp decline of neonatal mortality can be attributed not only to advances in technology, but also to establishment of risk-appropriate regional perinatal care. Regionalization stratifies hospitals and clinics by their available resources for neonatal care, from low-risk newborn nurseries to neonatal intensive care units (NICUs), and includes patient transport that aims to deliver optimal care to infants in need. The definition of level care has been usually given as follows: Level I nurseries provide a basic care for well-newborns; Level II units provide specialty care for moderately premature or ill infants (e.g., above 32 weeks gestation and 1,500 g at birth), with the capability of mechanical ventilation; Level III units provide subspecialty care for very premature or sick infants (e.g., less than 28 weeks gestation and 1,000 g at birth, or being in serious surgical condition), including major surgery. Initially, neonatal transport was only from facilities delivering lower-level care to those with tertiary NICUs. However, the care of premature and seriously ill infants who require prolonged hospital interferes with efficient NICU bed utilization, particularly for infants needing acute treatment such as respiratory supports. Transport of infants back to the referring hospital or clinic after their condition has been stabilized so that they can continue convalescent care closer to the family residence has been proposed to solve this problem. The number of NICUs providing care for premature and sick infants in community hospitals has been increasing. Consequently, interfacility neonatal transport in advance of home discharge has become possible and allows the sharing of available hospital beds, medical, and staff resources within a region. The development of regionalized care has resulted in a need for the appropriate selection of infants who need care at a tertiary NICU and the organization of an efficient transport system. Our NICU is one of the regional perinatal emergency service centers in Kanagawa prefecture, with six NICU and 12 growing care unit beds. We constantly care for very preterm infants of less than 28 weeks gestation, though we transfer infants with major cardiac anomalies or neurosurgical disorders to other tertiary NICU, where highly specialized surgical care is possible. Thereby, the level
care of our NICU is classified as facility corresponding to between tertiary and Level II. The study objective was to evaluate the performance of interfacility neonatal transport before home discharge. We describe our clinical experience and the role of non-tertiary NICUs in the setting of regionalization of care.

Materials and Methods
The Institutional Review Board at Nippon Medical School Musashikosugi Hospital approved this retrospective cohort study. The demographic and clinical data of all infants who were admitted to our NICU during the past 6 years, from April 2013 to March 2019, were retrieved from their medical records. Gestational weeks, birth weight, reason for hospitalization, length of hospital stay, and respiratory support at the time of transfer were included in the analysis. Facility level-of-care was classified as follows. The tertiary NICU provided highly complex care for very preterm infants of < 28 weeks gestation and for neonates requiring major surgery. Level II NICU care was delivered to moderately preterm infants of < 34 weeks gestation), and level I care was routine nursery care of newborns and mothers. The provision of transport before home discharge was determined by discussion between our NICU and the regional facility, both for acceptance and transfer of infants, following resolution of the acute-stage problem and the absence of need for intensive or specialized care.

Results

Demographic and clinical characteristics of infants admitted to our NICU
During the study period, 1,503 infants were admitted to our NICU from the obstetrics department of the hospital (in-born) or transferred from other hospitals or clinics (out-born). Nine infants died before discharge from our NICU; the remaining 1,494 live-discharged infants were included in the study. Of
those, 1,125 were in-born, and the remaining 369 were out-born (Fig 1). Sixty-two infants (4.1%) were of < 28 weeks gestation, 118 (7.9%) were of 28–31 weeks gestation, 564 (37.8%) were of 32–36 weeks gestation, and 739 (49.5%) were of 37 weeks gestation or more. The gestational age of 11 infants (0.7%) was uncertain because they were born to mothers without known pregnancy histories.

The birth weights of 71 infants (4.8%) were < 1,000 g, 96 infants (6.4%) weighed 1,000–1,499 g, 699 (46.8%) weighed 1,500–2,499 g, and 628 (42.0%) weighed 2,500 g or more. Respiratory support was needed by 366 infants (24.5%) and was provided by mechanical ventilators, continuous positive airway pressure (CPAP), or high flow nasal cannulas (HFNCs).

**Infants transferred to our NICU from other NICUs**

Of the 369 out-born infants, 33 (8.9%) were transferred from other NICUs after their acute clinical problem was resolved and their condition was stabilized, but were indicated for continuing convalescent care. Gestational age and birth weight were distributed as follows. Ten infants (30.3%) were of < 28 weeks gestation, ten (30.3%) were of 28–31 weeks gestation, 11 (33.3%) were of 32–36 weeks gestation, and 2 (6.1%) were of 37 weeks gestation or more. Thirteen infants (39.3%) were weighed less than 1,000 g at birth, seven (21.2%) weighed 1,000–1,499 g, 12 (36.4%) weighed 1,500–2,499 g, and one (3.0%) weighed 2,500 g or more (Fig 2). The median age at admission to our NICU was 27 (range, 7–120) days. All infants were eventually discharged to home from our NICU. Their median length of stay in our NICU was 25 (range, 7–76) days. The total hospital days, from birth to home discharge, was 2,465 days. The infants spent 969 days in our NICU before being home discharge. One infant was prescribed home oxygen therapy. The others did not require supplemental oxygen at the time of discharge. All infants are scheduled for regular follow-up clinic visits after home discharge.

**Infants transferred from our NICU to other hospitals or clinics**

Of the 1,494 living infants discharged from our NICU, 128 (8.6%) were transferred to other facilities before home discharge. Twenty-five (19.5%) were transported to tertiary-level NICUs for advanced
treatment, mainly for major cardiac surgery. The remaining 103 (80.5%) were transferred to other hospitals or to the original referring clinics after their acute-phase problems were resolved and they were clinically stable and indicated for continuing convalescent care (Fig 1). Sixteen of the 103 infants in the latter group were in-born; 87 were out-born. None of the infants required supplemental oxygen or intravenous infusions at the time of transfer. Fifteen of the 16 in-born infants (93.8%) were born preterm with low birth weights. Thirteen (81.3%) were born to mothers who were transported to the obstetrics department of our hospital because of high-risk pregnancies (Fig 2a). The median hospital stay of those in-born infants was 47 (range, 8–113) days, and all were transferred to Level II NICUs. Only five of 87 out-born infants (5.7%) had low birth weights of < 2,500 g, and 82 (94.3%) were returned to the hospitals or clinics where they were born (Fig 2b). The median hospital stay of the out-born infants was 4 (range, 1–15) days.

Discussion

Our NICU had a clinically significant impact on regional interfacility neonatal transport before home discharge, both on the acceptance of infants and the transfer of infants to convalescent care. The first evaluation was the acceptance of infants who had received acute treatment at another tertiary or higher level-of-care NICU, were clinically stable, and were transported to us. Those infants accounted for 8.9% (33/369) of all out-born admissions to our NICU. Most of those infants were born preterm and had low birth weights. Twenty-six of the 33 (78.8%) were given mechanical ventilation during the initial NICU stay and seven of the 26 (26.9%) still required respiratory support on admission to our NICU. All were extubated, but four were on CPAP and three were on HFNCs. The safety of infant with respiratory support is always a concern, especially after transport. Closer than usual attention was paid to the practice of weaning from pressure or flow support for those infants. All but the one infant who was prescribed home oxygen therapy were eventually discharged home without need for supplemental
oxygen. Our NICU covered 39.3% (969/2465) of the total hospital stay, from birth to home discharge, after transfer to us from other NICUs. The acceptance of infants who no longer required intensive care at other high level-of-care facilities contributed to efficient utilization of NICU beds within the region, especially for treatment of acute-phase problems, which demand considerable medical and staff resources. Convalescent transport facilitated frequent family visits and encouraged parents to participate in the care of their infants by decreasing financial and emotional stress. It also strengthened the relationship between the infants and their care providers in the community, allowing a smooth transition to support and follow-up after home discharge 4,6,7.

The second evaluation was transfer of infants from our NICU to other hospitals or clinics. Concurrent with acceptance of convalescent care transport from other NICUs, we transferred infants for the same purpose after their acute-phase problems had resolved. Of the 103 infants transferred from our NICU, some were in-born infants sent to other Level II NICUs, other were out-born infants returned to the referring hospitals or clinics. High-risk deliveries are not always predictable. Consequently, emergency transport, either maternal or neonatal, across regions is frequently carried out because of overcrowding in the nearest NICU. We found that 81.3% (13/16) of the in-born infants in this series were born to mothers who were transported to us for an imminent high-risk delivery. Eleven of the 13 infants had very low birth weight of < 1,500 g and nine received mechanical ventilation during their NICU stay, which was prolonged compared with that of infants accepted from other NICUs because supplemental oxygen was discontinued at the time of transfer. In contrast to this infant, out-born infants were returned to their original referring hospital or clinic after shorter lengths of stay because we actively promoted family bonding for infants who are not seriously ill. Despite the benefits of convalescent transport, changes in setting or caretakers, or increased risk associated with rehospitalization resulted in increased parental anxiety 7,8. Fortunately, there was no unplanned rehospitalizations or emergency room visits before first scheduled clinic follow-up after home
discharge. To avoid such events, close communication between the involved facilities to build a clear understanding of the criteria describing the clinical status of the infants.

In conclusion, our NICU played an important role in interfacility neonatal transport before home discharge for convalescent care. We both accepted and transferred infants, which contributed to bridge the gaps between higher level care facility and home. Efficient regionalization is essential to maintain the quality of perinatal health care service provided by the involved hospitals and clinics. The burden of selecting eligible infants for convalescent care and organizing their transport will likely increase in the future. Appropriate allocation of medical and staff resources for tertiary and for non-tertiary NICUs requires careful discussion and planning.

Acknowledgments

The authors express appreciation to the staff members at the NICU of Nippon Medical School Musashikosugi Hospital for dedicating special care to the infants in this study. The authors did not receive any support in the form of grants and/or equipment and drugs in this study.

Disclosure

The authors have no conflicts of interest to declare.
References


FIGURE LEDGENDS

**Figure 1.** Outcomes of infants enrolled in this study. Thirty-three infants from other NICUs, and 103 infants from our NICU were transferred for convalescent transport before home discharge.

**Figure 2.** Demographics of the 33 infants transferred from other NICUs. The vast majority of infants were preterm and had low birth weights.

**Figure 3 (a)** Demographics of in-born infants transferred from our NICU to other facilities. The majority were preterm and had low birth weights. **(b)** Demographics of out-born infants transferred from our NICU to other facilities. In contrast to in-born infants, only a few were preterm with low birth weights.
Total admission (1503)

Died before discharge (9)

Live discharge (1494)
In-born/Out-born (1125/369)

Home discharge (1366)

Transferred from other NICUs (33)

Level III NICUs (25)

Transferred to other facilities (128)

Level I, II facilities (103)

Figure 1
Demographics of infants transferred from other NICUs

Gestational age

Birth weight

Figure 2
Demographics of in-born infants transferred to other facilities

Figure 3a
Demographics of out-born infants transferred to other facilities

Figure 3b