

CLINICAL DATA READINESS IN INFECTION-RELATED SURGICAL ICU ADMISSIONS: A RETROSPECTIVE EVALUATION OF ROUTINE DOCUMENTATION RETRIEVABILITY

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Abstract

Background: We evaluated the completeness and retrievability of core clinical and laboratory treatment, and outcome variables from routine records of infection-related surgical ICU admissions and explored documentation gaps relevant to clinical evaluation and secondary data use.

Material and Methods: We performed a retrospective, single-center, record-based evaluation of infection-related ICU admissions during 2025. The predefined data sources comprised the ICU paper record, admission documentation, clinical progress notes, and laboratory reports physically available in the reviewed patient file. Variables were grouped into bedside physiological/neurological data, laboratory data, organ-support and treatment data, and administrative/outcome data. As an exploratory functional assessment, we evaluated whether the retrieved variables enabled complete retrospective reconstruction of qSOFA, conventional SOFA, NEWS, and MEWS, and conducted a respiratory-rate-based feasibility assessment of SIRS.

Results: Among 196 included patients, supplemental oxygen status, heart rate, systolic blood pressure, and SpO₂ were retrievable in 98.5%, 98.0%, 95.9%, and 93.9% of records, respectively. WBC and platelet count were each retrievable in 77.0%, creatinine in 76.5%, temperature in 67.9%, lactate in 52.6%, and an interpretable mental-status assessment in 52.0% of records. Bilirubin was retrievable in 18.4%, while the numerical respiratory rate was not retrievable within the predefined sources and assessment window. PaO₂ values were documented in arterial blood gas reports, but the corresponding FiO₂ was not routinely recorded in the reviewed paper documentation, preventing paired retrospective derivation of PaO₂/FiO₂.

Conclusions: Routine records of infection-related surgical ICU admissions contained substantial clinically relevant information, but retrievability varied markedly across documentation domains. The most prominent gaps involved structured bedside variables, particularly numerical respiratory rate and neurological assessment, while some laboratory and microbiological information may have been available outside the predefined paper sources. Improving the integration of existing data sources and standardizing a limited set of bedside fields may enhance ICU data readiness while reducing redundant documentation.

Keywords: *intensive care unit; clinical documentation; data retrievability; sepsis; medical records.*

Introduction

Routine intensive care generates a large volume of physiological, laboratory, treatment-related, and outcome-related data. The value of these data for bedside assessment, quality evaluation, audit, and secondary research depends on whether clinically important variables are consistently recorded, are readily retrievable from the available documentation, and linked to an appropriate clinical time point. Incomplete or fragmented documentation may therefore limit data use even when the underlying measurement has been performed, or intervention has been delivered (1,2). In this study, clinical data readiness refers to the extent to which routinely generated information is available in a retrievable and sufficiently structured form for standardized retrospective use.

This issue is particularly relevant in infection-related critical illness, where clinical assessment relies on combinations of bedside observations, organ-support data, and laboratory variables. The Sepsis-3 consensus defines sepsis as life-threatening organ dysfunction caused by a dysregulated host response to infection and operationalizes organ dysfunction using the Sequential Organ Failure Assessment (SOFA) score (2,3). Other commonly used systems, including qSOFA, SIRS, the National Early Warning Score (NEWS), and the Modified Early Warning Score (MEWS), similarly depend on sets of routinely measured clinical variables (2-7). Their retrospective use therefore provides a practical test of whether routine documentation is sufficiently complete for standardized secondary assessment.

Missing data should not automatically be interpreted as evidence that a measurement or intervention was not performed. In paper-based and hybrid information environments, clinically relevant information may be distributed across bedside charts, progress notes, laboratory reports, microbiology systems, anesthesia documentation, and electronic hospital platforms. Therefore, the absence of a retrievable value from a predefined documentation source may reflect fragmentation or limited accessibility rather than the absence of the underlying clinical activity (8). Previous studies have identified respiratory rate as one of the less consistently documented vital signs and have also raised concerns about the reliability of recorded values (9,10). Similarly, incomplete availability of individual SOFA data sets may affect retrospective score reconstruction and related secondary analyses (11,12).

The primary aim of this evaluation was to assess the retrievability of core clinical, laboratory, treatment, and outcome variables from routinely available records of infection-related surgical ICU admissions and to identify the main documentation gaps. Second, this report aims to describe the distribution of missing information across documentation domains and, as an exploratory assessment of data usability, to determine whether the available variables permitted complete retrospective reconstruction of qSOFA, conventional SOFA, NEWS, and MEWS, together with an RR-based feasibility assessment of SIRS.

Materials and Methods

Study Design and Setting

This retrospective, single-center observational evaluation was conducted in the surgical intensive care unit (ICU) of the University Clinical Center “Mother Teresa” in Skopje, North Macedonia. The

unit functions as a tertiary referral ICU and admits postoperative and emergency surgical patients, as well as patients transferred from surgical and medical departments or referred from other hospitals. The study included ICU admissions recorded between January and December 2025. The ICU admission logbook was screened to identify admissions associated with suspected or documented infection, sepsis or septic shock, or infection-related critical illness.

Study Population

A detailed record review was conducted for patients when the ICU admission diagnosis indicated an infection-related condition or a clinical presentation in which infection was considered relevant to critical illness. Screening was performed by one investigator using clinical and diagnostic categories defined before detailed record review and based on internationally accepted terminology for sepsis and infection-related critical illness (2,3). Screening diagnoses included sepsis or septic shock, severe infection, bacteremia, pneumonia with respiratory failure, abdominal infection including peritonitis or cholangitis, urogenital infection, meningitis or encephalitis, necrotizing soft-tissue infection, infection-associated shock or organ dysfunction, and fever requiring ICU-level management.

Admissions primarily related to isolated trauma, intoxication, or acute neurological injury or seizures without suspected infection, as well as elective postoperative admissions requiring routine monitoring without suspected infection or physiological deterioration, were excluded. Duplicate entries for eligible admissions were removed, retaining only the first eligible admission, and records unavailable from the hospital archive were excluded from the final analysis.

Documentation Sources and Data Extraction

Data were collected retrospectively by using a structured study database and predefined variable definitions. Primary record screening and data extraction were performed by one investigator under the supervision of a senior mentor. The predefined study source consisted of the ICU paper record, admission documentation, clinical progress notes, and laboratory reports physically available within the reviewed patient file. Laboratory or microbiological data not contained in the predefined source was not additionally retrieved from electronic hospital systems. Accordingly, the study evaluated source-specific retrievability from the reviewed record rather than definitive institutional availability or non-performance of a measurement or intervention.

The reviewed variables were organized into four documentation domains. Bedside physiological and neurological variables included heart rate, respiratory rate, systolic blood pressure, peripheral oxygen saturation (SpO₂), body temperature, supplemental oxygen requirement (presence or absence), and neurological status. Laboratory variables included white blood cell count, platelet count, serum creatinine, bilirubin, and lactate; oxygenation information required for PaO₂/FiO₂ derivation was also assessed. Treatment and organ-support variables included antimicrobial therapy, vasopressor therapy, mechanical ventilation, and blood culture results. Mechanical ventilation and vasopressor-use status could be ascertained for all patients in the analyzed cohort. Administrative and outcome variables included age, sex, admission diagnosis, source of ICU admission, and ICU outcome.

A variable was considered retrievable when the numerical value or clinically interpretable categorical information required for analysis could be identified in the predefined documentation source. Variables that could not be identified were classified as not retrievable. Clinically non-assessable data,

such as neurological status in patients who were already intubated and/or sedated, were distinguished from undocumented data whenever the record allowed this distinction.

Scope of Paper and Electronic Documentation

The present analysis was intentionally based on the predefined patient record described above. Electronic platforms used in routine care, including “Moj Termin” (electronic database) and separate laboratory or microbiology systems, were not queried to recover additional patient-level values that were absent from the reviewed file. Their potential complementary role is therefore considered in the interpretation of the findings, but patient-level completeness in those systems was not quantified and no combined paper-plus-electronic completeness estimate was generated.

Table 1. Documentation sources and scope of the present evaluation

Documentation source	Used for patient-level extraction	Role in this study
ICU paper record, admission documentation, progress notes	Yes	Primary source for bedside clinical findings, organ-support information, treatment documentation, and narrative assessments.
Laboratory reports physically present in the reviewed patient file	Yes	Source for laboratory values when included in the predefined record.
Electronic hospital, laboratory, and microbiology systems	No	Not queried for recovery of additional patient-level clinical values; complementary electronic completeness was not quantified.

Assessment Window

For physiological and laboratory variables, the measurement closest to the recorded ICU admission time within a predefined window of six hours before or after admission was used. The ICU admission time used for this analysis was retrieved from routine ICU admission documentation and patient charts. The same timestamp is routinely captured in the institutional electronic system (“Moj termin”), which was not used to recover missing clinical values. The same assessment window was applied consistently when evaluating variable availability. Because of the retrospective design, measurements within this interval could have preceded or followed diagnostic, operative, resuscitative, antimicrobial, ventilatory, or vasopressor interventions performed around the time of ICU admission.

Exploratory Reconstruction of Composite Assessment Systems

As a secondary functional assessment of data usability, we evaluated whether qSOFA, conventional SOFA, NEWS, and MEWS could be completely reconstructed based on the variables required by the published frameworks (3-6). We also conducted an exploratory SIRS feasibility assessment. For SIRS, temperature, heart rate, respiratory rate information, and white blood cell count were assessed. Since PaCO₂ was not used as an alternative respiratory criterion in the predefined analysis, this represents RR-based ability to reconstruct rather the respiratory criterion, rather than full reconstruction of all alternative SIRS criteria. qSOFA required respiratory rate, systolic blood pressure, and mental status. Conventional SOFA required complete data across the respiratory, cardiovascular, neurological, coagulation, hepatic, and renal domains; paired PaO₂/FiO₂ data were required for the respiratory

domain. NEWS and MEWS required their standard combinations of respiratory, cardiovascular, temperature, oxygenation, and consciousness variables (3-6).

A composite system was considered completely reconstructable only when all required components were retrievable within the predefined assessment window. Missing values were not imputed, unavailable components were not assumed to be normal, and partial scores were not used as substitutes for complete scores. For the RR-based SIRS feasibility assessment, the respiratory component was considered available only when a numerical respiratory rate could be retrieved. This exploratory analysis was intended to assess the feasibility of retrospective reconstruction based on the available documentation rather than prognostic performance.

Selected early management variables were analyzed descriptively based on the data we could retrieve from the reviewed records. Antimicrobial therapy was classified as therapeutic or prophylactic when the indication could be determined. Time to first therapeutic antimicrobial administration was evaluated only when the recorded data allowed a sufficiently interpretable time interval to be established. Lactate assessment was evaluated separately from the retrieved numerical lactate concentration. Blood-culture data were considered retrievable when evidence of sampling and/or microbiological results was available within the reviewed source; these data were not used to estimate the overall institutional blood-culture acquisition.

Study Outcomes

The primary aim was to assess the retrievability of individual core clinical, neurological, laboratory, treatment, organ-support, and outcome variables and to identify domains with the greatest documentation gaps. Secondary outcomes included the availability of selected early management variables. The complete reconstructability of qSOFA, conventional SOFA, NEWS, and MEWS, together with RR-based SIRS feasibility, was treated as an exploratory functional outcome of documentation completeness.

Statistical Analysis

The analysis was primarily descriptive. Categorical variables were summarized as numbers and percentages. Continuous variables were summarized as mean with standard deviation or median with interquartile range, depending on their distribution. For variables with incomplete availability, the number of patients with retrievable information was reported explicitly. The proportion of retrievable values was calculated for each variable using the full analytic cohort as the denominator unless otherwise specified. Missing variables and variables considered clinically non-assessable were described separately when appropriate. No imputation of missing data was performed.

Results

A total of 694 ICU admissions were recorded during 2025. Screening identified 217 potentially infection-related admissions. Ten duplicate eligible admissions were removed, leaving 207 unique admissions eligible for detailed review. Eleven records could not be retrieved from the hospital archive, leaving a final analytic cohort of 196 patients (Figure 1). The cohort included all principal surgical ICU admission pathways and had substantial requirements for invasive organ support.

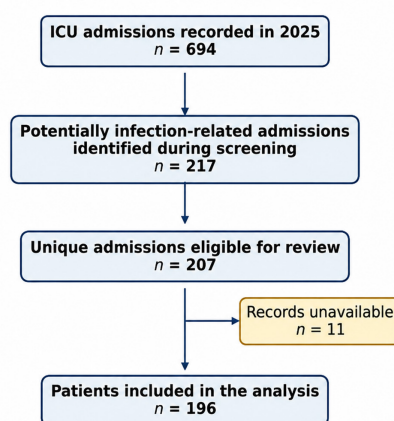


Figure 1. Flow of ICU admissions through screening, eligibility assessment, record retrieval, and final analysis. Ten duplicate eligible admissions were removed between initial screening and the set of unique admissions eligible for detailed review.

Among the 155 patients with retrievable age data, the median age was 69 years (IQR 59-74); 54.1% of the cohort were male. The most common admission sources were the operating room (35.7%) and surgical wards (29.1%). Mechanical ventilation and vasopressor-use status were ascertainable in all 196 patients; 156/196 (79.6%) received mechanical ventilation, and 113/196 (57.7%) received vasopressor therapy. ICU outcome was evaluable in 185 patients, with a mortality rate of 64.9%. Therapeutic antimicrobial therapy was identifiable in 123/196 (62.8%), prophylactic use in 65/196 (33.2%), and no antimicrobial use in 6/196 (3.1%). Among patients receiving therapeutic antimicrobials, administration within one hour was documented in 63/123 (51.2%). Timing was missing or uninterpretable in 20/123 patients, leaving 103 with interpretable timing; among these, 63/103 (61.2%) had documented administration within one hour. Lactate measurement was documented in 149/196 (76.0%), although a numerical lactate value was retrievable in 103/196 (52.6%). Blood-culture data was identifiable in 16/196 (8.2%) within the predefined study source (Table 2).

Table 2. Cohort characteristics and selected early management variables

Variable	Category	n/N	% or summary
Panel A. Cohort characteristics			
Age, years	Median (IQR)	155/196	69 (59-74)
Sex	Male/Female	106/90	54.1% / 45.9%
Admission source	Operating room	70/196	35.7%
	Surgical ward	57/196	29.1%
	Internal medicine departments	42/196	21.4%
	Emergency department	16/196	8.2%
	Other hospital	11/196	5.6%
Mechanical ventilation	Yes	156/196	79.6%
Vasopressor therapy	Yes	113/196	57.7%
ICU mortality	Among evaluable outcomes	120/185	64.9%

Variable	Category	n/N	% or summary
Panel B. Selected early management variables			
Antimicrobial therapy	Therapeutic	123/196	62.8%
	Prophylactic	65/196	33.2%
	None	6/196	3.1%
	Unclassifiable/missing	2/196	1.0%
Therapeutic antimicrobial timing	≤1 h (all therapeutic)	63/123	51.2%
Lactate measurement	Documented as performed	149/196	76.0%
Numerical lactate value	Retrievable	103/196	52.6%
Blood-culture data	Any retrievable evidence	16/196	8.2%

Data are n (%) unless otherwise specified. Age was retrievable for 155/196 patients. Mechanical-ventilation and vasopressor-use status were ascertainable for all 196 patients. ICU outcome was unavailable for 11 patients; mortality was therefore calculated among 185 evaluable outcomes. Therapeutic antimicrobial timing was missing or uninterpretable in 20/123 patients; among the 103 patients with interpretable timing, 63 (61.2%) had documented administration within 1 hour. IQR, interquartile range; ICU, intensive care unit.

Retrievability was high for cardiovascular and oxygen-related bedside variables. Supplemental oxygen status was identifiable in 193/196 records (98.5%), heart rate in 192/196 (98.0%), systolic blood pressure in 188/196 (95.9%), and SpO₂ in 184/196 (93.9%). Common laboratory variables showed moderate retrievability: WBC and platelet count were each retrievable in 151/196 (77.0%), and creatinine in 150/196 (76.5%). Temperature was retrievable in 133/196 (67.9%).

The largest gaps were concentrated in a smaller set of variables. A numerical lactate value was retrievable in 103/196 (52.6%) and an interpretable mental-status assessment in 102/196 (52.0%). Bilirubin was retrievable in 36/196 (18.4%). No numerical respiratory-rate value was available within the predefined source and assessment window; 21 records contained the qualitative term “tachydyspnoic” and seven contained “dyspnoic,” but these descriptions were not converted into numerical values. PaO₂ values were documented in arterial blood-gas reports, but corresponding FiO₂ was not routinely recorded in the reviewed paper documentation. Consequently, paired PaO₂ and FiO₂ information sufficient to derive PaO₂/FiO₂ was not retrievable within the predefined source and assessment window. Figure 2 and Table 3 summarize the variable-level pattern.

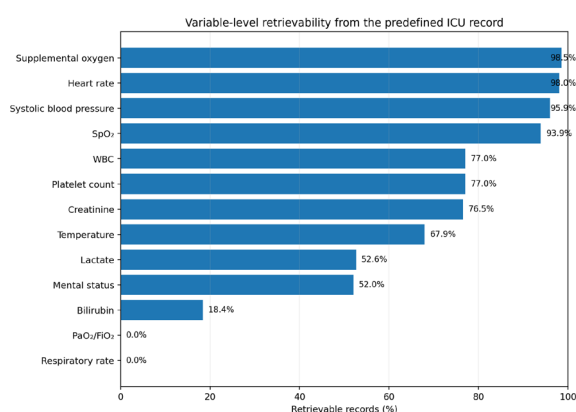


Figure 2. Variable-level retrievability from the predefined study source. The figure illustrates high re-

trievability for cardiovascular and oxygen-related observations, intermediate retrievability for several laboratory variables, and concentrated gaps in selected bedside and oxygenation variables.

Table 3. Completeness and retrievability of core ICU documentation variables

Domain	Variable	n/N	%	Main limitation / interpretation
Bedside / oxygen	Supplemental oxygen	193/196	98.5%	Highly retrievable
Bedside / oxygen	Heart rate	192/196	98.0%	Highly retrievable
Bedside / oxygen	Systolic blood pressure	188/196	95.9%	Six NM and two unavailable entries
Bedside / oxygen	SpO ₂	184/196	93.9%	Five NM/unmeasurable and seven unavailable entries
Laboratory	WBC	151/196	77.0%	Moderately complete
Laboratory	Platelet count	151/196	77.0%	Moderately complete
Laboratory	Creatinine	150/196	76.5%	Moderately complete
Bedside	Temperature	133/196	67.9%	Incomplete in approximately one third
Laboratory	Lactate	103/196	52.6%	Numerical value less often retrievable than documentation that measurement was performed
Neurological	Mental status	102/196	52.0%	15 explicit unavailable/N/A; 79 blank
Laboratory	Bilirubin	36/196	18.4%	Low retrievability from predefined record
Oxygenation	PaO ₂ /FiO ₂	0/196	0.0%	PaO ₂ was documented in arterial blood-gas reports, but corresponding FiO ₂ was not routinely recorded in the reviewed paper documentation; paired data were unavailable for retrospective derivation.
Bedside	Respiratory rate	0/196	0.0%	21 tachydyspnoic and 7 dyspnoic descriptions; no numerical value

Retrievability required a numerical value or clinically interpretable categorical assessment. Descriptive respiratory terms were not converted to numerical values. Missing components were not imputed or assumed normal. N/A, not applicable; NM, not measurable/unmeasurable as recorded.

Under the predefined complete-case rule, the available documentation did not allow a complete retrospective reconstruction of qSOFA, conventional SOFA, NEWS, or MEWS (0/196 for each), and the RR-based SIRS feasibility assessment was likewise incomplete in all 196 patients. This was a downstream consequence of concentrated documentation gaps rather than a finding of generalized data absence: numerical respiratory rate limited the RR-based SIRS assessment, qSOFA, NEWS, and MEWS; incomplete mental-status documentation further affected qSOFA, conventional SOFA, NEWS, and MEWS; and absent PaO₂/FiO₂ information prevented complete conventional SOFA reconstruction.

Discussion

The main finding of this record-based evaluation was that routine documentation for infection-related surgical ICU admissions contained substantial clinically relevant information, but completeness was uneven across documentation domains. Cardiovascular and oxygen-related observations were highly retrievable, and several common laboratory variables were available in approximately three-quarters

of records. In contrast, the largest gaps involved numerical respiratory rate, neurological assessment, bilirubin, lactate concentration, and $\text{PaO}_2/\text{FiO}_2$. This pattern suggests selective and source-specific incompleteness rather than a generalized absence of ICU documentation.

Respiratory rate was the clearest gap in bedside documentation. Although qualitative descriptors such as “tachydyspnoic” or “dyspnoic” were present in some records, no numerical value was retrievable within the predefined source and assessment window. Qualitative descriptions may be clinically meaningful; however, they do not allow a reproducible threshold-based retrospective assessment. Previous studies have similarly identified respiratory rate as one of the less consistently documented vital signs and have raised concerns about the reliability of recorded values (9,10). These findings support structured numerical recording of respiratory rate as a focused documentation improvement.

Neurological assessment represented another important gap in bedside documentation, with an interpretable mental-status assessment available in approximately half of the cohort. In a surgical ICU, neurological assessment may be complicated by intubation, sedation, residual anesthesia, emergency surgery, and pre-existing neurological impairment. A clinically non-assessable state should therefore remain distinguishable from undocumented information. Missing neurological information has also been recognized as a limitation in retrospective SOFA reconstruction (11,12). Standardized documentation incorporating a concise neurological descriptor or validated consciousness scale, together with an option to indicate sedation or non-assessability, could improve both clinical interpretation and secondary data use.

The laboratory findings illustrate a different aspect of retrievability. WBC, platelet count, and creatinine were available in approximately three-quarters of reviewed files, whereas bilirubin and numerical lactate values were less consistently retrievable. Importantly, electronic systems were not searched when the required information was not available in the predefined record. Low paper-record retrievability, therefore, cannot be interpreted as evidence that a test was not performed, consistent with the broader distinction between data availability and completeness for secondary use (8). Similar considerations apply to blood cultures. $\text{PaO}_2/\text{FiO}_2$. PaO_2 values were present in arterial blood gas reports, but the corresponding FiO_2 was not routinely documented in the reviewed paper charts, preventing retrospective pairing. Difficulties related to incomplete respiratory, bilirubin, and neurological components have also been described in retrospective SOFA assessment (11,12).

These findings suggest that improved integration of data already generated in electronic or departmental systems, together with standardized recording of a limited number of bedside variables, may enhance their usability without unnecessarily increasing documentation burden (1,8). Respiratory rate, neurological status, oxygen-delivery information, and clearly linked laboratory results appear particularly relevant. Structured fields may improve completeness, although completeness alone does not guarantee accuracy, as illustrated by previously reported clustering of recorded respiratory rate values (10).

The exploratory composite assessment analysis further illustrates the effect of individual gaps in the documentation. Under the predefined complete-case approach, qSOFA, conventional SOFA, NEWS, and MEWS could not be completely reconstructed, and the RR-based SIRS feasibility assessment was incomplete in all patients. This should not be interpreted as evidence that clinically important data were generally absent or that the assessment systems themselves perform poorly. These sys-

tems depend on combinations of required variables, and a single unavailable component may prevent complete retrospective reconstruction (3–7). In this cohort, absent numerical respiratory rate affected qSOFA, NEWS, MEWS, and the RR-based SIRS assessment, while conventional SOFA additionally depended on respiratory oxygenation data. The importance of missing individual SOFA components in retrospective analyses has also been demonstrated previously (11,12).

The selected early management variables similarly highlight the distinction between clinical activity and documentary retrievability. Antimicrobial use could be classified in almost all records, whereas precise timing was less consistently interpretable. Lactate measurement was documented more frequently than a corresponding numerical value was retrievable, while blood-culture data were rarely identifiable within the predefined source. Current sepsis guidance emphasizes timely antimicrobial treatment, lactate assessment, and microbiological sampling when clinically appropriate (2). These findings, however, reflect documentary retrievability and should not be interpreted as a direct measure of guideline adherence.

This evaluation has several strengths, including variable-level assessment, use of a predefined assessment window, distinction between unavailable and clinically non-assessable information when possible, and avoidance of unsupported imputation. Several limitations should also be acknowledged. This was a retrospective, single-center evaluation, and findings may not be generalizable to settings with different workflows or information systems. Retrievability was intentionally limited to predefined documentation sources, while electronic laboratory, microbiology, anesthesia, and other institutional systems were not queried for additional patient-level values. Eligibility screening and data abstraction were performed by one investigator without a formal inter-rater reliability assessment. The ± 6 -hour window may also have included measurements obtained before or after major clinical interventions. Finally, the evaluation addressed documentation completeness and data usability rather than diagnostic accuracy, prognostic performance, guideline adherence, or quality of care, and the SIRS analysis was limited to RR-based feasibility because PaCO₂ was not used as an alternative respiratory criterion.

Conclusion

Routine records of infection-related surgical ICU admissions contained substantial clinically relevant information, although retrievability varied across documentation domains. The main gaps were concentrated in selected variables, particularly numerical respiratory rate and neurological assessment, while some laboratory and microbiological data may have been available outside the predefined paper record. Better integration of existing data sources, together with standardized documentation of a limited set of bedside variables, could improve the completeness and usability of routine ICU data for clinical evaluation and secondary use.

Declarations

Ethics approval and consent to participate: The study protocol was approved by the Institutional Review Board of the Department of Anesthesiology and Reanimation, Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, North Macedonia. The study involved retrospective analysis of routinely collected clinical data and introduced no study-related intervention or modification of patient management. All data were anonymized before analysis and patient identifiers were replaced

with study codes. Confidentiality was maintained throughout data extraction, database preparation, analysis, and reporting.

Availability of data and materials: The data supporting the findings of this evaluation are available from the corresponding author upon reasonable request, subject to institutional and ethical requirements.

Informed consent: Inapplicable.

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Authors contributions: M.S. contributed to record screening, data collection, database preparation, and manuscript drafting. A.G.B. contributed to the conception and design of the evaluation, supervision, interpretation of the findings, and critical revision of the manuscript. A.L., M.T.N., P.B.M., contributed to the interpretation of the results, reviewed the manuscript, and approved the final version.

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References:

1. Sanchez-Pinto LN, Luo Y, Churpek MM. Big data and data science in critical care. *Chest*. 2018;154(5):1239-48. doi:10.1016/j.chest.2018.04.037.
2. Prescott HC, Antonelli M, Alhazzani W, et al. Surviving Sepsis Campaign: international guidelines for management of sepsis and septic shock 2026. *Crit Care Med*. 2026;54(4):725-812. doi:10.1097/CCM.0000000000007075.
3. Singer M, Deutschman CS, Seymour CW, et al. The third international consensus definitions for sepsis and septic shock (Sepsis-3). *JAMA*. 2016;315(8):801-10. doi:10.1001/jama.2016.0287.
4. Seymour CW, Liu VX, Iwashyna TJ, et al. Assessment of clinical criteria for sepsis: for the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA*. 2016;315(8):762-74. doi:10.1001/jama.2016.0288.
5. Bone RC, Balk RA, Cerra FB, et al. Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. The ACCP/SCCM Consensus Conference Committee. *Chest*. 1992;101(6):1644-1655. doi:10.1378/chest.101.6.1644.
6. Royal College of Physicians. National Early Warning Score (NEWS): standardising the assessment of acute-illness severity in the NHS. Report of a working party. London: Royal College of Physicians; 2012.
7. Subbe CP, Kruger M, Rutherford P, Gemmel L. Validation of a modified Early Warning Score in medical admissions. *QJM*. 2001;94(10):521-526. doi:10.1093/qjmed/94.10.521

8. Weiskopf NG, Hripcsak G, Swaminathan S, Weng C. Defining and measuring completeness of electronic health records for secondary use. *J Biomed Inform.* 2013;46(5):830–836. doi:10.1016/j.jbi.2013.06.010.
9. Jonsson T, Jonsdottir H, Möller AD, Baldursdottir L. Nursing documentation prior to emergency admissions to the intensive care unit. *Nurs Crit Care.* 2011;16(4):164–169. doi:10.1111/j.1478-5153.2011.00427.x.
10. Badawy J, Nguyen OK, Clark C, Halm EA, Makam AN. Is everyone really breathing 20 times a minute? Assessing epidemiology and variation in recorded respiratory rate in hospitalised adults. *BMJ Qual Saf.* 2017;26(10):832–836. doi:10.1136/bmjqs-2017-006671.
11. Brinton DL, Ford DW, Martin RH, Simpson KN, Goodwin AJ, Simpson AN. Missing data methods for intensive care unit SOFA scores in electronic health records studies: results from a Monte Carlo simulation. *J Comp Eff Res.* 2022;11(1):47–56. doi:10.2217/ce-2021-0079.
12. Alrawashdeh M, Klompas M, Rhee C. The impact of common variations in Sequential Organ Failure Assessment score calculation on sepsis measurement using Sepsis-3 criteria: a retrospective analysis using electronic health record data. *Crit Care Med.* 2024;52(9):1380–1390. doi:10.1097/CCM.0000000000006338.