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Healthcare Quality According to ICU Level of Care

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Abstract

Introduction: Little is known about the quality of healthcare in intensive care units (ICUs) in Poland. Data on patients hospitalized in ICUs in Warsaw and the results of their treatment are scarce. This information, crucial for improving the quality of ICU healthcare services, is not collected routinely. Quality indicators are essential in the concept of holistic quality management. Implementation of these indicators in ICUs is a complex and time-consuming process. Systematic increase in demand for quality assessment tools that can reflect real conditions of the practices of ICUs, prompts the search for effective solutions. **Methods:** The study included 12,155 patients hospitalized in 16 ICUs of Warsaw hospitals (8 ICUs, n = 3293 of the first level of care, and 8 ICUs, n = 8862 of the second level) between 1st January 2017 and 31st December 2018. ICUs in pediatric and oncological hospitals were excluded from the study. Characteristics and demography of patients as well as the structure, treatment and human resources of the ICUs in Warsaw were analyzed. Length of stay, unexpected extubations, nosocomial infections, ICU readmissions and standardized mortality ratios (SMR) were retrieved from National Health Fund, Ministry of Health, and other public databases. **Results:** In primary level ICUs patients' age (66.42 vs. 64.43 years; p = 0.005) and comorbidity rate (30.56% vs. 22.78%, p = 0.037) were higher when compared to ICUs of the second level of care. The crude mortality rate in ICUs in Warsaw was significantly higher than in other EU countries and differed between ICUs of the first and the second level (34.77% vs. 24.53%, respectively; p = 0.004). SMRs were however very low: 0.71 and 0.64 (ns), respectively. ICU readmission rate, unexpected extubations, central catheter related infections, and length of stay were identical in both groups. More patients were admitted to ICU form emergency department and/or discharged home in Level 1 ICUs (18.9% vs 12.9%, p < 0.03). **Conclusions:** There are no major differences in quality of care provided by Level 1 and Level 2 ICUs in Poland, although

more rigorous adhesion to admission and discharge policies is needed. Implementation of the instruments for assessing quality of ICUs including benchmarking, self-assessment of departments and evaluation of changes resulting from audits according to the Deming cycle is of utmost importance. Standardization of quality measures and markers, communication, and cooperation in reporting and creation of ICU medical registers is necessary to improve the quality of healthcare.

Keywords

Healthcare Quality, Intensive Care Unit, Mortality Rate, Standardized Mortality Rate, Unexpected Extubation, Nosocomial Infections, Readmission

1. Introduction

Advances in supportive care and monitoring of the critically ill are important components of the current healthcare system. Some system solutions are universal across the world, others are country-specific [1] [2]. Regardless of the developmental and systemic differences, health care relies on quality and evaluation of the services provided, which makes this topic extremely important and cosmopolitan [1] [2] [3]. Although several measures of ICU performance have been proposed over the last 50 years, Poland lacks tools for proper evaluation of the quality of healthcare and hospitals receive no feedback information from national insurance agency (National Health Fund, NHF) or ministry of health and implementation of improvements is not policy-encouraged. Especially ICUs, which operation combines many areas of expertise, technology, and diagnostic and therapeutic methods, require careful and precise evaluation. Experience from various countries around the world shows that both collection of data at regional/central level, creation of network tools and systematic implementation of quality indicators are necessary to constantly improve the quality of services provided in ICUs. Hence, quality evaluation plays a key role in improving the overall process [2] [3] [4]. In this process, identification of variables that describe quality, are feasible for collection and influence an outcome is of utmost importance. Classical quality indicators used most often in assessment of ICU performance are mortality (or standardized mortality according to APACHE II), duration of stay over 7 days, mean duration of stay, mean duration of mechanical ventilation, suboptimal pain therapy, standards compliant transfusion of blood products, prevention of ventilation associated pneumonia, normoglycemia, adequate sedation, stress ulcer and deep vein thrombosis prophylaxis, rate of delayed admission to and discharge from ICU, rate of surgeries cancelled and emergency admission delays due to lack of ICU beds, rate of unplanned readmissions within 48 hours, catheter associated sepsis, rate of infections with multi-resistant organisms, pressure sore rate, accidental extubations, staff to patients ratio, risk management, and patient/family satisfaction [3] [5]. Ten core quality

indicators are recommended in German intensive care units: upper body elevation, monitoring of sedation, analgesia and delirium, lung protective ventilation, weaning protocol and spontaneous breathing trials, early and adequate antibiotic therapy, therapeutic hypothermia after cardiac arrest, early enteral nutrition, documentation of meetings with relatives, hand disinfectant solution use, and 24-hour availability of specialists [6].

Organizational structure of ICUs and their network adopted by the country regulators can also affect quality and define treatment results. Formally, there are three levels of care of ICUs in Poland. They differ according to specific medical and staff requirements, that were defined in the Notice of the Ministry of Health (MoH) [7] and Guidelines of the Polish Society of Anesthesia and Intensive Therapy (PTAiIT) [2] [8]:

- 1st level of care ICU (Level 1): at least four intensive care beds, at least one intensive care specialist and one intensive care nurse available 24/7, a surgical ward, and an operating theater with at least one operating room [2] [7];

- 2nd level of care ICU (Level 2) requires additionally: at least 2 intensive care beds (6 in total), endoscopy service, department of general surgery or orthopedics and trauma of the musculoskeletal system and department of neurosurgery or general surgery that performs skull, brain, and spine surgery [2] [7];

- 3rd level of care ICU (Level 3) requires additional 2 intensive care beds (8 in total), department of vascular surgery, interventional radiology services and microbiological diagnostics [2] [7]. Neither of the Warsaw hospitals has Level 3 ICU, which is why this level was not included in the further analysis. Besides, contracted NHF remuneration can only go to Level 1 or Level 2 ICUs, and the contract does not grant extra value to any Level 3 ICU service.

The aim of the study was to assess available quality indicators in Level 1 and Level 2 ICUs in Warsaw based on two-year observation.

2. Methods

2.1. Data Collection

Analysis of accessible quality indicators from 16 ICUs in Warsaw was based on extremely dispersed data collected from publicly available sources: the National Health Fund (NHF), Ministry of Health (MoH), the Registry of Healthcare Providers (RPWDL), the Center for Healthcare Information Systems (CSIOZ), the Central Statistical Office (GUS). These data are collected and pooled from obligatory regular periodic reports filed by each hospital within the country, irrespective to ownership and organization. Some data were obtained directly from the hospitals. Data included:

- characteristics and demographics of patients (age, gender, number and cause of hospitalizations, types of treatment (surgical/non-surgical), comorbidity rate, bed-days);

- hospital and ICU structure (the number of departments, hospital and intensive care beds, occupancy rate);

- process of the treatment (the length of stay [LOS] in a hospital/ICU, Therapeutic Intervention Scoring System-28 [TISS-28] [8], mortality rate, standardized mortality ratio [SMR], infections rate, re-admissions);

- human resources (the number of consultants and residents, intensivists, and nurses).

No detailed analysis of individual medical history of patients hospitalized in the ICU has been carried out. An anonymized database of 12,155 patients was re-organized from NHF database, which attributed a separate record to each patient-day. The study used data from official and public sources. Although all ICUs informed of adverse event and SMR reporting system and analysis (**Table 1**), no data from internal audits were available to analysis.

Between 1st January 2017 and 31st December 2018, 20,032 patients were hospitalized in all ICUs in Warsaw (population 1,778,000). Patients admitted to pediatric (2660 patients) and oncological ICUs (5217 patients) were excluded from the study to improve homogeneity of the study group. No sample size calculation was made prior to the study, and all patients hospitalized in regular (non-pediatric, non-oncological) ICUs within the city of Warsaw were included into the study. We have deliberately chosen two-year range before COVID-19 era, when no shortage of resources affected the results. Post-Covid data are not yet available in public domains. A group of 12,155 patients hospitalized in 16 ICUs in Warsaw hospitals (8 Level 1 and 8 Level 2) were analyzed. Assessment of departments was based on a set of 9 safety and quality indicators recommended by the European Society of Intensive Care Medicine (ESICM) [9] [10] **Table 1**.

2.2. Definitions

To analyze the number of hospital admissions according to the main diagnosis, we used the disease code according to the International Classification of Diseases (ICD-10) by the World Health Organization [11].

All ICUs in Poland use TISS-28 scale (Therapeutic Intervention Scoring System) in their every-day practice. An indication for admission to ICU is TISS-28 > 19 points for three consecutive bed-days. As the scale assesses a total number of interventions in a patient and is widely used, we applied this scale to reflect the severity of patients' condition. Subjects of this study were assigned according to the TISS-28 scale to one of the groups: moderately ill (<27 points), severely ill (27 - 40 points), critically ill (>40 points) [6]. A bed-day is a unit in health statistics used by the National Health Fund. It is calculated as a day a patient confined to bed stays overnight in a hospital (in this case in ICU). Hence, either the day of admission or the day of discharge from an ICU is chargeable and hospital administration is supposed to choose the one with higher TISS-28 count.

Bed occupancy rate (BOR) is calculated as a total number of bed-days in a department divided by the number of beds and by the number of days in a time period analyzed, multiplied by 100 and expressed as percentage.

Table 1. Assessment of ICUs in Warsaw according to safety and quality indicators from the guidelines of the European Society for Intensive Care (ESICM).

	Description of indicator	Level 1	Level 2
STRUCTURE	ICU fulfils national requirements to provide intensive care	YES	YES
	24-h availability of a consultant intensivist	YES	YES
	Adverse event reporting system	YES	YES
PROCESS	Routine multi-disciplinary clinical rounds	YES	YES
	Standardized handover procedure for discharging patients	YES	YES
OUTCOME	Reporting and analysis of SMR	YES	YES
	Reporting re-admission rate within 48 h of ICU discharge	YES	YES
	Reporting of central venous catheter-related bloodstream infections	YES	YES
	Reporting of unexpected endotracheal extubations	YES	YES

ICU, intensive care unit; SMR, standardized mortality ratio.

Adjusted BOR means a total number of hospitalization days, including day of admission and discharge, divided by the number of beds and by the number of days, when the ICU ward was actually active and operational.

Charlson comorbidity index could not have been calculated from the retrievable data. An analysis of comorbidity rate according to the Polish Maps of Health Needs was based on Elixhauser's methodology, which models mortality in diagnosis-related groups using data and diagnoses from all medical consultations and interventions from the last year of a patient's history [12]. Comorbidity rate for ICUs in Poland distinguishes 5 categories: very low, low, medium, high, and very high [8]. Hence, each patient was assigned a specific category resulting from his health record available from public health providers.

Standardized mortality ratio (SMR) is a ratio of the observed to expected number of deaths. The ratio greater than 1 (SMR > 1) is a sign of higher-than-expected mortality and relatively poor quality of the services provided (excessive deaths). SMR < 1 means that the actual mortality rate is lower than predicted, so the quality of the procedure is appropriate. SMR is calculated according to patient's data on admission from disease severity [13] [14].

2.3. Ethics

This study was performed in compliance with the international guidelines for human research protection as set forth by the Declaration of Helsinki, CIOMS Guidelines and the International Conference on Harmonization of Good Clinical Practice.

2.4. Statistics

Quantitative variables are expressed as means with standard deviations or medians with ranges. Qualitative variables are expressed as absolute numbers and percentages. Normality of distributions of continuous variables was tested with

the Shapiro-Wilk test. ICUs-1 vs. ICUs-2 was compared using multivariate analysis of variance ANOVA for parametric variables or Kruskal-Wallis rank ANOVA and the median test for non-parametric variables. Categorical variables were tested with the use of chi-square test. Confidence interval for the SMR was calculated with the Poisson method using chi^2 transformation. p-value < 0.05 was considered significant. Analysis was performed with the STATA 13 Statistical Software (StatSoft, Cracow, Poland).

3. Results

3.1. Characteristics and Demographics of Patients

Records of 12,551 patients were divided into two groups depending on the ICU reference level: Level 1 group (N = 3293 patients) and Level 2 group (N = 8862). There were no major differences in quality of care provided by Level 1 and Level 2 ICUs in Poland. In the Level 1 group, patients' age (66.4 years) and proportion of patients admitted from outside the Mazovia region (14.2%) were noticeably higher when compared to the Level 2 group (respectively 64.4 years, p < 0.005 and 7.2%, p < 0.001). Comorbidity rate, crude and standardized mortality were also higher in Level 1 ICUs, however length of stay, readmissions, infections and unexpected extubations were identical. Detailed characteristics are provided in Tables 2-4.

Table 2. Demographic and clinical data of patients hospitalized in ICUs in Warsaw between 1 January 2017 and 31 December 2018.

Indicator	Total	Level 1	Level 2	p
Gender; % M, no. of W/M	4558/7597 (62.5)	1392/1901 (57.7)	3166/5696 (64.3)	**<0.001**
Age [years]	65.4 ± 3.5	66.4 ± 4.3	64.4 ± 2.0	**0.005**
Patients > 65 years old	7156 (58%)	2043 (62%)	4937 (55.7%)	**0.018**
Patients > 80 years old	2571 (21.2%)	785 (23.9%)	1638 (18.5%)	**0.049**
Diseases of the respiratory system (ICD-10 code "J")	4186 (34.4%)	1331 (40.4%)	2855 (32.2%)	0.172
diseases of the circulatory system (ICD-10 code "I")	1890 (15.6%)	411 (12.5%)	1479 (16.7%)	0.223
Injury, poisoning or others (ICD-10 code "S-T")	415 (3.4%)	105 (3.2%)	310 (3.5%)	0.419
Abnormal clinical and lab findings (ICD-10 code "R")	667 (5.5%)	189 (5.7%)	478 (5.4%)	0.392
Other diagnosis (different ICD-10 code "A-H, K-O, Q, V-Z")	4997 (41.1%)	1257 (38.2%)	3740 (42.2%)	0.317
Admission from outside the Mazovian district	1495 (12.3%)	238 (7.2%)	1257 (14.2%)	**<0.001**

Variables are expressed as mean ± SD or number (percentages). Significant differences are bolded (<0.05).

Table 3. Data on the structure of hospitals and ICUs in Warsaw.

Indicator	Total	Level 1	Level 2	p
The number of departments in hospital	11 [7.0 - 25.0]	8.0 [7.0 - 18.0]	15.5 [10.0 - 25.0]	**<0.001**
The number of hospital beds	396.5 ± 221.3	258.1 ± 100.2	534.9 ± 223.6	**<0.001**
The number of ICU beds	9.5 [4.0 - 42.0]	9 [4.0 -10.0]	17 [6.0 - 42.0]	**0.006**
The ratio of hospital to intensive care beds	638/19,032 (3.35%)	194/6194 (3.13%)	444/12,838 (3.46%)	0.386
The average number of occupied ICU beds per day	10.34 [2.43 - 33.45]	6.22 [2.43 - 8.79]	14.46 [4.22 - 33.45]	**0.003**
ICU bed occupancy rate (BOR); %	77.9 ± 7.9	78.0 ± 7.0	77.8 ± 8.78	0.921
Adjusted bed occupancy ratio; %	81.9 ± 8.3	81.1 ± 6.9	82.6 ± 9.5	0.540

Variables are expressed as mean ± SD, medians [range] or number (percentages). The significant differences are bolded (<0.05).

Table 4. Data on patients hospitalized in ICUs in Warsaw hospitals.

Indicator	Total	Level 1	Level 2	p
The number of patients (%); mean	12,155 (100) 379.84 ± 317.6	3293 (27.1) 553.88 ± 365.4	8862 (72.9) 205.81 ± 101.6	**0.001**
LOS in ICU; (days)	16.8 [1.64 - 52.08]	16.8 [4.25 - 43.26]	16.8 [1.64 - 52.08]	0.638
ICU re-admission rate within 48 h of ICU discharge (%)	4.55 [1.97 - 5.78]	4.52 [1.97 - 5.65]	4.59 [2.16 - 5.78]	0.745
Patients admitted from ED and/or discharged home from ICU; %	15.9 ± 7.9	18.9 ± 8.4	12.9 ± 6.3	**0.030**
Patients transferred between ICUs and other departments; %	84.1 ± 7.9	81.1 ± 8.4	87.1 ± 6.3	**0.030**
surgery; %	44.6 ± 25.8	35.5 ± 25.4	53.6 ± 23.6	**0.045**
internal diseases; %	14.7 ± 12.7	19.6 ± 13.7	9.9 ± 9.9	**0.029**
other, %	24.8 ± 16.6	26.1 ± 20.3	23.6 ± 23.3	0.677
Comorbidity rate:				
very low; %	7.9 ± 5.0	7.1 ± 5.0	8.7 ± 4.9	0.362
low; %	21.9 ± 9.9	18.2 ± 8.1	25.6 ± 10.4	**0.032**
medium; %	39.4 ± 8.0	40.1 ± 9.3	38.7 ± 6.6	0.614
high; %	26.7 ± 10.7	30.6 ± 10.7	22.8 ± 9.4	**0.037**
very high; %	5.0 ± 4.1	5.8 ± 4.6	4.2 ± 3.4	0.249
Standardized mortality ratio (SMR)	0.68 [0.41 - 1.08]	0.71 [0.54 - 0.96]	0.64 [0.41 - 1.08]	0.066

Continued

On mechanical ventilation; %	78.3 ± 9.6	78.7 ± 10.6	77.9 ± 8.7	0.819
The rate of unexpected endotracheal extubations (%)	4.4 [2.35 - 6.27]	4.2 [2.27 - 5.46]	4.4 [2.35 - 6.27]	0.111
Rate of central venous catheter-related bloodstream infections (%)	5.72 [1.25 - 9.26]	5.84 [1.75 - 9.26]	5.63 [1.25 - 8.79]	0.603
Day-beds with TISS-28: <27; %	12.7 ± 8.5	9.4 ± 7.1	16.1 ± 8.6	**0.024**
Day-beds, TISS-28: 28 - 40; %	63.9 ± 10.2	64.6 ± 11.5	63.5 ± 9.0	0.812
Day-beds, TISS-28: >40; %	23.3 ± 16.1	26.2 ± 17.1	20.5 ± 15.1	0.318
ICU re-admissions within 30 days; %, range	14.4 [5.10 - 25.50]	14.4 [5.10 - 23.90]	14.4 [5.90 - 25.50]	0.680
Infections; %	37.4 ± 6.4	36.8 ± 6.3	38.0 ± 6.4	0.372
Deaths; %	29.7 ± 10.0	34.8 ± 9.6	24.5 ± 7.6	**0.004**
Deaths with TISS-28 < 30; %	23.5 ± 16.6	31.4 ± 17.7	16.2 ± 12.0	**0.009**

Variables are expressed as means ± SD, medians [range] or number (percentages). The significant differences are bolded (<0.05).

3.2. Hospital and ICU Structure

Level 2 ICUs are located in multiprofile hospitals with bigger total number of departments and wards (median; 15.5 vs. 8.0; $p < 0.001$) and a general number of both hospital and intensive care beds compared to Level 1 (mean; 534.9 vs. 258.1; $p < 0.001$). Nevertheless, ratios of hospital beds to intensive care beds were comparable. The average occupancy ratio of intensive care beds in the Level 2 group was higher than in the Level 1 group (median; 14.46 vs. 6.22, $p = 0.003$), Table 3.

3.3. Process of the Treatment

Majority of patients (84.1%) were transferred between ICUs and other hospital departments. Only 15.9% of patients were admitted directly from the emergency room or discharged home. Patients in Level 2 were admitted more frequently from surgery wards compared to Level 1 (mean 53.6% vs 35.5%, respectively; $p = 0.045$), while those in Level 1 from internal disease departments (mean 19.6 vs 9.9% Level 2 ICUs; $p = 0.029$). More patients with comorbidities rate were hospitalized in Level 1 ICUs (Table 4). The crude death rate in ICUs in Warsaw was higher in Level 1 than Level 2 (34.8% vs. 24.5%, respectively; $p = 0.004$), Table 4.

3.4. Human Resources

Data on human resources in the Level 1 vs. Level 2 groups were analyzed. The number of patients per consultant intensivist, resident intensivist, nurse, and clinical nurse specialist was comparable (Table 5).

Table 5. Data on human resources in ICUs in Warsaw.

Indicator	Total	Level 1	Level 2	p
Number of patient-days per year per specialist intensivist	181.37 [111.86 - 308.42]	132.32 [109.57 - 248.01]	236.18 [146.54 - 368.78]	0.097
Number of patient-days per year per resident intensivist	695.65 [196.62 - 1421.43]	439.32 [144.51 - 999.54]	881.01 [482.83 - 1717.80]	0.214
Number of patient-days per years per nurse	111.83 ± 60.13	104.90 ± 56.09	118.77 ± 64.98	0.523
Number of patient-days per year per clinical nurse specialist	264.12 [193.89 - 264.12]	264.12 [194.73 - 323.08]	268.19 [264.12 - 409.88]	0.792

Variables are expressed as mean ± SD, medians [range].

4. Discussion

Only minor differences in accessible quality and performance indicators were observed between sixteen Level 1 and Level 2 ICUs of the city of Warsaw hospitals. The only significant variable was the crude mortality rate (or percentage of fatalities in the departments: 34.8% vs. 24.5%), higher in Level 1 ICUs, with insignificantly higher SMR (0.71 vs. 0.64). Central intravenous line-related infections, unexpected extubations, readmission rates, bed occupancy rate (BOR), length of stay, and available human resources were comparable.

The crude mortality rate in Warsaw ICUs was higher than in other EU countries (range: 25.8% - 33.5% vs. 6.7% - 17.8%, respectively) [15] [16]. While suboptimal treatment increases costs and risk of litigation [17], it was impossible to compare other factors of patient characteristics, comorbidities, and availability of intensive care beds per 1000 citizens. These factors strongly affect mortality and must be weighted when comparing quality of medical services in different systems [17]. Lower crude mortality rate in other EU countries results from a higher percentage of intensive care beds in relation to other hospital beds (3.35% in our study), leading to a greater number of admissions to ICUs [16] [18] [19]. In Poland, patients are often admitted to ICUs in critical condition with poor prognoses, and they occupy beds for extended periods [15] [16]. Delayed ICU admission is a crucial factor influencing patient survival and may lead to prolonged hospitalization and increased mortality [20] [21]. In Level 1 ICUs, the patients' age and comorbidity rate were higher, which could have led to an increased mortality rate. Although we were unable to explore this phenomenon with the available dataset, it may result from the misuse or lack of clear criteria and operating procedures defining indications, terms, and conditions for ICU admission. This hypothesis is supported by a disparity in the source of patients' admissions and the direction of discharges between Level 1 and Level 2 ICUs: majority of patients in Level 2 were admitted from surgical wards, and more pa-

tients were discharged directly home from Level 1. When a patient's condition does not necessitate ICU treatment, they should be promptly transferred to another department. This rule was violated more often in Level 1 ICUs (18% vs. 12%) [15] [22]. Level 1 ICUs also had more patients who received minimal medical attention, as measured by lower TISS-28 scores. It is possible that less activity was undertaken due to patients' age, poor condition, and prognosis, and some patients might never have been admitted to an ICU if strict criteria were followed. Admitting patients to an ICU solely for them to pass away is an inappropriate use of the resources of this round-the-clock service, which is crucial to any hospital. In our opinion, the significantly higher crude mortality rate than in other EU countries [15] [23] reflects either a misuse of ICU services or shortages in human resources and medical equipment due to insufficient healthcare funding (healthcare expenditures in Poland are the third lowest in the EU after Romania and Luxembourg). In many studies, a major factor influencing the quality of healthcare in ICUs is the nurse-to-patient ratio [24]. This ratio varies from one nurse per patient to one nurse per four patients in different countries. A shortage of qualified nurses can lead to an increase in adverse events, worsen treatment outcomes, and prolong the length of stay (LOS) [25] [26]. ICUs in Warsaw currently maintain a low nurse-to-patient ratio, with four patients per nurse. Increasing funding, improving the management of available financial resources, and recruiting additional medical staff would significantly alleviate this issue [24]. On the other hand, standardized mortality ratios in ICUs in Western Europe typically range from 0.48 to 0.82 so even in Level 1 ICUs, the SMR was excellent [1] [13] [14].

In the most developed countries, critically ill patients are exclusively treated in multidisciplinary hospitals. Recent studies indicate that ICUs vary significantly in terms of their structure, resources, and patient populations [27] [28]. This diversity makes it challenging to compare the performance of ICUs. Accurate analysis and evaluation of the quality of ICUs in Warsaw were difficult due to the absence of nationwide data registers, which is a problem faced across the nation. Only one region implemented the Silesian Register of ICUs [9]. Patient, structure, and economy-oriented measures have long ago formed the basis for quality assessment and registers of intensive care in Spain, Norway, UK, Germany, and the Netherlands [29] [30]. Foreign experience demonstrates that standardized digital registers are valuable in the interpretation of medical data [10] [31] [32] [33] [34]. Benchmarking of medical registers can help identify the best practices to implement in ICUs [35] [36]. Furthermore, it enables evaluations and the identification of weaknesses in the system, facilitating the development of improvement plans and the implementation of assessments in accordance with the Deming cycle [1] [37]. The global COVID-19 pandemic has underscored the significance of international data reporting and registration.

In general, all the data we used for analysis were reported by individual hospitals to third-party registries, and eventually, we managed to obtain them from various competent bodies. The issue lies in the dispersion of this data and the

lack of cooperation and harmonization among different government-controlled organizations regarding the integration, analysis, and drawing of conclusions from available information. The use of different data formats, coding systems, and storage software in various organizations further complicates the matter.

There is room for improvement through education of medical staff, defining ICU admission criteria, and improving diagnosis and management of futile therapy. Proper utilization of available tools should optimize utilization of intensive care beds [17] [30]. Certain aspects of critically ill patient care are universal, while others vary from country to country. There is a pressing need to compare the similarities and differences in ICU structure and procedures for the purpose of benchmarking and delivering the best possible medical services [36] [37] [38] [39]. Drawing from the experiences of other countries such as the Netherlands, Great Britain, Germany, or Spain, the construction and systematic implementation of quality programs in the field of intensive care should enable further optimization and improvement of treatment outcomes for critically ill patients [28] [34] [37]. The implementation of tools for assessing the quality of ICUs, which includes benchmarking, self-assessment of departments, and the evaluation of changes resulting from audits, is of paramount importance. Standardization of quality measures and markers, along with improved communication and cooperation in the realm of reporting and the creation of ICU medical registers, are necessary steps to enhance the quality of healthcare. This would not only contribute to enhancing the treatment results but also reduce the costs associated with intensive care.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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