

# In-hospital emergencies versus out-of-hospital emergencies admitted to ICU: is the outcome different? An observational study

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## Research Article

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# Abstract

**Background:** Rapid Response Systems (RRS) are now commonly implemented throughout hospital health systems to manage in-hospital emergencies (IHE). There is limited data on characteristics and outcomes of such patients admitted to an intensive care unit (ICU). The goal was to determine whether the hospital mortality of ICU patients was different depending on their admission pathway: in-hospital via rapid response teams (RRT), or out-of-hospital emergencies (OHE) via prehospital emergency medical systems.

**Results:** Out of 422 ICU admissions (Timone University Hospital ICU), 241 patients were retrospectively (2019-2020) included: 74 IHE versus 167 OHE. In-hospital mortality rates did not differ between both cohorts (n = 31(42%) vs. 63(39%) respectively, NS). IHE patients were older and had more comorbidities (immunosuppression and ongoing malignancy). OHE patients had more severe organ failures at presentation with more frequent mechanical ventilation support. Independent global hospital mortality risk factors were ongoing malignancy (OR = 10.4 [2.7-40], p < 0.001), SAPS II (OR = 1.05 [1.03-1.08], p < 0.0001) and SOFA scores (OR = 1.14 [1.01-1.3], p < 0.05), hemorrhagic stroke as admission diagnosis (OR = 8.4 [2.7-26], p < 0.001), and arterial lactate on arrival (OR = 1.11 [1.03-1.2], p < 0.01).

**Conclusion:** This study provides a thorough and comprehensive analysis of characteristics and outcomes of ICU admissions following a mature rapid response activation system, compared to the “conventional” out-of-hospital admission pathway. Despite the more vulnerable background of IHE patients, hospital mortality does not differ, supporting the use of early RRS to identify deteriorating ward patients.

**Take-home message:** Hospital mortality does not differ between in-hospital emergencies admitted to intensive care unit and conventional out-of-hospital admissions, supporting the use of early rapid response systems and the importance of early intensive care unit admission.

## Background

The goal of intensive care units (ICU) is to manage patients presenting one or more organ failures with two major admission pathways. On the one hand, healthcare facilities or investigation wards, otherwise known as in-hospital emergencies (IHE). On the other hand, and more frequently, patients become acutely unwell outside a healthcare institution: they are called out-of-hospital emergencies (OHE). The prognosis of ICU patients may be different depending on where the life-threatening emergency occurred: in or out of hospital. Even if past studies suggest that the IHE mortality rate in ICU is higher than the all-cause mortality rate (1–4), little data is available.

Hospitalized patients have a certain number of acute diseases that weaken their health status. One or more chronic diseases often worsen the global outcome. Their condition can be considered as worse or more vulnerable than the rest of the population. However, hospital wards guarantee a close monitoring and rapid care. As a matter of fact, in France, the organization of IHE is led by an expert recommendation (5,6). It relies on a medical team available 24/7, known as the medical emergency team (MET) or rapid

response team (RRT) (7). This management has significantly reduced in-hospital cardiac arrests and mortality in hospitalized patients (8–12).

OHE are subject to a more random management, depending on the medical response delay as well as the conditions of social environment. In France, the OHE are transported by prehospital emergency medical systems, and can transit in the emergency room (ER) before ICU admission.

The goal of this study is to compare the hospital mortality of ICU patients admitted after an IHE or an OHE and to define specific prognostic factors.

## Methods

This is a retrospective and monocentric cohort study performed from May 2019 to March 2020 in the ICU of Timone University Hospital (Marseille, France). All adult patients (over 18 years) admitted to the ICU were examined for eligibility. Adult patients admitted following a call for IHE were enrolled in the IHE group. Patients admitted following the intervention of the prehospital emergency medical system outside a healthcare institution were enrolled in the OHE group. These patients were either directly admitted to ICU or transited for less than 6 hours in the ER. In the IHE group, patients admitted to the hospital less than 24 hours before the call were excluded as it could imply an under-estimation of the initial severity. Elective surgical patients were excluded because of the absence of comparability in the OHE cohort. In the OHE group, patients admitted for severe trauma, intentional overdose and refractory cardiac arrest were excluded for the same reason. In the OHE group, patients who had been hospitalized 3 months or less prior to their current stay were also excluded because they were considered too recently back home. The ICU of Timone University Hospital of Marseille (10 beds) provides a 24/7 management of the IHE of 121 medical ward beds as well as the medical imagery wards. 500 patients are admitted on average per year (100 IHE vs. 400 OHE). This study was communicated to the Commission on Data Processing and Freedom and approved by APHM ethic committee (no need for consent of the participants, MR003 research #2020-81). All methods were carried out in accordance with relevant guidelines and regulations. We compared characteristics of both groups (IHE versus OHE) using univariate statistical test:  $\chi^2$  or Fisher exact test for qualitative variables and t-test for quantitative ones. Qualitative variables are resumed by counts and percentages whereas quantitative ones by medians and 25% and 75% interquartile ranges (IQR; 25%-75%). To analyze if type of admission (IHE or OHE) was independently associated with hospital mortality, we performed a multivariate logistic regression analysis with adjustment on other factors. To do so, we first led univariate analysis of mortality with different variables and then we introduced into the multivariate model variables whose p-value was less than 0,20 in the univariate analysis. We then performed a stepwise backward elimination of variables to conserve factors associated with mortality with a p-value less than 0.05; type of admission was forced into the model. Results of multivariate analysis were presented using Odds Ratios (OR) and their 95% Confidence Interval (CI). Analysis were performed using the SAS® software, version 9.4, and the threshold for statistical significance was defined at  $\alpha = 0.05$ .

# Results

During the study period, 422 patients were admitted to the ICU (**Figure 1**). A total of 74 patients met the inclusion criteria in the IHE group, and 167 in the OHE group (N = 241).

## *IHE versus OHE patients*

Characteristics of patients in both groups are presented in **Table 1**. ICU mortality (IHE: n = 26(35%) vs. OHE: n = 58(35%), NS) and in-hospital mortality (IHE: n = 31(42%) vs. OHE: n = 63(39%), NS) were not different between IHE and OHE patients. IHE patients were older (66 yr. [58-75] vs. 63 [52-71], p < 0.05) with male predominance (n = 54(74%) vs. n = 99(59%), p < 0.05). Only 50% (n = 37) were considered as independent in activities of daily living before hospitalization (vs. OHE: 86% (n = 143), p < 0.0001). Patients in both groups had the same medical background and comorbidities except for two conditions more frequently seen in the IHE group: immunosuppression (n = 18(24%) vs. OHE: n = 7(4%), p < 0.001) and ongoing malignancy (n = 19(26%) vs. n = 2(1%), p < 0.001). Causes of ICU admission did not differ between the two groups except for cardiac arrest (OHE: n = 51(31%) vs. IHE: n = 11(15%), p < 0.05) and hemorrhagic stroke (OHE: n = 21(13%) vs. IHE: n = 1(1%), p < 0.01) more frequent in the OHE group. No difference was found in each sub-category of shock (septic, hemorrhagic, cardiogenic, other), respiratory failure (pneumonia, ARDS, acute left ventricular failure, other), or low Glasgow Coma Scale (ischemic stroke, seizure, central nervous system infection, other). There was an iatrogenic component to 20% (n = 15) of the IHE deteriorations (vs. OHE: 6% (n = 10), p < 0.001) and 18% (n = 13) for hospital-acquired infection (vs. OHE: 0.6% n = (1), p < 0.001). Sepsis-related Organ Failure Assessment (SOFA) score and Simplified Acute Physiology Score II (SAPS II) were lower in the IHE cohort (SOFA: 7 [4-11] vs. 8 [5-11] – SAPS II: 43 [36-64] vs. 51 [38-65], NS). We found no significant differences between time of admission and most of the biochemistry results upon arrival in the ICU (**Supplementary Table 1**). Arterial lactate level was significantly lower in the IHE group (1.9 mmol/L [1.1-3.8] vs. OHE: 2.2 [1.4-6.3], p < 0.05) and arterial pH was significantly higher (7.40 [7.29-7.45] vs. 7.33 [7.19-7.41], p < 0.01). The other three biochemical differences were a more pronounced anemia in the IHE cohort (hemoglobin = 10.2 g/dL [8,6-12.5] vs. OHE: 12.1 [10.8-13.7], p < 0.001), higher venous bicarbonate (20.5 mmol/L [17-23.5] vs. 19.5 [14.8-22.1], p < 0.05), and higher levels of serum bilirubin (12 mmol/L (6-19) vs. 8 (5-15), p < 0.005). In terms of organ replacement therapies initiated, the two groups significantly differed. 66% (n = 46) of IHE received mechanical ventilation versus 88% of OHE (n= 147, p < 0.001) and the length of their ventilatory support was lower (2 days [1-5] vs. OHE: 3 [2-7], p < 0.05). IHE stayed less time in the ICU (3 days [1-5] vs. OHE: 4 [2-7], p < 0.05), whereas their total hospital stay was much longer (20 days [10-37] vs. 10 [4-20], p < 0.0001).

**Table 1.** Patient characteristics according to their admission pathway: IHE versus OHE

	IHE n = 74	OHE n = 167	<i>p</i>
<b>Age, years</b>	66 [58-75]	63 [52-71]	< 0.05
<b>Gender (male), n(%)</b>	55(74)	99(59)	< 0.05
<b>Comorbidities, n(%)</b>			
Diabetes mellitus	25(34)	37(22)	NS
Cardiovascular disease	45(61)	87(52)	NS
Chronic kidney failure	6(8)	8(5)	NS
Cirrhosis	5(7)	4(2)	NS
Severe COPD or chronic respiratory failure	6(8)	13(8)	NS
Chronic heart failure	3(4)	4(2)	NS
Ongoing malignancy	19(26)	2(1)	< 0.001
Immunosuppression	18(24)	7(4)	< 0.001
<b>Independent in activities of daily living</b>	37(50)	143(86)	< 0.0001
<b>Admission, n(%)</b>			
Time of admission (working hours)	36(49)	60(36)	NS
Cause of admission			
Cardiac arrest	11(15)	51(31)	< 0.05
Shock	29(39)	44(26)	NS
Respiratory failure	20(27)	27(16)	NS
Neurological failure	14(19)	45(27)	NS
Ischaemic stroke	2(3)	3(2)	NS
Hemorrhagic stroke	1(1)	21(13)	< 0.01
Iatrogenic component	15(20)	10(6)	< 0.001
Hospital-acquired infection	13(18)	1(0.6)	< 0.0001
<b>Severity Assessment</b>			
SOFA	7 [4-11]	8 [5-11]	NS
SAPS II	43 [36-64]	51 [38-65]	NS
<b>Biochemistry</b>			

Arterial pH	7.40 [7.29-7.45]	7.33 [7.19-7.41]	< 0.01
Arterial lactate, mmol/L	1.9 [1.1-3.8]	2.2 [1.4-6.3]	< 0.05
<b>Organ replacement therapies</b>			
Ventilatory support			
NIV, n(%)	11(15)	29(17)	NS
HFNO, n(%)	13(18)	37(22)	NS
Mechanical ventilation, n(%)	46(62)	147(88)	< 0.001
Length of ventilatory support, days	2 [1-5]	3 [2-7]	< 0.05
Hemodynamic support			
Catecholamines, n(%)	45(61)	95(57)	NS
Dose of Norepinephrine, µg/kg/mn	0.5 [0.3-1]	0.6 [0.3-1.2]	NS
Renal replacement therapy, n(%)	8(11)	11(7)	NS
<b>Outcomes</b>			
Length of stay, days			
ICU	3 [1-5]	4 [2-7]	< 0.05
Hospital	20 [10-37]	10 [4-20]	< 0.0001
Mortality, n(%)			
ICU	26(35)	58(35)	NS
Hospital	31(42)	63(39)	NS
WSLT, n(%)			
WLST in ICU	22(30)	40(24)	NS
Deaths following WLST in ICU	13(18)	25(15)	NS

*IHE: In-Hospital Emergencies, OHE: Out-of-Hospital Emergencies, COPD: Chronic Obstructive Pulmonary Disease, SOFA: Sepsis-related Organ Failure Assessment, SAPS II: Simplified Acute Physiology Score II, NIV: Non-Invasive Ventilation, HFNO: High Flow Nasal Oxygen, WSLT: Withdrawal of Life Sustaining Therapies, ICU: Intensive Care Unit. Variables are presented as medians [IQR; 25%-75%].*

*Survivors versus non-survivors (in-hospital mortality).*

The demographic and admission characteristics of survivors versus non-survivors are presented in **Table 2**. Patients alive at hospital discharge were significantly younger (62 yr. [51-70] vs. 66 [59-76],  $p < 0.05$ ) with fewer diabetes mellitus ( $n = 29(20\%)$  vs. non-survivors:  $n = 32(34\%)$ ,  $p < 0.05$ ) and ongoing cancer ( $n = 5(3\%)$  vs.  $n = 16(17\%)$ ,  $p < 0.001$ ). There was no difference between survivors and non-survivors for other comorbidities. Patients admitted for cardiac arrest (survivors:  $n = 22(15\%)$  vs. non-survivors:  $n = 40(43\%)$ ,  $p < 0.001$ ) and hemorrhagic stroke (survivors,  $n = 6(4\%)$  vs. non-survivors,  $n = 18(19\%)$ ,  $p = 0.001$ ) had a higher risk of death. In contrast, patients admitted for acute cardiogenic pulmonary oedema (survivors:  $n = 11(8\%)$  vs. non-survivors:  $n = 0$ ,  $p < 0.05$ ) or epilepsy (survivors:  $n = 21(15\%)$  vs. non-survivors:  $n = 3(3\%)$ ,  $p < 0.001$ ) were less likely to die. In non-survivors, 40% of hospital deaths followed a Withdrawal of Life-Sustaining Therapy (WLST) decision. As expected in deceased patients, SOFA and SAPS II scores were higher, biochemistry results (PT, INR, serum creatinine, serum urea, kalemia, arterial pH, arterial lactate, and venous bicarbonate) were more altered (for biochemical variables, see significant results in **Table 2**, non-significant results are presented in **Supplementary Table 2**), and organ replacement therapies were more frequent.

**Table 2.** Patient characteristics according to in-hospital mortality

	<b>Survivors</b> <b>n = 143</b>	<b>Non-survivors</b> <b>n = 94</b>	<b>p</b>
<b>Age, years</b>	62 [51-70]	66 [59-76]	< 0.05
<b>Comorbidities, n(%)</b>			
Diabetes mellitus	29(20)	32(34)	< 0.05
Cardiovascular disease	72(50)	58(62)	NS
Chronic kidney failure	6(4)	8(9)	NS
Cirrhosis	6(4)	2(2)	NS
Severe COPD or chronic respiratory failure	10(7)	8(9)	NS
Chronic heart failure	3(2)	4(4)	NS
Ongoing malignancy	5(3)	16(17)	< 0.001
Immunosuppression	12(8)	13(14)	NS
<b>Independent in activities of daily living</b>	109(76)	84(89)	NS
<b>Admission, n(%)</b>			
Time of admission (working hours)	51(36)	43(48)	NS
<b>Cause of admission</b>			
Cardiac arrest	22(15)	40(43)	< 0.001
Shock	50(35)	23(24)	NS
Respiratory failure	34(24)	9(10)	NS
Acute cardiogenic pulmonary oedema	11(8)	0	< 0.05
Neurological failure	37(26)	22(23)	NS
Epilepsy	21(15)	3(3)	< 0.001
Hemorrhagic stroke	6(4)	18(19)	0.001
Iatrogenic component	14(10)	11(12)	NS
<b>Severity Assessment</b>			
SOFA	7 [4-10]	9 [7-12]	< 0.001
SAPS II	42 [33-52]	63 [52-74]	< 0.001
<b>Biochemistry</b>			
PT, %	78 [63-95]	68 [48-80]	0,001

INR	1.16 [1.03-1.35]	1.29 [1.16-1.64]	< 0.001
Serum creatinine, µmol/L	88 [63-126]	114 [74-144]	< 0.05
Serum urea, mmol /L	7.3 [4.8-10.8]	8.3 [6.3-15.3]	< 0.05
Kalemia, mmol/L	3.8 [3.5-4.3]	4.3 [3.6-4.9]	< 0,001
Arterial pH	7.38 [7.30-7.44]	7.27 [7.12-7.38]	< 0,001
Arterial lactate, mmol/L	1.9 [1.2-3.5]	3.5 [1.6-10]	< 0,001
Arterial pCO <sub>2</sub> , mmHg	35 [29-44]	41 [34-53]	< 0,001
Venous bicarbonate, mmol/L	20.4 [17.1-22.6]	17.5 [14.1-22.6]	< 0,05
<b>Organ replacement therapies</b>			
Ventilatory support			
NIV, n(%)	31(22)	7(7)	< 0.05
HFNO, n(%)	37(26)	11(12)	< 0.05
Mechanical ventilation, n(%)	101(71)	83(88)	< 0.01
Length of ventilatory support, days	2 [1-5]	3 [1-7]	NS
Hemodynamic support			
Catecholamines, n(%)	67(47)	65(69)	0.001
Dobutamine, n(%)	8(6)	14(15)	< 0.05
Dose of Norepinephrine, µg/kg/mn	0.4[0.25-0.71]	0.7 [0.4-1.42]	0.001
Renal replacement therapy, n(%)	7(5)	12(13)	< 0.05
<b>Outcomes, n(%)</b>			
WLST in ICU	8(6)	54(27)	< 0.001

*COPD: Chronic Obstructive Pulmonary Disease, SOFA: Sepsis-related Organ Failure Assessment, SAPS II: Simplified Acute Physiology Score II, PT: Prothrombin Time, INR: International Normalized Ratio, NIV: Non-Invasive Ventilation, HFNO: High Flow Nasal Oxygen, WLST: Withdrawal of Life Sustaining Therapies, ICU: Intensive Care Unit. Variables presented as medians [IQR; 25%-75%].*

#### Independent prognostic factors of in-hospital mortality

All the potential risk factors contributing to hospital mortality were analyzed. Cardiac arrest, hemorrhagic stroke, diabetes mellitus, ongoing malignancy, mechanical ventilation, catecholamine use, renal replacement therapy and WLST were correlated with hospital mortality on univariate analysis ( $p < 0.05$ ).

On the other hand, acute cardiogenic pulmonary edema, epilepsy, and non-invasive ventilation methods were correlated with hospital survival on univariate analysis ( $p < 0.05$ ). On multivariate analysis (**Table 3**), IHE admission pathway was not an independent risk factor associated with hospital mortality. SAPS II (OR 1.05, 95% CI 1.03-1.08,  $p < 0.0001$ ), SOFA score (OR 1.14, 95% CI 1.01-1.3,  $p < 0.05$ ), hemorrhagic stroke as admission diagnosis (OR 8.4, 95% CI 2.7-26,  $p < 0.001$ ), ongoing malignancy (OR 10.4, 95% CI 2.7-40,  $p < 0.001$ ), and arterial lactate on ICU arrival (OR 1.11, 95% CI 1.03-1.2,  $p < 0.01$ ) were the independent risk factors associated with hospital mortality.

**Table 3.** Multivariate analysis of risk factors for in-hospital mortality

	Odds ratio	95% CI	p
<b>IHE vs. OHE</b>	1.29	0.55-2.99	0.55
<b>SAPS II</b>	1.05	1.03-1.08	< 0.0001
<b>SOFA</b>	1.14	1.01-1.3	< 0.05
<b>Hemorrhagic stroke</b>	8.4	2.7-26	< 0.001
<b>Ongoing malignancy</b>	10.4	2.7-40	< 0.001
<b>Arterial lactate</b>	1.11	1.03-1.2	< 0.01

*IHE: In-Hospital Emergencies, OHE: Out-Of-Hospital Emergencies, SOFA: Sepsis-related Organ Failure Assessment, SAPS II: Simplified Acute Physiology Score II*

## Discussion

This present study is the first to compare ICU patients' outcomes regarding their admission pathway: in or out-of-hospital. Despite the inherent bias of a single-center, retrospective study, its strengths include the strict comparability of its patients and their standardized management strategy. It concerns patients admitted for medical issues only and excludes patients with very specific ICU prognosis: elective surgical patients, severe trauma, intentional overdose and refractory cardiac arrests.

We found no difference in terms of hospital mortality between these two groups of emergencies while obvious differences describe them. IHE are more vulnerable patients. Indeed, they are older, characterized by much less independence in activities of daily living and more comorbidities, mainly immunosuppression and ongoing malignancy. IHE are mostly admitted for respiratory failures or shock. OHE patients are younger, have less comorbidities and are mostly admitted for cardiac arrest or coma caused by a hemorrhagic stroke. OHE suffer from more severe organ failures at presentation, have more lactic acidosis and more mechanical ventilation. In brief, our study brings out a similar mortality rate in both groups, highlighting more severe patients in the OHE group compared to the more vulnerable patients in the IHE group. Relating to IHE patients, our study underlines the importance of early ICU admission. Indeed, our results suggest that we manage these patients promptly, before they reach the

severity of our OHE cohort. 8 IHE patients (12%) admitted to the ICU had already showed warning signs leading to a prior call from the ward. Severity scores and hospital mortality in this sub-group are much higher than those in patients immediately managed in ICU after a first call (SAPS II in “prior-call group”: 65 [53-82] vs. “first-call” group: 42 [36-59],  $p = 0.084$ ; hospital mortality in “prior-call” group: 89% ( $n = 7$ ) vs. “first-call” group: 36% ( $n = 23$ ),  $p < 0.01$ ). This data indicates that a delayed response may worsen patient outcome, as shown in a large studies (13,14).

In our study, hospital mortality in the two groups was high: 42% in the IHE group, 39% in the OHE group. A recent review of the literature shows an in-hospital mortality rate of 29% for IHE transferred to ICU. Studies from this review originated from many different countries and rates ranged from 7 to 35% (15). Another large Australian study reveals a hospital mortality rate of 35% in the same group of patients (16). In our study, the high median severity scores (SOFA: 7 [4-11] and SAPS II: 43 [36-64]) highlight the validity of an ICU admission. These elements either do not appear or are much lower (17) in other studies. Furthermore, our IHE patients are mostly medical patients. Medical category of admission is proven to be a major predictive factor of mortality in critically ill patients (18,19). Cultural differences, critical care capacity and resources, and whether critical care is deemed justified or futile have great influence on consequent results (20). One must be careful when interpreting such rates. As mentioned earlier, previous studies suggest that hospital mortality rates of patients admitted after RRT review were higher than the overall mortality rates (1–4). However, these studies took place at least 15 years ago, and RRS have improved. Tirkkonen et al. (15) suggest that ICU mortality rates of IHE patients are higher than the overall ICU mortality rates in recent multicentre studies (21,22), but no specific study was yet designed to compare in-hospital and out-of-hospital emergency outcomes.

This study reveals five independent risk factors for hospital mortality: SOFA and SAPS II score, hemorrhagic stroke as admission diagnosis, arterial lactate on ICU arrival, and ongoing malignancy. Our study confirms abundant evidence that lactate concentration is a predictor of mortality (23). The addition of lactate to ICU prognostication has been also shown to improve preexisting scores (24). The first four risk factors for hospital mortality found in our study are not useful decision-aid tools for ICU triage. Indeed, the MET or ICU physician do not initially know these four elements, when the patient’s admission needs to be decided. However, ongoing malignancy is a well-known independent risk factor for hospital mortality in critically ill patients (25,26). In line with recent data, in this population, hospital mortality increases tenfold. Even though new strategies of ICU admissions in cancer patients have been developed according to major recent advances in oncology, METs should bear in mind that ongoing malignancy is a key hospital mortality predictor. Along with age, it appears to be very useful for risk stratification of deteriorating patients in wards and determination of appropriate escalation of care. Our observations cannot be extrapolated to haematological malignancies as only solid cancer patients are represented in our study. Our results encourage strategies of time-limited trials of intensive care for critically ill patients with cancer. Indeed, after a 2 to 4-day trial, with the hindsight of initial severity scores and their progression, it seems appropriate to establish a joint assessment for re-evaluation of goals of therapy and level of care (27).

## Conclusion

This study provides a thorough and comprehensive analysis of characteristics and outcomes of ICU admissions following a mature rapid response activation system, compared to the “conventional” out-of-hospital admission pathway in France. Our study supports the use of early rapid response systems to identify deteriorating ward patients and underlines the importance of early ICU admission, before severe organ failure. Patients with arterial lactate over 2 mmol/L should easily be admitted. Regarding more vulnerable patients, namely solid cancer patients, multiple organ failure after a 2 to 4-day trial of intensive care should lead physicians to question the appropriateness of a full-code ICU management.

## List Of Abbreviations

ICU: Intensive Care Units; IHE: In-Hospital Emergencies; OHE: Out-of-Hospital Emergencies; MET: Medical Emergency Team; RRT: Rapid Response Team; RRS: Rapid Response System; ER: Emergency Room; IQR: Interquartile Ranges; OR: Odds Ratio; CI: Confidence Interval; SOFA: Sepsis-related Organ Failure Assessment; SAPS II: Simplified Acute Physiology Score II; COPD: Chronic Obstructive Pulmonary Disease; WLST : Withdrawal of Life-Sustaining Therapy ; APACHE: Acute Physiology and Chronic Health Evaluation; MPM: Mortality Probability Model

## Declarations

### Ethics approval and consent to participate

This study was communicated to the Commission on Data Processing and Freedom and approved by APHM (Assistance-Publique Hôpitaux de Marseille, Pr Xavier Thirion, délégué à la protection des données de l'AP-HM). The need of informed consent was waived by APHM ethics committee (MR003 research #2020-81).

### Consent for publication

Written informed consent was not obtained for publication of these data. Consent to publish was not applicable for this study.

### Availability of data and material

EC had full access to all data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. All the data are available in the supplementary file 3.

### Competing interests

The authors declare that they have no competing interests.

### Funding

The authors declare that they received no funding.

## Authors' contributions

JC devised and supervised the study. EC, MG and JC performed research. EC and JC wrote the manuscript. EC is the guarantor for the content of the manuscript, including the data and analysis. VP and MG analyzed the data. EC, JB, ALS, FB, AT, CA, MG and JC took care of patients. All authors read and approved the final manuscript.

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## Figures

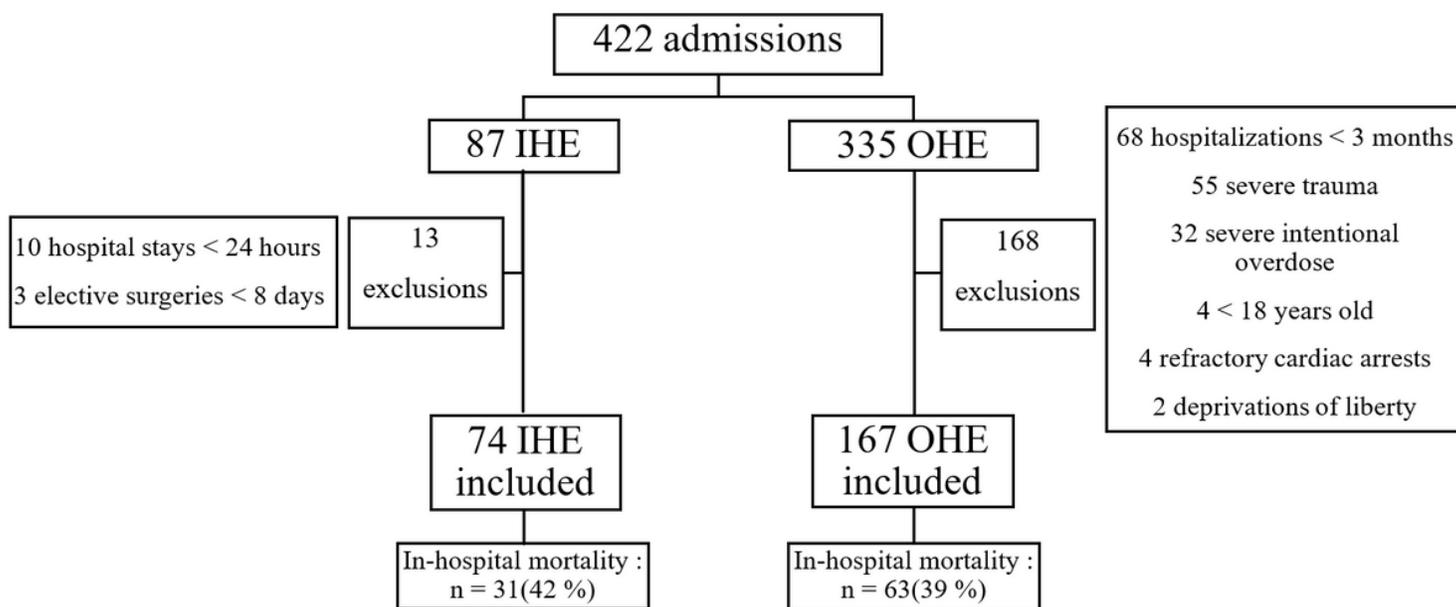


Figure 1

Flow chart

## Supplementary Files

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