Mortality predictive performance of SAPS 3 and MPM_0-III in adult patients admitted to the ICU of the Aga Khan Hospital, Dar-Es-Salaam, Tanzania

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Background Illness predictive scoring systems are significant and meaningful adjuncts of patient management in the intensive care unit. They assist into predicting patient outcomes, improve clinical decision making and provide insight into the effectiveness of care and management while optimizing the use of hospital resources. We evaluated mortality predictive performance of Simplified acute physiology score (SAPS 3) and Mortality probability models (MPM_0-III) and compared their accuracy in predicting outcome, as well as identifying disease pattern and factors associated with increased mortality. Methods This was a retrospective cohort study of adult patients admitted to the Intensive Care Unit (ICU) of the Aga Khan Hospital, Dar-es-Salaam, Tanzania between August 2018 and April 2020. Demographics, clinical characteristics, outcomes, source of admission, primary admission category, length of stay and the support provided with worst physiological data within the first hour after admission were extracted. SAPS 3 andMPM_0-III scores were calculated using an online web-based calculator. The performance of each model was assessed by discrimination and calibration. Discrimination between survivals and non – survivors was assessed by the area under the receiver operator characteristic curve (ROC) and calibration was estimated using the Hosmer-Lemeshow goodness-of-fit test. Results A total of 331 patients were enrolled in the study with a median age of 58 years (IQR 43-71), most of whom were males (62.8%), of African origin (53.8%) and admitted from the emergency department (92.4%). In- intensive care unit mortality was 16.1%. Discrimination was very good for all models, the area under the receiver-operating characteristic (ROC) curve for SAPS 3 and MPM_0-III was 0.89 (95%CI: 0.844-0.935) and 0.90 (95%CI: 0.864-0.944) respectively. Calibration as calculated by Hosmer-Lemeshow

goodness-of-fit test showed good calibration for both SAPS 3 and MPM_0-III with Chi- square values of 4.61 and 5.08 respectively and P – Value (>0.05). Conclusion Both SAPS 3 and MPM_0-III performed well in our cohort of patients admitted to the intensive care unit of a private tertiary hospital. The overall ICU mortality was lower compared to reported mortality from studies done in other intensive care units in tertiary referral hospitals within Tanzania.

MORTALITY PREDICTIVE PERFORMANCE OF SAPS 3 AND MPM_0-III IN ADULT PATIENTS ADMITTED IN ICU OF THE AGA KHAN HOSPITAL, DAR-ES-SALAAM, TANZANIA

A SINGLE CENTER RETROSPECTIVE COHORT STUDY

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ABSTRACT

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Methods

This was a retrospective cohort study of adult patients admitted to the Intensive Care Unit (ICU) of the Aga Khan Hospital, Dar-es-Salaam, Tanzania between August 2018 and April 2020. Demographics, clinical characteristics, outcomes, source of admission, primary admission category, length of stay and the support provided with worst physiological data within the first hour after admission were extracted. SAPS 3 and MPM_0-III scores were calculated using an online web-based calculator. The performance of each model was assessed by discrimination and calibration. Discrimination between survivals and non – survivors was assessed by the area under the receiver operator characteristic curve (ROC) and calibration was estimated using the Hosmer-Lemeshow goodness-of-fit test.

Results

A total of 331 patients were enrolled in the study with a median age of 58 years (IQR 43-71), most of whom were males (62.8%), of African origin (53.8%) and admitted from the emergency department (92.4%). In- intensive care unit mortality was 16.1%. Discrimination was very good for all models, the area under the receiver-operating characteristic (ROC) curve for SAPS 3 and MPM_0-III was 0.89 (95%CI: 0.844-0.935) and 0.90 (95%CI: 0.864-0.944) respectively. Calibration as calculated by Hosmer-Lemeshow goodness-of-fit test showed good calibration for both SAPS 3 and MPM_0-III with Chi- square values of 4.61 and 5.08 respectively and P – Value (>0.05).

Conclusion

Both SAPS 3 and MPM_0-III performed well in our cohort of patients admitted to the intensive care unit of a private tertiary hospital. The overall ICU mortality was lower compared to reported mortality from studies done in other intensive care units in tertiary referral hospitals within Tanzania.

Key words: SAPS 3, MPM_0-III, Mortality, performance

BACKGROUND

The burden of critical care and ICU mortality is greatest in countries with low global national income (1). The reported ICU mortality widely varies from one setting to the other, with higher rates reported in low and middle-income countries (LMICs) (1-3). As of 1st July 2020, the World Bank upgraded Tanzania's economic status from a low to lower- middle income country due to its strong economic performance over the past decade. However, availability of Intensive Care Units is very limited; none of seven district hospitals surveyed in 2009 had an ICU. The four national referral hospitals had a total of only 38 ICU beds serving a population of 57 million (4). This is in contrast to high income countries (HICs) which generally have between 5 to 30 ICU beds per 100 000 people(5). Thus availability and improvement of quality of critical illness in LMICs is necessary to reduce this burden and even more significant in the coming years as the population ages and prevalence of comorbidities increases (6).

Despite the use of high cost and sophisticated devices, ICU mortality rates remain high. The burden of diseases compounded by a severe lack of resources, specialists, and data on outcomes, makes prediction of ICU outcomes in terms of morbidity and mortality a crucial component of care across the continent. In high-income settings mortality prediction models are not only used to predict outcome but also used as tools for quality enhancement and analytical decision making.

These predictive scoring systems were developed more than 25 years ago using patient characteristics. They help quantify the severity of illness, estimate the gravity of the disease, help predict outcome and facilitate quality care as well as help manage resource allocation (7, 8). The three major predictive scoring systems used to predict mortality in general ICU patients are the Acute Physiologic and Chronic Health Evaluation (APACHE) scoring system, the Simplified Acute Physiologic Score (SAPS), and the Mortality Prediction Model (MPM_0) (9). APACHE-IV, SAPS 3, and MPM_0-III are the latest versions of the afore mentioned scoring systems (10-12). When selecting a predictive scoring system for use in a given ICU, it is essential to use a model that is well proven, established and validated contextually. APACHE-IV has long been considered more precise for predicting mortality than the other scoring systems, but is perceived as burdensome and more costly especially in resource limited settings (13). The MPM_0-III is beneficial in resource limited setting since as it has lowest extraction burden among the three models and is available without cost on various medical information sites. This Model was considered to have fair discrimination and was well calibrated in a study done at a parent hospital in Nairobi, Kenya (14). However, it was considered to have a modest ability in predicting mortality in a cohort of Rwandan ICU patients admitted to two public hospitals (15). External validation in other ICU populations reported

that SAPS 3 had good discrimination, but poorer calibration, when compared with APACHE-IV and MPM_0-III (16-18). However, it may have greater potential for international use since the score was derived from data in more than one country (11). No study to date has assessed the performance of SAPS 3 in LMICs, especially in sub- Saharan Africa.

These afore mentioned predictive scoring systems have been compared in different studies and have produced variable results. The existence of large number of scoring systems with contrasting performance suggests the best fit model is ICU specific. Thus, each particular ICU needs to determine which scoring system performs best in their setup; hence there was a great need to carry out a comparative study in our cohort of patients to identify the best performing model. The study had two main objectives 1.) To compare performance of MPM_0-III and SAPS III in order to identify which model best fits in the ICU of the Aga Khan Hospital, Dar-es-Salaam and to identify disease pattern and risk factors associated with higher rates of in – ICU mortality.

METHODS

This was a single centre retrospective cohort study, conducted at the ICU of the Aga Khan Hospital, Dar-es-salaam, Tanzania. The study protocol was approved by the Ethical Research committee (ERC) of the Aga Khan University (AKU/2020/051/fb) and individual consent of each study participant was not required. The Aga Khan Hospital is the largest Private Hospital and the only Joint Commission International Accredited (JCIA) accredited hospital in Tanzania. The Intensive care unit (ICU) of the Aga Khan Hospital is 15 bed modern and well-equipped unit which provides level III services to all kind of critically ill patients. The unit is divided in 3 sections – 7 adult ICU beds (having 2 Isolation rooms), 4 reserved for cardiac patients and 4 beds set aside for paediatrics. The ICU provides both invasive and non-invasive mechanical ventilation, invasive hemodynamic monitoring, inotropic support and basic neuro-critical care. Patients requiring haemodialysis are transported to the dialysis Unit within the hospital premises. The ICU is run by a multidisciplinary team, comprising of the primary care physician, physiotherapist and dietician led by full time critical care specialist. The nurse-to-patient ratio ranges between 1:1 and 1:2. All adult patients aged 18 and above admitted to the ICU were eligible for the study. Patients admitted for observation, having incomplete data and those whose duration of stay in the unit was less than an hour as well as those diagnosed with COVID – 19 were excluded from the study. Admissions to the ICU are only limited to those meeting a strict admitting criteria set by the hospital. A total of 747 adults patients were admitted to the ICU from August 2018 to April 2020. A sample size of 331 patients was determined to be sufficient to give the study a 80% power and 95% confidence for

detection of 10% difference in performance between SAPS-III and MPM_0-III. The ICU admission register was used to identify patients admitted and patient confidential files were retrieved from the medical records. The medical file numbers were entered into a computer and computer generated random sampling was performed until the desired sample size was achieved. Patient demographics and Clinical data were extracted using patient records and were entered into a spreadsheet Microsoft Office 1 Excel 2010 (Redmond, WA, USA). Data was extracted by experienced junior doctors who have had working experience in the ICU and was independently verified by the primary author for accuracy and completeness. The reasons for admission were grouped into 11 categories: Surgery, Gastroenterology, Neurology, endocrinology, Respiratory, cardiovascular, Nephrology, sepsis, oncology, hematology, Obstetrics and Gynecology. When multiple diagnoses were present, the leading one, with the worst prognosis was selected as the main reason for admission

SAPS 3 and MPM-III were calculated using an online scoring calculator, available on www.uptodate.com. Descriptive analysis of demographic characteristics was done and presented as percentages while the categorical and continuous outcome variables were analysed and presented as means and medians with interquartile ranges respectively. All statistical analysis was done using STAT version 15. The area under the Receiver Operating Characteristic (ROC) curve was used to evaluate the discrimination of the models. A ROC curve with an area of 0.7–0.8 was considered fair, 0.8–0.9 good and > 0.9 excellent. The area under the ROC curves was compared using non-parametric Wilcoxon statistics. A Hosmer-Lemeshow goodness-of-fit test was used to assess the calibration of the models with a p-value of > 0.05 considered statistically significant. However, all other statistical tests with a p-value of < 0.05 were considered statistically significant.

RESULTS

General characteristic of the participants

A total of 331 patients were included in the study. Out of the 331 patients 278(83.9%) survived and 53(16.1%) died. Table 1 below shows general and clinical characteristic of the cohort and provides a comparison of survivors to non-survivors. The median age of the cohort was 58 years (IQR 43-71) with more than half of the admitted patients being male (62.8%). Most of the patients were admitted to the ICU from the emergency department (92.5%), who were at home prior (96.1%), aged between 45-64 years (34.4%) and were of the African origin (53.8%). Among the patients majority of them were suffering from Neurological disease (19%), sepsis (18.1%), respiratory (10.9%) and cardiovascular (10.9%) related conditions. Median ICU and hospital LOS were 4 (2-6) and 6 (4-10) days respectively.

When survivors and non survivors were compared, there was statically significant difference (P value <0.05) in age, length of ICU stay, admitting category and code status. Higher mortality rates were noted in elderly 70 years (IQR 55-78) and those who stayed longer in the unit 6 days (IQR 2-11) with a greater proportion of non-survivors being admitted due to sepsis (24.5%) and Neurological diseases (18.9%). Higher mortality rate was also noted in do- not- resuscitate (DNR) patients (50.9%) compared to those without limitations of care. There was no statistically significant difference between survivors and non survivors by sex, ethnicity and prior location before ICU admission.

The overall SAPS-III scores for all the patients was 42 (IQR: 32-51) of which non-survivors had a higher score 60 (IQR: 51-68) than the survivors 39 (IQR: 31-48) with p-value (< 0.0001). Similarly, the median MPM_0-III scores in non-survivors was 5(IQR: 4-6) was higher than survivors 3(IQR: 2-4) with p-value (<0.0001).

Table 2 below, illustrates the type of support patients received in the first 24 hours of ICU admission. Of the 331 Patients admitted to the ICU, 123 (37.2%) patients received support in the first hour of ICU admission that included: mechanical ventilation, inotropes and hemodialysis. When single support was used, higher proportions of survivors were kept on either inotropes (10.4%) or mechanical ventilation (6.1%). However, of the non-survivors, most of them were kept on the mechanical ventilation (17.0%). There was a significant difference between the two groups (survivors and non-survivors) for patients kept on mechanical ventilation (p-value=0.007), inotropes and mechanical ventilation (p-value < 0.001) as well as those kept on all the three support (p- value 0.0001).

Table 3 below highlights, comorbid amongst the critical ill patients admitted to the ICU. More than one comorbid condition per critically ill patient was recorded when present. The most common comorbid condition amongst our cohort was Hypertension (52.6%) and diabetes mellitus (32.3%). When comorbid were compared between Survivors and non Survivors, there were statically significant difference among those suffering with chronic Kidney Disease (p-value=0.0030) and liver cirrhosis (p-value=0.0022).

Calibration of each scoring system exhibited good performance. The goodness of fit Hosmer-Lemeshow test and p value of each scoring system is shown in Table 4 below.

The receiver operating characteristic (ROC) curve results of SAPS-III and MPM-III in prediction of mortality are shown below in Figure 1 below. The area under the ROC was calculated to evaluate the predictive value of the scoring systems. The Area under the ROC curve for the SAPS-III scores system showed statistically significant predictive marker of mortality (AUC: 0.8892; 95%CI: 0.844-0.935). The cut-off value for SAPS-III was 54 with the sensitivity of 72% and specificity of 90%. The MPM-III scoring system also showed a statistically significant predictive marker for the outcome of interest (AUC: 0.904; 95%CI: 0.864-0.944). The cut-off value for MPM-III was 4, with sensitivity of 74% and specificity of 87%. There was no significant difference between the ROC curves between the two models (P-value=0.2418) (Table 5).

The overall estimated median (IQR) predicted mortality among the 331 ICU patients was 6 %(2%-20%) on SAP-III model and 11.5 %(3.8%-27.9%) based on MPM_0-III model. The stratified analysis by survivors and non-survivors are shown in Figure 2 below. The median predicted mortality risk for survivors are lower than those of Non-survivors. In the SAPS-III model, the estimated median for survivors was 5 %(IQR: 1%-11%) while for the non-survivors this was 50% (IQR: 34%-69%) Based on the MPM-III model the median predicted mortality was 9.1% (3.1%-1.7%), and 68.5% (IQR: 42.7%-84.0%) for survivors and non-survivors respectively.

Multiple Clinical factors were associated with increased adjusted odds of mortality. These included length of ICU stay (adjusted odds ratio [aOR], 1.462; $P = 0.001$) and those transferred from the ward (aOR, 5.341; $P < 0.022$). However, it was protective to stay longer in the hospital as the odds of mortality decreased as the length of hospitalization increased (aOR, 0.717; $P = 0.002$) (Table 6).

DISCUSSION

To our knowledge, this is the first study to report on performance of predictive scoring models in Tanzania and more so in a private setting. Accurate discrimination and calibration are two key characteristics that should be met by all predictive scoring systems. Both SAPS 3 and MPM_0-III, performed well in our cohort. According to our results, SAPS 3 score of higher than 54 can predict

mortality with sensitivity of 72% and specificity of 90%. A MPM_0-III score of greater than 4 can predict mortality with sensitivity of 74% and specificity of 87%.

Discrimination describes the accuracy of a given prediction. In our cohort, the discriminatory capability of both SAPS 3 (20 variables) AND MPM_0-III (16 variables) was good. There was no statistically significance difference when both these models were compared, suggesting that the model with more variables was not associated with better discriminatory performance. MPM_0-III has been externally validated in various ICU in North America (12, 13, 19) and has shown to have good discrimination which was similar to our study finding. However, a study done at Aga Khan University Hospital, Nairobi, Kenya (14) and two public ICU in Rwanda(15) showed MPM_0-III to have fair discrimination amongst their cohort. This observed difference in discrimination maybe due to the effect of case mix between the study settings. Similarly SAPS 3 has been externally validated in various ICUs, in Italy (16), Brazil (17), Austria (18) and found to have good discriminatory capability amongst their cohort. Despite SAPS 3 having greater prospective for international generalizability there has been no published studies evaluating its performance in Sub- Saharan African ICUs. This is the first study that reports its potential for application in LMICs.

Calibration describes how the instrument performs over a wide range of predicted mortalities. Calibration is sensitive to alterations in case-mix and patient care/interventions. Despite its tendency to deteriorate over time and leading to overestimation of mortality (17), both SAPS 3 AND MPM_0-III were well calibrated amongst the critically ill patients admitted at our study setting. Our study findings were contrary to SAPS 3 validation studies mentioned earlier which reported poor calibration and overestimation of mortality (16-18). However, external validation studies have reported MPM_0-III to have good calibration (12, 13, 19). Earlier studies mentioned that were conducted in Sub Saharan African have produced contrasting results. The MPM_0-III was well calibrated amongst the critical ill patients admitted to the ICU of the Aga Khan University, hospital, Nairobi (14) but showed poor calibration amongst all adult patients admitted to Rwanda's two public ICUs (15). These findings highlight the similar treatment protocols and interventions amongst the two sister hospitals located in different geographical regions.

In this retrospective study we also aimed to identify patient demographics, disease patterns, clinical outcomes as well as factors associated with higher risk of mortality in patients admitted to the ICU of the Aga Khan Hospital, Dar-es-Salaam. Based on this retrospective observational cohort, the in - ICU mortality was 16.1%, which is far less than the reported mortality among all other tertiary referral hospitals of Tanzania 41.4% (20) but slightly exceeds rates reported in western Europe and north

America(1). This disparity is not surprising; Since the Intensive care unit at our setting is better-resourced and comparable in various ways to facilities in HICs.

The ICU cohort amongst the four tertiary referral hospital in Tanzania was younger (median age 34 years, IQR 21-53) compared to our study population (median age 58 years, IQR 43–71) this variation could be due to the exclusion of patients aged less than 18 years in our study. However both the cohorts had male predominance 57.5% and 62.8 % respectively (20). The bulk of admission was contributed by those suffering with Neurological disease, sepsis, respiratory and cardiovascular related conditions. Mortality was highest among those admitted due to sepsis. Our results are in parallel with a large intercontinental data base that emphasized association of sepsis with high mortality rates in all countries (1).The Median Length of ICU stay is similar to reports from tertiary hospitals in Sub- Saharan Africa (20, 21).

Our results highlight the impact of prolonged Length of Stay (LOS) in the ICU which is associated with higher adjusted odds of in ICU mortality. Prolonged LOS in the ICU may be attributed to development of multi- systemic complications necessitating continued organ support. Additionally there are no laws and guidelines in Tanzania with regards to withdrawal or limitations of support hence we hypothesize that significant fraction of patients with chronically ill conditions and with poor outcomes are admitted for extended intervals before succumbing to death. Our study findings are comparable to several studies done in well-equipped ICU's that concluded patients with multiple diseases and having organ dysfunction were key factors that increased the ICU LOS (22, 23). However contrasting results have also been published that LOS in ICU was not an independent risk factor for in-hospital mortality, nevertheless it had small effect on long-term mortality after hospital discharge (24). Contrary to the LOS in the ICU, overall LOS in the hospital was considered protective in our study as the adjusted odds of mortality decreased as the length of hospitalization increased.

Those patients transferred from the general ward to the ICU also had higher adjusted odds of mortality; this is not surprising since it is a mere reflection of deteriorating physiological and clinical condition or acquisition of a new hospital-acquired illness. Because many life threatening illnesses benefit from early interventions, few studies have advocated early and immediate transfer to the ICU for treatment to have a substantial impact on in hospital mortality and LOS (25, 26).

We identified several Limitations in Our Study. Firstly, this was a single center study and as such the findings may not be valid across all patient populations in Tanzania. Secondly, since our study was a

retrospective design it restricted us on follow up of outcome after ICU discharge and doesn't provide the same level of evidence as a prospective study design.

CONCLUSION

In Summary, This is the first and largest study to report on performance of predictive scoring models in Tanzania. Our study concluded both SAPS 3 and MPM_0-III to perform well among critically ill patients admitted to the ICU of the Aga Khan Hospital, Dar-es-salaam, Tanzania. We found our in –ICU mortality to be much lower compared to other tertiary referral hospitals in Tanzania. Amongst out cohort, patients with Sepsis had the highest mortality rate. Prolonged ICU stay and those transferred from general wards to ICU being key factors of mortality. For future Practice, Performance of predictive scoring models tend to deteriorate over time, termed as worsening of discrimination and calibration resulting in overestimation of mortality (17). Thus periodic updating is crucial for sustaining accuracy of these predictive models.

Our findings conclude that sepsis remains to be a lethal problem amongst our study population thus clinical research targeting infection prevention efforts and early implementation of targeted interventions would be key to improved outcomes. The study also highlighted increased mortality rates among patients transferred from the ward to the ICU, thus vigilant and cautious monitoring would be key in identifying high risk patients admitted to the general wards.

ABBREVIATIONS

- APACHE: Acute physiology and chronic health evaluation
- SAPS: Simplified acute physiology score
- MPM: Mortality probability models
- LOS : Length of Stay
- ICU :- Intensive care Unit

DECLARATION

Ethics approval and consent to participate

The Study was approved by the Aga Khan University Ethical research committee (AKU- ERC, EA). The National Institute for Medical Research (NIMR) mandates the AKU – ERC to approve health research conducted by Tanzanian staff and students under the Act of Parliament No. 23 of 1979 and its amendments in 1997.

Consent for publication

Not Applicable

Availability of Data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request

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Authors' contributions

NK conceptualized and designed the study, NK and OA carried out data collection and drafted the manuscript. EA, SS and SS were the content supervisor of the project. JO was the methodology supervisor and carried out the data analysis as well as initial interpretation of the project. NK, EA, SS, OA, JO, SS reviewed and revised the analyzed data and manuscript. All authors read and approved the final manuscript.

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Table 1(on next page)

General and clinical characteristics of patients (N=331)

Table 1: General and clinical characteristics of patients (N=331)

Characteristics	All(N=331)	Survivors (n=278)	Non-survivors (n=53)	p-value
	N (%)	n (%)	n (%)	
Sex				
Male	208(62.8)	174(62.6)	34(64.2)	0.829
Female	123(37.2)	104(37.4)	19(35.8)	
Age group in years				
< 45	87(26.3)	79(28.4)	8(15.1)	
45-64	114(34.4)	99(35.6)	15(28.3)	
65-74	61(18.4)	51(18.4)	10(18.9)	0.015
75-84	51(15.4)	36(12.9)	15(28.3)	
> 84	18(5.4)	13(4.7)	5(9.4)	
Ethnicity				
African	178(53.8)	152(54.7)	26(49.1)	
Asian	136(41.1)	111(39.9)	25(47.2)	0.589
Other	17(5.1)	15(5.4)	2(3.8)	
Admitted from				
Emergency	306(92.5)	257(92.5)	49(92.5)	
Wards	15(4.5)	12(4.3)	3(5.7)	0.800
Clinic	10(3.0)	9(3.2)	1(1.9)	
Location before ICU admission				
Home	318(96.1)	267(96.0)	51(96.2)	0.950
Hospital	13(3.9)	11(4.0)	2(3.8)	
Admitting Category				
Surgery	38(11.5)	36(12.9)	2(3.8)	
Gastroenterology	31(9.4)	25(9.0)	6(11.3)	
Neurology	63(19.0)	53(19.1)	10(18.9)	
Endocrinology	18(5.4)	17(6.1)	1(1.9)	
Respiratory	36(10.9)	35(12.6)	1(1.9)	
Cardiovascular	36(10.9)	30(10.8)	6(11.3)	0.014
Nephrology	16(4.8)	12(4.3)	4(7.6)	
Sepsis	60(18.1)	47(16.9)	13(24.5)	
Obstetrics and Gynecology	10(2.0)	9(3.2)	1(1.9)	
Hematology	7(2.1)	5(71.4)	2(3.8)	
Oncology	16(4.8)	9(3.2)	7(13.2)	
Code Status on Admission				
DNR	40(12.1)	13(4.7)	27(50.9)	< 0.001
Full Code	291(87.9)	265(95.3)	26(49.1)	
Age in years	**58(43-71)** †	**55.5(41-70)** †	**70(55-78)** †	**0.0003**‡
SAPS 3 scores	**42(32-51)** †	**39(31-48)** †	**60(51-68)** †	**< 0.0001**‡
MPM_0III scores	**3(2-4)** †	**3(2-4)** †	**5(4-6)** †	**< 0.0001**‡
LOS ICU (days)	**4(2-6)** †	**4(2-6)** †	**6(2-11)** †	**0.0029**‡
LOS Hospital (days)	**6(4-10)** †	**6(4-10)** †	**8(3-13)** †	**0.3248**‡

†median (IQR); ‡: p-value for Mann-Whitney U test; LOS: Length of Stay, DNR: Do Not resuscitate. Data in median (IQR), and n (%)

Table 2(on next page)

Type of support received in the first hour of ICU admission

Table 2: Type of support received in the first hour of ICU admission

Type of support	All(N=331)	Survivors (n=278)	Non-survivors (n=53)	p-value
	N (%)	n (%)	n (%)	
None	208(62.8)	196(70.5)	12(22.6)	< 0.001
Hemodialysis	13(3.9)	11(4.0)	2(3.8)	0.9498
Inotropes	33(10.0)	29(10.4)	4(7.6)	0.5206
Mechanical ventilation	26(7.9)	17(6.1)	9(17.0)	0.0070
Inotropes, Hemodialysis	5(1.5)	5(1.8)	0(0.0)	0.3252
Inotropes, mechanical ventilation	36(10.9)	15(5.4)	21(39.6)	< 0.001
Mechanical ventilation, Hemodialysis	3(0.9)	3(1.1)	0(0.0)	0.4474
Inotropes, mechanical ventilation, hemodialysis	7(2.1)	2(0.7)	5(9.4)	0.0001

Data presented in n (%)

Table 3(on next page)

Comorbid conditions among critically ill patients admitted to the ICU

Table 3: Comorbid conditions among critically ill patients admitted to the ICU

Comorbidity	All(N=331)	Survivors (n=278)	Non-survivors (n=53)	p-value
	N (%)	n (%)	n (%)	
Hypertension	174(52.6)	146(52.5)	28(52.8)	0.9553
Diabetes Mellitus	107(32.3)	87(31.3)	20(37.7)	0.3613
Heart Failure	53(16.0)	41(14.7)	12(22.6)	0.1510
Chronic Kidney Disease	45(13.6)	31(11.2)	14(26.4)	0.0030
HIV	21(6.3)	16(5.8)	5(9.4)	0.314
COPD	17(5.1)	15(5.4)	2(3.8)	0.6239
CAD	17(5.1)	15(5.4)	2(3.8)	0.6239
Liver Cirrhosis	16(4.8)	9(3.2)	7(13.2)	0.0022
DM & HTN	87 (26.3)	72 (25.9)	15 (28.3)	0.7157
HTN & CKD	39 (11.8)	27 (9.7)	12 (22.6)	0.0075
DM & HTN & CKD	30 (9.1)	21 (7.6)	9 (17.0)	0.0285

Data presented in n (%)

Table 4(on next page)

Goodness of fit Hosmer-Lemeshow test and p-value of each scoring model

Table 4: Goodness of fit Hosmer-Lemeshow test and p-value of each scoring model

Scoring Model	Chi – Square	P – Value
MPM 0- III Score	5.08	0.2791
SAPS III	4.61	0.7980

Table 5(on next page)

Area under curve and 95% confidence Intervals for the models

Table 5: Area under curve and 95% confidence Intervals for the models

Variable	Cut-off	AUC	LL	UL	P-value
MPM 0- III Score	4	0.904	0.864	0.944	0.2418
SAPS III	54	0.8892	0.8440	0.935	

LL: Lower limits; UL: Upper limits; AUC: Area under the ROC curve

Table 6(on next page)

Factors associated with increased odds of mortality among critically ill patients

Table 6: Factors associated with increased odds of mortality among critically ill patients

Characteristics	Unadjusted Odds ratio			Adjusted Odds ratio		
	OR	95%CI	P-value	OR	95%CI	P-value
Age in years	1.032	1.014-1.051	0.001	1.020	0.997-1.043	0.086
LOS in ICU	1.068	1.021-1.117	< 0.001	1.462	1.179-1.814	0.001
LOS in hospital	1.017	0.994-1.041	0.141	0.717	0.580-0.886	0.002
Sex						
Male	ref					
Female	0.935	0.507-1.723	0.829	0.870	0.399-1.893	0.725
Admitted From						
Emergency	ref					
Wards	1.311	0.357-4.819	0.683	5.341	1.278-22.322	0.022
Clinic	0.583	0.072-4.704	0.612	1.033	0.114-9.347	0.977
Code status						
DNR	ref					
Full code	0.047	0.022-0.102	< 0.001	0.052	0.021-0.129	< 0.001

Figure 1

Receiver operating curve for predicting the survival outcome according to SAPS III and MPM-0 III models

Figure 1: Receiver operating curve for predicting the survival outcome according to SAPS III and MPM-0 III models

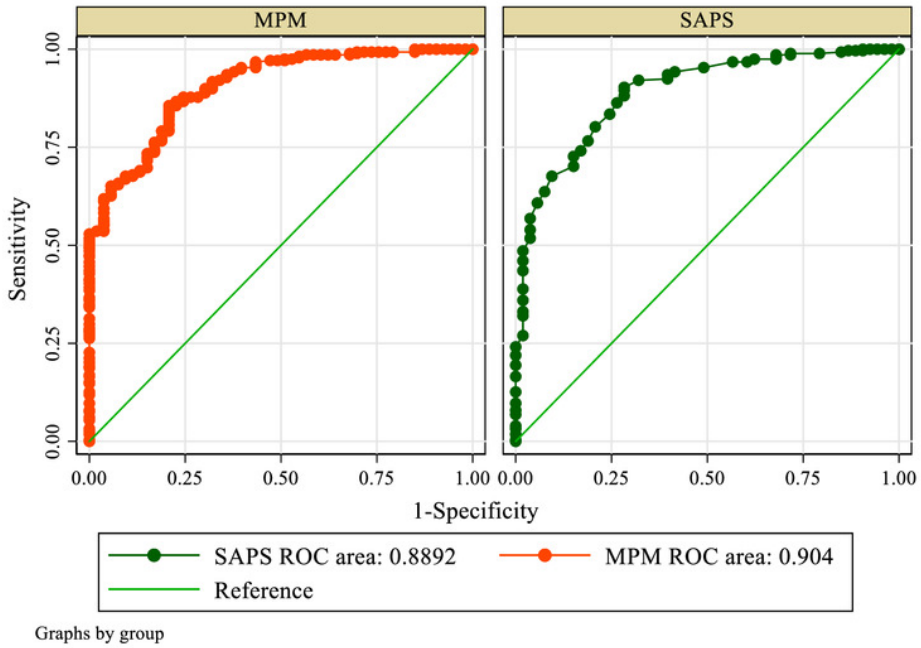

Table 7 (on next page)

Median predicted mortality rates for SAPS-III and MPM-III

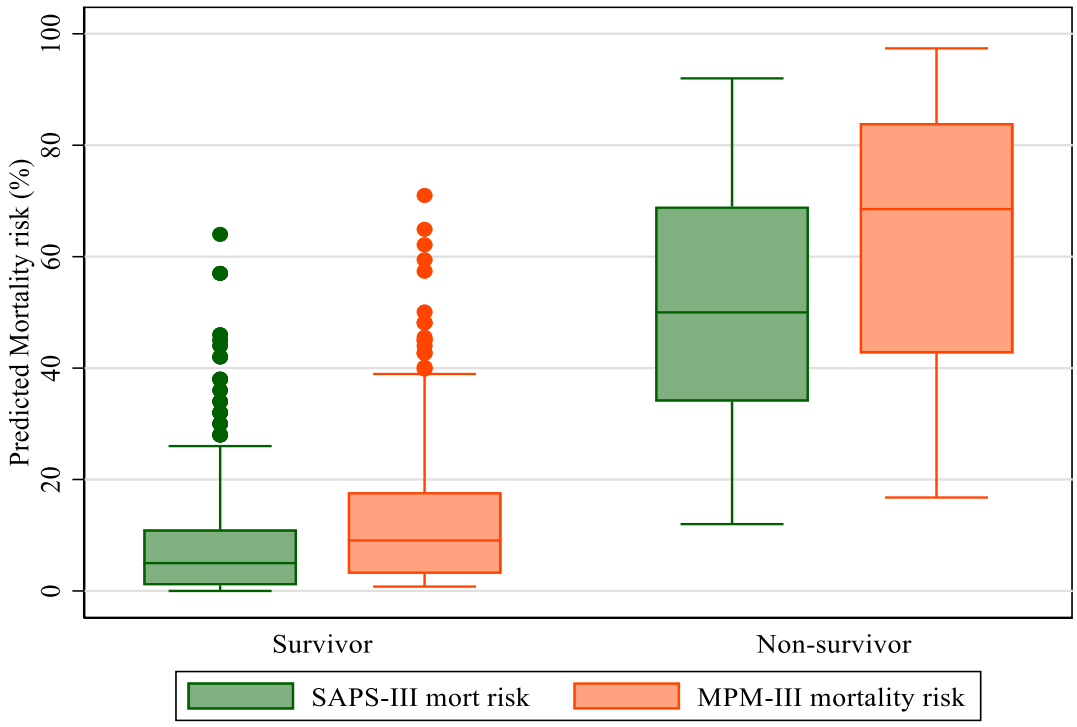

Figure 2: Median predicted mortality rates for SAPS-III and MPM-III