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Weekend admissions to paediatric/neonatal intensive care units are associated with longer hospitalisation time but not with greater mortality

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Abstract

Background. To evaluate the impact on mortality and duration of stay of weekend admission of paediatric patients to the Paediatric/Neonatal Intensive Care Unit (PNICU).

Methods. Retrospective, nine-year cohort study. The study was performed in a tertiary level PNICU between 1January 1999 and 31 December 2007. Data about the day of admission, diagnosis, outcome, and duration of stay was collected using a computerised database.

Results. 2,223 out of 2,240 patients treated in the PNICU during the analysed period were enrolled to the analysis. 61.9% of the group were newborns. Overall mortality equalled 10.9% and did not differ depending on weekend or weekday admission (10.95% vs. 10.86% respectively, $P = 0.96$). A negative trend of mortality in both groups was observed ($P < 0.001$). The frequency of deaths occurring during the initial 48 hours of treatment also did not differ between weekend and weekday admissions (4.1% vs. 3.3%, $P = 0.52$). Overall duration of PNICU stay was significantly longer for weekend admissions (median 10 vs. 8 days, $P = 0.01$). The difference was absent in the neonatal group (12 vs. 11 days; $P = 0.9$) but was evident in children (median 6 vs. 5 days $P = 0.002$) regardless of primary diagnosis. The difference was the greatest in children with sepsis and/or haematological malignancy (five days in both subgroups, $P = 0.01$ and 0.002 respectively).

Conclusions. No day-of-admission-dependent differences of mortality were detected in the analysed group. Weekend admissions were associated with longer duration of PNICU stay in children.

Key words: pediatric intensive care unit, prognosis; pediatric intensive care unit, mortality

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BACKGROUND

The effect of weekend admissions has been previously discussed in an adult population as one contributing to increased mortality and morbidity [1]. Similar analyses have been performed among paediatric [2] and neonatal populations [3]. However, such comparisons have not yet been carried out in a central European middle-income country. Furthermore, neither of the cited papers evaluated any relation between the day of admission and the duration of stay in the intensive care unit (ICU). As data on paediatric/neonatal ICUs is scarce, we chose to investigate the subject in our own unit.

The aim of this study was to evaluate the effect of weekend admissions on mortality and duration of ICU stay.

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METHODS

Data concerning patient age, day of admission, reason for admission, and duration of ICU stay was collected. Data regarding all subjects treated in the ICU between January 1999 and December 2007 was extracted from the institutional medical database using custom-designed text mining software. The output was then validated manually to assure validity of the extracted information. Data was statistically analysed in respect of differences in overall mortality, early mortality (i.e. death within 48 hours of admission) and duration of ICU stay. Patients readmitted to the ICU or after prior hospitalisations in similar units elsewhere were excluded from the analysis. Weekend admissions were defined as those occurring on Saturday or Sunday.

Statistical analysis was performed using a χ^2 test for categorical variables and U Mann-Whitney test for continuous variables. Continuous variables are presented as medians and interquartile ranges (IQR). Trend analysis was performed using analysis of variance with planned contrast comparisons for linear trend. The study period was chosen to include a total of at least 2,100 patients needed to confirm a 3% difference in mortality with a statistical power of 80%, which the authors deemed probable, based on available literature data. Statistica 7.0 (Statsoft, Tulsa, OK, USA) software was used for all calculations. As indices of statistical significance, we chose a P level < 0.05 or a 95% confidence interval not covering the number 1.

Table 1. Group characteristics: demographic data, diagnosis and mortality. Percentages calculated in respect of the whole group (n = 2,223). As most patients had more than one diagnosis at admission, sum of percentages exceeds 100

Characteristic	n (%)
Males/females	1,267/956
Overall mortality	243 (10.9%)
Early mortality	88 (3.96%)
Neonates	1,377 (61.9%)
Older children (> 1 month of age)	846 (38.1%)
Most frequent diagnoses in newborns (n = 1,377)	
Prematurity	575 (41.7%)
Very low birth weight	421 (30%)
Congenital infection	520 (37.8%)
Respiratory distress syndrome	436 (31.7%)
Transient tachypnoea	40 (2.9%)
Meconium aspiration syndrome	38 (2.8%)
Most frequent diagnoses in children (n = 846)	
Suspected/documented sepsis	504 (59.7%)
Meningitis, encephalitis, status epilepticus	212 (25.1%)
Postoperative care	167 (19.7%)
Neuromuscular disorders with respiratory failure	100 (11.2%)
Haematological malignancy*	51 (6.0%)

*no patients admitted following bone-marrow or stem cell transplantation

RESULTS

Over the analysed period, after the exclusion of readmitted patients, a total of 2,240 children were treated in the ICU. General characteristics of this group are presented in Table 1. A total of 2,223 patients were eligible for analysis. The missing 17 patients were excluded due to incomplete data. A total of 243 patients died, 88 deaths occurring within the initial 48 hours of treatment. A progressive decline of mortality rate was observed throughout the whole analysed period (P = 0.01; Figure 1), which was caused by a reduction of neonatal mortality (P = 0.02). This observation was not confirmed in older children (P = 0.26). The largest number of patients were admitted on Wednesday and Thursday (16.4%), and the least on Sunday (10.5%). Weekend admissions constituted 22% of all admissions (n = 479). Neonates presented marginally higher mortality than older children (11.96% vs. 9.32%; P = 0.06). In the analysed group, odds ratio of death or early death did not differ between patients admitted at the weekend or on weekdays (OR 0.99; 95% CI 0.72–1.37 and OR 0.80; 95% CI 0.46–1.39 respectively). In subgroup analysis, weekend admissions were not associated with worse outcome in terms of overall or early mortality in newborns (OR 0.93; 95% CI 0.66–1.43 and OR 0.68; 95% CI 0.33–1.40 respectively) and children alike (OR 0.97; 95% CI 0.54–1.75 and OR 1.05; 95% CI 0.45–2.44).

Differences in duration of stay of survivors were found between weekend and weekday admissions (10 days [IQR 5–20]) and 8 days (4–20) respectively; P = 0.01). This difference persisted in children (6 (IQR 3–14) vs. 5 (2–10) days; P = 0.002) but was absent in newborns (12 [IQR 6–24] vs. 11 [6–26] days; P = 0.90). Table 2 shows the differences in duration of stay of children and newborns depending on the diagnosis.

DISCUSSION

The presented epidemiological results of a typical paediatric/neonatal ICU in Poland show that mortality (e.g. 8.82% in 2007) is slightly higher than that observed in similar units in highly developed countries [4]. On the other hand, the persisting negative trend suggests that further improvement is possible. Organisational issues associated with unequal daily workload distribution are suspected to be one of the barriers hindering mortality rate reduction [2, 3]. The question as to whether day of admission plays a role in increasing the chance of death is therefore one

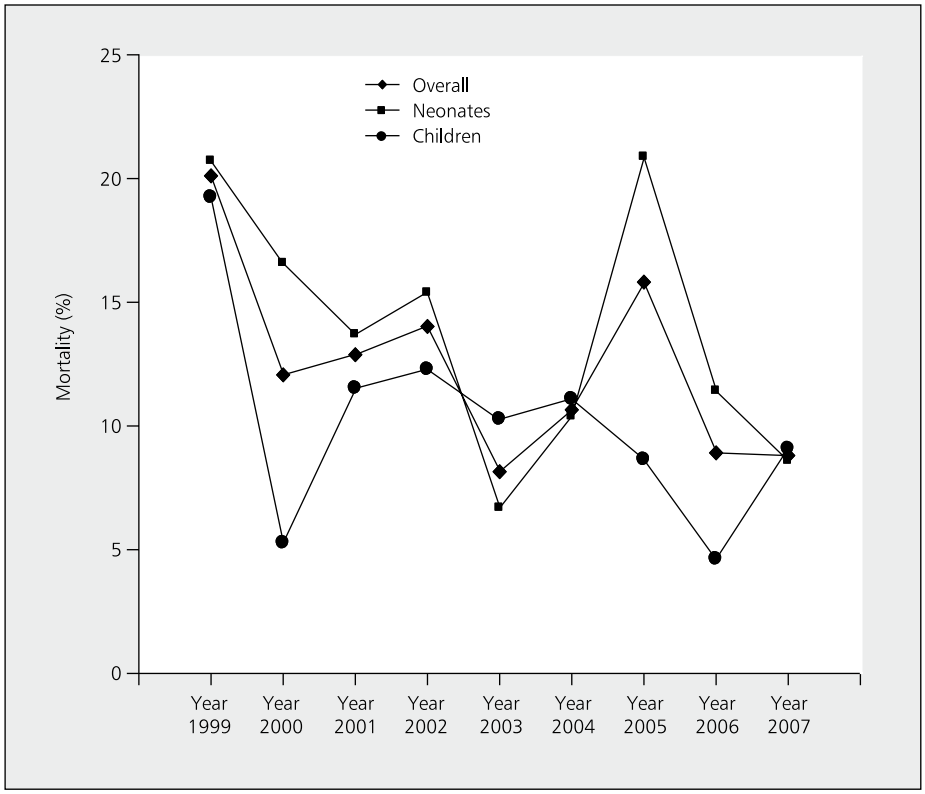

Figure 1. Mortality rate during analized period

Table 2. Differences in duration of intensive care unit (ICU) stay depending on diagnosis at admission. Data shown as medians and interquartile ranges due to non-normal distributions. All values expressed in days

Neonates: Duration of ICU treatment of survivors with most frequent diagnoses			
	Weekday admission	**Weekend admission**	***P* value**
Prematurity	28 (12–55)	24 (13–52)	0.14
Very low birth weight (< 1,500 g)	39 (21–66)	37 (14–60)	0.97
Congenital infection	11 (7–26)	12.5 (7–24)	0.95
Respiratory distress syndrome	24 (12–45)	23 (12–45)	0.94
Transient tachypnoea	7 (4–9)	5 (4–6)	0.91
Meconium aspiration syndrome	10 (8–13)	12.5 (12–24)	0.89
Children: Duration of ICU treatment of survivors with most frequent diagnoses			
	Weekday admission	**Weekend admission**	***P* value**
Suspected/documented sepsis	8 (3–18)	13 (6–26)	0.01
Meningitis, encephalitis, status epilepticus	5 (2–11)	5 (3–14.5)	0.006
Postoperative care	3 (2–5)	3.5 (3–12)	0.001
Neuromuscular disorders	7 (3–16)	12 (4.5–15)	0.002
Haematological malignancies	3 (2–6.5)	8 (3–12)	0.002

of vital importance. Our ICU is characterised by full and immediate availability of laboratory and imaging procedures on weekdays, whereas on Saturday and Sunday only rudimentary diagnostic procedures were readily available (blood gas analysis, electrolytes, glucose, blood cell count and chest X-ray) without for instance the possibility for an ECHO investigation or microbiology analysis). Despite the persisting difference between the availability of diagnostic procedures and the number of physicians on site (one or two during weekends, at least three during weekdays), we did not discover substantial differences in mortality depending on the day of admission.

Considering that 62% of patients admitted to the ICU were newborns transferred from level I and level II hospitals, the rapid provision of specialised healthcare to such patients should be the mainstay of treatment. Therefore a suspicion was raised that such patients may have been provided with inadequate standards of care, and that quality improvement should be focused on them.

The difference in early mortality and overall mortality was slight: 0.5% and 0.11% respectively. Considering statistical power issues, a sample size of 24,000 up to 3,000,000 patients would be needed to confirm the difference in early and overall mortality. As these values exceed by five-fold the number of paediatric patients treated in ICUs in Poland per year, we believe that these differences are negligible and insignificant from the epidemiological point of view in our country. These results differ from those collected by Hixson who reported increased mortality in children admitted at weekends [2]. His work however did not include neonates and yielded a difference of 2.8% in a group of 5,968 patients. Similar findings were made among children admitted to a rural hospital in Kenya, with the difference in mortality reaching 1.4% [5]. The findings of the aforementioned studies stand in contrast to those of Gould [3] and Arias [6] who did not observe significant risks associated with weekend admission. The latter author however, did observe a difference in mortality related to the hour of admission; we did not perform such analysis.

Although mortality rates did not differ in all analysed subgroups, the duration of ICU stay was significantly longer among patients admitted at weekends, and was caused by longer hospitalisation of children. The lack of difference in hospitalisation time of neonates is not surprising though, as the most important factors determining the clinical course of such patients are: gestational age, birth weight, and the presence of congenital anomalies [7, 8, 9, 10], all of which are unrelated to the day of admission to the ICU. In older children however, the difference in duration of stay was evident regardless of diagnosis. Particularly high differences were observed in children with sepsis and/or haematological disorders (difference of medians equaled five days in both groups of patients). This may be due to the more severe condition of septic patients who are diagnosed and transferred during the weekend, although definite proof of such a relation would be somewhat unlikely to persist over nine years. It may also have been caused by the reduced availability of diagnostic procedures and laboratory tests during the weekend that delayed the introduction of proper treatment. The exact cause of this prolongation of ICU stay is however difficult to explain. Moreover, neither of the previously cited authors analysed such outcomes. We were unfortunately unable to stratify patients by risk of death using clinical rating scales such as PRISM III (*Paediatric Risk of Mortality III)* or PIM (*Paediatric Index of Mortality)* as these were not verified and calibrated until the final year of the observation period. Nevertheless, a highly significant difference in duration of stay between weekend and weekday admission in a relatively large group of children, regardless of the primary diagnosis, cannot be attributed purely to chance. Whereas in patients in postoperative care the blame can be placed on purely organisational issues, a similar relation in patients with other diseases is worrying and highlights the need for a thorough investigation of the subject. Regardless of the underlying causes of this observation, prolongation of ICU therapy may be a significant negative factor related to weekend admission.

CONCLUSIONS

Weekend admissions are not associated with increased mortality in neonatal and paediatric populations in a level III paediatric/neonatal ICU in Poland, but do result in prolongation of the ICU stay.

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