PICE

Dutch Pediatric Intensive Care Evaluation

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ISBN 9789078022039

PICE

Report 2003-2005
Dutch Pediatric Intensive Care Evaluation

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Stichting PICE - Rotterdam, 2008

http://www.pice.nl

ISBN 9789078022039

Idse H.E. Visser on behalf of the Dutch PICE study group
Dutch Pediatric Intensive Care Evaluation, PICE Report 2003-2005.

Internet: http://www.pice.nl
mail to: info@pice.nl

illustrations: Annelies Diertens www.karmijnkunstenzo.nl

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Introduction

We are pleased to present to you this report containing information of all the admissions in the PICUs of the Netherlands in 2003-2005. In these years the quality and completeness of the data have improved substantially. A comparison of 3 years is now possible, showing a rather stable population of patients although some changes can be recognized. Examples are the decrease in the number of neonatal patients (below 28 days at admission), a gradual small increase in age of the admitted patients, and the increase in the use of specialized retrieval teams. This is the first report in English, so, the distribution of this report will now also be outside the Netherlands and we hope to receive interesting feedback on our data. The majority of our PICUs is still not fully automated in their data management. This means that they still document the data manually. This is a great effort and we thank all our colleagues for their continuing support.

Jan A. Hazelzet MD PhD FCCM, chairman of the PICE Board

Summary

In this report we describe our findings in the period from 2003 to 2005. During this period there was a steady rise in registered admissions and patients in the Dutch pediatric intensive care units (PICUs). The number of admissions increased from 4230 in 2003 to 4532 in 2004 and 4663 in 2005, and the average daily number of patients present in a pediatric intensive care unit (occupied beds), increased from 74 in 2003 and 2004 to 81 in 2005.
The winter was the busiest period each year with regard to admissions and occupancy. Although admissions in 2004 and 2005 were more equally distributed throughout the year than in 2003, seasonal differences in occupancy of the PICU were greatest in 2005. (**Chapters 1 & 2**)

The length of stay (LOS) in PICU remained stable over time, with a median of 3 days and a mean of 6 days stay in PICU. Patients with a prolonged stay in PICU, with a LOS of over 4 weeks, were a small (3%), but not unimportant part of the PICU population: this group consumed a relatively large portion (30%) of the intensive care time each year. (**Chapter 3**)

Demographics of admitted patients showed a gradual small increase in age, with a median age of 1.6 in 2003 to 1.7 in 2004 and 1.8 years in 2005, and a mean age from 4.2 to 4.3 and 4.5 years. The percentage of neonates (below 28 days at admission) in PICU declined from 12.4% in 2003 to 11.9% in 2004 and 10.3% in 2005. With regard to sex, boys formed the majority in the pediatric intensive care population, with 58% to 57% of all annual admissions. This is in line with the majority of admissions below 19 years of age admitted to all hospitals in the Netherlands. (**Chapter 4**)

The majority of admissions to the PICUs were unplanned and ranged from 58% to 54% and 56% between 2003 and 2005. Together with the daily differences in the number of intensive care patients, the proportion of unplanned admissions shows the difficulty in planning in PICU. (**Chapter 5 & 2**)

The top-10 reasons for admission barely changed within this three-year period; most common were postoperative reasons (40%), followed by respiratory reasons (20%). (**Chapter 7**)

The Principal PICU diagnoses for admission to the PICU reflect the great variety within the PICU population: 262 different primary diagnoses in 2003, 260 in 2004 and 262 in 2005, the most common diagnosis not exceeding 5% of all admissions in a year. Yet although the population showed a wide variety in principal diagnoses, there is little variation from year to year in the top-10, and of the top-3 most frequently registered principal diagnoses, two remained in the top-3 each year: seizures (3.2% to 4.3%) and respiratory failure (2.8%-4.7%). (**Chapter 8**)

The rate of intraregional retrievals and the degree of specialization of the escorting team increased. In the three years from 2003 to 2005, interhospital admissions from within the referral region increased from 69% to 77% and 80%. The use of specialized retrieval teams increased: 30% of all interhospital retrievals was accompanied by a specialized team in 2003, 35% in 2004 and 43% in 2005. This increase was even more apparent in patients who were ventilated within the first hour after arrival: 38% to 56% and 63%. (**Chapter 11**)

The unadjusted mortality rate of the PICU population varies from 5.2% in 2003 to 4.3% in 2004 and 4.7% in 2005. When adjusted for severity of illness with prognostic mortality models PIM1 and PRISM2, the obtained Standardized Mortality Ratio (SMR) for the PIM1 was 0.94 in 2003, 0.85 in 2004 and 0.95 in 2005, and the SMR for the PRISM was 0.63 in 2003, 0.64 in 2004 and 0.56 in 2005. Both show a lower degree of mortality than might be expected with these models, and even significantly less when adjusted with the PRISM. (**Chapter 12**)

Pediatric Intensive Care Evaluation

PICE stands for Dutch Pediatric Intensive Care Evaluation (Pediatrische Intensive Care Evaluatie). On May 17, 2000, the PICE was set up as a foundation and registered with the Chamber of Commerce in Rotterdam, under #24306405.
The foundation supervises the national registration of admission data for all pediatric intensive care units in the Netherlands. At the time of its founding, the PICE registry was communicated to the appropriate government body (*Registratiekamer*) under #0-0043501 (St.PICE 2000 and 2002).
The board of the PICE is responsible for the foundation's progress; the PICE study group provides the substantive content (see appendix B for details).
The PICE study group, which consists of representatives from the eight academic centers, is an independent body, yet reports regularly to the intensive care children section (SICK) of the Dutch Pediatric Association (NVK) (SICK, policy vision 2003).

Objectives

The PICE registry has the following three objectives:

-Anonymous and continuous registration of data pertaining to admissions to Dutch pediatric intensive care departments. This with a view to obtaining insight in type and seriousness of illness of children admitted to IC, their treatment, and outcome.
-Benchmarking of the various units, which can lead to adaptation and improvement of unit management.
-Evaluation of the effect of policy changes, such as harmonization with neonatology, capacity extension, development and evaluation of a transport system and diagnosis-treatment combinations (DBC's).

Pediatric intensive care

Pediatric intensive care is the section of the health care system involved in monitoring, or support, of the vital functions of acute and chronically sick children aged (approximately) four weeks to 18 years. In that sense, it distinguishes itself from neonatology and intensive care for adults. This relatively young field of expertise was founded within the academic hospitals. As of January 1 2003, this field of expertise is governed by Article 8 of the Dutch law on the particular medical achievements (WBMV) and is by this law assigned to all academic centers. Because of this (recognition under Article 8), evaluation by the PICE is now mandatory for all pediatric intensive care units (Health, Welfare and Sport 2002 and IGZ 2001).
In the pediatric intensive care units, care is delivered by Pediatric Critical Care nurses, for whom the procedure for national recognition of training is still ongoing; pediatric intensivists, recognized by the Dutch association for pediatrics (NVK); and anesthetists, for whom national recognition by the joined intensivists commission (GIC) is also ongoing.

Financial support:

The Dutch PICE is funded by a grant from the Ministry of Health, Welfare and Sport, as well as by all academic hospitals in the Netherlands whose pediatric intensive care departments participate in the PICE.

PICE registry, Data collection, control and reporting

Data 2003-2005

This report presents the combined data of the PICE registry from the years 2003-2005.
Nationwide registration began in 2003, but due to organizational and software issues, some centers began at a later date. Certain parts of the registration, such as the collection of diagnoses and prognostic mortality scores, were completed for all centers by the end of 2004 (regarding the quality of the data, see: *Appendix A).*
Changes in software and dataset definitions over the years were few, and if they did lead to changes, the previous values and definitions were converted to the newer ones, using the data collection from 2005 as a basis for comparison with previous years.

Dataset

The dataset for the PICE registry and its definitions were discussed and established in the PICE study group prior to 2003. The minimal set of data for registration consists of 22 items, with 47 parameters, and reflects information from PICU admissions on demography, admission, length of stay, diagnoses, severity of illness, and discharge reasons (*Appendix B* and PICE Dataset 2004).

Data collection and control

Data is registered locally at the PICU, from routinely measured data available in medical records from the PICU and/or hospital, by dedicated and trained PICU staff, under the supervision of the pediatric intensivist representative in the PICE study group. Upon entry into the local database, the registered admissions automatically receive a code, and after local standardized control and validation by the supervisor, the automatically encoded and encrypted data are extracted and sent - anonymously - to the central registry database. In the central database a second standardized quality control is performed on the data, and the findings are sent back to the local registry supervisor when inconsistent or in error. After corrections are made at the local registry, the data is sent once again to the central registry database, where the abovementioned procedure is repeated.
Since studies by Van Keulen and Gemke (2005) on the effect of training on the use of prognostic mortality scores (PIM and PRISM) showed a significant increase in data quality, the PICE Study Group has set up a training program for all PICU staff involved in the registration of mortality scores and diagnoses. In addition to mortality scores and diagnoses, the training program deals with all other standard data definitions used in the registration software and on the PICE website.

Reported data & Tables

The data presented in this report reflects the combined registration of all PICUs in the Netherlands. Unless otherwise mentioned, the values shown in the Tables and Figures are the gross national averages, and not those of individual centers. For example: the national Dutch average of a median length-of-stay is three days, but this may differ from one center to the next. Individual values are reported in a separate benchmark report, which is sent to the individual centers only.
In some Tables, the ‘PICU Range’ is shown, indicating the value of the highest and lowest scoring PICU with respect to the item involved.
Differences between years are tested for statistical significance; when an increase or decrease is described, it is statistically significant at a 95% confidence level.
If the distribution of data is skewed, a median with interquartile range ($P_{25\text{-}75}$) is shown first in the Table.
Equally distributed data is presented with the mean and standard deviation (SD) first in the Table.
In Chapter 12, on mortality and standardized mortality ratio (SMR), 95% confidence intervals (95%CI) are presented; these show the limits within which the true value, with a statistical reliability of 95%, can be found. The 95%CI is calculated using the method as described by Ulm (Ulm 1990).
Unless otherwise mentioned, the total number of observations (N=) in each Table represents all admissions in that year used to calculate the values (such as mean, median and percentage) in that same Table.

Chapter 1 Admissions to the pediatric intensive care unit: 2003-2005

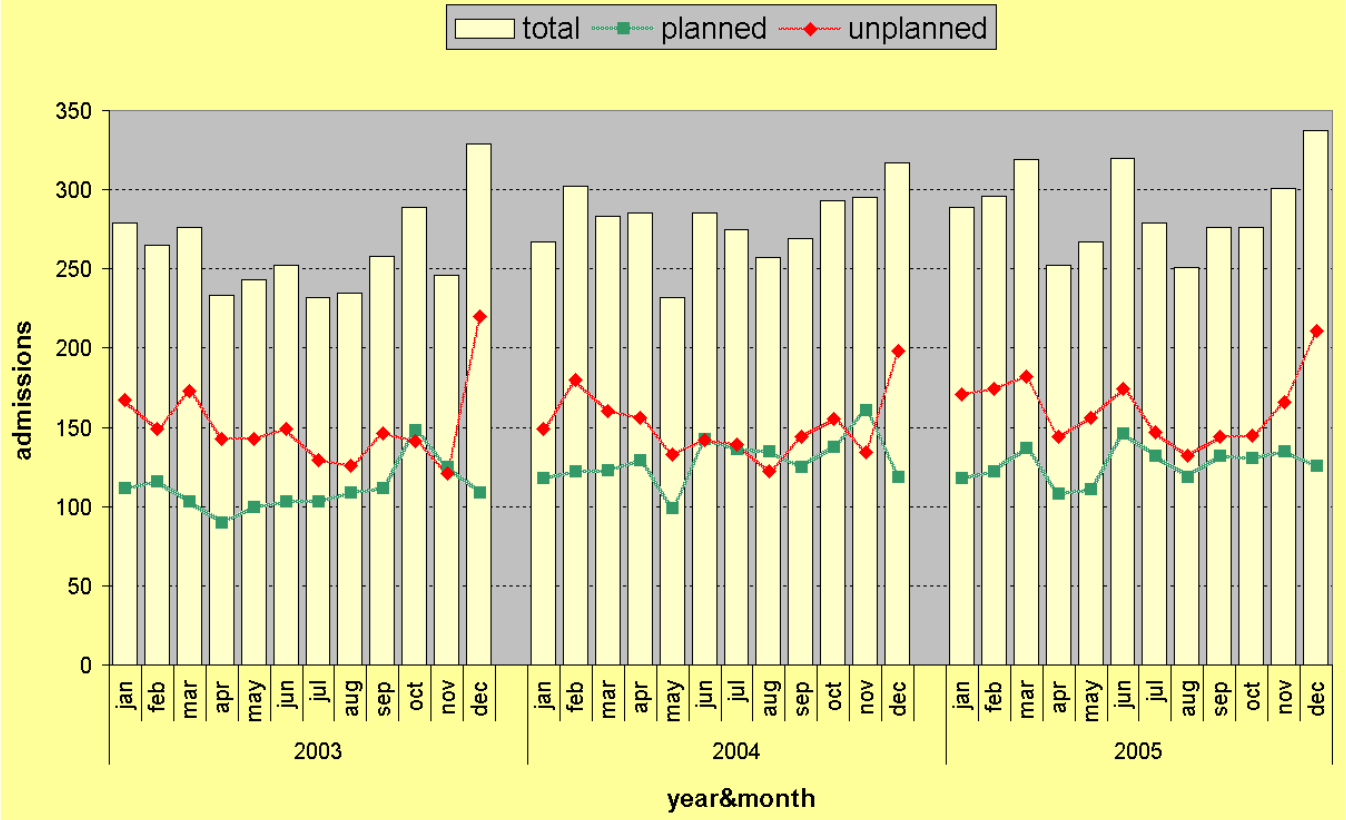
Since 2003, the total number of annual admissions to the collective pediatric intensive care units (PICUs) in the Netherlands has increased, but there is no increase in each individual center (*Table1*).

Table 1.1 Annual number of admissions to the 8 Dutch PICUs, 2003-2005

Year	L	M	V	G	N	A	U	R	PICE
2003	285	339	347	397	566	586	632	1078	4230
2004	300	390	413	559	524	594	590	1162	4532
2005	366	346	391	587	579	582	613	1199	4663

Admissions to the PICU are unevenly distributed throughout the year. In summer, fewer patients are admitted than in winter, with the lowest number of admissions in August and the highest in December. This seasonal effect in number of admissions is most apparent in 2003 and greater for unplanned admissions than planned ones (*Figure 1.1).*

Figure 1.1 Number of admissions per month



Like the number of admissions, the total number of calendar days during which patients stayed in pediatric intensive care (PICU days) showed an increase in 2005 as compared to 2004 (*Table 1.2)*. Because all patients in care at any given moment per day within the same year are counted, including those admitted in a previous year, the number of admissions (N=) contributing to the total of PICU days is greater than the total number of annual admissions presented in Table 1.1.

Table 1.2 Annual number of PICU days

	2003	2004	2005
PICU days	>27058*	27202	29375
N=	**4270**	**4608**	**4720**

* The number of PICU days in 2003 is actually higher than that shown in this Table, since not all patients already in pediatric intensive care *before* 1-1-2003 are registered.

Chapter 2 Patients in pediatric intensive care

Over the three-year period from 2003 to 2005, we saw an annual rise in the number of admissions and average number of days of intensive care. When measured on a daily basis, the average number of patients in pediatric intensive care is highest in 2005, with a total of 81 different patients in care per day, as compared to an average of 74 patients per day in 2004 and 2003 (*Table 2.1).*

The average number of admissions and patients in intensive care does not fully reflect the dynamics of daily practice in the PICU. The number of patients cared for each day reveals that there can be a quiet large difference in the number of occupied beds from one day to the next. This daily difference, on average, was five patients in 2003, six in 2004 and five in 2005, with a maximum daily difference of 18 patients in 2003, 21 in 2004 and 18 in 2005 (*Table 2.1)*. The maximum daily difference in number of patients in individual PICUs varies in 2005 from 4 to 8.

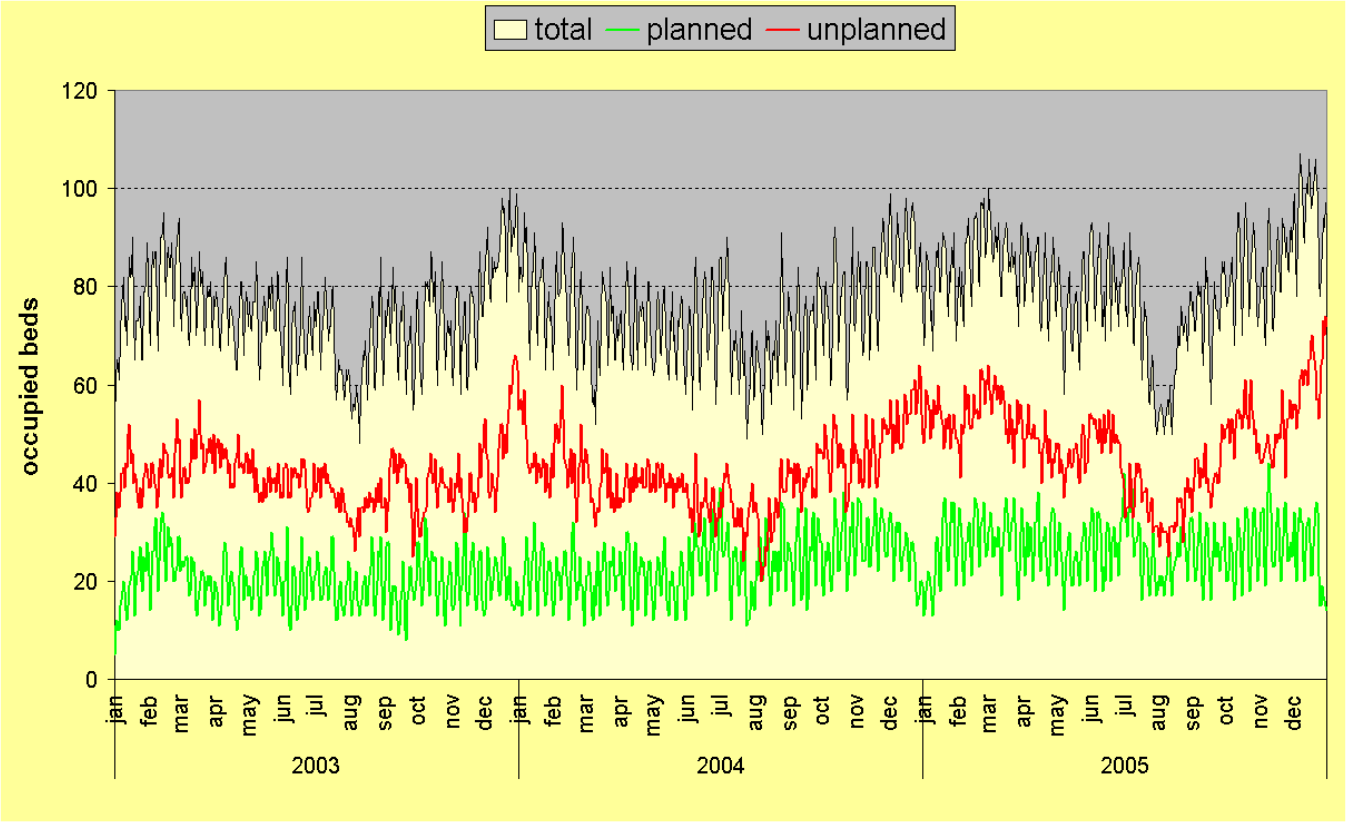
Table 2.1 Daily number of patients in pediatric intensive care & differences between days

	Daily number of patients			Daily difference in number of patients		
	2003	**2004**	**2005**	**2003**	**2004**	**2005**
Mean	74.1	74.3	80.5	5.3	5.9	5.2
Median	74	74	81	5	5	5
Maximum	100	99	107	18	21	18

Patients already in PICU *before* 1-1-2003 are partially missing, since nationwide registry only began in 2003.

The days with the greatest number of intensive care patients were in winter and with the least number of patients in summer. The busiest day in 2005 was December 7th and the quietest was August 14th; the 14 busiest days in 2005 were (all but one) in December and the 14 quietest days (all but one) in August. The end of the year showed the greatest difference in planned and unplanned patients in intensive care: the number of unplanned admissions rose in December and fewer planned admissions were scheduled during Christmas and New Year's (*Figure 2.1).*

Figure 2.1 Daily number of patients in pediatric intensive care



Chapter 3 Length of stay in PICU

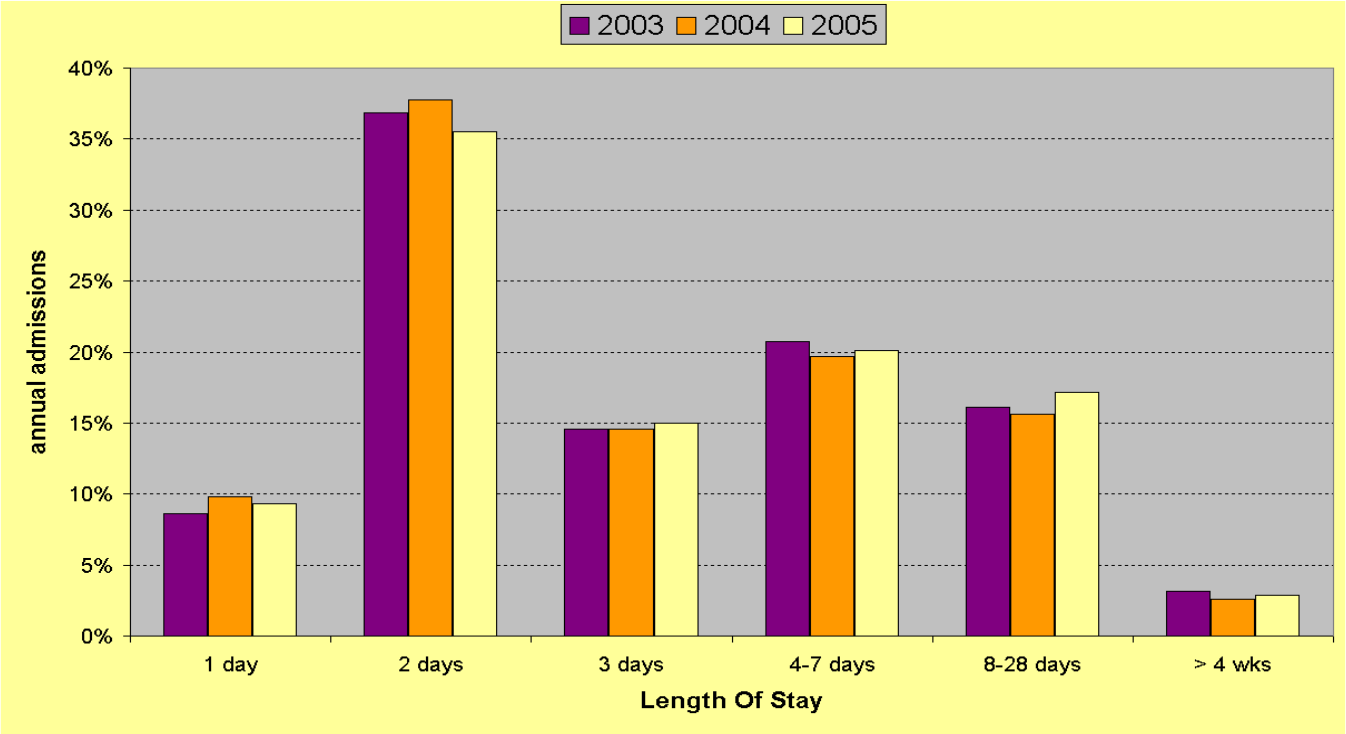
The length of stay (LOS) at the PICU shows only a slight change over the years, with a median LOS of three days (*Table 3.1*). The mean LOS was 6.5 days in 2003, 6.1 days in 2004 and 6.3 days in 2005. LOS is measured in number of calendar days during which the patient stayed at the PICU.

Table 3.1 LOS mean and median (number of calendar days)

	2003	2004	2005
Median LOS (days)	**3**	**3**	**3**
P_{25-75} (days)	2-6	2-5	2-6
Maximum LOS (days)	337	500	351
Mean LOS (days)	6.5	6.1	6.3
N=	**4230**	**4532**	**4663**

The difference between mean and median LOS is caused by several patients with an excessive LOS. The maximum LOS was 337 days for patients admitted in 2003, 500 days for those admitted in 2004 and 351 days for those in 2005. However, half the population stayed three calendar days or less in PICU, and about 80% of all admissions were discharged from the PICU within one week (*Figure 3.1*).

Figure 3.1 Percentage of annual admissions by Length of Stay 2003-2005



Although patients with a stay of more than four weeks in PICU form a fairly small (3%) percentage of all admissions, they consume about 30% of intensive care time each year. Of those patients with a prolonged stay, those admitted in 2003 (3.1%) consumed 31.5% of PICU time; in 2004 this group formed 2.6% of all admissions and consumed 28.7% of PICU time, and in 2005 2.9% consumed 28.3% of all pediatric intensive care days (*Table 3.2)* . There are substantial differences between centers, from year to year, in intensive time-use by patients with a prolonged stay (between 10.7% and 50.6% of all PICU days).

Table 3.2 Prolonged stay (>4 weeks) in PICU

	2003	2004	2005
% of total annual admissions	3.1%	2.6%	2.9%
Percentage of all PICU-days	**31.5%**	**28.7%**	**28.3%**

Chapter 4 Patient characteristics-demographics: Age and sex

4.1 Age

There are no fixed age limits for admission to the PICU; generally speaking, patients are admitted as early as neonatal, if not preterm, and up to 16 or 18 years of age. Median age at admission to the PICU lies between 1.6 and 1.8 years; the mean age, between 4.2 and 4.5 years, is heavily influenced by a few older patients (*Table 4.1.1).*

Table 4.1.1 Age (years) at admission to PICU

	2003	2004	2005
Median	1.6	1.7	1.8
P_{25-75}	0.3-7.1	0.3-7.3	0.3-7.8
Maximum	26.9	23.4	20.1
Mean	4.2	4.3	4.5
N=	**4230**	**4531**	**4663**

There is a decline in the small but substantial number of neonates (less than 28 days old) in pediatric intensive care: 12.4% in 2003, 11.9% in 2004 and 10.3% in 2005 of total PICU population (*Table 4.1.2).*

Table 4.1.2 Age-classes of PICU population

	2003	2004	2005
< 28 days	12.4%	11.9%	10.3%
28 - 364 days	31.1%	30.2%	31.0%
1 - 4 yrs.	25.5%	25.1%	25.2%
5 - 17 yrs.	30.6%	32.2%	32.9%
>= 18 yrs.	0.4%	0.5%	0.5%
N=	**4230**	**4531**	**4663**

4.2 Sex ratio

The majority of admissions consist of male patients: 58.4% in 2003, 57.9% in 2004 and 57.2% in 2005. Predominance of male patients under 19 years of age is similar to the hospital admissions outside the PICU: 58% in 2004 and 56% in 2005 (National Medical Registration). The predominance of young males in hospital and PICU is higher than the average of 51% males under 19 years of age in the total Dutch population within this period (Statistics Netherlands).

Table 4.2 Admissions by sex (percentage males)

	2003	2004	2005
Total % male	58.4%	57.9%	57.2%
< 28 days	55.0%	60.3%	59.4%
28 - 364 days	61.3%	60.4%	61.6%
1 - 4 yrs.	57.3%	58.3%	57.4%
5 - 17 yrs.	57.9%	54.6%	52.0%
>= 18 yrs.	44.4%	45.8%	60.0%
N=	**4228**	**4526**	**4657**

Chapter 5 Urgency of admission

Admissions are categorized, according to urgency, as 'planned' or 'unplanned' admissions. Planned admissions consist of all patients scheduled in advance for a PICU admission, including elective admissions after elective surgery or admissions for an elective procedure (e.g. insertion of a central line), or elective monitoring, or review of home ventilation.
Most admissions to the PICU are unplanned: 57.6% in 2003, 53.9% in 2004 and 56.2% of all admissions in 2005 (*Table 5.1*).

Table 5.1 Urgency of admissions

	2003	2004	2005
Unplanned admissions	57.6%	53.9%	56.2%
N=	**3122**	**3352**	**3462**

One particular center where urgency was not registered at more than 25% of all admissions (58% missing in 2003, 42% in 2004 and 29% in 2005) has been excluded from the urgency analysis.

Both planned and unplanned admissions showed an increase over the period 2003-2005. Seasonal effects were most obvious for unplanned admissions, with a significant peak in the month of December. The percentage of unplanned patients in PICU was highest at the end of the year, during the winter holidays, when the number of planned admissions dropped sharply (*Figures 1.1. and 2.1).*

Chapter 6 Patients receiving mechanical ventilation

In 2005 there was a higher registration (both in number and in percentage) of PICU admissions who received mechanical ventilation than in previous years. Together with the number of ventilated patients in PICU, the number of days on which patients received any form of mechanical ventilation (ventilation days) was higher in 2005 than in the two previous years (*Table 6.1).*
This increase may well be a registration effect, since the PICU population did not differ much in reason for admission, diagnoses, and severity of illness scores (*see chapters 7, 8 and 12).*
Ventilated PICU patients stayed (on average) approximately 2 to 2.5 times longer in the PICU than non ventilated patients (the median LOS for all centers in the whole period was 2 days), and showed little difference from year to year in ventilation days and LOS (*Table 6.1*).

Table 6.1 Admissions and mechanical ventilation

	2003	2004	2005
% mechanically ventilated admissions per year	48.9%	48.4%	55.8%
Number of ventilation days by year of admission	13305	13602	16084
ventilation days as part of total PICU days	48.5%	49.6%	54.5%
Mean ventilation days	6.4	6.2	6.2
Median number ventilation days	3	2	3
Mean LOS	8.8	8.3	8.9
Median LOS	5	4	4
N=	**4230**	**4531**	**4663**

Chapter 7 Primary reason for admission

The primary reason for admission indicates the need for intensive care known at the time of admission to the PICU. This is not the same as PICU-diagnosis, which is described in the following chapter (Chapter 8 & *Appendix B).*

The most common reason for admission each year is a postoperative (2003: 40%, 2004: 43% and 2005: 39% of all annual admissions), followed by respiratory problems (2003: 21%, 2004: 20% and 2005: 21%) and circulatory problems (2003: 8%, 2004: 6% and 2005: 6%).
The top-10 most common primary reasons for admission have changed little over the years. The top-7 reasons in 2005 are also present in the top-10 of 2003 and 2004 (*Table 7.1*).

Table 7.1 Primary reason for admission to the PICU

	2003		2004		2005	
	%	*rank*	%	*rank*	%	*rank*
Postoperative	40.4	*1*	42.7	*1*	38.8	*1*
Respiratory***	21.4	*2*	19.8	*2*	20.8	*2*
Circulatory****	7.8	*3*	5.9	*3*	6.0	*3*
Monitoring (unspecified)	3.6	*5*	5.1	*4*	5.5	*4*
Special medication/procedure	5.2	*4*	4.5	*5*	4.0	*5*
Seizures	2.7	*7*	2.9	*6*	4.0	*6*
Preoperative	1.4	*12*	1.7	*11*	3.6	*7*
Neurotrauma	1.8	*11*	2.1	*10*	2.7	*8*
Hart disease (congenital)	3.2	*6*	2.4	*7*	2.3	*9*
Trauma (unspecified)	1.9	*10*	2.3	*9*	1.8	*10*
N =**	**3150**		**3368**		**4663**	

Ranking based on year 2005

** The total number of observations in 2003 and 2004 is much lower than the total number of admissions in these years, due to the exclusion of one particular center at which the reason for admission, before 2005, was registered for only half the population.

*** Respiratory problems consist of: “Unspecified respiratory insufficiency”,”Parenchyma”, “Upper and lower airway problems”.

**** Circulatory problems consist of: “Unspecified circulatory insufficiency” and “Shock”.

Chapter 8 Diagnoses

In addition to a primary, general reason for admission (Chapter 7), the Dutch PICE registry uses the ANZPIC diagnostic classification to collect diagnoses for patients admitted to the PICU (Slater 2003; PICE, Diagnosecodes).
A principal PICU diagnosis reflecting the diagnosis most directly responsible for the PICU admission and a principal underlying diagnosis reflecting the diagnosis that has contributed to the need for PICU admission is recorded for each admission,.

8.1 Principal PICU diagnosis: main diagnostic groups

The most common diagnostic group responsible for PICU admission is that of Respiratory diagnoses, followed by Post Procedures – Miscellaneous, and Cardiac Surgery. The ranking of the principal PICU diagnosis groups differs from year to year, but the top-3 always consists of these same three groups (*Table 8.1*).
In the group 'Miscellaneous', the two main diagnoses are 'sepsis' and 'septic shock': together 44% in 2003, 59% in 2004 and 48% in 2005.

Table 8.1 Principal PICU diagnosis: main groups

	2003		2004		2005	
	%	*rank*	%	*rank*	%	*rank*
Respiratory	20.6	*1*	20.3	*1*	20.3	*1*
Post procedures – Miscellaneous	15.1	*3*	14.2	*3*	17.6	*2*
Cardiac Surgery	16.9	*2*	18.7	*2*	15.6	*3*
Neurological	8.4	*5*	8.6	*4*	8.4	*4*
Miscellaneous	6.6	*6*	5.0	*8*	6.6	*5*
Cardiovascular	8.7	*4*	6.2	*7*	6.5	*6*
Thoracic & ENT Surgery	3.9	*10*	4.2	*10*	5.6	*7*
Neurosurgery	5.5	*8*	6.8	*6*	5.6	*8*
Injury	5.7	*7*	6.9	*5*	5.1	*9*
IC procedure / Monitoring	4.3	*9*	4.7	*9*	4.6	*10*
Renal / Gastrointestinal	2.5	*11*	3.1	*11*	2.7	*11*
Life Threatening Events	1.0	*12*	0.7	*12*	0.6	*12*
Endocrine / Metabolic	1.0	*13*	0.7	*13*	0.6	*13*
N = *	**3152**		**3369**		**4657**	

Ranking based on year 2005

* In 2003 and 2004, one center only registered diagnoses for half the population; that center has been excluded completely from this chapter for those two years.

8.2 Principal PICU diagnosis: Specific diagnoses

The diversity in specific principal PICU diagnoses reflects the diversity of the population in the pediatric intensive care setting: 262 different specific principal PICU diagnoses) in 2003, 260 in 2004, and 262 in 2005. The top-5 most frequent specific diagnoses in 2005 (seizures, bronchiolitis, respiratory failure, head trauma and spinal instrumentation) also forms part of the top-10 in 2004 and 2003, albeit in different order (*Table 8.2).*

Table 8.2 Top-10 specific principal PICU diagnoses

	2003		2004		2005	
	%	*rank*	%	rank	%	*rank*
Seizures	3.2	*2*	3.7	2	4.3	*1*
Bronchiolitis	2.8	*4*	3.5	3	3.4	*2*
Respiratory failure	4.0	*1*	4.7	1	2.8	*3*
Trauma – Head	2.2	*8*	3.2	4	2.6	*4*
Spinal Instrumentation	2.2	*9*	1.5	14	2.4	*5*
Pneumonia or Pneumonitis	2.6	*5*	2.2	7	2.4	*6*
General Surgery – Other	2.6	*6*	1.8	9	2.2	*7*
IC Diagnostic Monitoring – Elective	0.8	*34*	1.3	19	2.2	*8*
IC Procedure	3.0	*3*	2.9	5	2.0	*9*
Post Procedure – Other	1.2	*19*	1.9	8	1.9	*10*
N=	**3152**		**3369**		**4657**	

Ranking based on year 2005

8.3 Principal Underlying diagnoses: main groups

In addition to the principal PICU diagnosis, in the PICE registry also the principal underlying diagnosis is documented, which reflects the most important diagnosis that has contributed to the need for PICU admission.

The most common principal underlying diagnosis group is the ‘Cardiovascular’, followed by ‘Respiratory’ and ‘Miscellaneous’ diagnoses. The ranking and percentage of the principal underlying diagnostic groups barely alters from 2003 to 2005 (*Table 8.3*). The diagnostic group ‘Miscellaneous’ consists of a wide variety of specific diagnoses, the two most frequent of which are ‘leukemia or lymphoma’ and ‘scoliosis’, 18% and 12% resp. in 2003, 16% and 15% in 2004 and 12% and 14% resp. of all ‘Miscellaneous’ diagnoses in 2005.

Table 8.3 Principal underlying diagnosis group

	2003		2004		2005	
	%	*rank*	%	*rank*	%	*rank*
Cardiovascular	24.8	*1*	24.2	*1*	22.1	*1*
Respiratory	18.2	*2*	19.1	*2*	19.7	*2*
Miscellaneous	15.4	*3*	13.9	*4*	15.2	*3*
Neurological	14.5	*4*	15.2	*3*	14.1	*4*
Renal / Gastrointestinal	7.7	*5*	7.7	*5*	8.1	*5*
Trauma	6.3	*6*	7.4	*6*	6.6	*6*
General Surgery	4.1	*7*	3.8	*7*	5.7	*7*
IC procedure / Monitoring	1.7	*10*	1.9	*9*	2.0	*8*
Thoracic- & ENT Surgery	1.2	*12*	1.4	*12*	1.6	*9*
Endocrine / Metabolic	2.0	*9*	1.5	*10*	1.5	*10*
Neurosurgery	1.3	*11*	1.5	*11*	1.5	*11*
Cardiac Surgery	2.0	*8*	2.2	*8*	1.4	*12*
Life Threatening Events	0.6	*13*	0.4	*13*	0.5	*13*
N=	**3152**		**3370**		**4657**	
% same PICU and principal underlying diagnosis group	**47.4**		**44.2**		**49.0**	

Ranking based on year 2005

Chapter 9 Origin of patients

The main origin of patients admitted to the PICU was the same hospital as that in which the PICU was located: 67% of admissions in 2003, 69% in 2004, and 69% in 2005. Other sources of admission were other hospitals (26% in 2003, 24% in 2004, and 25% in 2005), followed by patient's home or site of the accident, which comprised 6% of the admissions in 2003, 2004 and 2005 (*Table 9.1).*

Table 9.1 Origin of patients

	2003	2004	2005
Same hospital as PICU	66.9%	69.3%	68.6%
Other hospital	26.3%	23.7%	25.0%
Home / site of accident	5.9%	6.4%	5.9%
Abroad	0.2%	0.2%	0.1%
Other	0.7%	0.3%	0.4%
N=	**4222**	**4531**	**4663**

Most patients were admitted directly from the operating room (including those from recovery) or from the inpatient ward; both comprised about 35% of all annual admissions (*Table 9.2).*

Table 9.2 Location before admission to PICU

	2003	2004	2005
Operating room, including recovery	33.6%	36.6%	36.6%
Inpatient ward	36.8%	35.2%	34.1%
Emergency Department	13.6%	11.7%	13.5%
Other ICU	5.0%	5.8%	5.5%
High Care	1.5%	1.1%	1.3%
Delivery room	1.6%	1.9%	1.6%
Other location *	8.1%	7.7%	7.4%
N=	**4203**	**4524**	**4625**

* including patients admitted directly to PICE from home, site of accident, and abroad, or other units.

A small percentage of the admissions (approximately 5%) received intensive care in another ICU before being admitted to the PICU. The type of ICU changed over time; in the period 2003-2005 there was a decrease in the number of admissions from neonatal ICUs (NICU), and an increase from adult ICUs. The proportion of referrals from other PICUs was stable – and rare: fewer than 15% of all post-ICU admissions and way below 1% of all admissions annually (*Table 9.3).*

Table 9.3 Intensive care before PICU admission

	2003	2004	2005
NICU	2.4%	2.3%	1.9%
Adult ICU	2.0%	2.7%	2.8%
Other PICU	0.6%	0.8%	0.7%
N=	**4203**	**4524**	**4625**

Chapter 10 Discharge after PICU: Destination and reason

10.1 Destination after discharge

As with the origin of patients, the destination after discharge from PICU barely changed over time. After discharge from PICU most patients remained in the hospital where they had received their intensive care: 75% in 2003, 76% in 2004, and 75% in 2005 (*Table 10.1.1)*.

Table 10.1.1 Destination after discharge (excluding deceased patients)

	2003	2004	2005
Stay in hospital	74.3%	76.1%	74.9%
To other hospital	16.9%	14.3%	14.9%
Home	8.1%	9.2%	9.7%
Abroad	0.3%	0.1%	0.1%
Other	0.4%	0.3%	0.5%
N=	**4006**	**4334**	**4444**

The most common destination after discharge was the inpatient ward, followed by a high-care unit. A small proportion (2.8% to 2.5%) was discharged to another ICU elsewhere (*Table 10.1.2)*.

Table 10.1.2 Hospital location at discharge (excluding deceased patients)

	2003	2004	2005
Inpatient ward	88.3%	66.3%	60.5%
High Care [1]	- - -	21.2%	26.6%
Intensive Care	2.8%	2.7%	2.5%
Other	0.5%	0.4%	0.5%
Out of hospital	8.4%	9.5%	9.9%
N=	**3972**	**4274**	**4404**

[1] Until 2004 'high-care' unit as location was not registered, and was part of the 'inpatient ward' in the PICE registry.

10.2 Discharge reason

The most common reason for discharge from PICU of patients who survived (*see: Chapter 12*) was that intensive care was no longer needed: a little over 95% each year. A small percentage (between 3.3% and 2.3%) of the living patients discharged still needed some kind of intensive or specialized care outside the PICU. A very small percentage (under 1%) of the discharges left the PICU for palliative care elsewhere. Despite the abovementioned increase in capacity, some patients (less than 1%) were discharged early because the capacity of the PICU was temporarily inadequate. On the other hand, some patients had to stay longer than necessary in the PICU due to a lack of capacity at the intended destination.

Table 10.2.1 Discharge reason (excluding deceased patients)

	2003	2004	2005
IC no longer needed	95.5%	97.0%	96.2%
Specialized care elsewhere	1.7%	1.3%	1.4%
Intensive Care elsewhere	1.6%	1.0%	1.1%
Discharged for palliative care	0.8%	0.4%	0.4%
Early discharge	0.4%	0.3%	0.9%
N=	**4006**	**4334**	**4441**
Discharge delayed	1.3%	0.7%	0.6%
N=	**4008**	**4334**	**4444**

Chapter 11 Transport: specialized interhospital retrievals & referral region

11.1 Interhospital retrievals

The introduction and implementation of specialized pediatric transport teams over the years resulted in more retrievals being accompanied by a specialized team. Whereas the percentage and number of interhospital retrievals has been roughly the same each year (*Table 9.1)*, the percentage of retrievals accompanied by specialized pediatric/neonatal critical care transport teams including mobile medical teams increased from 30.2% of all interhospital retrievals in 2003 to 35.3% in 2004 and 43.4% in 2005 (*Table 11.1.1*) .

Table 11.1.1 Specialization transport teams of all interhospital retrievals

	2003	2004	2005
Specialized (PICU/NICU) team receiving center	18.5%	25.6%	34.5%
Specialized (PICU/NICU) team other center	11.7%	9.7%	8.9%
Non PICU/NICU specialist	30.2%	32.5%	29.8%
Paramedics only	39.2%	32.1%	26.7%
Not medical escorted transport	0.5%	0.1%	0.1%
(Total interhospital retrievals) N=	**1106**	**1071**	**1163**

The increase in specialized retrieval was even more apparent in the retrieved patients who received mechanical ventilation within the first hour after admission: 38% was transported to the PICU by a specialized team in 2003, 56% in 2004 and 63% in 2005 (*Table 11.1.2)*.

Table 11.1.2 Specialization transport team of patients ventilated within 1st hour on PICU

	2003	2004	2005
Specialized (PICU/NICU) team receiving center	25.5%	44.4%	51.9%
Specialized (PICU/NICU) team other center	12.6%	11.5%	10.6%
Non PICU/NICU specialist	39.6%	30.6%	27.6%
Paramedics only	22.3%	13.3%	9.9%
Not medical escorted transport		0.2%	
(Total transports ventilated within 1st hr) N=	**444**	**435**	**597**

11.2 Referral regions

Seven different referral regions were established in 2003 to ensure the lowest possible waiting times and to distribute evenly the burden of transport among the various PICUs (SICK, September 2003). The interhospital retrievals from the region of the receiving center (intra regional transport) increased from 69.0% in 2003, to 76.7% in 2004 and 79.6% in 2005. Transport between the University hospitals hardly changed (*Table 11.2.1).*

Table 11.2.1 Interhospital retrievals by region of referring hospital

	2003	2004	2005
From the region of receiving PICU	69.0%	76.7%	79.6%
N=	**1105**	**1066**	**1150**
From other University hospital	10.1%	9.4%	9.7%
N=	**1105**	**1066**	**1150**

Chapter 12 Mortality in PICU

12.1 Mortality

The annual national mortality rate in PICU is about 5%. Of all admissions to the PICU in the Netherlands in 2003, 5.2% died in intensive care, in 2004, 4.3%, and in 2005, 4.7%. Crude mortality rate differed between centers; the greatest difference was in 2005 and varied from 2.6% and 7.3% (*Table 12.1).*

Table 12.1 Mortality rate in the PICU

Year	Dead on arrival [1]	Deceased in PICU	within 1st 2 hrs [2]	Mortality rate	PICU Range	N=
2003	1	221	6	5.2%	4.1% - 6.8%	**4229**
2004	1	196	4	4.3%	3.0% - 5.7%	**4531**
2005		219	8	4.7%	2.6% - 7.3%	**4663**

[1] excluded from the PICU mortality rate and SMR; includes patients admitted for organ donations.
[2] Patients dying within two hours after admission to the PICU are excluded from overall PRISM-score and -SMR.

Crude mortality rate in the period 2003-2005 was standardized using two different prognostic mortality scores: the Paediatric Index of Mortality (PIM1) and the Pediatric Risk of Mortality (PRISM) *(Shann 1997 and Pollack 1988).* To obtain the Standardized Mortality Ratio (SMR), the observed mortality in the PICU is divided by the predicted mortality. An SMR equal to one indicates that the observed mortality in the PICU is the same as that predicted, and an SMR greater than one indicates that the PICU has a higher mortality than predicted by the model used. The uncertainty around the SMR due to the small numbers of observed mortality is described by confidence intervals based on a Poisson distribution. (Ulm, 1990)

Excluded from calculating PIM, PRISM, and their SMR were admissions from those centers that were excluded from the chapter on mortality, as a whole, in 2003 and 2004 (see *Appendix A* Data Quality); furthermore, patients who died within two hours after admission to PICU were also excluded from the PRISM. All other admissions were included, also those admitted from or discharged to another IC, and patients under 28 days old or 16 years and older at admission. Admissions with a missing PIM1 or PRISM score were treated as though they had a so-called ‘normal’ score and mortality risk (both below a mortality risk of 0.01).

The two models used to standardize mortality were analyzed for their degree of compatibility with the Dutch PICE. This study by the PICE study group showed that both models were compatible with the Dutch PICUs, in terms of discriminating power between non-survival and survival with far better performance of the PRISM. But both models were poorly calibrated to the Dutch data (Visser 2007).

12.2 PIM1 & SMR

The SMR for the overall Dutch PICU was never higher than 0.95 and for individual centers never significantly above one. The SMR for individual centers varied between 0.63 [±95%CI:0.29;1.19] and 1.17 [±95%CI:0.72;1.78] (column 'SMR PICU-Range'), with the highest lower limit of the 95% confidence interval never exceeding 0.82 for any individual center in the period 2003-2005 (*Table 12.2.1*).

Table 12.2.1 PIM1 & SMR

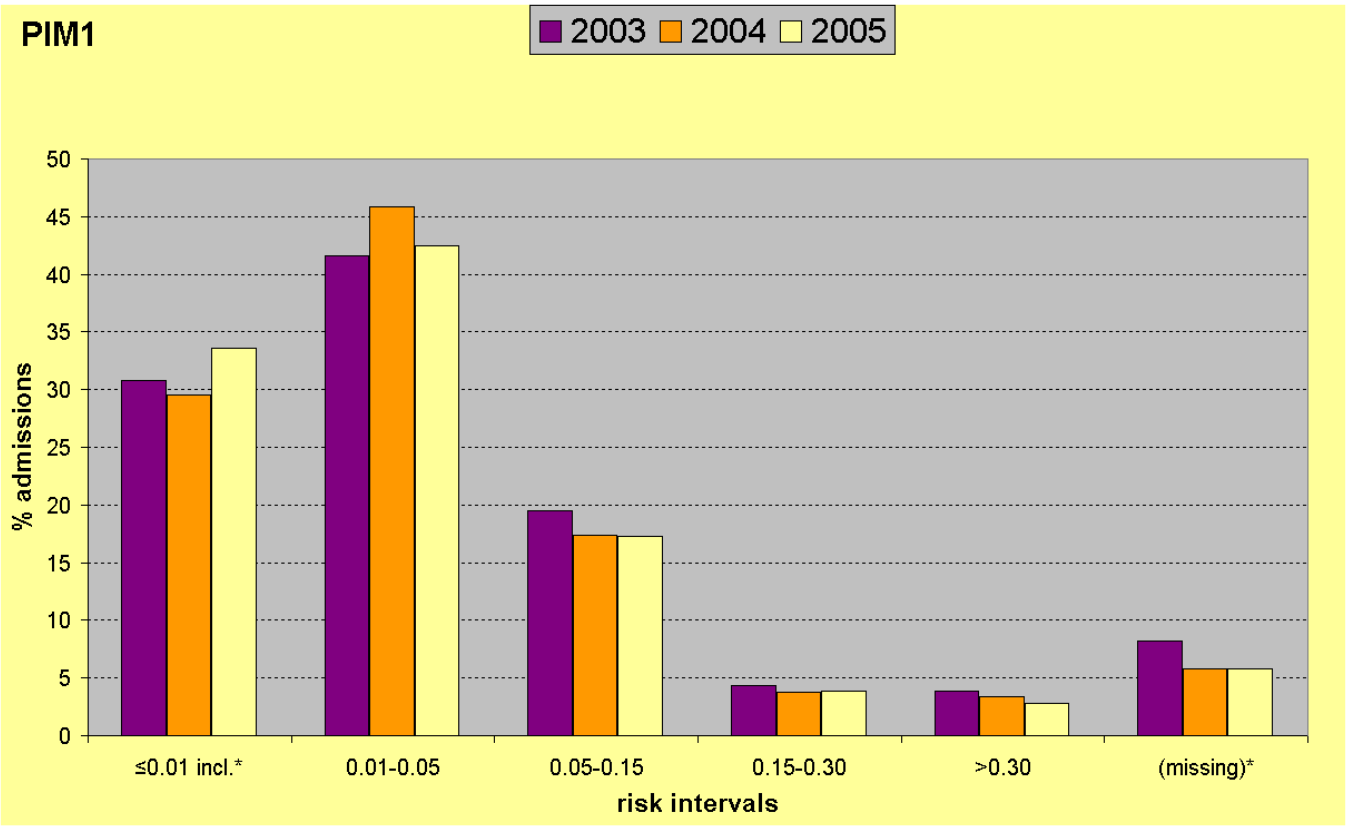
Year	SMR-PIM [1] [±95%CI]	Mean risk	Median risk	SMR PICE-Range [±95%CI]	N= [2]
2003	0.94 [0.80;1.10]	0.06	0.02	0.75 [0.41;1.26] – 1.05 [0.70;1.53]	**2805**
2004	0.85 [0.72;1.01]	0.05	0.02	0.63 [0.33;1.10] – 1.01 [0.69;1.42]	**2956**
2005	0.95 [0.83;1.09]	0.05	0.02	0.63 [0.29;1.19] – 1.17 [0.72;1.78]	**4663**

[1] In the PICE registry the fiO2/paO2 ratio is not measured for patients with intracardiac shunts or chronic respiratory insufficiency, which may result in lower PIM1 scores and therefore a higher SMR.

[2] The difference in numbers of observed cases before 2005 is due to difficulties, at several centers, with registration of the PIM1 and PRISM scores. Not until 2005 were all centers included in the overall SMR for the Dutch PICE registration.

The overall PICU population in the Netherlands showed little variation from year to year, in the period 2003-2005, in the mortality risk as calculated with the PIM1. A large proportion of the PICU population had a relatively small risk of mortality. Half the population had a mortality risk below 0.02 throughout that period (*Table 12.2.1*) and more than 70% each year had a risk of 0.05 or less, including those with a missing score for the PIM1 (*Figure 12.2.1).*

Figure 12.2.1 Admissions and mortality risk (PIM1)



* 'missing' risks are included into the risk interval ≤ 0.01 (see also paragraph 12.1)

12.3 PRISM & SMR

As mentioned in paragraph 12.2, the SMR for the overall Dutch PICU was never higher than one. After standardizing mortality on PRISM, the national adjusted SMR was even significantly lower than one. For individual centers the adjusted SMR was always below one, with the highest lower limits of the 95% confidence interval never exceeding 0.63. (*Table 12.3.1*)

Table 12.3.1 PRISM & SMR

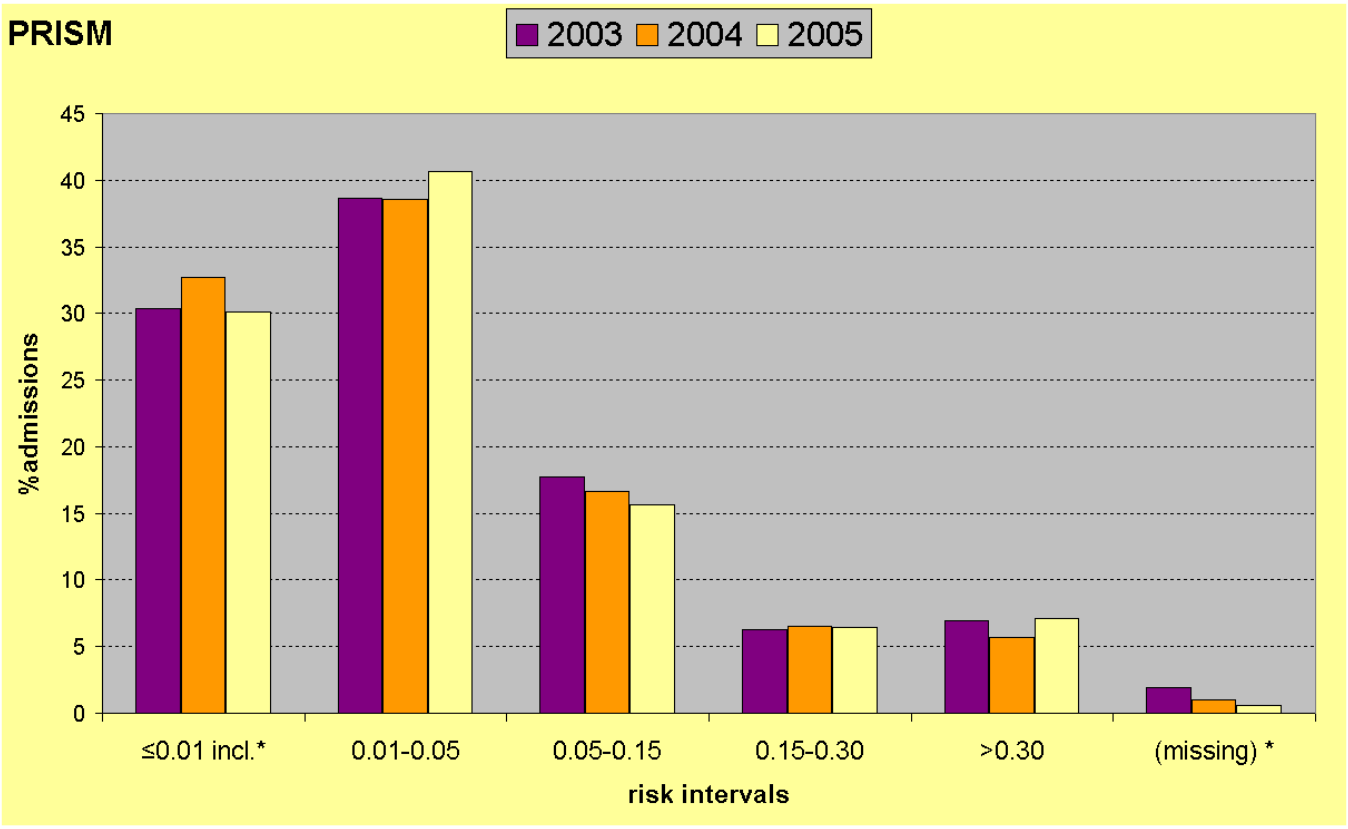
Year	SMR-PRISM[1] [±95%CI]	Mean risk	Median risk	SMR PICU-Range [±95%CI]	N= [2]
2003	0.63 [0.52;0.76]	0.08	0.02	0.50 [0.25;0.89] – 0.80 [0.51;1.17]	**2213**
2004	0.64 [0.54;0.76]	0.07	0.02	0.53 [0.35;0.57] – 0.81 [0.54;1.18]	**2770**
2005	0.56 [0.49;0.65]	0.08	0.02	0.43 [0.31;0.59] – 0.88 [0.63;1.19]	**4655**

[1] Patients deceased within two hours after admission were excluded

[2] The difference in numbers of observed cases before 2005 is due to difficulties, at several centers, with registration of the PIM1 and PRISM scores. Not until 2005 were all centers included in the overall SMR for the Dutch PICE registration.

As with the PIM1 (*Table 12.2.1)* the severity of illness of the overall PICU population in the Netherlands, according to PRISM, showed little variation from year to year in the period 2003-2005.
The median risk of mortality based on PRISM was the same as that for the PIM1: half the population had a mortality risk below 0.02 throughout that period (*Table 12.3.1*) and about 70% each year had a risk of 0.05 or less, including those with a missing score for the PRISM (*Figure 12.3.1).*

Figure 12.3.1 Admissions and mortality risk (PRISM)



* 'missing' risks are included into the risk interval ≤ 0.01 (see also paragraph 12.1)

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Appendix A Data quality

The PICE registry uses a dataset with definitions established in 2003 by the PICE study group, following intensive discussion and expert meetings. These definitions, together with instructions on the registration, are available on the PICE website and in the registration software, and are also utilized during the compulsory, centrally-organized training programs.
All PICU staff involved in PICE Registration is required to follow training programs in data registration, use of diagnoses classification, and scoring of prognostic mortality scores PIM and PRISM. Data control is performed on missing data, range checks and inconsistencies following standardized procedures upon entry into the registry software, and again after entry into the central PICE database. Before entering the local data into the central database, the appointed local data supervisor, an experienced pediatric intensivist and member of the study group, must validate the local data.
Despite this set of quality controls, data may still be omitted from registration or found to be unreliable. These data are considered 'missing' and left out of the final analysis, except for the PIM1 and PRISM, where missing is treated as 'normal', and for mechanical ventilation, where missing data were treated as 'not ventilated'. If there was a particularly large amount of missing data for a specific center and year (>20%), the PICU and year concerned was excluded completely from the analysis (*Table A, 3rd column 'PICUs used'*).
One center with two PICUs (a unit specialized in postoperative patients and a general unit) had major organizational problems in one of the two existing units which led to about half the data missing on urgency, reason for admission, diagnoses, PIM1 and PRISM. This center was excluded from the analysis in the relevant chapters. Two other centers had problems registering enough reliable scores for the PIM1 and PRISM in 2003 and 2004, and were also excluded from the respective analyses. One temporary admission of an adult (43 years of age) was included only in the analysis of number of admissions, occupied beds and LOS (Chapter1 – Chapter3).

Table A

Table A shows the number of PICUs used for the various analyses in this report (3rd column 'PICU used'), the number of admissions from the PICUs available for the analysis (4th column 'available data'), and the percentage of available data with missing values (5th column '% missing of available').

Table A Available and missing data in the PICE Report 2003-2005.

Chapter	Subject	PICUs used			available data			% missing of 'avalaible'		
		2003	2004	2005	2003	2004	2005	2003	2004	2005
1	Admissions	All 8	All 8	All 8	4230	4532	4663	0	0	0
2	Occupied beds	All 8	All 8	All 8	4230	4532	4663	0	0	0
3	LOS	All 8	All 8	All 8	4230	4532	4663	0	0	0
4.1	Age	All 8	All 8	All 8	4230	4531	4663	0	0	0
4.2	Sex ratio	All 8	All 8	All 8	4230	4531	4663	0.05	0.11	0.13
5	Urgency	7	7	7	3152	3369	3464	0.95	0.50	0.06
6	Ventilation	All 8	All 8	All 8	4230	4531	4663	0	0	0
7	Admission Reason	7	7	All 8	3152	3369	4663	0.06	0.03	0.02
8.1&8.2	PICU Diagnosis	7	7	All 8	3152	3369	4657	0	0	0.13
8.3	Underlying diagn.	7	7	All 8	1832	2099	2587	0	0	0
9.1	Origin of admissions	All 8	All 8	All 8	4230	4531	4663	0.19	0	0
9.2&9.3	Location pre-admiss	All 8	All 8	All 8	4203	4524	4625	0.64	0.15	0.81
10.1	Destination	All 8	All 8	All 8	4008	4334	4444	1.00	0.53	2.10
10.2	Destination- location	All 8	All 8	All 8	4008	4334	4444	2.02	2.15	3.11
10.3	Discharge reason	All 8	All 8	All 8	4008	4334	4444	0.05	0	0.07
11.1	Retrieval team	All 8	All 8	All 8	1106	1071	1163	0.54	0.46	0.09
11.2	Referral regions	All 8	All 8	All 8	1106	1071	1163	0.63	0.93	1.20
12.1	Mortality	All 8	All 8	All 8	4230	4531	4663	0	0	0
12.2	PIM1-SMR	6	6	All 8	2805	2956	4663	8.2	5.8	5.8
12.3	PRISM-SMR	5	6	All 8	2213	2770	4655	1.9	1.0	0.6

Appendix B Abbreviations & links, definitions and minimal PICE-dataset

LOS: Length of stay; number of calendar days during which a patient stays in PICU during a PICU admission.
Occupied beds: Number of different patients (admissions) in care on the PICU; a patient discharged in the morning and readmitted later that same day counts for 2 occupied beds on that day.
PICU: Pediatric Intensive Care Unit; an intensive care unit specialized in the care of children from birth to about 16 to 18 years of age.
PICU days: the sum of all patients in care each calendar day during a specific period. A patient contributes one PICU day for each calendar during which the patient stayed in the PICU. The number of PICU days in a specific year can include patients admitted in a previous year but still in PICU during the specific year, e.g. a patient admitted to the PICU on 31-12-2001 and discharged the next day contributes one PICU day to 2001 and one PICU day to 2002.
PIM: Paediatric index of mortality
Primary reason for admission: The need for intensive care known to the PICU at the time of admission.
Principal PICU diagnosis: The diagnosis most directly responsible for the PICU admission.
Principal underlying Diagnosis: The most important diagnosis contributing to the need for PICU admission.
PRISM: Pediatric risk of mortality.
Ventilation days: Sum of PICU days on which the patient has received mechanical ventilation.

ANZPIC: Australian and New Zealand Paediatric Intensive Care
http://www.anzics.com.au/section.asp?Section=paediatric
IGZ: The Netherlands Health Care Inspectorate [Dutch: Inspectie voor de Gezondheidszorg] http://www.igz.nl/uk/
IRS: Inspektor Research Systems; registration software for the PICE www.inspektor.nl/pice
LMR: National Medical Registry [Dutch: LMR Landelijke Medische Registratie]
http://www.swov.nl/uk/research/kennisbank/inhoud/90_gegevensbronnen/inhoud/lmr.htm
NICE: National Intensive Care Evaluation, evaluation of Dutch Intensive Care for adults [Dutch: Nationale Intensive Care Evaluatie] http://www.stichting-nice.nl/introductie.jsp?lang=en
NVK: Dutch Pediatric Association [Dutch: Nederlandse Vereniging voor Kindergeneeskunde]
http://www.nvk.pedianet.nl/index.htm
PICANet: Paediatric Intensive Care Audit Network [United Kingdom] http://www.picanet.org.uk/
PICE: Pediatric Intensive Care Evaluation; evaluation of Dutch Pediatric Intensive Care. www.pice.nl .
SICK: Section Children's Intensive Care; section of the NVK
http://www.nvk.pedianet.nl/index.htm
Statistics Netherlands: Dutch Central bureau of statistics [Dutch: CBS, Centraal Bureau voor de Statistiek]
http://www.cbs.nl/en-GB/default.htm
VWS: Dutch Ministry of Health, Welfare and Sport [Dutch: ministerie van Volksgezondheid, Welzijn en Sport]
http://www.minvws.nl/en/

PICE Dataset: the set of items and their definitions that form part of the PICE registry

Minimal PICE Dataset www.pice.nl/dataset.htm :
- Demographics: age at admission, sex, home region.
- Admission characteristics: admission date to hospital and PICU, urgency & type of admission, referring specialist, primary reason for admission, place & location of origin before admission, transport.
- Patient characteristics: mental status at admission (EMV), PIM1, PRISM, PICU diagnosis, underlying diagnoses, days with mechanical ventilation.
- Discharge characteristics: discharge date, reason for discharge, survival, destination and transport

Appendix C PICE: foundation, study group and participating centers

PICE Foundation

Jan A. Hazelzet, President
Carin Verlaat, Secretary
Douwe R. van der Heide, Treasurer

PICE study group

The Dutch PICE study group is formed by pediatric intensivists and a pediatric intensive care nurse representing all eight participating centers:

Job van Woensel	MD PhD	Amsterdam, AMC-EKZ
Frans Plötz	MD PhD	Amsterdam, VUmc
Marcel Albers	MD PhD	Groningen, UMCG
Douwe van der Heide	PCCN	Groningen, UMCG
Karin Hogenbirk	MD	Leiden, LUMC
Dick van Waardenburg	MD	Maastricht, MUMC+
Carin Verlaat	MD	Nijmegen, UMCN
Jan Hazelzet	MD PhD FCCM	Rotterdam, ErasmusMC-Sophia
Robert Jan Houmes	MD PhD	Rotterdam, ErasmusMC-Sophia
Koos Jansen	MD PhD	Utrecht, UMCU-WKZ

Since 2003, the study group has been assisted by a researcher and since mid-2006 by a data quality officer.

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Participating centers

All eight of the pediatric intensive care units in the Netherlands participate in the Dutch PICE.
These PICUs are part of the eight Dutch university hospitals:

Amsterdam: Academic Medical Center (AMC) – Emma Children's Hospital (EKZ)
Amsterdam: VU university medical center (Vumc)
Groningen: University Medical Center Groningen (UMCG) – Beatrix Children's Hospital
Leiden: Leiden University Medical Center (LUMC)
Maastricht: Maastricht University Medical Center+ (MUMC+)
Nijmegen: Radboud University Nijmegen Medical Center (UMCN)
Rotterdam: Erasmus Medical Center (Erasmus MC) – Sophia Children's Hospital
Utrecht: University Medical Center Utrecht (UMCU) – Wilhelmina Children's Hospital (WKZ)

Acknowledgements

We like to thank all medical, nursing and administrative PICU staff members involved in the registration of data for the PICE for their continuous effort and support.

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ISBN 9789078022039