# Factors associated with hypothermia during intra-hospital transport in patients assisted in a Neonatal Intensive Care Unit

*Fatores associados à hipotermia durante o transporte intra-hospitalar em pacientes internados em Unidade de Terapia Intensiva Neonatal*

*Factores asociados a la hipotermia durante transporte intrahospitalario en pacientes internados en una unidad de terapia intensiva neonatal*

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**ABSTRACT**

**Objective:** To determine frequency and factors associated with hypothermia during intra-hospital transports of patients assisted in a neonatal intensive care unit (NICU).

**Methods:** Cross-sectional study nested in a prospective cohort of infants submitted to intra-hospital transports performed by a trained team from January 1997 to December 2008 at a NICU of a public university hospital. Transports of patients aged more than one year and/or with weight higher than 10kg were excluded. Factors associated with hypothermia during intra-hospital transports were studied by logistic regression analysis.

**Results:** Among the 1,197 transports performed during the studied period, 1,191 (99.5%) met the inclusion criteria. The 640 transported infants had mean gestational age of 35.0±3.8 weeks and birth weight of 2341±888g. They presented the following underline diseases: single or multiple malformations (71.0%), infections (7.7%), peri/intraventricular hemorrhage (5.5%), respiratory distress (4.0%) and others (11.1%). Patients were transported for surgical procedures (22.6%), magnetic resonance (10.6%), tomography imaging (20.9%), contrasted exams (18.2%), and others (27.7%). Hypothermia occurred in 182 (15.3%) transports and was associated with (OR; 95%CI): weight at transport <1000g (3.7; 1.4-9.9), weight at transport 1000-2500g (1.5; 1.0-2.2), pre-transport axillary temperature <36.5°C (2.0; 1.4-2.9), central nervous system malformation (2.8; 1.8-4.4); use of supplemental oxygen (1.6; 1.0-2.5); mechanical ventilation prior to transport (2.5; 1.5-4.0); transport for surgeries (1.7; 1.0-2.7) and the years 2001, 2003 and 2006 (protection factors).

**Conclusions:** Intra-hospital transports presented increased risk for hypothermia, showing that this kind of transport should be done by skilled teams with adequate equipment.

Key-words: transportation of patients; newborn infant; risk factors; hypothermia

**RESUMO**

**Objetivo:** Determinar a frequência e os fatores associados à ocorrência de hipotermia em transportes intra-hospitalares de pacientes internados em uma unidade neonatal de cuidados intensivos.

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**Métodos:** Estudo transversal aninhado em uma coorte prospectiva de crianças submetidas a transportes intra-hospitalares realizados por uma equipe treinada de janeiro de 1997 a dezembro de 2008 na unidade de cuidados intensivos de um hospital público universitário. Foram excluídos os transportes de pacientes com mais de um ano e/ou com peso na data do transporte superior a 10kg. Os fatores associados à hipotermia durante o transporte foram estudados por regressão logística.

**Resultados:** Dos 1.197 transportes realizados no período do estudo, 1.191 (99,5%) atenderam aos critérios de inclusão. As doenças de base das 640 crianças estudadas (idade gestacional: 35,0±3,8 semanas; peso ao nascer: 2341±888g) foram: malformações únicas ou múltiplas (71,0%), infecções (7,7%), hemorragia peri/intraventricular (5,5%), desconforto respiratório (4,0%) e outros (11,8%). Os pacientes foram transportados para realização de cirurgias (22,6%), ressonância magnética (10,6%), tomografia (20,9%), exames contrastados (18,2%) e outros procedimentos (27,7%). A hipotermia ocorreu em 182 (15,3%) transportes e se associou ao (OR; IC95%): peso ao transporte <1000g (3,7; 1,4-9,9); peso ao transporte 1000-2500g (1,5; 1,0-2,2); temperatura axilar pré-transporte <36,5°C (2,0; 1,4-2,9); presença de malformações do sistema nervoso (2,8; 1,8-4,4); uso de oxigênio inalatório (1,6; 1,0-2,5); ventilação mecânica antes do transporte (2,5; 1,5-4,0); cirurgias (1,7; 1,0-2,7) e anos de 2001, 2003 e 2006 (protetores).

**Conclusões:** Os transportes intra-hospitalares apresentaram risco elevado de hipotermia, mostrando que devem ser realizados por equipe habilitada e com equipamentos adequados.

**Palavras-chave:** transporte de pacientes; recém-nascido; fatores de risco; hipotermia.

**RESUMEN**

**Objetivo:** Determinar la frecuencia y los factores asociados a la ocurrencia de hipotermia en transportes intrahospitalarios de pacientes internados en una unidad neonatal de cuidados intensivos.

**Método:** Estudio transversal anidado en una cohorte prospectiva de niños sometidos a transportes intrahospitalarios realizados por un equipo entrenado de ene/1997 a dic/2008 en la unidad de cuidados intensivos de un hospital público universitario. Se excluyeron los transportes de pacientes con más de un año de edad y con peso en la fecha del transporte superior a 10kg. Los factores asociados a la hipotermia durante el transporte fueron estudiados por regresión logística.

**Resultados:** De los 1197 transportes realizados en el periodo de estudio, 1191 (99,5%) atendieron a los criterios de inclusión. Las enfermedades de base de los 640 niños estudiados (edad gestacional: 35,0±3,8sem; peso al nacer: 2341±888g) fueron: malformaciones únicas o múltiples (71%), infecciones (7,7%), hemorragia peri/intraventricular (5,5%), angustia respiratoria (4,0%) y otros (11,8%). Los pacientes fueron transportados para realización de cirugías (22,6%), resonancia magnética (10,6%), tomografía (20,9%), exámenes contrastados (18,2%) y otros procedimientos (27,7%). La hipotermia ocurrió en 182 (15,3%) transportes y se asoció al (OR; IC95%): peso al transporte <1000g (3,7; 1,4-9,9); peso al transporte 1000-2500g (1,5; 1,0-2,2); temperatura axilar pre-transporte <36,5ºC (2,0; 1,4-2,9); presencia de malformaciones del sistema nervioso (2,8; 1,8-4,4); uso de oxígeno inhalatorio (1,6; 1,0-2,5); ventilación mecánica antes del transporte (2,5; 1,5-4,0); cirugías (1,7; 1,0-2,7) y años de 2001, 2003 y 2006 (protectores).

**Conclusiones:** Los transportes intrahospitalarios presentan elevado riesgo de hipotermia, mostrando que deben ser realizados por personas habilitadas y con equipos adecuados.

**Palabras-clave:** transporte de pacientes; unidad neonatal; factores de riesgo; hipotermia.

## Introduction

There are few studies related to intrahospital transports, even though the procedure is very common, especially in neonatal practice[1]. Despite the facts that they take place within the hospital environment, that the distances involved are relatively short and that safety is apparently guaranteed, intrahospital transports can constitute an additional risk to patients[1-3].

One prospective study with 180 intrahospital transports of pediatric patients showed a 74% rate of clinical complications, with hypothermia occurring in 11% of cases, and changes of heart rate in 16%, blood pressure in 21%, respiratory rate in 24% and oxygenation in 6%. In that study, clinical complications were associated with disease´s severity and duration of transport[2]. In other study with intrahospital transports of 40 children from zero to 10 years, clinical complications occurred in 30% of transport, being abnormal heart rate the most frequent of them[3].

In a study conducted in Brazil with 502 intrahospital transports in a neonatal unit, hypothermia was the most common intercurrent clinical condition, diagnosed in 17% of transports.

Factors associated with hypothermia were: transports that took place during the first year of the study - soon after a neonatal transport protocol had been adopted at the unit, longer duration of transport and central nervous system malformations[1]. There are no other studies published on morbidity associated with intrahospital transport specifically in the neonatal setting.

In this context, the objective of the present study was to determine the frequency of hypothermia during intrahospital transport and to determine the factors associated with this event in patients treated in a neonatal unit at a referral teaching hospital.

## Methods

Cross-sectional study nested in a prospective cohort performed at a tertiary and public neonatal unit of a teaching hospital. The study analyzed all intrahospital transports of patients less than 1 year old and less than 10,000g in weight carried out by the unit's Transport Team on weekdays from January of 1997 to December of 2008 between 8:00 and 17:00.

The transport team comprised a second year neonatal fellow and a nurse or nurse aid from the unit with experience in neonatal intensive care practices. The pediatrician was trained in neonatal resuscitation, had experience with advanced life support procedures and had attended a regular course in neonatal transport during the first year of fellowship with monthly theoretical and practical lessons on a range of aspects of the subject. The same patient was included more than once if he/she was transported more than once on different occasions while in the neonatal unit and within the study period.

Patients were transported in transport incubators equipped with a pulse oximeter and a perfusion pump powered by batteries. From 1999 onwards, a double-walled incubator was used and from 2000 onwards an electronic mechanical ventilator was used to provide respiratory support. Before 2000, when a mechanical ventilator was not available, ventilation was provided manually using a self-inflating bag or manual mechanical ventilator (CFR - Continuous Flow Reviver).

Data were collected regarding the demographic and clinical characteristics of the transported patients (gender, gestational age and birth weight, age and weight on the day of transport, vital signs, the disease that motivated the transport and the respiratory support provided during transport) and on the transports themselves (year of the transport, destination and duration of the transport - defined as from leaving until returning to the neonatal unit). Vital signs were recorded at the start of the transport, during the transport and on return to the unit. The following parameters were used to define clinical complications related to abnormal vital signs:

- Axillary temperature was taken using a digital thermometer every 10 minutes during transport. Temperatures below 36.0°C were defined as hypothermia and temperatures above 37.5°C were defined as hyperthermia[4].
- Heart rate was taken by precordial auscultation or measured by pulse oximetry. Bradycardia was defined as a heart rate of less than 80 bpm and tachycardia diagnosed above 180 bpm, on at least two separate readings[5].
- Oxygen saturation was measured by pulse oximeter throughout transport and hypoxemia was defined as persistent readings of less than 88%, requiring changes to ventilator settings or oxygen therapy. Hyperoxia was defined as saturation persistently over 95%, requiring a reduction in the fraction of oxygen administered. Saturation drop was defined as a persistent 5% reduction on baseline oxygen saturation[6].
- Arterial blood pressure was measured for all patients on vasopressors by oscillometric devices. Arterial hypertension was defined as a mean arterial blood pressure above 75mmHg in neonates and 95mmHg in infants. Arterial hypotension was defined as a mean arterial blood pressure below the sum of gestational age in full weeks plus five for neonates or below 55mmHg for infants[7].
- Apnea was defined as a respiratory arrest lasting more than 20 seconds, with or without bradycardia and/or hypoxemia[8].
- Hypercapnia was diagnosed when $pCO_2$ was greater than 45mmHg and hypocapnia when $pCO_2$ was below 35mmHg[9].

Capillary glycemia was assessed at the start of the transport, every 60 minutes during transportation and immediately after the patient arrived back at the neonatal unit. Hypoglycemia was defined as a result less than 40mg/dL, irrespective of gestational age, and hyperglycemia as greater than 150mg/dL[10].

The occurrence of clinical problem related to the transport was recorded prospectively on dedicated charts completed for each transport, by the neonatologist responsible.

Factors associated with hypothermia were analyzed using logistic regression. Initially, a univariate analysis was conducted including the following variables that might be associated with the outcome of interest: gestational age at birth; birth weight; postnatal age and weight on day of transport; axillary temperature, heart rate, mean arterial blood pressure, oxygen saturation and capillary glycemia,

all measured before transport; underlying disease; transport destination and respiratory support immediately before transport. The following continuous variables were categorized into subgroups: gestational age (<28; 28-34; >34 weeks), birth weight and weight on day of transport (<1000; 1000-2500; >2500g), age on day of transport (<7; 7-28; >28 days), axillary temperature (<36.5; ≥36.5ºC), underlying disease (malformation of the central nervous system; malformation of the gastrointestinal system; others), destination (operating room; magnetic resonance or tomography; others), respiratory support before transport (mechanical ventilation; inhaled oxygen; no need for oxygen).

Variables that were significant from a clinical point of view and had a p value <0.20 on the univariate analysis were included in the multiple logistic regression model. The model was constructed by removing non-significant variables one by one until a final model was obtained with p<0.05 for the likelihood ratio. Statistical analysis was performed on SPSS for Windows v.17.0 (Statistical Package for Social Sciences, Chicago, IL, United States).

This project was approved by the Research Ethics Committee of the *Universidade Federal de São Paulo*.

## Results

A total of 1197 transports took place during the study period, 6 (0.5%) of which were excluded from the analysis because the children transported weighed more than 10kg and/or were older than 1 year. Therefore, data were analyzed from 640 children (342 males, 53%) with a mean gestational age of 35.0±3.8 weeks (range: 22-42) and a mean birth weight of 2341±888g (range: 580-5200). These children were subject to 1191 intrahospital transports: 129 (10.8%) in 1997, 132 (11.1%) in 1998, 131 (11.0%) in 1999, 108 (9.1%) in 2000, 82 (6.9%) in 2001, 45 (3.8%) in 2002, 85 (7.1%) in 2003, 23 (1.9%) in 2004, 101 (8.5%) in 2005, 110 (9.2%) in 2006, 126 (10.6%) in 2007 and 119 (10.0%) in 2008. On the day of transport, the mean chronological age was 42±50 days (range: 1-360) and the mean body weight was 2794±1082g (range: 610-9080). Duration of transport was 101±61 minutes, with a range of 10 minutes to 6 hours.

The underlying diseases related to indications for transport were: 352 (29.6%) children had malformations of the central nervous system, 152 (12.8%) had heart disease, 130 (10.9%) had genetic or chromosomal syndromes, 116 (9.7%) had malformations of the gastrointestinal system, 105 (8.8%) had genitourinary malformations, 66 (5.5%) had periventricular-intraventricular hemorrhage, 62 (5.2%) had acquired infections, 48 (4.0%) had respiratory distress, 39 (3.3%) had asphyxia, 39 (3.3%) had apnea, 37 (3.1%) had seizures, 30 (2.5%) had congenital infections and 15 (1.3%) had other conditions.

Transports destinations were: surgery in 269 (22.6%) cases; tomography in 247 (20.9%); radiological exams with contrast in 217 (18.2%); magnetic resonance in 127 (10.6%); ultrasound in 124 (10.4%); electroencephalogram in 72 (6.0%); echocardiogram in 48 (4.0%); other X-rays in 39 (3.3%) and, in 48 cases (4.0%), transports were for other reasons.

With relation to respiratory support immediately before transport, 223 (18.7%) needed positive pressure ventilation, 238 (20.0%) needed inhaled oxygen and 730 (61.3%) patients were breathing room air. Table 1 lists physiological parameters measured before and after transport.

Technical complications were as follows: venous access was lost in 37 (3.1%) cases, accidental extubation occurred in 7 (0.6%), selective intubation in 2 (0.2%), obstruction of the tracheal tube in 1 (0.1%) case and a vesical catheter was lost in 3 (0.3%) cases. There were equipment failures in 58 (4.9%) transports, with oxygen or compressed air failures in 10 (0.8%), and problems with oximeters in 19 (1.6%), incubators in 14

**Table 1 -** Physiological parameters and capillary glycemia measured before and after transport.

| | Pre-transport | | Post-transport | |
|---|---|---|---|---|
| | Mean±SD | $P_{25}$-$P_{75}$ | Mean±SD | $P_{25}$-$P_{75}$ |
| Temperature[&] | 36.6±0.4 | 36.4-36.8 | 36.4±0.6 | 36.4-36.7 |
| HR[&] | 139±14 | 130-150 | 140±15 | 130-150 |
| $SO_2$ [&] | 94±3 | 92-96 | 94±3 | 91-96 |
| BP* | 51±10 | 45-56 | 51±10 | 45-56 |
| Glycemia[#] | 89±19 | 80-100 | 97±28 | 80-112 |

*n=664; [#]n=1000; [&]n=1191; $P_{25}$-$P_{75}$: 25th and 75th percentiles; Axillary temperature: (ºC); HR: heart rate (rpm); $SO_2$: oxygen saturation (%); BP: mean arterial blood pressure (mmHg); glycemia (mg/dL).

(1.2%), perfusion pumps in 13 (1.1%), self-inflating bag in 1 (0.1%) and the mechanical ventilator in 1 (0.1%) transport.

Clinical complications occurred during 326 (27.4%) transports: hypothermia (15.3%), hyperoxia (5.5%), saturation drops (4.2%), need to increase the ventilatory support (4.2%), hyperthermia (1.4%), hyperglycemia (1.4%) and apnea (1%). In 79 (6.6%) cases, more than one clinical problem occurred during the same transport procedure.

Transports with and without hypothermia were compared in terms of the patients' demographic and clinical data and in terms of the characteristics of the transportation performed (Table 2). Factors associated with hypothermia were initially analyzed using univariate logistic regression (Table 3). A multiple logistic regression was then conducted with the following variables with clinical and statistical significance ($p<0.20$) identified by univariate analysis: year of transport, gestational age at birth, age and weight on day of transport, underlying disease causing the transport, pre-transport axillary temperature, destination and duration of transport and type of respiratory support at start of transport. The final logistic regression model is shown in Table 4.

## Discussion

Intrahospital transport is a very common procedure that is part of the routine activities of neonatal care since frequently patients need surgeries and imaging tests and imaging exams such as magnetic resonance and tomography provided outside the neonatal units[1]. Despite this, few studies have been conducted investigating the procedure, and the majority of those that have been published deal exclusively with transport between different hospitals[11,12]. This study analyzed 12 years' experience of intrahospital transport of patients in a neonatal intensive care unit at a university hospital with proper equipment and a dedicated transport team.

In this study, the frequency of technical complications was 9%, which is similar to what has been observed in intrahospital transports of older children and adults[13]. In general, intrahospital transport of non-neonatal patients is performed using their own beds, which reduces the incidence of some complications such as: loss of venous access, extubation and catheter loss or obstruction [14]. Newborn infants need to be transferred to a transport incubator, increasing

**Table 2 -** Patients ´characteristics according to the presence of hypothermia during transport.

| | Hypothermia (n=177) | No hypothermia (n=1014) | p |
|---|---|---|---|
| Gestational age (weeks) | 34.8±4.0 | 35.1±3.7 | 0.327# |
| Birth weight (g) | 2367± 908 | 2336±884 | 0.674# |
| Age on day of transport (days) | 31±42 | 38±51 | 0.066# |
| Weight on day of transport (g) | 2642±1082 | 2821±1080 | 0.042# |
| CNS malformations | 75 (42.4%) | 277 (27.3%) | <0.001& |
| Surgery | 71 (40.1%) | 198 (19.5%) | <0.001& |
| Duration (minutes) | 120±65 | 98±60 | < 0.001# |
| Duration >120 minutes | 73 (41.2%) | 259 (25.5%) | <0.001& |
| Pre-transport temp. | 36.6±0.4 | 36.6±0.4 | 0.941# |
| Pre-transport temp. <36.5ºC | 75 (42.4%) | 284 (28.0%) | <0.001& |
| Pre-transport HR | 137±14 | 140±14 | 0.041# |
| Pre-transport BP* | 51±10 | 52±10 | 0.375# |
| Pre-transport $SO_2$ | 93±3 | 94±3 | 0.178# |
| Pre-transport $FiO_2$ | 29±16 | 25±11 | < 0.001# |
| Pre-transport glycemia | 88±22 | 89±18 | 0.383# |
| Pre-transport MV | 61 (34.5%) | 162 (16.0%) | <0.001& |

CNS: central nervous system; Temp: axillary temperature in ºC; HR: heart rate (rpm); BP: mean arterial blood pressure (mmHg); $SO_2$: oxygen saturation (%); $FiO_2$: fraction of inspired $O_2$; glycemia (mg/dL); MV: mechanical ventilation; *n=664; #: *t* test; &: $c^2$ test.

**Table 3 -** Factors associated with hypothermia during intrahospital transport: univariate analysis

| | OR | 95%CI | p |
|---|---|---|---|
| Transported in 2001 | 0.302 | 0.109 - 0.835 | 0.021 |
| Transported in 2003 | 0.218 | 0.072 - 0.658 | 0.007 |
| Transported in 2005 | 0.379 | 0.161 - 0.894 | 0.027 |
| Transported in 2006 | 0.393 | 0.172 - 0.896 | 0.026 |
| Birth weight <1000g | 1.350 | 0.779 - 2.340 | 0.285 |
| Gestational age <28 weeks | 1.197 | 0.608- 2.353 | 0.603 |
| Age <7 days | 1.474 | 0.992 - 2.189 | 0.055 |
| Weight on the day of transport < 1000g | 4.209 | 1.753 - 10.102 | 0.001 |
| CNS malformations | 1.990 | 1.400 - 2.831 | <0.001 |
| Surgery | 2.863 | 1.958 - 4.186 | < 0.001 |
| Duration <120 minutes | 2.377 | 1.592 - 3.550 | < 0.001 |
| Pre-transport temperature <36.5°C | 1.890 | 1.361 - 2.624 | < 0.001 |
| Pre-transport MV | 3.103 | 2.131 - 4.518 | <0.001 |
| Inhaled oxygen | 1.524 | 1.000 - 2.323 | 0.050 |

SNC: central nervous system; MV: mechanical ventilation; axillary temperature in °C.

**Table 4 -** Factors associated with hypothermia during intrahospital transport: final multiple logistic regression model.

| | OR | 95%CI | p |
|---|---|---|---|
| Transported in 2001 | 0.224 | 0.079 - 0.637 | 0.005 |
| Transported in 2003 | 0.213 | 0.068 - 0.666 | 0.008 |
| Transported in 2006 | 0.374 | 0.156 - 0.894 | 0.027 |
| Weight on day of transport <1000g | 3.695 | 1.382 - 9.880 | 0.009 |
| Weight on day of transport 1000-2500g | 1.475 | 1.006 - 2.162 | 0.046 |
| CNS malformations | 2.814 | 1.800 - 4.398 | <0.001 |
| Surgery | 1.690 | 1.042 - 2.741 | 0.033 |
| Pre-transport temperature <36.5°C | 2.003 | 1.405 - 2.856 | <0.001 |
| Transported with inhaled $O_2$ | 1.584 | 0.999 - 2.511 | 0.050 |
| Pre-transport MV | 2.471 | 1.542 - 3.958 | <0.001 |

SNC: central nervous system; $O_2$: oxygen; Hosmer-Lemeshow test: 0.633, p<0.001. MV: mechanical ventilation. Variables included in the model: year transported, age and weight on day of transport, pathology causing transport, pre-transport temperature, destination and duration of transport and type of respiratory support before transport.

the risk of such complications. Continued medical education and implementation of standard routines together with a dedicated and trained transport team can minimize these risks[1,15,16]. According to Edge *et al*, loss of venous access, accidental extubation, obstruction of the cannula by secretions and equipment failures are more common when transports are not performed by a trained team[17].

The frequency of clinical complications in this study was elevated, similar to the report for interhospital transports of newborn infants published by Lim and Ratnavel[12]. Other studies have also reported elevated rates of clinical problems during intrahospital transports of adults and children, varying from six to 71%[1,2,13,15,18-20], indicating that the risk of morbidity in intrahospital transports may be comparable with the risk

observed at transports between different hospitals. These data provide evidence to support the recommendation that the same level of care and professional education is needed for both types of transport of newborn infants.

The most common clinical complication in this study was hypothermia, followed by problems associated with respiratory support, such as: hyperoxia, saturation drop and increased need for oxygen or a need to change ventilator settings. The high rate of hypothermia observed in the study was also described by Wallen *et al*, that showed 11.2% of hypothermia in children and adolescents transported for surgery and diagnostic procedures in a referral hospital[2]. This finding can be explained, on the one hand, by neonatal characteristics such as the limited ability to produce heat, the large surface area with relation to the body weight and the small amount of subcutaneous tissue[21]. On the other hand, factors related to transports themselves, such as the year of transport, underlying disease and transport destination, contributed to the high rate of hypothermia seen on the present study. The skills and qualifications of the transport team are important to avoid hypothermia. Morbidity and mortality related to transport are directly proportional to each degree of body temperature lost during transport[22,23].

In this context, the factors associated with hypothermia in the patients studied here were: body temperature below 36.5ºC at transport start, body weight less than 2500 g on the day of transport, CNS malformations, transport to operating room and need for respiratory support at transport start. All of these factors were associated with difficulties in control of body temperature. Patients with pre-transport body temperature below 36.5ºC had twice the likelihood of hypothermia during transport. Some authors[4] consider temperatures between 36.0 and 36.4ºC acceptable for critically ill newborn infants. However, in this study, these limits conferred an additional risk of hypothermia, in line with the concept of mild hypothermia suggested by the World Health Organization, that defines it as an axillary temperature between 36.0 and 36.4ºC[24,25].

Several procedures have been recommended in order to reduce the risk of hypothermia, such as double-walled incubators with servo-controlled temperature and humidified and heated gases for intubated patients, in addition to wrapping patients in PVC film or in polyethylene bags and also using head caps to avoid heat loss through the head in preterm infants and those patients with hydrocephalus[21,26]. With the exception of heated and humidified gasses, all these precautions were employed in the transports described here and yet the rate of hypothermia was comparable with that observed in interhospital transports[22,23], demonstrating once more the need to adopt the same level of standardized care for both modes of neonatal transport. One further measure for preventing hypothermia during intrahospital transport suggested by this results is to maintain axillary temperature greater than or equal to 36.5ºC before starting transport, and avoid transporting newborn infants with body temperature between 36.0 and 36.4ºC. Furthermore, continued education of health professionals in charge of the procedure is also needed to prevent hypothermia. The range of variation of this complication in different years, with some years conferring protection against hypothermia during intrahospital transport, indicates that the team's training varied over the period analyzed and that assessment of the quality of continuing education in transport and of the theoretical and practical knowledge of the professionals should be a constant concern.

The main limitation of this study is that it is based on one center experience and with a high number of neonates with congenital malformations. Nevertheless, this is a study of a large sample of patients with prospective data collection and reflects 12 years' experience of intrahospital transports of a neonatal unit in a public referral university hospital with a standardized routine and a team trained to perform transports.

Intrahospital transports can be associated with a high risk of neonatal complications, with particular emphasis on hypothermia. These risks should be assessed and the appropriate clinical and technical conditions should also be assured before recommending and performing transports. The transport team should undergo continuing education.

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