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Characteristics of patients who were admitted to the intensive care unit through the emergency department: a monocentric retrospective observational study

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Received: 8 April 2024 / Accepted: 22 May 2024
Published online: 01 June 2024

Abstract

Background The intensive care of critically ill patients is of great importance for emergency care. To achieve this, patients in need of intensive care must be quickly identified. On the other hand, misallocation of intensive care beds to patients who do not necessarily require intensive care must be avoided. Emergency departments play a crucial role in these decision-making processes.

Methods In a retrospective single-center study, we examined the characteristics of patients admitted to the intensive care unit through our emergency department, as well as the subsequent course of patients who were referred for intensive care via the emergency medical services.

Results During the 12-months study period, 632 patients were admitted to an intensive care unit within the hospital through our emergency department. Of these patients, 15.2% presented themselves at the emergency department independently, while 84.8% were transported by emergency medical services. Among the patients brought in by the emergency medical services and subsequently admitted to the intensive care unit, 27.6% were registered for the resuscitation room, 25.2% for an intermediate care/intensive care unit, and 47.2% with a different care destination. Of the 373 patients registered for the resuscitation room, 45.6% were admitted to an intensive care unit. 24.1% of the patients were admitted to an intensive care unit. 24.1% of the patients were admitted to a non-intensive care unit. 12.9% of the patients died in the emergency department, and 17.4% of the patients were able to be discharged home after treatment in the emergency department. Among the 635 patients registered for further care on an intermediate/intensive care unit by the emergency medical services, 21.8% were admitted to an intensive care unit, 58.2% of the patients were admitted to a non-intensive care unit. 3% of the patients died in the emergency department, and 17.0% of the patients were able to be discharged after treatment in the emergency department.

Conclusions The emergency departments play a crucial role in the allocation of intensive care unit beds by selecting appropriate patients and preventing misallocations.

Keywords Emergency medical services · Emergency service · Hospital · Intensive care units · Intermediate care · Resuscitation room

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1 Background

The early care of critically patients in an intensive care unit (ICU) is of great importance. Delayed treatment can lead to increased mortality and worsened outcomes [1, 2]. However, in recent years, admission to ICUs have significantly increased in Western countries [3–5]. A bed in an ICU or IMC (intermediate care) has become a scarce resource that needs to be carefully managed [6]. Misallocation with relatively healthy patients who don't truly require intensive care should be avoided to ensure access to ICU care for those who really need it [7, 8].

In acute care hospitals, a large number of ICU admission occurs through the emergency department (ED) [9, 10]. Various triage systems are used in the ED to assess the urgency of patient treatment [11, 12]. The more urgent the triage level, the faster medical care must be provided. Patients are typically presented to the ED either through self-presentation or admission by emergency medical services. In the ambulance, a preliminary diagnosis is often made, or at least a key clinical symptom is defined. Additionally, an initial assessment of the patient's need for urgent treatment is performed, along with an estimation of these resources required at the receiving hospital, such as a resuscitation room or IMC/ICU bed.

Not all patients transported by emergency medical services require an ICU bed during their course of treatment, even among those initially designated for the resuscitation room or IMC/ICU care. On the other hand, self-presenting patients are not necessarily healthier. Even among self-presenting patients, a certain percentage may later require admission to an IMC/ICU.

In a monocentric retrospective observational study, we describe the patient population that was admitted through the ED of a German university hospital located in a major city. Additionally, we describe the characteristics of patients referred by emergency medical services for resuscitation rooms or IMC/ICU care. We also outline the characteristics of patients who presented themselves in the ED and later required IMC/ICU care.

2 Materials and methods

2.1 Study design and settings

We conducted a monocentric retrospective observational study on internal medicine and surgical patients treated in the Emergency Department of the LMU University Hospital, Ludwig-Maximilians-University Munich, Germany, located in the city center between July 2022 and June 2023. This study excluded patients treated in other specialties in the ED. Patients admitted to the hospital's ICU who were not admitted through the ED were also excluded. Patients treated within the hospital and subsequently transferred to the ICU via our resuscitation room were also excluded. The initial assessment in the ED was performed using the Emergency Severity Index (ESI), a five-level triage algorithm that assesses the urgency of treatment based on the severity of the illness an anticipated resource need. The lower the assigned level, the higher the urgency of treatment [11, 12].

2.2 Data collection

The patient's clinical chief complaint, as determined by the emergency medical services during transport to the ED, was used for data analysis. Data for patient characteristic were analyzed from our clinic information system (epias®). The discharge diagnosis from the ED, made when patients were transferred to the ICU, was also analyzed. Diagnoses were based on the International Classification of Diseases (ICD).

2.3 Statistical analysis

We described the patient characteristics, pre-hospital and in-hospital information. Data were shown for age as the median and standard deviation (SD), and as numbers and percentages for categorical variables. For statistical analysis unpaired t-test was used.

The study was approved by the Ethics Committee of Ludwig-Maximilians-Universität München (LMU). Procedures were performed in accordance with ethical standards (institutional and national) for human experimentation and the 1975 Helsinki Declaration.

3 Results

3.1 Characteristics of patients admitted to the intermediate care or intensive care unit (IMC/ICU) through the emergency department (ED)

From July 2022 to June 2023, a total of 27,232 internal medicine and surgical patients were treated at the Emergency Department, city center located, of the LMU University Hospital (Ludwig-Maximilians-University) Munich. Of these, 25% (n = 6808) received inpatient care. 9.2% (n = 632) of these patients required treatment in an IMC/ICU (Table 1). The mean age of patients was 61.2 years. 38.9% (n = 246) were female, and 61.1% (n = 386) were male (p < 0.001). 236 (37.3%) patients were classified as ESI level 1, 297 (47.0%) as ESI level 2, 91 (14.4%) as ESI level 3, and 8 (1.3%) as ESI level 4. No patients were categorized into level 5. 96 (15.2%) patients who needed intensive care were self-referred to the hospital, while 536 (84.8%) were transported by the emergency medical service (p < 0.001). 148 (27.6%) of the patients transported by the emergency medical service were registered for the resuscitation room, 135 (25.2%) were registered for the IMC/ICU, and 253 (47.2%) were admitted without a specific treatment goal. 501 (79.3%) patients admitted to the IMC/ICU were internal medicine patients, and 131 (20.7%) were surgical patients (p < 0.001).

3.2 Characteristics and course of patients registered for the resuscitation room in the emergency department (ED)

We examined the characteristics and further course of patients (n = 373) who were announced as patients for the resuscitation room via the ambulance service (Table 2). The mean age was 43.2 years, 38.3% (n = 143) being female and 61.7% (n = 230) male. Triage assigned 276 (74%) patients to level 1, 48 (12.9%) patients to level 2, 36 (9.6%) patients to level 3, and 13 (3.5%) patients to level 4. No patients were classified as level 5. 37.9% (n = 148) of patients were admitted to hospital's IMC/ICU, while 5.9% (n = 22) had to be transferred to an external hospital's ICU due to a lack of available ICU beds within our own facility. 8.8% (n = 33) were able to be admitted to an internal or surgery regular ward within the hospital. 2.4% (9%) had to be transferred to an internal medicine or surgical regular ward at an external hospital, again

Table 1 Characteristics of patients admitted to the intermediate care or intensive care unit (IMC/ICU) through the emergency department (ED)

	IMC/ICU admission	p
Total number	n = 632	
Age (years, mean, SD)	61.2 ± 24.8	
Sex		
Female	n = 246 (38.9%)	
Male	n = 386 (61.1%)	< 0.001
ESI level		
1	n = 236 (37.3%)	
2	n = 297 (47.0%)	
3	n = 91 (14.4%)	
4	n = 8 (1.3%)	
Self-presentation in the ED	n = 96 (15.2%)	
Admission by emergency medical service	n = 536 (84.8%)	< 0.001
Admission for resuscitation room	n = 148 (27.6%)	
Admission for IMC/ICU	n = 135 (25.2%)	
Other admissions	n = 253 (47.2%)	
Medical specialty		
Internal medicine	n = 501 (79.3%)	
Surgery	n = 131 (20.7%)	< 0.001

Table 2 Characteristics and course of patients registered for the resuscitation room in the emergency department (ED)

	Resuscitation room registration
Total number	n = 373
Age (years, mean, SD)	43.2 ± 21.7
Sex	
Female	n = 143 (38.3%)
Male	n = 230 (61.7%)
ESI level	
1	n = 276 (74.0%)
2	n = 48 (12.9%)
3	n = 36 (9.6%)
4	n = 13 (3.5%)
Treatment after ED	
Admission to IMC/ICU	n = 148 (39.7%)
Admission to IMC/ICU (extern)	n = 22 (5.9%)
Regular ward (internal medicine or surgery)	n = 33 (8.8%)
Regular ward (internal medicine or surgery) (extern)	n = 9 (2.4%)
Discharge to home	n = 65 (17.4%)
Death	n = 48 (12.9%)
Others	n = 48 (12.9%)

Table 3 Characteristics and course of patients registered for the intermediate care or intensive care unit (IMC/ICU) in the emergency department (ED)

	IMC/ICU registration
Total number	n = 635
Age (years, mean, SD)	44.2 ± 26.2
Sex	
Female	n = 218 (34.3%)
Male	n = 417 (65.7%)
ESI level	
1	n = 89 (14.0%)
2	n = 420 (66.1%)
3	n = 126 (19.9%)
Treatment after ED	
Admission to IMC/ICU	n = 135 (21.3%)
Admission to IMC/ICU (extern)	n = 3 (0.5%)
General ward (internal medicine or surgery	n = 311 (49.0%)
General ward (internal medicine or surgery) (extern)	n = 17 (2.7%)
Psychiatric department	n = 11 (1.7%)
Psychiatric department (extern)	n = 21 (3.3%)
Discharge to home	n = 108 (17.0%)
Death	n = 19 (3.0%)
Others	n = 10 (1.5%)

due to bed availability issues in our own hospital. 17.4% (n = 65) of patients were discharged directly from the ED. The "other" group [n = 48 (12.9%)] included patients, who had to be transferred to other specialty areas.

3.3 Characteristics and course of patients registered for the intermediate care or intensive care unit (IMC/ICU) in the emergency department (ED)

We analyzed the characteristics and course of patients who were announced for further care in the IMC/ICU (Table 3). The mean age was 44.2 years. 34.4% (n = 218) were female, 65.7% (n = 417) were male. 14.0% (n = 89) were classified as ESI level 1, 66.1% (n = 420) as level 2, and 19.9% (n = 126) as level 3. No patients were classified as level 4 or 5. 21.3% (n = 135) were actually admitted to an IMC/ICU in our hospital after initial treatment in the ED. 0.5% (n = 3) had to be transferred to an external IMC/ICU because there were no corresponding capacities available in our own hospital. 49.0% (n = 311) were able to be admitted to a general internal or surgical ward in our own hospital, 2.7% (n = 17) to a corresponding ward in an external hospital. 1.7% (n = 11) were transferred to the psychiatric department of our hospital, 3.3% (n = 21) to an external psychiatric department. 17.0% (n = 108) of the patients were discharged, and 3.0% (n = 19) died. The 'other' group (n = 10 (1.5%)) included patients who had to be transferred to other specialty areas.

3.4 Characteristics of patients who presented themselves independently at the emergency department (ED) and were admitted to the intermediate care or intensive care unit (IMC/ICU)

During the observation period, 96 patients who presented themselves to the ED independently had to be further cared for in an IMC/ICU (Table 4). 33.3% (n = 32) of the patients were female, 66.7% (n = 64) were male. Among these patients, 18.8% (n = 18) were classified as ESI level 1, 33.5% (n = 37) as level 2, 39.6% (n = 38) as level 3, and 3.1% (n = 3) as level 4. No patient was classified as level 5.

Chief complaints identified by the ambulance service for patients referred to the resuscitation room or to the intermediate care or intensive care unit (IMC/ICU) upon arrival at the emergency department (ED).

Table 5 shows the chief complaints identified by the ambulance service for patients referred to the resuscitation room or to the IMC/ICU. In the group of patients referred to the resuscitation room, a total of 21 different complaints were reported. The five most common chief complaints were polytrauma (n = 155, 41.6%), resuscitation (n = 63, 16.9%), internal medicine emergency (n = 36, 9.7%), trauma emergency (n = 26, 7.0%), and intoxication (n = 19, 5.1%). 5.1% (n = 19) presented with acute breathlessness, 3.0% (n = 11) had surgical emergencies, 2.7% (n = 10) arrived with the complaint of sepsis. 2.4% (n = 9) were categorized as other emergencies. 1.3% (n = 5) were reported as myocardial infarction. Each 0.8% (n = 3) arrived with cardiogenic shock or an amputation. Each 0.5% (n = 2) were reported as acute abdomen, anaphylaxis, unexplained unconsciousness, stabbing injury, gastrointestinal bleeding, or n/a (not applicable). One patient (0.3%) arrived as a diabetic emergency, and one patient (0.3%) was transferred as a secondary transfer from another clinic.

In the group of patients who were registered for IMC/ICU care, internal medicine emergencies were leading (n = 228, 35.9%), followed by intoxication (n = 194, 30.6%), sepsis (n = 82, 12.9%), other emergencies (n = 40, 6.3%), acute breathlessness (n = 36, 5.7%), resuscitation (n = 14, 2.2%), anaphylaxis (n = 13, 2.0%), and gastrointestinal bleeding (n = 5, 0.7%). Each 0.6% (n = 4) were registered as cardiogenic shock and diabetic emergency, while 0.5% (n = 3) each were registered

Table 4 Characteristics of patients who presented themselves independently at the emergency department (ED) and were admitted to the intermediate care or intensive care unit (IMC/ICU)

	Self-presentation
Total number	n = 96
Age (years, mean, SD)	66.7 ± 15.9
Sex	
Female	n = 32 (33.3%)
Male	n = 64 (66.7%)
ESI level	
1	n = 18 (18.8%)
2	n = 37 (38.5%)
3	n = 38 (39.6%)
4	n = 3 (3.1%)

Table 5 Patient's chief complaint, determined by the emergency medical service

Resuscitation room registration	n (%)	IMC/ICU registration	n (%)
Polytrauma	155 (41.6)	Internal medicine emergency	228 (35.9)
Resuscitation	63 (16.9)	Intoxication	194 (30.6)
Internal medicine emergency	36 (9.7)	Sepsis	82 (12.9)
Trauma emergency	26 (7.0)	Other emergency	40 (6.3)
Intoxication	19 (5.1)	Acute breathlessness	36 (5.7)
Acute breathlessness	19 (5.1)	Resuscitation	14 (2.2)
Surgical emergency	11 (3.0)	Anaphylaxis	13 (2.0)
Sepsis	10 (2.7)	Gastrointestinal bleeding	5 (0.7)
Other emergency	9 (2.4)	Cardiogenic shock	4 (0.6)
Myocardial infarction	5 (1.3)	Diabetic emergency	4 (0.6)
Amputation	3 (0.8)	n/a	3 (0.5)
Cardiogenic shock	3 (0.8)	Trauma emergency	3 (0.5)
Acute abdomen	2 (0.5)	Polytrauma	2 (0.3)
Anaphylaxis	2 (0.5)	Myocardial infarction	2 (0.3)
Unexplained unconsciousness	2 (0.5)	Unexplained unconsciousness	2 (0.3)
Stabbing injury	2 (0.5)	Stabbing injury	1 (0.2)
Gastrointestinal bleeding	2 (0.5)	Surgical emergency	1 (0.2)
n/a	2 (0.5)	Collapse	1 (0.2)
Diabetic emergency	1 (0.3)		
Secondary transfer by emergency medical service	1 (0.3)		

as n/a, trauma emergency, and each 0.3% (n = 2) were registered as polytrauma, myocardial infarction and unexplained unconsciousness. Each 0.2% (n = 1) were stabbing injuries, surgical emergencies, and collapse.

3.5 Diagnoses of patients admitted to the intermediate care or intensive care unit (IMC/ICU) through the emergency department (ED)

We examined the diagnostic groups of patients admitted to the IMC/ICU through the ED. Taken together, traumatic diagnoses (S00–S99, M00–M99) were the most prevalent at 19.7%, followed by diseases of the respiratory system (J00–J99) at 18.0%, diseases of the circulatory system (I00–I99) at 16.4%, intoxications and their psychological consequences (T00–T99, F00–F99) at 11.5%, diseases grouped under R diagnoses (R00–R99: symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified) at 7.9%, certain infections and parasitic diseases (A00–A99) at 7.4%, diseases of the digestive system (K00–K99) at 6.0%, and endocrine, nutritional and metabolic diseases (E00–E99) at 5.6%. The number of diseases of the genitourinary system (N00–N99) was low at 1.6%. All other diagnoses combined accounted for 5.4% (Table 6).

4 Discussion

In Germany, acute hospital care is provided by direct presentation of patients to the ED or referral of patients by their primary care general practitioner, specialist physicians or the ambulance service. Our work has shown that patients who needed admission to an IMC/ICU through our ED came from various referral sources. The significant majority of patients, at 84.4%, were transported to the ED by the ambulance service and were subsequently admitted to the IMC/ICU after primary treatment in the ED. Nonetheless, 15.2% of critically ill patients presented themselves independently at the ED. Of the patients transported to the ED by the ambulance service and later admitted to the IMC/ICU, 27.6% arrived as admission to the resuscitation room, and 25.2% as IMC/ICU admissions. The majority of ambulance referrals (47.2%) for patients subsequently receiving intensive care came as transports without resuscitation room or IMC/ICU admission. In total, significantly more patients triaged internally (79.3%) than surgically (20.7%) were admitted to the IMC/ICU. Significantly more men (61.1%) than women (38.9%) were admitted to the ICU.

Table 6 Diagnoses of patients admitted to the intermediate care or intensive care unit (IMC/ICU) through the emergency department (ED)

ICD	Diagnosis	n (%)	ICD	Diagnosis	n (%)
I21	Acute myocardial infarction	33 (5.2)	J18	Pneumonia	29 (4.5)
I46	Cardiac arrest	29 (4.5)	J44	Chronic obstructive pulmonary disease	26 (4.1)
I48	Atrial fibrillation and flutter	16 (2.5)			
I49	Other cardiac arrhythmias	13 (2.1)	J81	Pulmonary edema	18 (2.8)
I26	Pulmonary embolism	13 (2.1)	J69	Pneumonitis due to solids and liquids	16 (2.5)
R57	Shock	18 (2.8)	J96	Respiratory failure	15 (2.4)
R00	Abnormalities of heart beat	12 (1.9)	J84	Interstitial pulmonary disease	11 (1.7)
R55	Syncope and collapse	10 (1.6)			
R40	Coma	10 (1.6)	A41	Sepsis	25 (4.0)
			A49	Bacterial infection of unspecific site	11 (1.7)
K92	Other diseases of digestive system	18 (2.8)	A46	Erysipelas	11 (1.7)
K81	Cholecystitis	10 (1.6)	B50	Plasmodium falciparum malaria	3 (0.5)
K59	Other functional intestinal disorders	10 (1.6)	E87	Disorders of fluid, electrolyte and acid–base balance	15 (2.4)
N39	Other disorders of urinary system	10 (1.6)	E10	Type 1 diabetes mellitus	10 (1.6)
T65	Toxic effects of other and un- specified substances	15 (2.4)	E14	Unspecified diabetes mellitus	10 (1.6)
T43	Poisoning by psychotropic drugs	13 (2.1)	F11	Mental and behavioural disorders due to use of opioids	14 (2.2)
T51	Toxic effect of alcohol	13 (2.1)			
T39	Poisoning by nonopioid analgesics	3 (0.5)	F10	Mental and behavioural due to use of alcohol	14 (2.2)
S06	Intracranial injury	27 (4.3)			
S32	Fracture of shoulder	15 (2.4)	M25	Joint disorders	9 (1.4)
S32	Fracture of lumbar, spine and pelvis	14 (2.2)	M62	Muscle disorders	8 (1.3)
S30	Injury of abdomen	12 (1.9)			
S72	Fracture of femur	12 (1.9)			
S27	Injury of intrathoracic organs	11 (1.7)			
S82	Fracture of the lower leg	8 (1.3)			
S22	Injury of thoracic spine	8 (1.3)			
	Others	34 (5.4)			

The distribution of patients by ESI level is also interesting. 37.1% of patients were assigned to level 1, meaning immediate medical care without delay is necessary. 47.0% of patients were assigned to level 2, where treatment should occur within 10 min. Still, 14.4% of intensive care patients were at level 3, and thus should be cared for within 30 min. Some of these patients (1.3%) were even categorized as level 4, where medical care could be justifiable after 90 min. The observation that a portion of patients admitted from the ED to the intensive care unit were not initially categorized in the most urgent levels is not new [9]. Of course, during the implementation of ESI triage, it cannot be completely ruled out that there may be some degree of misclassification [13]. This could also be primarily because the goal of the initial triage is to assess the urgency of treatment, rather than the severity and complexity of the condition [14]. The indication for care in the IMC/ICU becomes apparent for these patients during the course of diagnosis and treatment in the ED.

A patient presenting with general symptoms and abdominal pain may be triaged with relatively low urgency. However, laboratory investigations reveal a life-threatening hypercalcemia, necessitating intensive medical monitoring. However, delayed ICU admission from the ED, for example, due to overcrowding and resulting long wait and treatment times, has been shown to lead to increased mortality and poorer outcomes for critically ill patients in the ED, as well as for various specific patient groups [15–20]. The role of ED in identifying patients in need of urgent intensive care is undisputed [21–23]. There have been and continue to be differences between different clinics in whether critically ill patients are first stabilized in the ED or quickly transferred to the ICU [24–26]. Additionally, it makes a difference whether patients can be admitted to an ICU within their own hospital or if they need to be transported to an ICU in another hospital. Patients who require transfer generally have an increased hospital mortality and longer hospital stays [27, 28]. In such observations, it is always important to consider how and where data collection, such as for prognostic scores, is conducted. A patient who is directly admitted to the ICU from the ED may potentially have worse initial intensive care prognostic scores than

a patient who was stabilized in the ED and admitted to the ICU with significantly more stable vital parameters at the time of transfer to the ICU [21].

In our ED, patients are not immediately transferred to an IMC/ICU but are always stabilized before any transfer is carried out. We have all the necessary resources available for this. However, we do not have our own IMC or ICU station in our ED where such patients could be treated over an extended period.

We have also examined how many patients transported by the ambulance service to the resuscitation room of the ED actually needed to be admitted to the ICU during their course of treatment. 39.7% of patients were admitted to an ICU within our own hospital, and 5.9% were transferred from our ED to an ICU at another hospital because there were no available beds in our own ICUs. 11.2% were able to be transferred to a regular ward, either within our own hospital or an external one. Remarkably, 17.4% of these patients were able to be discharged directly from the ED to go home.

Among the group of patients referred by the ambulance service for the IMC/ICU, the proportion of patients admitted to an IMC/ICU within our own hospital (21.3%) or an external ICU (0.5%) was significantly lower. The majority of patients (51.7%) could be transferred to a general ward, either within our own hospital or an external one. Here as well, 17.0% of the patients could be discharged directly from the ED to go home.

In the initial triage in the ED, significant differences in the distribution of ESI levels were observed between patients transported to the resuscitation room and those scheduled for IMC/ICU care. Among the resuscitation room patients, 74.0% were assigned to ESI level 1, whereas only 14.0% of IMC/ICU patients were designated as ESI level 1. For most patients, 66.1% were categorized as ESI level 2. Notably, none of the IMC/ICU patients were classified as ESI level 4, while among the resuscitation room patients, 3.5% were assigned to ESI level 4. Among the patients who presented themselves in the ED and required further care in the IMC/ICU after treatment, only 18.8% were classified as ESI level 1. The majority of patients fell into ESI levels 2 (38.5%) and level 3 (39.6%). The reason most patients treated in the resuscitation room were categorized as ESI level 1 can be explained by the fact that resuscitated and intubated patients, as well as those in severe shock, are primarily transported to the resuscitation room by the emergency medical services. Patients with polytrauma are also initially managed in our resuscitation room. Only 2 polytrauma patients were brought to our ED via an IMC/ICU referral from the emergency medical services.

In Germany, there is the German Emergency Department Data Registry AKTIN, which collects real-time data from emergency medicine. A total of 58 hospitals in Germany participate with their ED in AKTIN. This enables the analysis of data from approximately 1.5 million patient cases annually. AKTIN primarily collects data obtained at the beginning of treatment in the ED, such as age, gender, referral method, triage outcome, and admission diagnosis [29]. Data concerning the subsequent in-hospital course, such as admission to regular wards, admission to an intensive care unit, or discharge after treatment, are not captured. However, in our facility, patients are not only treated in the resuscitation room when they have obviously severe injuries and/or trauma with disturbances in vital parameters (polytrauma A) but also when they have the potential for serious injuries based on the mechanism of the accident (polytrauma B), even if there are no apparent injuries upon arrival. In the group of resuscitation room admissions, only 20 out of the total 155 polytrauma patients (12.9%) qualified as polytrauma A, whereas 135 patients (87.1%) were categorized as polytrauma B patients. For many of these polytrauma B patients, a clinically significant polytrauma can be ruled out during the course of evaluation, and these patients can often be discharged directly from the ED.

In Germany, the legal framework for emergency services is determined by the federal states. The organization of emergency services is managed by the municipalities, while the logistical implementation is carried out through integrated control centers (ILS). An integrated control center is a central facility responsible for coordinating and managing various emergency services, such as fire department, ambulance service, and emergency medical services. It receives emergency calls, coordinates the emergency personnel, and dispatches them to the incident locations according to the reported emergencies. The corresponding data is collected through the web-based care capacity proof system IVENA [30]. IVENA is available in almost all of Germany, with nationwide coverage planned. IVENA provides real-time information on the current treatment and care capabilities of hospitals. The application facilitates interregional collaboration and offers a comprehensive and detailed overview of resources. It allows for rapid exchange between hospitals, integrated control centers for emergency services, health authorities, and other medical services. The emergency physicians or paramedics on-site in prehospital care transmit their suspected diagnosis and their assessment of the required resources, such as intensive care or regular ward, to the integrated control centers. The available resources for diagnosis and treatment urgency are displayed to the control centers in real-time through IVENA, and the emergency services are directed accordingly to the appropriate hospital. The hospitals are also informed in real-time about incoming emergency service arrivals. If hospitals are unable to provide certain resources for specific reasons, this information is also transmitted to the control centers through IVENA. Until a few years ago, internal patients who were brought in by emergency services

for intensive care were typically admitted directly to the intensive care unit. However, in recent years, these patients are usually admitted through the ED, where the decision is made regarding the location for their inpatient care.

Our own data show that only a relatively small portion of patients initially planned for emergency room or intensive care treatment actually needed to be transferred to an intensive care unit during their course, and yet a significant proportion of patients initially not deemed in need of intensive care ended up requiring intensive medical care. This demonstrates that the correct initial preclinical assessment of the patient is extremely challenging and does not provide a reliable parameter for determining the ultimately necessary resource for further treatment.

Another reason for the relatively low ad mission rate to the IMC/ICU, especially in the group of IMC/ICU referrals, may be the high proportion of patients with intoxication. These patients initially present with significantly impaired consciousness and low GCS scores, leading to prehospital assumptions of intensive care involvement. However, after monitoring in the ED, the condition of these patients often improves considerably, allowing for transfer to a psychiatric department or even discharge home.

In the diagnosis groups of patients admitted to the IMC/ICU, traumatic diagnoses were collectively predominant, followed by diseases of the respiratory system, diseases of the circulatory system, intoxications and their psychological consequences and other diagnoses.

With IVENA, we have a digital recording system that provides insights into the preclinical situation in emergency care and the available resources in hospitals, such as the number of reported available intensive care beds. AKTIN, on the other hand, offers a relatively comprehensive registry that collects information at the onset of treatment in ED. These data collection systems serve as the basis for various scientific publications [31–34]. Political decision-makers also rely on these care data. However, especially intra-clinical decisions regarding further inpatient care, whether on regular wards or intensive care units, which are primarily made in the ED, have so far been inadequately or not at all recorded. As our data shows, there are significant discrepancies here between the initial assessment in preclinical care and at the very beginning of treatment in the ED and the actual localization for further treatment. Even in this section of emergency care, systematic data collection should be implemented for the future. For our analysis, we utilized data from our clinical information system, epias®, for the ED. From this system, we also provide our ED data, which are collected in the AKTIN register. Expanding registry data to include subsequent intra-clinical decisions in emergency care should thus be fundamentally feasible. This could provide even clearer insights into the crucial role that ED play in the allocation of emergency patients. For instance, while data on the general distribution of ED patients into different triage levels exist [35], there has been no study to date that describes the characteristics of patients transferred from the ED to the IMC/ICU in as much detail as we are doing here. However, it's important to note that a single-center study may come with certain limitations in terms of generalizability.

5 Conclusion

EDs play a crucial role in the efficient allocation of ICU resources. They must promptly identify patients who require intensive medical care, even if they were not initially scheduled for ICU treatment. However, EDs must also identify patients who were initially registered by the emergency medical services for ICU care but, over the course of their treatment, can be transferred to other medical areas or even discharged to go home. A functioning structure of the EDs is therefore indispensable for the proper allocation of the scare resource of an intensive care bed.

Author contributions MW conceived and designed the study, analyzed the data, and drafted the manuscript.

Funding Open Access funding enabled and organized by Projekt DEAL.

Data availability All data generated or analyzed during this study are included in this published article.

Declarations

Ethics approval and consent to participate The study was approved by the Ethics Committee of Ludwig-Maximilians-Universität München (LMU).

Consent for publication Not applicable.

Competing interests The author declare that they have no competing interests.

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