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The differences between two selected intensive care units located in central and northern Europe — preliminary observation

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Abstract

Background: The aim of this study was to evaluate possible differences in the functioning of two selected intensive care units in Poland and Finland. The activity of the units was analysed over a period of one year.
Methods: The following parameters were compared: demography of treated populations, site of admission, category of illness, severity of illness (APACHE-II scale), mean length of stay, demanded workload (TISS-28 scale), mortality (both ICU and hospital) and standardized mortality ratio (SMR).
Results: The results of this study indicated that most of the patients in the Polish ICU, regardless of age, diagnosis and APACHE II score, presented significantly longer lengths of stay (14.65 ± 13.6 vs 4.1 ± 4.7 days, $P = 0.0001$), higher mean TISS-28 score (38.9 ± 9.1 vs 31.2 ± 6.1, $P = 0.0001$) and higher ICU and hospital mortality (41.5% vs 10.2% and 44.7% vs 21.8%, respectively, $P = 0.0001$). The values of SMR were 0.9 and 0.85 for the Finnish and Polish ICUs, respectively.
Conclusion: The collected data indicate huge differences in the utilisation of critical care resources. Treatment in Polish ICU is concentrated on much more severely ill patients which might be sometimes accompanied by futility of care. In order to verify and correctly interpret the presented phenomena, further studies are needed.

Key words: intensive care unit; ICU; critical care; length of stay; mortality

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Critical care has developed globally as an independent and continuously growing branch of medicine. However, there are still significant discrepancies in the organisation of critical care between different countries and regions. The experience gained through years of work in Scandinavian hospitals has drawn the authors' attention to the existence of organizational differences between Polish and Scandinavian intensive care treatment. In the absence of an organized form of monitoring the functioning of intensive care on a national scale in Poland, the authors decided to select one department and evaluate its activity with a comparable department in Finland. The aim of this preliminary study was to identify possible differences in ICU performance by an evaluation of measures of ICU outcomes.

METHODS

The Central Hospital in Pori (Finland) and the Regional Hospital in Olsztyn (Poland) are comparable in terms of size

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Table 1. Organisational characteristics and figures (data) describing compared hospitals, ICUs and served populations

Hospital	Olsztyn	Pori
Number of hospital*/ICU beds	441/15	394/10
Hospital/ICU annual budget (mln EUR)	42/3.9	254/5.4
End of life procedure	No	Yes
Nurse-to-patient ratio	1:2	1:1
PDMS**	No	Yes
EWS***	No	Yes
Expected length of life (years)****	80.6 (female) 72.6 (male)	83 (female) 77 (male)

*Hospital in Pori does not provide cardiac surgery or neurosurgical services
**Patient data management system
***Early Warning System
****Data relating to the whole country

and services offered. Cardiac surgery and neurosurgical patients were excluded from the study as the hospital in Pori does not provide neurosurgical and cardiac surgery services. Both ICUs' mean values of demanded workload, length of stay (LOS) and mortality show similarities with the mean values observed on a national scale. The general characteristics of ICUs, hospitals and served districts are shown in Table 1. The study analysed the demographics and the distribution of different patient groups. The mean length of stay, demanded workload and mortality were investigated regarding age, site of admission, category and severity of illness.

The comparison of the activity of both units covered the period of one year (2011). While the data obtained from Poland were derived exclusively for the purpose of this study, the data from Finland were retrieved from a national registry (Intensium Ltd). Patients were classified according to age, diagnosis, severity of illness and site of admission. Severity of illness was described using the Acute Physiology and Chronic Health Evaluation II (APACHE II) scoring system. All patients were divided according to APACHE diagnostic categories (Table 2). The site of admission to an ICU was determined as: hospital ward, operation room, emergency room or another ICU. Demanded workload was described using the Therapeutic Intervention Scoring System (TISS-28). Data obtained from Pori were converted from TISS-76 to TISS-28, where TISS-28 = 3.33 + 0.97 (TISS-76) [1]. In our study, the TISS scores were calculated for each calendar day the patient remained in the ICU. To assess the mean intensity of care, the mean daily TISS score for each patient was calculated. Mortality was described in terms of ICU mortality (deaths in the ICU) and hospital mortality (deaths of patients both in the ICU and in other wards, after the ICU care had been completed).

Due to the epidemiological, retrospective and observational nature of this study, ethical approval was not requested and the informed consent of patients was not required. All the collected data are presented with the permission of the participating institutions.

STATISTICAL METHODS

Using the Student's t-test for independent groups, we determined if the mean values of the studied variables (age, gender, APACHE II score, TISS-28 and length of stay) differed significantly between hospitals. A comparison of differences in the incidence of mortality between hospitals was performed using a chi-square test. SPSS version 17 was used for statistical analysis, and a P value of < 0.05 was assumed to be significant.

RESULTS

Selected organisational differences between hospitals and ICUs are presented in Table 1. Overall, older patients were treated in the Finnish ICU (Table 3). When comparing different age groups, younger patients (age < 44 and 45–54 years) were treated more often in Olsztyn, whereas in Pori, older patients (age > 65 years) were more frequently represented (Table 2). The main admission site to the ICU in Olsztyn was another hospital ward, whereas in Pori, it was an emergency room (Table 2).

Significantly more patients in Pori came to the unit because of intoxication and metabolic disorders, whereas trauma patients were treated more often in Olsztyn (Table 2).

The mean APACHE II score was significantly higher in the patient group treated in Olsztyn compared to those treated in Pori (Table 3). Moreover, the percentage of patients presenting the highest APACHE score (APACHE II > 31) was higher in Olsztyn (Table 2). Indeed, in all age groups the mean APACHE II score was also higher in Olsztyn (Table 2).

The mean length of stay in the unit, regardless of age, site of admission (except when coming from another ICU), diagnostic category and APACHE score group was significantly longer in Olsztyn (Table 2).

Table 2. Demographics in different patients groups as a fraction (%) of all admitted patients

Characteristics	Olsztyn	Pori	*P* value
Age group			
< 44	30.4	15.7	0.0001
45–54	17.8	10.1	0.03
55–64	25.3	23.1	0.5
65–74	16.2	26.4	0.002
> 75	10.3	24.7	0.0001
Site of admission			
Hospital department	48.2	29.9	0.0001
Operation room	18.6	22.1	0.27
Emergency room	30.4	45.8	0.0001
Other ICU	2.8	2.3	0.68
Diagnostic category			
Vascular surgery	10.7	7.6	0.16
Gastrointestinal surgery	8.7	13.4	0.06
Circulatory insufficiency	15.8	19.8	0.19
Intoxication	1.6	7.2	0.001
Metabolic disorders	5.5	12.8	0.16
Neurological disorders	7.1	11.5	0.0001
Postoperative/others	2.5	1.9	0.19
Respiratory insufficiency	15.4	19.6	0.3
Trauma	29.2	4.5	0.0006
APACHE II score group			
6–10	4.9	4.0	0.54
11–15	9.5	16.7	0.08
16–20	16.2	22.1	0.06
21–25	18.2	23.7	0.08
26–30	16.6	15.9	0.8
> 31	35.6	16.1	0.0001

ICU — intensive care unit

Compared with Pori, patients in Olsztyn were treated more intensively as expressed by a significantly higher mean daily TISS-28 score (Table 3). Significant differences were noted for all categories of analyzed variables (except for the lowest APACHE score group) (Table 4).

The mean ICU and hospital mortality were higher in the population treated in Olsztyn than in the population treated in Pori (Table 3). Significant differences were observed in all age groups (except for the hospital mortality in patients older than 65 years old) and in most diagnostic categories (Table 5). In almost all APACHE score groups (except two lowest score groups and Apache score group 21–25, where the hospital mortality was not different), both ICU and hospital mortality were higher in Olsztyn (Table 5). The difference between hospital mortality and ICU mortality in Olsztyn was significantly lower than the difference observed in Pori (Table 3). The mean values of standardized mortality ratio (SMR) were 0.9 and 0.85 for the Finnish and Polish ICUs, respectively.

Table 3. Characteristics and figures describing ICU care and outcomes for the whole study population. Data given as mean ± SD or %

	Olsztyn	Pori	*P* value
Number of admissions (excluding neurosurgical and cardiac surgery patients)	253	485	
Proportion of females (%)	30.4	37.3	0.06
Mean age in years	52.6 ± 17.2	61.9 ± 17.4	0.0001
Mean APACHE score	27.1 ± 10.4	22.4 ± 8.5	0.0001
Mean length of ICU stay (days)	14.6 ± 13.6	4.1 ± 4.7	0.0001
Mean daily TISS-28 score	38.9 ± 9.1	31.2 ± 6.1	0.0001
ICU mortality in (%)	41.5	10.2	0.0001
Hospital mortality (%)	44.7	21.8	0.0001
Differences between hospital and ICU mortality (%)	3.2	11.6	0.0001

ICU — intensive care unit

Table 4. Length of stay in days (LOS) and TISS-28 in different patient groups. Values are presented as the mean ± standard deviation and mean daily score, respectively

	LOS			TISS-28		
Characteristics	**Olsztyn**	**Pori**	***P* value**	**Olsztyn**	**Pori**	***P* value**
Age group (years)						
< 44	14.6 ± 13.5	2.7± 3.7	0.0001	38.2 ± 13.2	27.2 ± 6.3	0.0001
45–54	14.3 ± 13.8	4.6 ± 6.6	0.0001	39.3 ± 7.2	29.8 ± 7.6	0.0001
55–64	15.7 ± 14.6	4.5 ± 4.33	0.0001	38.9 ± 6.3	32.6 ± 5.8	0.0001
65–74	15.5 ± 13.7	4.4 ± 5.3	0.0001	38.6 ± 6.5	32.1 ± 5.8	0.0001
> 75	11.3 ± 10.1	4.1 ± 4.0	0.0001	41.0 ± 6.4	32.3 ± 4.8	0.0001
Site of admission						
Hospital department	14.8 ± 13.1	5.1 ± 4.5	0.0001	39.3 ± 6.6	29.6 ± 5.5	0.0001
Operation room	14.1 ± 14.9	2.9 ± 3.8	0.0001	39.7 ± 15.6	32.0 ± 5.7	0.0001
Emergency room	15.0 ± 14.2	4.0 ± 5.1	0.0001	37.8 ± 7.2	30.1 ± 6.3	0.0001
Other ICU	11.9 ± 8.8	6.4 ± 5.9	0.13	40.4 ± 7.8	32.0 ± 6.4	0.025
Diagnostic category						
Vascular surgery	13.9 ± 16.5	2.9± 4.1	0.0003	38.9 ± 5.9	31.5 ± 6.5	0.0001
Gastrointestinal surgery	17.9 ± 16.0	3.6± 5.2	0.0001	41.0 ± 5.6	33.6 ± 5.4	0.0001
Circulatory insufficiency	12.4 ± 10.3	3.95± 4.7	0.0001	39.5 ± 6.0	33.4 ± 5.36	0.0001
Intoxication	8.8 ± 11.7	1.4 ± 1.5	0.0005	35.3 ± 8.3	25.8 ± 4.2	0.0004
Metabolic disorders	12.7 ± 10.0	4.5 ± 4.7	0.0001	36.1 ± 9.4	30.5 ± 6.2	0.0062
Neurological disorders	14.2 ± 14.6	4.1 ± 4.2	0.0001	38.2 ± 5.7	28.6 ± 5.8	0.0001
Postoperative/others	14.8 ± 17.2	2.5 ± 1.2	0.0001	39.4 ± 6.5	27.7 ± 2.8	0.0002
Respiratory insufficiency	13.1 ± 12.1	5.5 ± 4.7	0.0001	37.3 ± 6.1	32.3 ± 5.3	0.0001
Trauma	16.4 ± 13.4	5.4 ± 8.2	0.0004	39.6 ± 13.7	30.0 ± 6.7	0.0021

cont. →

Table 4 cont. Length of stay in days (LOS) and TISS-28 in different patient groups. Values are presented as the mean ± standard deviation and mean daily score, respectively

	LOS			TISS-28		
Characteristics	**Olsztyn**	**Pori**	***P* value**	**Olsztyn**	**Pori**	***P* value**
APACHE II score group						
6–10	9.1 ± 5.7	3.0 ± 4.1	0.001	30.0 ± 7.4	26.02 ± 6.3	0.17
11–15	15.4 ± 11.0	2.9 ± 3.4	0.0001	33.5 ± 6.5	29.03 ± 5.1	0.0007
16–20	13.8 ± 11.6	3.5 ± 3.9	0.0001	36.4 ± 5.9	30.5 ± 5.4	0.0001
21–25	15.9 ± 10.6	4.5 ± 5.3	0.0001	37.9 ± 6.4	32.2 ± 5.9	0.0001
26–30	18.0 ± 17.3	4.9 ± 5.1	0.0001	39.3 ± 5.3	32.52 ± 5.3	0.0001
> 31	13.2 ± 14.9	5.1 ± 5.7	0.0001	42.9 ± 11.5	34.37 ± 6.0	0.0001

ICU — intensive care unit

Table 5. Mean value of intensive care unit (ICU) and hospital mortality for different patient groups

	ICU mortality (%)			Hospital mortality (%)		
Characteristics	**Olsztyn**	**Pori**	***P* value**	**Olsztyn**	**Pori**	***P* value**
Age group						
< 44	27.3	1.3	0.0001	28.6	2.7	0.0001
45–54	53.3	10.4	0.0001	53.3	16.7	0.0002
55–64	48.4	6.8	0.0001	54.7	15.7	0.0001
65–74	39.0	17.8	0.006	43.9	31.4	0.15
> 75	50.0	11.2	0.0001	53.8	32.2	0.05
Site of admission						
Hospital department	49.2	14.4	0.0001	53.3	29.4	0.0001
Operation room	31.9	8.91	0.0002	34.0	17.0	0.003
Emergency room	36.4	8.3	0.0001	39.0	18.8	0.0003
Other ICU	28.6	11.1	0.3	28.6	33.3	0.95
Diagnostic category						
Vascular surgery	48.1	8.6	0.0001	51.9	11.4	0.0005
Gastrointestinal surgery	36.4	14.5	0.03	40.9	31.1	0.4
Circulatory insufficiency	47.5	20.0	0.001	50.0	35.6	0.05
Intoxication	0.0	0.0		0.0	0.0	
Metabolic disorders	21.4	6.7	0.09	28.6	11.8	0.11
Neurological disorders	61.1	3.6	0.0001	66.7	14.5	0.0001
Postoperative/others	0.0	0.0		0.0	0.0	
Respiratory insufficiency	41.0	9.3	0.0001	46.2	26.7	0.03
Trauma	36.5	14.3	0.05	37.8	28.5	0.4

cont. →

Table 5 cont. Mean value of intensive care unit (ICU) and hospital mortality for different patient groups

	ICU mortality (%)			Hospital mortality (%)		
Characteristics	**Olsztyn**	**Pori**	***P* value**	**Olsztyn**	**Pori**	***P* value**
APACHE II score group						
6–10	0	0		0	0	
11–15	8.3	1.3	0.07	7.3	7.7	0.9
16–20	24.4	2.9	0.0001	29.3	10.0	0.004
21–25	32.6	9.4	0.0001	34.8	24.5	0.19
26–30	40.5	16.7	0.005	42.9	29.2	0.009
> 31	67.8	27.6	0.0001	72.2	49.3	0.003

DISCUSSION

An analysis of the investigated populations revealed that significantly older patients were treated in Pori, which can be considered a reflection of the demographic situation in Finland. The higher number of younger patients treated in the Polish ICU appears to be because Olsztyn serves as a regional trauma-referring centre, whereas in Pori more seriously injured patients (head trauma) had been transferred elsewhere. The incidence of trauma in the Olsztyn group of patients was high and remained the main cause of admission to the Polish ICU. An emergency room was the main site of admission to the ICU in Pori, whereas in Olsztyn, most patients came from another hospital ward. This indicates differences in the distribution of patients coming to the hospital and can indicate some difficulties in direct transfer of patients to the ICU. When compared to Pori, the disparity between expenditures on the treatment of patients in the ICU and other hospital wards observed in Olsztyn are exceptionally high (Table 1). In practice, this can result in less efficient therapy outside the ICU, which in turn leads to the need for treatment in intensive care.

When examining other results of this study, it is striking that the length of stay, demanded workload and mortality were significantly higher in most of the Olsztyn population than those in Pori. In discussing these findings, we attempted to identify possible organisational reasons for such significant differences.

LENGTH OF STAY (LOS)

A prolonged ICU stay can adversely affect one's health status by increasing the risk of infection, complications and, possibly, mortality [2, 3]. It has been demonstrated that LOS in an ICU is affected by several medical, social, psychological and institutional factors [4]. In our study, all patients in Olsztyn, regardless of age, APACHE score group and APACHE diagnostic category stayed in the ICU much longer than patients in Pori. The above observation is confirmed by national data regarding the mean LOS in ICU in Poland and Finland, which is 14 and 4.2 days, respectively [5]. One of the possible explanations for such a dramatic difference observed in our study is the presence of an intermediate (step down) unit at Pori hospital. It is located next to the ICU subunit where most of the ICU patients are shifted before they can be discharged to the ward. Moreover, patients who are less ill and require less aggressive treatment are treated there instead of the ICU. The Polish hospital organisational system does not provide care in such units. In most cases, patients after the completion of intensive care can be discharged directly to the hospital ward. Due to the limited availability of beds there, this is often difficult to achieve. Additionally, treating uninsured patients leads to procedural problems with their transfer out of the unit and significantly extends their stay in an ICU.

Another factor that affects LOS is the decision-making process regarding an end-of-life care strategy. An ETHICUS study revealed that the mostly Protestant or nonreligious doctors in Scandinavian countries had the highest rate of withholding/withdrawing treatment in Europe [6]. In predominately Roman Catholic Poland, the religious factor may also be a part of the explanation for the prolonged length of stay in an ICU. In practical terms, in Finland, all aspects of terminal care are addressed in recommendations issued by the Finnish Ministry of Social Affairs and Health [7]. In contrast, there are no clear regulations regarding the withholding/withdrawing of treatment or "do not resuscitate" (DNR) orders in Poland. This results in physicians fearing accusations of malpractice.

Another group that occupies ICU beds for prolonged periods before discharge becomes possible are patients who require further treatment for chronic illness. Prior to the discharge of such patients, a vacant place in a long-term nursing facility must be found. In Poland, this is not easily

accomplished. In 2011, Poland had 231 sites per 100,000 inhabitants in such institutions, whereas Finland had 1087 per 100,000 [8].

DEMANDED WORKLOAD

The mean daily TISS scores, which reflect the intensity of care, were significantly higher in almost all measured groups of patients in Olsztyn. We can only speculate that variation in practice is a factor that could have influenced the calculated TISS score. A good example of this phenomenon was presented in a study analysing the odds ratio across 34 ICUs using pulmonary artery catheters. The results varied by 38% according to the patient's race, 33% according to their insurance status and finally by 200 to 400% based on how the ICU was organised and staffed [9]. Another issue that may be relevant to our study is the fact that the non-invasive forms of ventilation are used only occasionally in Olsztyn, while in Finland they are common [10]. It should also be noted that the TISS scoring system is a primary source for determining funding of intensive care in Poland, whereas in Finland, funding is based mainly on the defined categorisation of workload.

Trends of increasing TISS-28 values with increase of age and severity of illness were common in both investigated populations and obviously can be explained by the increased intensity of care required for older and more unwell patients, as has been observed in other studies also [1].

When discussing demanded workload, there are other aspects that are not included in the TISS-28 score. The nurse-to-patient ratio appears to be an important aspect. It has been demonstrated by numerous studies that units that provide a standard nurse-to-patient ratio of at least 1:1 are characterised by fewer complications, lower infection rates, shorter LOS and finally lower mortality [11, 12]. According to the European Society of Intensive Care Medicine recommendations, patients with multiple acute organ failures of an immediate life-threatening character require a nurse-to-patient ratio of 1:1 [13]. The ICU in Olsztyn can offer a nurse-to-patient ratio of 1:2, whereas Pori offers a 1:1 ratio. Moreover, the processing of patients' documentation is not included in the TISS-28 scoring. For employed staff, these activities are time consuming. As the amount of information concerning each patient can become overwhelming, the implementation of computerised patient data management systems (PDMS) makes its documentation and interpretation easier and faster. Although such systems were implemented in Finland years ago, in Poland they do not yet exist.

MORTALITY

Only a few studies on intensive care have reported ICU mortality on a national level. The available data indicate significant geographical differences, displaying the lowest mortality in Australia and New Zealand (9%) and the Scandinavian countries (9.1%) [14]. Significantly higher mortality has been reported in Italy (16.9%) [15] and Saudi Arabia (20% — isolated report from one unit) [16]. After the exclusion of cardiac and paediatric intensive care, the average mortality in Polish adult intensive care units in 2011 amounted to 50.1% (Study of the overall hospital morbidity 2011. National Institute of Public Health — National Institute of Hygiene. Unpublished data). This number was not very different from the results observed in Olsztyn.

One of the possible explanations for huge disparities between ICU mortality in Olsztyn and Pori can be found in the fact that significantly more severely ill patients were treated in the Polish unit. This situation may reflect the worse general health of the Polish population, which is expressed by a much shorter life expectancy (Table 1). The high mortality rate among trauma patients and those in the < 44 age group observed in Olsztyn may be explained by the above-mentioned fact that this hospital is a trauma centre which treats patients with severe multi-organ injuries. Another factor that influences mortality is a delayed detection of clinical deterioration on the other ward, or lack of the beds in the ICU. The introduction of Early Warning System (EWS) criteria allows one to establish early identification of patients at risk of deterioration. In Pori the medical emergency team must assess every hospital patient who fulfils strictly defined criteria of acute clinical deterioration. In Polish hospitals such a scoring system, based on a single parameter trigger, does not exist. As it has been shown in others studies, delayed admission to an ICU has its own impact on survival rates [17] while the presence of EWS in hospital can significantly reduce the hospital mortality and morbidity [18, 19]. Finally, the significantly more frequent admission of patients presenting extremely high APACHE scores in Olsztyn may suggest that at least a portion of them could present a medical exercise in futility, which, as a consequence, affected mortality. The appropriate use of intensive care requires respect for the strict criteria for admission to an ICU. Such regulations effectively define patients who are likely to benefit from ICU care [20]. In Poland, they were just introduced as applicable law in 2012, whereas in Finland, such criteria have existed in the form of recommendations for many years [21, 22]. At this point, it is necessary to stress that ICU mortality cannot be considered as a simple reflection of ICU performance [23]. The calculation of the standardised mortality ratio (SMR) appears to be the most popular tool in evaluating the effectiveness of treatment in an ICU. It should be remembered, however, that a meaningful evaluation of the effectiveness of treatment, based on the SMR requires that the analysed populations are homogeneous and similar in terms of severity of illness. In

this study, the investigated populations were different in these aspects. However, the observed satisfactory values of SMR have a certain amount of information regarding the effectiveness of treatment. Thus, it can be assumed that the reasons for differences in mortality depend rather on the organization of work and utilisation of hospital resources.

The variance between hospital and ICU mortality can serve as an indicator of the number of patients who died after being discharged from an ICU. The high value of this variable in the Pori population (11.6%) may suggest that a significant number of patients with poor prognosis were transferred for the purpose of terminal care elsewhere. In contrast, the majority of deaths regarding the Olsztyn patients took place in the ICU (only 3.2% after discharge). The possibilities for transferring dying patients to other organisational units in Polish hospitals are limited, whereas, in Finland, it is a common practice. The shortage of beds that are dedicated for terminal care, as well as lack of laws regulating the issue of end of life (as discussed above) appears to be the most important obstruction in patient "flow" through Polish ICUs.

LIMITATIONS

Our study presents several limitations. These include the lack of data concerning the numbers and conditions of DNRs, the number of ventilation days, the degree of invasive hemodynamic monitoring, readmission rates, admissions after resuscitation, places where patients were sent after discharge from ICU/hospital care and the number of ICU stay-induced nosocomial infections. Moreover, the case-mix varied across both populations.

CONCLUSIONS

The factors that may affect differences in the utilisation of critical care resources between institutions are the decision-making process governing when to start and complete treatment, the patient's condition at the moment of admission to the ICU, the number of staff employed and the possibility of transferring patients to other organisational units after treatment completion. The significantly higher mortality observed in the Polish ICU may have resulted from its predominant focus on the treatment of extremely ill patients. The high values of these parameters suggest the possibility of frequent futility of care. However, the observed differences in mortality indicate a need for research that would allow a comparison of the effectiveness of treatment in similar groups of patients.

The demonstration of a significant divergence in the functioning of ICUs in both countries should prompt the carrying out of an investigation based on an in-depth analysis. Moreover, the authors believe that the implementation of a critical care national registry in Poland could serve as a beneficial tool in verifying and correctly interpreting the phenomena observed in this study.

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