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Prospective paediatric intensive care registry in Latvia: one year outcomes

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Background. In Latvia, there is a single eight-bed paediatric intensive care unit (PICU) where all critically ill children are admitted. A recent retrospective audit of the outcomes of paediatric critical care in this unit revealed a high number of unplanned extubations and excess crude mortality. In 2017, our centre joined the UK and Ireland based Paediatric Intensive Care Audit Network (PICANet) as a pilot project to investigate the feasibility of developing a paediatric critical care registry in Latvia and in the Baltic states.

Methods. Riga Stradins University Ethics Committee approved the study. Anonymized data on all patients admitted to our unit from 1 June, 2017 to 31 May 2018 were prospectively entered onto the PICANet database.

Results. A total of 774 PICU admissions were analysed; 45% of admissions were elective. The median age was 59 months (IQR: 14–149). The highest admission rate was on Wednesdays representing the flow of elective surgical patients. The median length of stay was 0.95 days (IQR: 0.79–1.98). Twenty-five percent required respiratory support. The expected number of deaths estimated using the Paediatric Index of Mortality 3 (PIM 3) 15.16; 15 patients (1.94%) died resulting in Standartized Mortality Ratio (SMR) of 0.99 (95% CI 0.57–1.60). The emergency readmission rate within 48 hours after PICU discharge was 0.9%. There were 1.8 unplanned extubations per 100 invasive ventilation days. Other paediatric intensive care audit networks reported similar adjusted mortality rates but lower rates of unplanned extubations. Thirty days after PICU discharge, 653 (84.36%) patients were alive and outside hospital, 98 (12.66%) were inpatients, six (0.78%) had died, two (0.26%) were lost to the follow-up. We observed a marked peak of infant emergency respiratory admissions in February.

Conclusions. This project explored the possibility of prospective paediatric critical care audit in Latvia by joining an established international network. This allowed direct comparison of outcomes between the countries. Excess mortality was not observed during one-year data collection period, however a high rate of unplanned extubations was revealed. The results allowed a better planning of elective patient flow by spreading elective cases over the week to avoid "rush hours"

Keywords: pediatric, critical care, intensive care

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INTRODUCTION

Childhood mortality in Latvia has decreased several-fold over the last 25 years, but Latvia still has one of the highest rates in Europe (it is higher only in Romania and Bulgaria) (1). While out-of-hospital deaths from external causes is the major reason for this (2), about a half of paediatric in-hospital deaths occur in the only paediatric intensive care unit (PICU) at the Children's Clinical University Hospital in Riga (unpublished data).

In Latvia, there are about 200 PICU admissions per 100,000 children per year, excluding neonates (3). For most of these children, intensive care provides life-saving treatment and crude mortality is relatively low – about 2% (3). However, intensive care is a highly specialized and very expensive field of medicine and some of the technologies used are high-risk. The benefit of many treatments like continuous renal replacement therapy, advanced ventilatory support, and many high cost drugs has not been proven and high-quality data supporting their use is sparse (4). Guidelines developed to standardize practice are dependent on an evidence base that is surprisingly thin considering the large amount of data generated by intensive care units (5). Often clinical practice and medical research manage medical data on parallel planes, not taking advantage of the benefits offered by possible links. The reasons for this are not just organizational, but also technological and legal. However, there are four national paediatric intensive care databases in Europe – in Portugal, the Netherlands, United Kingdom (UK) and Ireland, Italy – where these challenges have been overcome successfully. These databases allow a standardized analysis of mortality, complications, resource availability, seasonality, and compliance with national standards (6). This type of epidemiological analysis is a prerequisite for quality improvement, effective planning, and cost saving. In addition, the existing outcome databases offer great opportunities to study more effective modes of treatment (7, 8), prediction (9), and risks for different groups of diseases (10) and patients (11).

Since June 2017, in collaboration with Riga Stradins University and the University of Leeds Children's Clinical University, Children's Clinical University Hospital in Riga has joined the UK and the Republic of Ireland based Paediatric Intensive Care Audit Network (PICANet) (12). The PICANet dataset contains demographics, mortality risk adjustment data (Paediatric Index of Mortality 3, PIM3) (13), treatment interventions, as well as the outcomes on intensive care discharge and 30 days after (6). The aim of this study was to evaluate the outcomes for Latvia over the first year of the entry of prospective data into the database.

METHODS

This is a prospective observational study. Riga Stradins University Ethics Committee approved the study. Information about the study was provided to the parents in a form of a leaflet. Participants could opt-out at any time.

All patients who were admitted to our unit from 1 June 2017 to 31 May 2018 were included in the study. Standardized data collection forms were used to prospectively collect clinical and demographic data which was then entered onto the PICANet database via a web-based interface (14). Personal data was removed with the exception of the date of birth and encrypted personal ID numbers using SHA256 for the purposes of calculating age, identifying readmissions, and conducting 30-day follow-up. The predicted probability of mortality was calculated using PIM3 (13). PIM3 is a mortality risk prediction model based on the presence of a high or low risk diagnosis and blood gas, blood pressure, pupillary examination, and data on mechanical ventilation on admission. In addition, admission diagnosis, co-morbidities, surgical procedures, intensive care interventions and anthropometric data were recorded for each patient. Outcomes at discharge and at 30-day follow-up were death and disposition (palliative care or hospice, hospital ward, home or other hospital). These data are available through Children's Clinical University Hospital electronic medical records, which are linked to the Population Register of Latvia. At the beginning of 2018, there were 358,762 children <18 in Latvia (15).

Individual patient data were downloaded from the PICANet web application and analysed locally. We analysed the epidemiologic data (age, sex, diagnostic groups), the patient flow, and quality metrics – this included the rate of unplanned extubations and emergency readmission rate within 48 hours of PICU discharge. Bed census was calculated as the number of patients present on the unit at 10 minutes past midnight.

SMR was calculated as the ratio of observed to the expected number of deaths. The confidence interval for SMR was calculated using Mid-P exact test.

RESULTS

Paediatric intensive care population

During the study period, there were 774 PICU admissions (660 unique patients) with admission prevalence of 216 per 100,000 children <18 per year. All admissions were included in the study, 45% were elective, the majority of which were for recovery after surgery (Table). Fifteen patients died (1.94%). PIM3 predicted 15.16 deaths resulting in an SMR of 0.99 (95% CI 0.57–1.60). The most common diagnostic groups were cardiovascular, neurological, and gastrointestinal. Twenty-two percent of patients required mechanical ventilation, the most common modality being invasive ventilation (Fig. 1). On 30-day follow-up, 653 (84.36%) patients were alive and outside hospital, 98 (12.66%) were inpatients, additional six (0.78%) had died, and two (0.26%) were lost to the follow-up (Fig. 2).

Patient flow

The most frequent source of admission was the operating theatre (Fig. 2). The highest number of patients was admitted on Wednesdays, which

Table. Characteristics of the study population

	Emergency	Elective	Total
Number (%)	429 (55)	345 (45)	774
Male sex (%)	252 (59)	174 (50)	426
Median age, months (IQR)	53 (14–150)	72 (14–171)	59 (14–159)
Median PIM3 (IQR)	0.0124 (0.0042–0.0239)	0.0025 (0.0016–0.0038)	0.0045 (0.0021–0.0131)
Died (%)	15 (3.4)	0	15 (1.94)
Diagnostic group (%):			
Respiratory	58 (14)	4 (1)	62 (8)
Cardiovascular	31 (7)	127 (37)	158 (20)
Neurologic	97 (23)	44 (13)	141 (18)
Gastrointestinal	55 (13)	41 (12)	96 (12)
Other	188 (44)	129 (37)	317 (41)

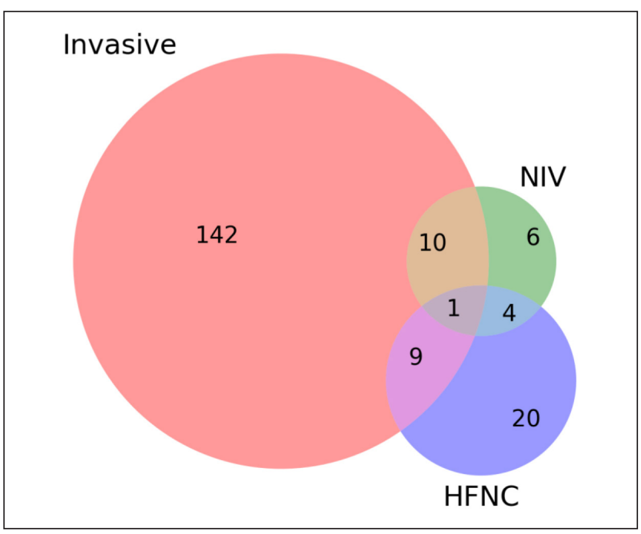

Fig. 1. Modes of respiratory support. NIV – non-invasive ventilation; HFNC – high-flow nasal cannula

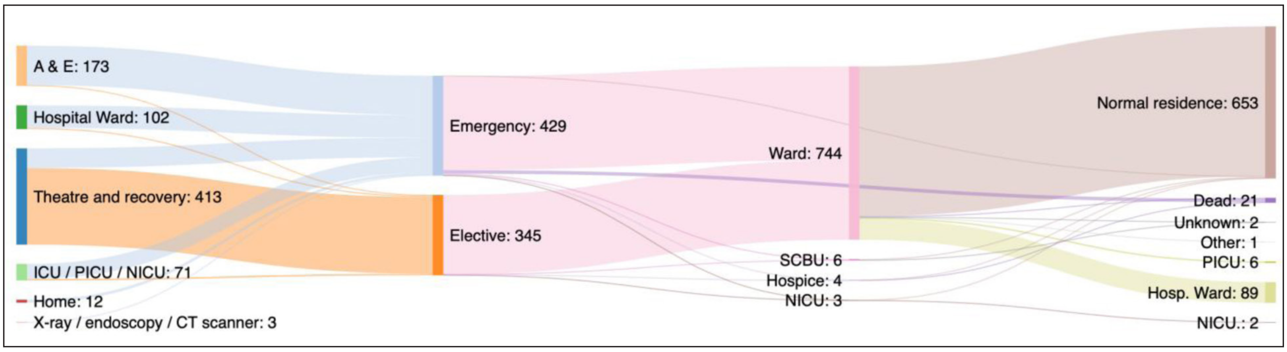

Fig. 2. Sources of admission, types of admission, discharge destination and location on 30-day follow-up. A&E – accident and emergency unit, ICU – intensive care unit, PICU – paediatric intensive care unit, NICU – neonatal intensive care unit, SCBU – special care baby unit

was mostly driven by elective surgical patients (Fig. 3). The median midnight census was 5 (IQR: 3–6) but marked fluctuations were observed over the year (Fig. 4). The median length of stay was 0.96 days (IQR 0.79–1.96). We observed a peak of infant emergency respiratory admissions in February (Fig. 5).

Quality metrics

Seven patients were re-admitted within 48 hours after PICU discharge (the mean readmission rate 0.9%, 95% CI 0.44–1.85%). There were 1.8 unplanned extubations per 100 invasive ventilation days (95% CI 1.0–3.35).

DISCUSSION

To our knowledge, this was the first prospective intensive care audit in the Baltic countries. We did not observe excess mortality in this short observation period. PIM3 was developed as a tool for predicting mortality based on clinical and laboratory data obtained within the first hour of contact with paediatric intensive care. It has been validated in United Kingdom, Ireland, Australia and New Zealand (13). The performance of PIM3 is impacted by the admission threshold to intensive care, case mix, and organisation of health care.

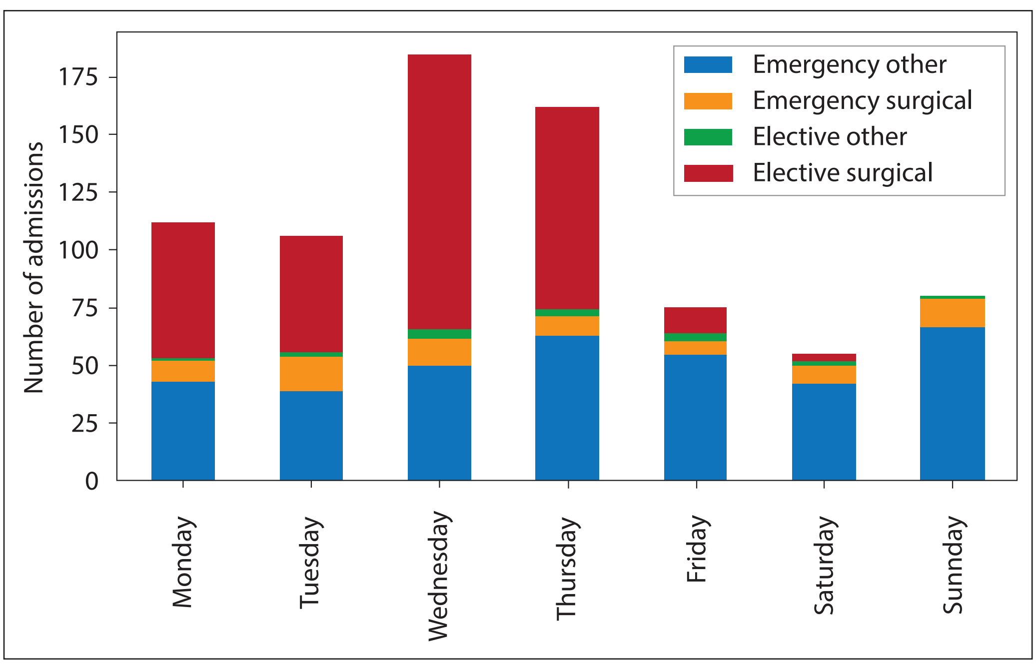

Fig. 3. Admissions by day of week

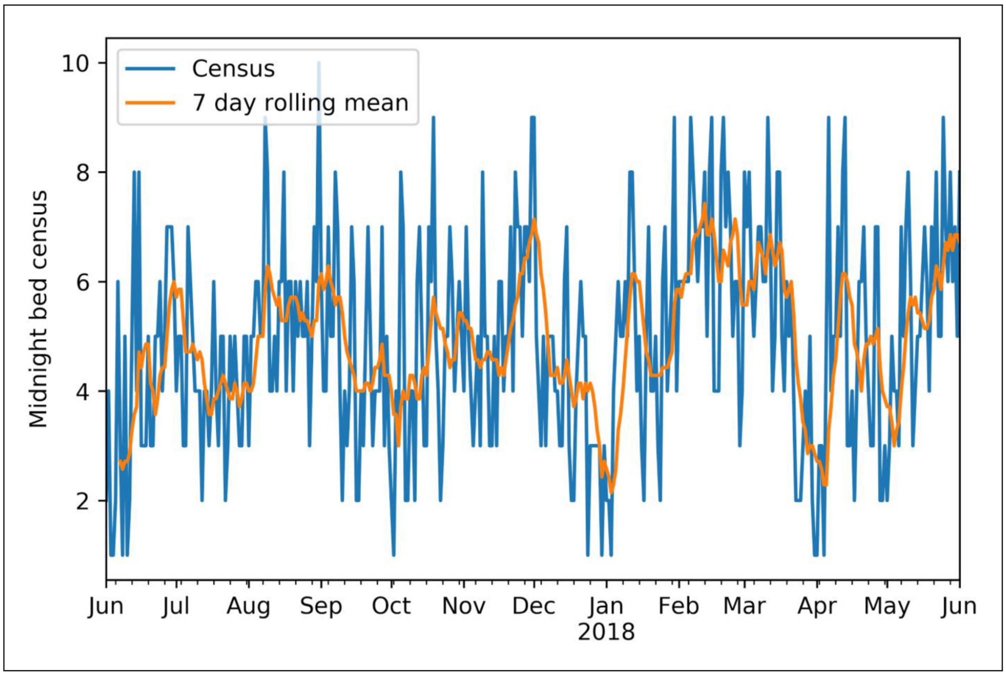

Fig. 4. Bed census over time

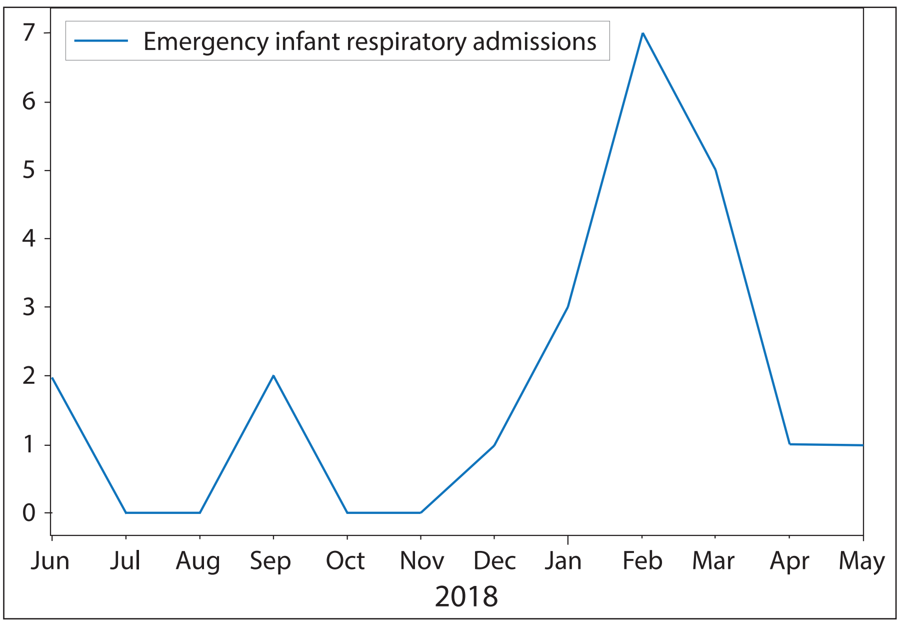

Fig. 5. Number of infant respiratory admissions

We found that crude mortality in the Latvian PICU population (1.94%) was lower than in the UK and Ireland (PICANet registry), Australia and New Zealand (ANZPIC registry), and Dutch (PICE registry) populations (3.8, 2.5, and 2.9%, respectively) (6, 16, 17). However, this can be explained by higher mortality risk on admission, as SMR was within defined control limits for all individual units in these countries. The differences in the populations are also illustrated by the proportion of children needing invasive mechanical ventilation in the PICU: in Latvia it was 22%, while it was reported as 64 and 50.6% in PICANet and ANZPIC reports, respectively (6, 17). This highlights the importance of using mortality prediction tools to account for different patient case mix and policies of admission to the PICUs, when inter-unit comparisons are made.

The median length of stay of 0.96 days was similar to that reported in PICANet and ANZPIC units (1 and 1.6 days, respectively). The short length of stay in our PICU is mostly driven by a large proportion (45%) of elective postoperative admissions. Again, this proportion is much lower in PICANet and ANZPIC populations (39.7 and 31.7%, respectively).

Admissions of infants for respiratory failure have a seasonal pattern in the PICU and depend on annual outbreaks of viral respiratory infections. In the UK and Ireland this peak is observed in November-January, while in Australia and New Zealand in June-July. We detected a marked rise in respiratory failure admissions in February-March in Latvia. This finding is in line with a previous observation of a later respiratory syncytial virus season in Northern Europe (Latvia, Sweden, and Russia) (18–20).

We observed a low emergency readmission rate within 48 hours – 0.9%, although the confidence interval is rather wide due to the low number of observed events. PICANet reports a 48-hour emergency readmission rate of 1.6%. ANZPIC reports 72-hour emergency readmission rate, which in 2016 was 2.7%. High emergency readmission rates might indicate that patients are discharged too soon from the PICU and/or inadequate provision of step-down care. As discussed above, on average our PICU population seems to be lower risk and the low readmission rate may simply reflect this fact rather than indicate the quality of care. We observed a high rate of unplanned extubations – 1.8 per 100 invasive ventilation days, which is several times higher than observed in the UK and Ireland (0.4). Although this finding needs further investigation, it is likely that nursing standards and policies play a pivotal role.

We used a standardized dataset which allowed us to compare our results with other PICUs in the UK and Ireland. There is also a considerable overlap with the data collected by the ANZPIC registry allowing us to further expand the scope of comparison. The use of PIM3 score allowed us to adjust observed mortality for mortality risk on admission.

LIMITATIONS

The organization of paediatric critical care and the resources available in Latvia are markedly different to the UK and Ireland. The outcome is also likely affected by the events leading to PICU admission, e.g. quality of primary and secondary care and the timing of transfer of critically ill children from general district hospitals. Availability of intermediary units affects the length of stay, admission and readmission thresholds. In our hospital there are no intermediary or step-down units, therefore most patients requiring high-dependency care will be admitted to the intensive care unit.

CONCLUSIONS

Prospective critical care auditing produced important insights into organization and delivery of intensive care in Latvia. It highlighted the problem of the high number of unplanned extubations. Further quality monitoring is planned to find and address the causes. This study also highlighted the need for a better planned flow of elective patients to avoid excess workload in the "rush hours".

CONFLICT OF INTEREST:

None declared.

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PLANUOJAMAS VAIKŲ INTENSYVIOS TERAPIJOS REGISTRAS LATVIJOJE: VIENERIŲ METŲ REZULTATAI

Santrauka

Įžanga. Latvijoje yra vienas aštuonių lovų intensyviosios terapijos skyrius, kuriame priimami visi kritinės būklės vaikai. Neseniai atliktas retrospektyvinis vaikų intensyvios priežiūros rezultatų auditas šiame skyriuje atskleidė didelį neplanuotų ekstubacijų ir per didelio mirtingumo skaičių. 2017 m. šis gydymo centras prisijungė prie Didžiosios Britanijos ir Airijos vaikų intensyviosios terapijos audito tinklo (PICANet). Tai bandomasis projektas, skirtas ištirti vaikų intensyvios priežiūros registro kūrimo galimybes Latvijoje ir Baltijos šalyse.

Metodai. Rygos Stradinšo universiteto etikos komitetas patvirtino tyrimą. Anoniminiai duomenys apie visus pacientus, kurie gydėsi vaikų intensyviosios terapijos skyriuje nuo 2017 m. birželio 1 d. iki 2018 m. gegužės 31 d., buvo perspektyviai įrašyti į PICANet duomenų bazę.

Rezultatai. Iš viso išanalizuota 774 priėmimo atvejų į vaikų intensyvios terapijos skyrių duomenys; 45 % priėmimų buvo pasirenkamieji. Vidutinis amžius – 59 mėnesiai (IQR: 14–149). Daugiausiai pacientų buvo priimta trečiadieniais, tai atspindėjo planinių chirurginių operacijų srautą. Vidutinė hospitalizacijos skyriuje trukmė buvo 0, 95 dienos (IQR: 0,79–1,98). 28 % pacientų reikėjo kvėpavimo palaikymo. Tikėtinas mirčių skaičius, apskaičiuotas pagal vaikų mirtingumo rodiklį 3 (PIM 3) – 15,16; 15 pacientų (1, 94%) mirė, todėl standartizuotas mirtingumo rodiklis (SMR) buvo 0, 99 (95 % PI 0,57–1,60). Neatidėliotinas readmisijos lygis per 48 valandas po išrašymo iš vaikų intensyvios terapijos skyriaus buvo 0, 9 %. 100 invazinių vėdinimo dienų teko 1,8 neplanuoto ekstubavimo. Kiti vaikų intensyviosios terapijos audito tinklai pranešė apie panašius pakoreguotus mirtingumo rodiklius, tačiau mažesnius neplanuotų ekstubacijų rodiklius. Praėjus trisdešimčiai dienų po išrašymo iš intensyvios terapijos skyriaus, 653 (84, 36%) pacientai buvo gyvi ir išrašyti iš ligoninės, 98 (12,66 %) gydėsi stacionare, šeši (0,78 %) mirė, du (0,26 %) nepasirodė kontroliniam stebėjimui. Vasario mėnesį pastebimai išaugo kūdikių neatidėliotino priėmimo atvejų skaičius dėl kvėpavimo takų ligų.

Išvados. Šiame projekte buvo analizuota vaikų intensyvios terapijos audito galimybė Latvijoje, prisijungiant prie tarptautinio tinklo. Tai leido tiesiogiai palyginti tarptautinių tinklų rezultatus. Per vienerių metų duomenų rinkimo laikotarpį nepastebėta pernelyg didelio mirtingumo, tačiau buvo nustatyta nemažai neplanuotų ekstubacijų. Rezultatai leido geriau planuoti planuojamą pacientų srautą, per savaitę paskirstant pasirenkamuosius atvejus, kad būtų išvengta „piko valandų“.

Raktažodžiai: pediatrija, reanimacija, intensyvi terapija