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ORIGINAL ARTICLE

# Rehospitalization of preterm infants below 32 weeks of gestational age in the first 2 years post discharge

## Rehospitalización en prematuros menores de 32 semanas o menores de 1.500 g en los primeros 2 años posteriores al alta

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**What do we know about the subject matter of this study?**

According to the available literature, preterm newborns, especially those younger than 32 weeks or weighing less than 1500 g at birth, are at higher risk of hospital readmission after discharge.

**What does this study contribute to what is already known?**

It provides local evidence in Chile, based on recent data from a public health center over a long period, and is comparable with international data. It confirms the high percentage of readmissions in this group of preterm newborns, especially in the first 6 months after discharge, as well as their severity. This is relevant information to consider at the time of discharge and to plan preventive health strategies in the follow-up.

## Abstract

Preterm infants, especially those of lower gestational age (GA), are at high risk of hospital readmission in the early years. **Objective:** To describe the frequency and characteristics of readmissions in preterm infants younger than 32 weeks of GA or weighing less than 1500 g (< 32w/< 1500 g) at 2 years post-discharge from neonatology. **Patients and Method:** Retrospective observational study of a cohort of newborns < 32w/< 1500 g discharged from a public health care center (2009-2017). The frequency, time of occurrence, risk factors, causes, and severity of hospital readmissions were analyzed. The respective perinatal characteristics and subsequent readmissions were described. The Ethics Committee approved the data collection protocol. **Results:** 989 newborns < 32w/< 1500 g were included; 410 (41.5%) were readmitted at least once before the age of 2 years, equivalent to 686 epi-

**Keywords:**
Patient Readmission; Premature Infant; Very Low Birth Weight; Respiratory Tract Infections; Risk Factors; Bronchopulmonary Dysplasia

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sodes (1.7/child); 129 children (31.4%) were admitted to the Pediatric Intensive Care Unit (PICU), with a mean length of stay of 7.7 days. The greatest risk for hospital readmission was during the first 6 months post-discharge. The main cause was respiratory (70%) and respiratory syncytial virus was the most frequent germ. The risk factors associated with readmission due to respiratory causes were bronchopulmonary dysplasia (BPD) (OR: 1.73; 95%CI: 1.26-2.37) and number of siblings (OR: 1.18; 95%CI: 1.04-1.33). **Conclusions:** Newborns < 32s/< 1500 g are at high risk of hospital readmission due to respiratory causes and PICU admission in the first months post-discharge; BPD and number of siblings were the main risk factors.

## Introduction

During the last decades, improved obstetric and neonatal management has allowed an increase in the survival of the most immature preterm and very low birth weight newborns. However, upon discharge from neonatal intensive care units (NICUs), preterm newborns may have major morbidities with short-, medium-, and long-term consequences, such as bronchopulmonary dysplasia (BPD), nerve neurological sensory disorders, and gastrointestinal tract alterations, among others[1], which require the use of high-cost healthcare resources in neonatology units[2,3] and during follow-up[4]. A study in Massachusetts, United States, estimated a cost of USD 9,356 in care and support services required per surviving newborn for an extremely preterm (< 28 weeks) newborn during the first year of life, compared to USD 1,430 for a term newborn[5].

Several studies have shown that hospital readmission in this group of preterm newborns is a frequent problem during the first years of life, with rates three to four times higher than those of term newborns[6,7], with the first year after discharge being the most frequent, with a decline in the following years[8].

In order of frequency, respiratory, surgical, and non-respiratory infections are the main causes of readmissions described by international and national networks or local experiences. Preterm newborns of lower gestational age (GA) and those with BPD have a higher health risk and readmissions than those who do not have BPD[8]. Socioeconomic status is also another factor to consider that can determine a greater susceptibility to illness[9].

This point is especially relevant from a public health perspective for parents and health personnel, who, after discharge from the neonatology department, should closely follow the patient, adjust care, and educate the family on management recommendations.

At the national level, there are few published data on the frequency, causes, and time after discharge when hospital readmissions occur during early infancy in this group of preterm newborns[10]. The objective of this study is to describe the frequency and risk factors for readmission in a population of preterm newborns younger than 32 weeks or weighing less than 1500 g (< 2w/< 1500g) during the first 2 years after discharge , identifying the main causes, the periods of greatest vulnerability, and the severity of the first admissions.

## Patients and Method

Retrospective study of an observational cohort of newborns < 32w/< 1500g discharged from the neonatology unit of the *Hospital Dr. Sótero del Río*, users of the public health service of the Metropolitan Region, Chile, where a follow-up program up to 7 years of age is carried out according to nationally established regulations[11]. We selected preterm newborns admitted between 2009 and 2017 with data up to 2 years of age. Preterm newborns with major malformations and those discharged from other maternity wards were excluded.

Maternal history and neonatal morbidity were obtained from the review of neonatal clinical records and readmission data from digital discharge summaries. Hospital readmission was defined as a stay longer than 24 hours in a pediatric center after hospital discharge.

### Neonatal variables

The neonatal variables were GA (defined by prenatal ultrasound or clinical neonatal examination), sex, birth weight (g), and 1 and 5 minutes Apgar scores.

### Hospital stay variables

The following were recorded: use of surfactant; diagnosis of intracerebral hemorrhage (ICH) according to Papile et al.[12] severity classification grade I-IV, with severe ICH (ICH III-IV); late sepsis (≥ 72 hours), defined by alterations in general condition and hematological parameters and/or positive blood cultures; ductus surgical closure according to registry (DUCTUS-op); retinopathy of prematurity (ROP-treated); surgical necrotizing enterocolitis (NEC) (according to surgical registry and Bell staging criteria as objective markers of severity); BPD, defined as oxygen de-

pendency at 36 weeks of corrected GA; total days of mechanical ventilation (MV) (conventional or high frequency); preseence of seizures; use of palivizumab, and days of hospitalization in neonatology.

**Variables at discharge from neonatology**

Breastfeeding at discharge (defined as any intake volume at discharge); oxygen therapy at discharge; anthropometry: weight (g), length (cm), head circumference (cm), and GA at discharge were considered.

**Maternal variables**

Maternal variables included age, educational level defined as the number of completed years, number of children, primiparity, prenatal care, prenatal corticosteroid use (at least one dose), multiple pregnancy, and type of delivery (vaginal or cesarean).

**Hospital readmission variables**

The first 3 hospitalizations of each child up to 24 months after discharge from neonatology were recorded. The time elapsed between discharge and each readmission was calculated. Total days of stay, days in the Pediatric Intensive Care Unit (PICU), and days in MV were recorded. The main causes were categorized as respiratory, non-respiratory infections, surgical, digestive, and others. In cases with respiratory causes, the results of the viral panel were recorded.

**Statistical analysis**

Cathegorical variables are described with the number of cases and proportions and numerical variables with mean and standard deviation if symmetrical or median and range if asymmetrical. The proportion between hospitalized and non-hospitalized preterm newborns was compared using Pearson's chi-square test. The difference in medians for numerical variables was assessed with the Student's t-test or Mann-Whitney test depending on whether the assumption of normality of the means was met. Multiple imputation was performed on variables with missing data, using the Multiple Imputation by Chained Equations (MICE) algorithm. 10 data sets were imputed, in which the percentage of imputed observations per variable ranged from 0.1% to 15.17%.

The joint association between readmission and the explanatory variables (sex, GA, twins, Apgar at 1 minute ≤ 3, number of children, infection, use of continuous positive airway pressure [CPAP], BPD, $O_2$ at discharge, DUCTUS-op, NEC-op, severe ICH, ROP-op, periventricular leukomalacia [PVL], Presence of seizures, use of palivizumab, and breastfeeding at discharge) were evaluated using logistic regression. Using the backward method and the Wald test, a final model was selected. Similarly, a regression was fitted for hospital readmission for respiratory causes.

In the subgroup of readmitted patients, logistic regression was adjusted to evaluate risk factors for PICU admission. The odds ratio (OR) with its 95% confidence interval (95%CI) was reported.

The probability of readmission during the first two years after discharge was plotted on a Kaplan-Meier curve. For point times, the probability was calculated with its 95%CI. A p-value < 0.05 was considered significant. Statistical analyses were performed using the Stata 14.0 software.

## Results

During the study period, 1059 preterm newborns were admitted to the follow-up polyclinic, of which 989 (93.3%) had information up to 2 years after discharge. The population was categorized according to the year of admission in the periods 2009-2011 (n = 324), 2012-2014 (n = 390), and 2015-2017 (n = 275), finding no significant differences between the periods, so we presented the overall results. Mean GA was 29.3 ± 2.3 weeks; birth weight 1274 ± 347 g; male sex 43.6%, BPD 20.9%, and $O_2$ at discharge 13.1% (supplementary table 1, available in the online version). Eight infants died during the follow-up period,

Of the 989 preterm newborns, 410 (41.5%) were readmitted at least once before the age of 2 years; 184 (18.6%) and 92 (9.3%) required a second and a third readmission, respectively, totaling 686 episodes (1.7/child), of which 551 (80.3%) occurred during the first year after discharge. The first six months after discharge was the period with the highest concentration of readmissions (359 episodes; 52.3%). The cumulative probability of readmission of a discharged newborn at 45 days and 12 months was 17.3% (95%CI:14.9-19.6) and 37.1% (95%CI: 34.1-40.1), respectively (figure 1).

1.8% (18/989) of neonates discharged from neonatology required three readmissions within the first 6 months.

129 children out of 410 (31.4%) required admission to PICU, accounting for 1,538 of 6,961 total hospital days, with a mean of 7.7 days per episode. The mean duration of MV was 7.6 days (figure 2). The likelihood of PICU admission of a readmitted patient before 1 month was 3.3 times higher than those readmitted after 1 month (OR: 3.25; 95%CI: 1.96-5.38).

The subgroup of preterm newborns who required more than 2 readmissions showed greater severity, with a greater number of days in PICU and longer duration in MV.

**Risk factors for hospital readmission**

When comparing the neonatal and maternal characteristics of preterm newborns who were readmitted

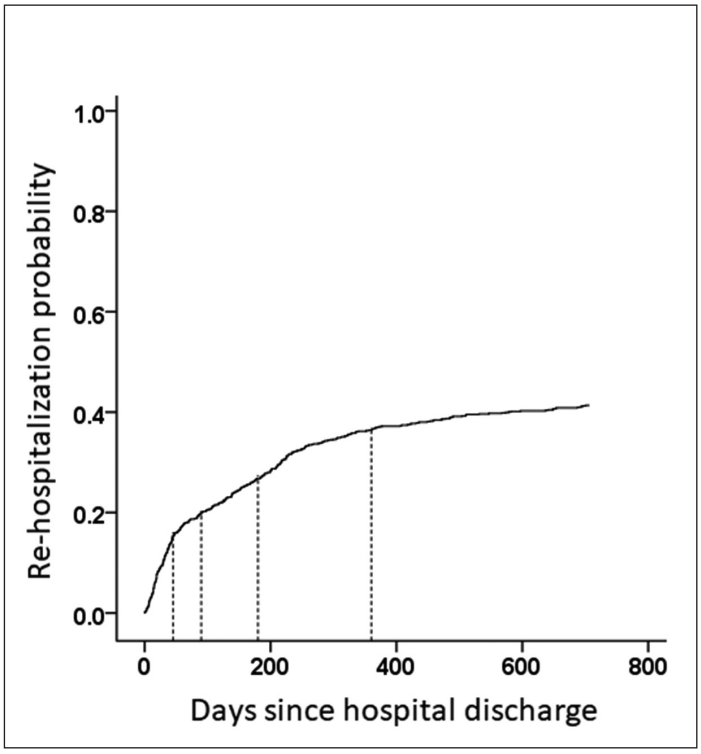


**Figure 1.** Re-hospitalization probability after hospital discharge in extreme preterm infants. Chile, 2009-2017. Of Re-hospitalization probability by any cause in extreme preterm infants as a function of time after hospital discharge, Chile, 2009-2017. The vertical lines, from left to right, mark the probabilities of a discharged infant to be re-hospitalized at 45 days (17.3%, 95%CI: 14.9-19.6), 3 months (20.7%, 95%CI: 18.2-23.3), 6 months (27.8%, 95%CI: 25.0-30.6), and 1 year (37.1%, 95%CI: 34.1-40.1).

versus those who were not, lower birth weight, lower GA, Apgar at 1 minute ≤ 3, longer time in MV, oxygen dependency at 36 weeks, surgical NEC, and longer length of stay in neonatology were independently associated with a higher risk of readmission at 2 years after discharge due to any cause. Breastfeeding at discharge did not reach significance to be a protective factor (table 1).

In the logistic regression analysis, the following were recognized as risk factors for readmission due to any cause before 2 years of age: 1 minute Apgar ≤ 3 (OR: 1.72; 95%CI: 1.19-2.47), twins (OR: 1.57; 95%CI: 1.11-2.21), number of children > 1 (OR: 1.13; 95%CI: 1.004-1.28),surgical NEC (OR: 2.48; 95%CI: 1.37-4.48), and $O_2$ at discharge (OR: 1.57; 95%CI: 1.07-2.31). A p-value of < 0.0001 was observed in the overall significance of the model.

For respiratory readmission, BPD (OR: 1.73; 95%CI: 1.26-2.37) and number of children > 1 (OR: 1.18; 95%CI: 1.04-1.33) were found to be risk factors for readmission before 2 years (figure 3). The p-value of the overall significance of the model was 0.0001.

**Main causes of hospital readmission**

The main cause of readmission was respiratory (515/686 episodes; 75%). When disaggregated by readmission, this trend was maintained (first readmission 303/410 = 73.9%, second readmission 145/184 = 78.8%, and third readmission 77/92 = 72.8%).

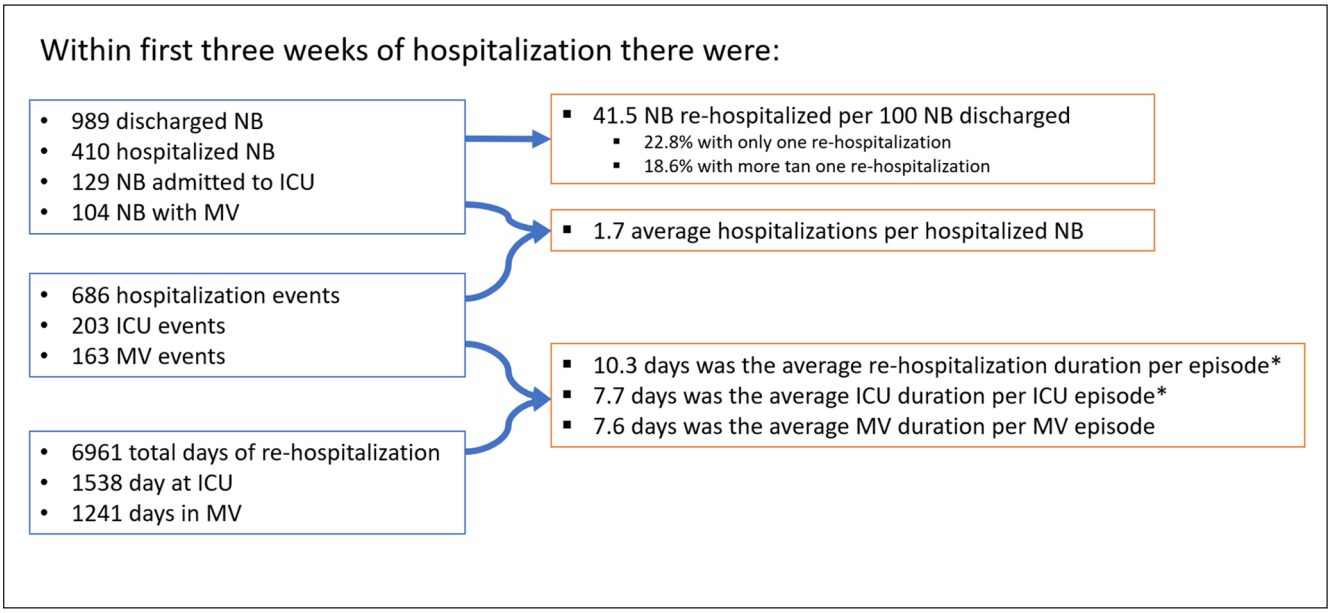


**Figure 2.** Global characterization of the first three post-discharge re-hospitalizations, in number of newborns, number of episodes and total days of hospitalization of extreme preterm infants in Chile, 2009-2017. *These figures are slightly different from those obtained from the crude ratio, given some missing values in hospitalization length (days) and NICU length stay (days). (Crude figures: 10.1 y 7.6 respectively). ICU: intensive care unit, MV: mechanical ventilation, NB: newborn

**Table 1. General description and perinatal characteristics of newborns by any-cause 2-year re-hospitalization. Chile, 2009-2017**

| | Without Rehospitalization (n = 579) | With Rehospitalization (n = 410) | Total (n = 989) | P value |
|---|---|---|---|---|
| Newborn descriptives | | | | |
| Male sex, % | 45.4 | 41.0 | 43.6 | 0.165 |
| GA (weeks), mean (SD) | 29.5 (2.3) | 29.0 (2.3) | 29.3 (2.3) | 0.002 |
| GA ≤ 28 weeks, % | 31.4 | 36.1 | 33.4 | 0.125 |
| Birthweight (g), mean (SD) | 1306 (343) | 1228 (348) | 1274 (347) | < 0.001 |
| Twin, % | 14.5 | 20.0 | 16.8 | 0.024 |
| Cesarean birth, % | 75.8 | 80.5 | 77.8 | 0.084 |
| 1-min Apgar score ≤ 3, % | 12.1 | 21.2 | 15.8 | < 0.001 |
| 5-min Apgar score ≤ 3, % | 0.4 | 2.0 | 1.0 | 0.020 |
| Maternal characteristics | | | | |
| Age (years), mean (SD) | 27.8 (6.9) | 27.2 (6.9) | 27.5 (6.9) | 0.182 |
| Education, (years), % | | | | |
| < 8 | 12.2 | 12.2 | 12.2 | 0.205 |
| > =8, <= 12 | 57.8 | 62.9 | 60.0 | |
| > 12 | 30.0 | 24.9 | 27.8 | |
| Pregnancy control, % | 96.3 | 96.8 | 96.5 | 0.669 |
| Number of siblings, mean (SD) | 0.82 (1.1) | 0.98 (1.1) | 0.89 (1.1) | 0.022 |
| Primiparous, % | 49.5 | 42.1 | 46.4 | 0.024 |
| Prenatal steroids, % | 87.8 | 86.8 | 87.4 | 0.653 |
| Neonatal stay | | | | |
| Length of stay (days), median (range) | 48.0 (19-313) | 58.5 (13-235) | 52 (13-313) | < 0.001 |
| Sepsis % | 33.0 | 43.1 | 37.4 | 0.003 |
| MV, % | 44.7 | 55.3 | 49.2 | 0.002 |
| Days of MV, median, (range)[(a)] | 4 (1-80) | 8 (1-179) | 5 (1-179) | < 0.001 |
| CPAP, % | 75.2 | 80.0 | 77.2 | 0.078 |
| $O_2$ 28 days, % | 28.5 | 36.1 | 31.7 | 0.012 |
| Bronchopulmonary dysplasia, % | 17.2 | 26.1 | 20.9 | < 0.001 |
| Oxygen at discharge, % | 10.3 | 17.1 | 13.1 | 0.002 |
| Surgical ductus, % | 2.4 | 4.3 | 3.3 | 0.110 |
| Surgical enterocolitis, % | 3.6 | 9.7 | 6.3 | < 0.001 |
| Surgical rethinopaty, % | 2.0 | 2.6 | 2.2 | 0.593 |
| Severe intracranial hemorrhage, % | 3.4 | 5.2 | 4.2 | 0.179 |
| Leukomalacia, % | 8.6 | 9.4 | 8.9 | 0.683 |
| Presence of Seizures, % | 9.8 | 16.4 | 12.6 | 0.003 |
| Palivizumab use, % | 16.9 | 21.7 | 18.9 | 0.059 |
| Weight at discharge (g), mean (SD) | 2523 (587) | 2690 (751) | 2593 (665) | < 0.001 |
| Length at discharge (cm), mean (SD) | 45.8 (2.9) | 46.7 (3.6) | 46.2 (3.3) | < 0.001 |
| Head circumferece at discharge (cm), mean (SD) | 33.2 (2.1) | 33.5 (2.6) | 33.3 (2.3) | 0.029 |
| GA at discharge (weeks), mean (SD) | 37.7 (3.8) | 39.0 (4.5) | 38.2 (4.2) | < 0.001 |
| Breastfeeding at discharge, % | 54.2 | 47.6 | 51.4 | 0.054 |

CPAP: Continuous positive airway pressure, GA: gestational age, MV: mechanical ventilation, SD: standard deviation. [(a)]for ventilated subgroup.

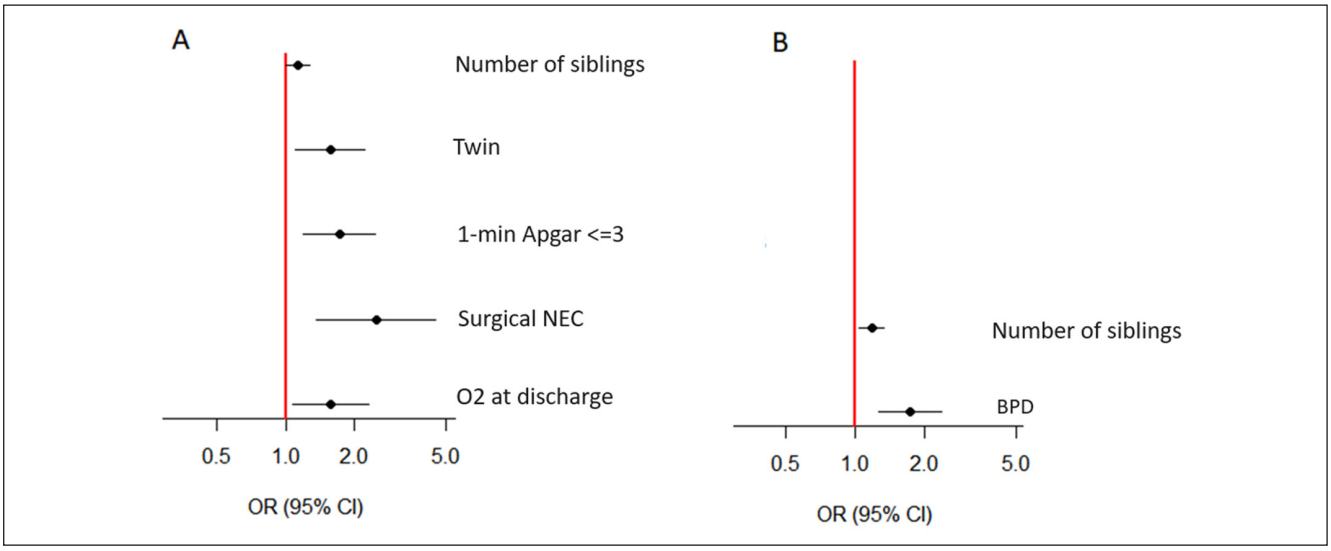


**Figure 3.** All-cause and respiratory risk factors for a 2-year re-hospitalization period. Chile, 2009-2017. Adjusted odds ratios (95%CI) of significant covariates after backwards variable selection process. Number of siblings >1, 1-minute Apgar score ≤ 3, being twins, surgical NEC and home oxygen therapy (O2 at discharge) were risk factors for a 2-year re-hospitalization for any cause (panel A). Number of offspring >1 and bronchopulmonary dysplasia were risk factors for a 2-year re-hospitalization due to a respiratory cause (panel B). BPD: bronchopulmonary dysplasia at 36 weeks of corrected gestational age. NEC: necrotizing enterocolitis. 95% CI: 95% confidence Interval. OR: odds ratio

Within all months of the year, the main cause of readmission was respiratory, with a significant increase during the winter months (85-95 % from June to September) (Supplementary figure 1, available in the online version). Readmissions becuase of a surgical indication occurred in the months from December to February.

A viral panel was performed in 69.3% (476/686) of the readmission episodes with respiratory syncytial virus (RSV) as the main isolated germ.

The second most frequent cause was due to a surgical indication (7.7%; 53/686 episodes); the main reason was the performance of hernia surgery (54.7%; 29/53). Non-respiratory infections were the third cause (7.1%; 49/686 episodes), the most frequent being urinary tract infections. Table 2 describes the first three readmissions during the 2 years after discharge.

## Discussion

Readmission rates between single or multicenter studies will depend on the characteristics of the GA of the selected population, the study period, differences in criteria for readmission, available health resources, and neonatal health policies or systems, whether in high-risk obstetric care and/or neonatal management[13,14].

In our cohort, 41.5% (410/989) of those discharged < 32w/< 1500g between 2009 and 2017 were readmitted before 2 years after discharge, a figure similar to that described in the literature[1,15-18]. In an Australian multicenter study of 2939 preterm newborns with GA < 32 weeks, discharged from 9 neonatal ICUs and followed up to 3 years, it was observed that 63% required at least one readmission, most in the first 12 months after discharge[19]. In a tertiary center in Vietnam, 47% of preterm newborns were readmitted before 1 year of age[20]. Similarly to what has been described, our population presented most readmissions in the first year after discharge, declining in the second year. It should be noted that 17.3% of those discharged were readmitted before 45 days and 26% (256/989) before 6 months.

Respiratory tract infection was the most frequent reason for hospital readmission, particularly in those with history of BPD. Charkaluk describes in a French cohort in an EPIPAGE-2 publication with 2571 preterm newborns < 32 weeks born in 2011, that a quarter of the population required readmission due to respiratory causes in the first year[21]. Infections due to RSV were prevalent in newborns younger than 1 year, as reported in the literature[22-24]. In our group, the respiratory cause accounted for 75% of all readmissions before the age of 2, a higher frequency than that reported in other studies that show percentages from 40 to 50%, suggesting as possible factors different socioeconomic conditions, overcrowding, exposure to germs during multiple check-ups at the follow-up centers, and the short duration of breastfeeding. The high frequency of respiratory causes was similar in each of the first 3 readmissions (73.9%, 78.8%, and 72.8%, respectively).

The most relevant risk factors for readmission of any cause were lower birth weight and GA, neonatal

**Tabla 2. Characteristics of three first rehospitalizations. Chile, 2009-2017.**

| | First rehospitalization | Second rehospitalization | Third rehospitalization |
|---|---|---|---|
| Re-hospitalized / total (n) | 410/989 (41.5%) | 184/989 (18.6%) | 92/989 (9.3%) |
| Months since neonatal discharge, n (%) | | | |
| Before 1 | 100 (24.4) | 5 (2.7) | 0 (0.0) |
| Between 1 and 3 | 96 (23.4) | 32 (17.4) | 3 (3.3) |
| Between 3 and 6 | 69 (16.8) | 39 (21.2) | 15 (16.3) |
| Between 6 and 9 | 68 (16.6) | 33 (17.9) | 21 (22.8) |
| Between 9 and 12 | 27 (6.6) | 26 (14.1) | 17 (18.5) |
| Between 12 and 18 | 32 (7.8) | 25 (13.6) | 18 (19.6) |
| Between 18 and 24 | 18 (4.4) | 24 (13) | 18 (19.6) |
| Re-hospitalization cause, n (%) | | | |
| Respiratory infection | 303 (73.9) | 145 (78.8) | 67 (72.8) |
| Non-respiratory infection | 3 8 (9.3) | 7 (3.8) | 5 (5.4) |
| Surgical | 32 (7.8) | 16 (8.7) | 16 (17.4) |
| Other | 37 (9.0) | 16 (8.7) | 16 (17.4) |
| Days of stay, median (range) | 5 (1-189) | 5 (1-315) | 5.5 (1-204) |
| ICU use, n (%)[(a)] | 129 (33.2) | 40 (23.3) | 34 (37.0) |
| Days at ICU, median (range) | 5 (1-40) | 4 (1-28) | 6 (1-53) |
| MV, n (%)[(a)] | 104 (27.2) | 32 (18.4) | 27 (31.8) |
| Days of MV, median (range) | 5 (1-40) | 5 (2-18) | 7 (2-53) |
| Viral panel performed, n (%)[(a)] | 282 (72.3) | 130 (71.9) | 64 (69.5) |
| Viral panel outcome, n (%) | | | |
| Positive to any virus | 151 (53.5) | 68 (52.3) | 43 (67.2) |
| Negative to all viruses | 131 (46.5) | 62 (47.7) | 21 (32.8) |
| Virus, n (%)[(b)] | | | |
| Syncytial Respiratory | 113 (40.1) | 33 (25.4) | 20 (68.8) |
| Parainfluenza 1/2/3 | 19 (6.6) | 18 (13.4) | 6 (9.4) |
| Metapneumovirus | 12 (4.3) | 8 (6.2) | 5 (7.8) |
| Adenovirus | 8 (2.8) | 10 (7.7) | 4 (6.3) |
| Influenza A/B | 4 (1.4) | 1 (0.8) | 1 (1.6) |
| Rotavirus | 2 (0.7) | 0 (0.0) | 0 (0.0) |
| Rhinovirus | 1 (0.4) | 2 (1.5) | 0 (0.0) |
| Pneumovirus | 0 (0.0) | 1 (0.8) | 0 (0.0) |

ICU: intensive neonatal care unit, MC: mechanical ventialtion

asphyxia, prolonged stay in neonatology and MV, higher percentage of surgical NEC, and BPD. These clinical factors were similar to those reported in other studies[8,18] which mainly emphasize the greater susceptibility to disease due to immaturity and the presence of comorbidities[17,26].

The risk factors associated with respiratory readmissions were BPD (increasing the risk of readmission by 73% compared with those without BPD) and the mother's greater number of children (increasing the risk of readmission by 18% for each additional child). In the literature, it has been described that preterm newborns with BPD are almost twice as likely to be readmitted compared with those without BPD[18,27,28]. In the EPIPAGE-2 cohort study, the risk factors identified were BPD, presence of siblings, male sex, and nursery attendance together with history of incomplete immunization with palivizumab[21]. MV in the neonatal period and history of discharge in the winter period were associated with a greater need for oxygen therapy during readmission; in our casuistry, male sex was not found to be a risk factor (table 1, figure 3).

Infections due to RSV were the most prevalent in our study, similar to what is reported in the literature[22-24]. Prophylaxis with palivizumab has been shown to decrease the risk of hospitalization due to RSV in the first year[29]; in our cohort, only 19% received immunization with palivizumab because, within the initial years (2009-2014), it was restricted to children under 6 months with a diagnosis of BPD (defined as 28 days of oxygen therapy) or oxygen-dependent at discharge who were discharged in the period of highest viral circulation, with 4 doses. In 2015, this was increased to 5 doses. From 2016, the administration of palivizum-

ab was extended to all children under 29 weeks and/or with BPD and their twin siblings. Only since 2019 was implemented by law 20,850 the administration of palivizumab to all preterm < 32w/< 1500g and their twin sibling under 12 months of age[30].

Hospital readmissions in preterm newborns contribute to the severity and high cost associated with PICU requirement[2,19,31]. In the study by Kuo et al, 36.8% of the population studied had at least one PICU hospitalization during the first year after discharge and the most frequent cause was respiratory infection[31]). Similarly, in our study, one-third (31.4%) of the hospitalized preterm newborns required admission to the PICU with a mean stay of 7.7 days.

The characteristics of the first three hospitalizations were similar (admission to PICU, length of stay, and need for MV), with respiratory causes being the main reason for admission (70%) and RSV as the main isolated germ.

Certain non-biological factors described in the literature, such as different levels of parental knowledge and skills to cope with the newborn's risk condition, social or stress aspects, as well as parental anxiety and depression, confirm the increased need for special care after discharge[9,32]. The description of the biological risk factors inherent to this population is important, but still insufficient to address strategies to contain and mitigate the problem. The transition to home after a NICU stay is a multifactorial problem, with a high social and economic impact, which should be addressed comprehensively by a multidisciplinary team.

As a weakness of our analysis, we were unable to obtain the mother's smoking history, duration of breastfeeding, nursery attendance, and social risk factors inherent to the family.

As a strength, it is highlighted that the data presented constitute relevant information to consider at the time of discharge and to plan preventive health strategies in the follow-up. This information is representative of a population of preterm newborns < 32w/< 1500g, recruited in a recent period (2009-2017) in a public healthcare center and followed up at 2 years of age, according to the national established regulations[11] and it was described the severity in each of the first 3 admissions.

Possible preventive strategies include a combination of caregiver and family education, as well as expansion of the RSV prevention program, ideally at home (which ensures adherence, timeliness, and number of recommended doses). In addition to the general measures, breastfeeding reinforcement, vaccination, and isolation of sick siblings should be incorporated. The application of these measures can significantly reduce the risk of readmission due to respiratory causes.

## Conclusion

The frequency of hospital readmissions in this cohort of preterm newborns < 32w/< 1500g was 41.5% for the initial two years after discharge from neonatology, the time of highest risk being the first 6 months. The main cause was respiratory, and the most frequently isolated germ was RSV. One-third of the readmitted patients required PICU. The characteristics of the first three hospitalizations were similar regarding PICU admission, need for MV, and length of stay. BPD and the number of siblings were the main risk factors associated with readmission due to respiratory causes.

## Ethical Responsibilities

**Human Beings and animals protection:** Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

**Data confidentiality:** The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

**Rights to privacy and informed consent:** The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the correspondence author.

## Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

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