Performance in mortality prediction of SAPS 3 And MPM-III scores among adult patients admitted to the ICU of a private tertiary referral hospital in Tanzania: A retrospective cohort study

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Background: Illness predictive scoring systems are significant and meaningful adjuncts of patient management in the Intensive Care Unit (ICU). They assist in predicting patient outcomes, improve clinical decision making and provide insight into the effectiveness of care and management of patients 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 performance 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 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 the worst physiological data within the first hour of ICU 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 survivors 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 male (n=208, 62.8%), of African origin (n=178, 53.8%) and admitted from the emergency department (n=306, 92.4%). In- hospital mortality of critically ill patients 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 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 in-hospital mortality of critically ill patients was lower compared to studies done in other intensive care units in tertiary referral hospitals within Tanzania.

1   **Performance in mortality prediction of SAPS 3 and MPM-III**
2   **scores among adult patients admitted to the ICU of a private**
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4   **study**

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ABSTRACT

Background

Illness predictive scoring systems are significant and meaningful adjuncts of patient management in the Intensive Care Unit (ICU). They assist in predicting patient outcomes, improve clinical decision making and provide insight into the effectiveness of care and management of patients while optimizing the use of hospital resources. We evaluated the mortality predictive performance of the Simplified Acute Physiology Score (SAPS 3) and Mortality Probability Models (MPM$_0$-III) and compared their performance in predicting outcomes as well as identifying disease patterns and factors associated with increased mortality.

Methods

This was a retrospective cohort study of adult patients admitted to the 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 the worst physiological data within the first hour of ICU 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 survivors 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 male (n=208, 62.8%), of African origin (n=178, 53.8%) and admitted from the emergency department (n=306, 92.4%). In-hospital mortality of critically ill patients was 16.1%. Discrimination was very good for all models, the area under the 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 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 in-hospital mortality of critically ill patients was lower compared to studies done in other intensive care units in tertiary referral hospitals within Tanzania.

BACKGROUND

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67 The burden of critical care and ICU mortality is greatest in countries with low global national income (1).

68 The reported ICU mortality widely varies from one setting to the other with higher rates reported in low

69 and middle-income countries (LMICs) (1-3). As of 1st July 2020, the World Bank upgraded Tanzania's

70 economic status from a low to lower-middle income country due to its strong economic performance over

71 the past decade. However, the availability of intensive care units in Tanzania is very limited; none of the

72 seven district hospitals surveyed in 2009 had an ICU. The four national referral hospitals had a total of

73 only 38 ICU beds serving a population of 57 million (4). This is in contrast to high-income countries

74 (HICs) which generally have between 5 to 30 ICU beds per 100 000 people (5). The availability and

75 improvement of quality of care of critical illness in LMICs is necessary to reduce this burden and even

76 more significant in the coming years as the population ages and prevalence of comorbidities increases (6).

77 Despite the use of high-cost and sophisticated devices, ICU mortality rates remain high. The burden of

78 diseases compounded by a severe lack of resources, specialists and data makes prediction of ICU

79 outcomes in terms of morbidity and mortality a crucial component of care across the continent. In HICs

80 mortality prediction models are not only used to predict outcome but also as tools for quality

81 enhancement and analytical decision making. These mortality predictive models were developed more

82 than 25 years ago using patient characteristics. They help quantify the severity of illness, estimate the

83 gravity of the disease, help predict outcome and assist in resource allocation (7, 8).

84

85 The three major predictive scoring systems used to predict mortality in general ICU patients are the Acute

86 Physiologic and Chronic Health Evaluation (APACHE) scoring system, the Simplified Acute Physiologic

87 Score (SAPS) and the Mortality Prediction Model (MPM_0) (9). APACHE-IV, SAPS 3, and MPM_0-III are

88 the latest versions of the aforementioned scoring systems (10-12). When selecting a predictive scoring

89 system for use in a given ICU, it is essential to use a model that is well-proven, established and validated

90 contextually. APACHE-IV has long been considered more precise for predicting mortality but is

91 perceived as burdensome and more costly especially in resource-limited settings (13). MPM_0-III is

92 considered superior in resource-limited settings since it has the lowest extraction burden among the three

93 models and is available without cost on various medical information sites. MPM_0-III has been a well-

94 studied tool in East Africa. Nevertheless, its performance in predicting outcomes among critically ill

95 patients admitted to ICU's in Kenya (14) and Rwanda (15) are contradictory. External validation of SAPS

96 3 among patients admitted to the ICU's in Austria, Brazil and Italy reported that SAPS 3 had a good

97 ability to predict outcomes but performed poorly across all probabilities of death when compared with

98 APACHE-IV and MPM_0-III (16-18). SAPS 3 may have greater potential for international use since the

99   score was derived from data in more than one country (11). No study to date has assessed the

100   performance of SAPS 3 in LMICs, especially in Sub-Saharan Africa.

101

102   These aforementioned predictive scoring systems have been compared in different studies and have

103   produced variable results. The existence of a large number of scoring systems with contrasting

104   performance suggests the best fit model is ICU specific. Thus, each particular ICU needs to determine

105   which scoring system performs best in its setup; hence there was a need to carry out a comparative study

106   in our cohort of patients to identify the best performing model. There have been no studies done in

107   Tanzania that have compared the performance of these scoring models. The study had two main

108   objectives: 1). To compare the performance of MPM_0-III and SAPS 3 in order to identify which model

109   best fits in the ICU of the Aga Khan Hospital, Dar es Salaam. 2). To identify disease patterns and risk

110   factors associated with higher mortality rates among critically ill patients.

METHODS

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113   This was a single centre retrospective cohort study, conducted in the ICU of the Aga Khan Hospital, Dar-

114   es- Salaam, Tanzania. The Aga Khan Hospital is the largest private hospital and the only Joint

115   Commission International (JCI) accredited hospital in Tanzania. The ICU of the Aga Khan Hospital is a

116   15 bed unit which provides level III services to all kind of critically ill patients. The ICU is capable of

117   providing mechanical ventilation, inotropic support and renal replacement therapy. The unit is divided in

118   3 sections – 7 adult general ICU beds (including 2 isolation rooms), 4 for cardiac patients and 4 for

119   paediatrics. The ICU is an open-model one run by a multidisciplinary team comprising of physician of the

120   primary specialty of care, physiotherapist and dietician led by a full-time critical care specialist. The

121   nurse-to-patient ratio ranges between 1:1 and 1:2. All adult patients aged 18 and above admitted to the

122   ICU were eligible for the study. Patients admitted for observation, having incomplete data and those

123   whose duration of stay in the unit was less than an hour as well as those diagnosed with COVID–19 were

124   excluded from the study. Admissions to the ICU are limited to those meeting a strict admitting criteria set

125   by the hospital. A total of 747 adults patients were admitted to the ICU from August 2018 to April 2020.

126   A sample size of 331 patients having a specific outcome (death or discharge home) was determined to be

127   sufficient to give the study a 80% power and 95% confidence for detection of 10% difference in

128   performance between SAPS 3 and MPM_0-III. The ICU admission register was used to identify patients

129   admitted and patient files were retrieved from the medical records. The medical file numbers were entered

130   into a computer and computer generated random sampling was performed until the desired sample size

131   was achieved. Patient demographics and clinical data were extracted using patient records and were

132   entered into a spreadsheet on Microsoft Office Excel 2010 (Redmond, WA, USA). Data was extracted by

133   experienced junior doctors with working experience in the ICU and was independently verified by the

134   primary author for accuracy and completeness. The reasons for admission were grouped into 11

135   categories: surgery, gastroenterology, neurology, endocrinology, respiratory, cardiovascular, nephrology,

136   sepsis, oncology, hematology, obstetrics and gynecology. When multiple diagnoses were present, the

137   leading one with the worst prognosis was selected as the main reason for admission.

138

139   Descriptive analysis of demographic characteristics were done and presented as percentages while the

140   categorical and continuous outcome variables were analysed and presented as means and medians with

141   interquartile ranges respectively. Categorical and continuous variables between survivors and non-

142   survivors were compared using Pearson's chi-square test and Mann-Whitney U test respectively. SAPS-3

143   and MPM_0-III were calculated using an online scoring calculator, available on www.uptodate.com.

144   Accurate discrimination and calibration are key distinguishing features that should be met by all

145   predictive scoring models. Discrimination of the model was assessed by the area under the receiver

146   operating characteristic (ROC) curve. An area of 0.7–0.8 is reflected as fair, 0.8–0.9 good and > 0.9

147   excellent. Non-parametric Wilcoxon statistics was used to compare the area under the ROC curves (19).

148   A Hosmer-Lemeshow goodness-of-fit test which follows chi-square distribution was used to evaluate the

149   model fit as well as calibration of the models with a p-value of > 0.05 signifying no evidence of poor fit

150   (19). However, all other statistical tests with a p-value of < 0.05 were considered statistically significant.

151   Any variable with P-Value <0.05 and those considered clinically significant in explaining mortality in the

152   ICU were considered in multivariable model. Determinants of mortality among critically ill patients were

153   identified using binary logistic regression; odds ratio with corresponding 95% Confidence intervals (CI)

154   and P-value were reported. All statistical analysis was done using STATA version 15. The study protocol

155   was approved by the Ethical Research Committee (ERC) of the Aga Khan University (AKU/2020/051/fb)

156   and individual consent of each study participant was exempted since it did not affect the rights and

157   welfare of the patients.

RESULTS

159   **General characteristics of the participants**

160   A total of 331 patients were included in the study. Out of the 331 patients (n=278, 83.9%) survived and

161   (n=53, 16.1%) died. Table 1 below shows general and clinical characteristic of the cohort and provides a

162   comparison of survivors to non-survivors. The median age of the cohort was 58 years (IQR 43-71) with

163   more than half of admitted patients being male (n=208, 62.8%) and of African origin (n=178, 53.8%)..

164   Most of the patients were admitted to the ICU from the emergency department (n=306, 92.5%), who were

165 at home prior (n=318, 96.1%) with majority of them suffering from neurological disease (n=63, 19%),

166 sepsis (n=60, 18.1%), respiratory (n=36, 10.9%) and cardiovascular (n=36, 10.9%) related conditions.

167 Median ICU and hospital LOS were 4 (2-6) and 6 (4-10) days respectively.

168

169 When survivors and non-survivors were compared, there was a statistically significant difference (P-value

170 <0.05) in age, length of ICU stay, admitting category and code status. Higher mortality rates were noted

171 in the elderly aged between 75-84 years (n=15, 28.3%), those suffering from sepsis (n=13, 24.5%) and

172 neurological diseases (n=10, 18.9%). Higher percentage of mortality was also noted in Do-Not-

173 Resuscitate (DNR) patients (n=27, 50.9%) compared to those without limitations of care. There was no

174 statistically significant difference between survivors and non-survivors by sex, ethnicity and prior

175 location before ICU admission. The overall SAPS 3 score for all the patients was 42 (IQR: 32-51) of

176 which non-survivors had a higher score 60 (IQR: 51-68) than the survivors 39 (IQR: 31-48) with p-value

177 (<0.0001). Similarly, the median MPM_0-III score in non-survivors, 5 (IQR: 4-6) was higher than

178 survivors, 3 (IQR: 2-4) with p-value (<0.0001).

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181 Table 2 below, illustrates the type of support patients received in the first 24 hours of ICU admission. Of

182 the 331 patients admitted to the ICU, (n=123, 37.2%) patients received support in the first hour of ICU

183 admission that included: mechanical ventilation, inotropes and hemodialysis. Highest mortality was noted

184 amongst those who required inotropic support and mechanical ventilation (n=21, 39.6%) in the first hour

185 of ICU admission.

186

187 Table 3 below highlights comorbid conditions amongst the critical ill patients admitted to the ICU. More

188 than one comorbid condition per critically ill patient was recorded when present. The most common

189 comorbid condition amongst our cohort was hypertension (n=174, 52.6%) and diabetes mellitus (n=107,

190 32.3%).When comorbid conditions were compared between survivors and non- survivors, a higher

191 percentage of mortality with statistically significant difference (P value <0.05) was noted among those

192 suffering with chronic kidney disease (n=14, 26.4%) and liver cirrhosis (n=7, 13.2%).

193

194

195 Calibration of each scoring system exhibited good performance. The goodness of fit Hosmer-Lemeshow

196 test and p-value of each scoring system is shown in Table 4 below. The area under ROC of SAPS 3 and

197 MPM_0-III in prediction of mortality are shown below in Figure 1 below. The area under the ROC was

198 calculated to evaluate the predictive value of the scoring systems. The area under the ROC curve for the

199   SAPS 3 showed a statistically significant predictive marker of mortality (AUC: 0.8892; 95%CI: 0.844-

200   0.935). The cut-off value for SAPS 3 was 54 with the sensitivity of 72% and specificity of 90%. The

201   MPM_0-III scoring system also showed a statistically significant predictive marker for the outcome of

202   interest (AUC: 0.904; 95%CI: 0.864-0.944). The cut-off value for MPM_0-III was 4, with sensitivity of

203   74% and specificity of 87%. There was no statistically significant difference between the ROC curves of

204   the two models (P-value=0.2418) (Table 5).

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207   The overall estimated median (IQR) predicted mortality among the 331 ICU patients was 6% (2%-20%)

208   on the SAPS 3 model and 11.5% (3.8%-27.9%) based on the MPM_0-III model. The stratified analysis by

209   survivors and non-survivors is shown in Figure 2 below. The median predicted mortality risk for

210   survivors is lower than those of non-survivors. In the SAPS 3 model, the estimated median for survivors

211   was 5% (IQR: 1%-11%) while for the non-survivors this was 50% (IQR: 34%-69%)   Based on the

212   MPM_0-III model the median predicted mortality was 9.1% (3.1%-1.7%) and 68.5% (IQR: 42.7%-84.0%)

213   for survivors and non-survivors respectively.

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216   Multiple clinical factors were associated with increased adjusted odds of mortality. These included length

217   of ICU stay (adjusted odds ratio [aOR], 1.462; P-value = 0.001) and those transferred from the ward

218   (aOR, 5.341; P -value< 0.022). However, it was protective to stay longer in the hospital as the odds of

219   mortality decreased as the length of hospitalization increased (aOR, 0.717; P-value = 0.002) (Table 6).

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223   # DISCUSSION
224
225   To our knowledge, this is the first study to report on performance of predictive scoring models in

226   Tanzania and more so in a private setting. Accurate discrimination and calibration are two key

227   characteristics that should be met by all predictive scoring systems. Both SAPS 3 and MPM_0-III

228   performed well in our cohort. According to our results, a SAPS 3 score of higher than 54 can predict

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

230   mortality with sensitivity of 74% and specificity of 87%.

231
232   Discrimination describes the accuracy of a given prediction. In our cohort, the discriminatory capability

233   of both SAPS 3 (20 variables) and MPM_0-III (16 variables) was good. There was no statistically

234 significance difference when both these models were compared, suggesting that the model with more
235 variables was not associated with better discriminatory performance. MPM_0-III has been externally
236 validated in various ICUs in North America (12, 13, 20) and has shown to have good discrimination
237 which was similar to our study finding. However, a study done at Aga Khan University Hospital,
238 Nairobi, Kenya (14) and two public ICUs in Rwanda(15) showed MPM_0-III to have fair discrimination
239 amongst their cohort. This observed difference in discrimination may be due to the effect of differences in
240 proportion of case mixes between the study settings. Similarly SAPS 3 has been externally validated in
241 various ICUs in Italy (16), Brazil (17), Austria (18) and found to have good discriminatory capability
242 amongst their cohort. Despite SAPS 3 having greater prospective for international generalizability there
243 has been no published studies evaluating its performance in Sub-Saharan African ICUs. This is the first
244 study that reports its potential for application in LMICs.

245

246 Calibration describes how the instrument performs over a wide range of predicted mortalities. Calibration
247 is sensitive to alterations in case-mix and patient care and interventions. Despite its tendency to
248 deteriorate over time and leading to overestimation of mortality (17), both SAPS 3 and MPM_0-III were
249 well calibrated amongst the critically ill patients admitted at our study setting. Our study findings were
250 contrary to SAPS 3 validation studies mentioned earlier which reported poor calibration and
251 overestimation of mortality (16-18). However, external validation studies have reported MPM_0-III to have
252 good calibration (12, 13, 20). Earlier studies mentioned that were conducted in Sub-Saharan Africa have
253 produced contrasting results. The MPM_0-III was well calibrated amongst the critical ill patients admitted
254 to the ICU of the Aga Khan University Hospital, Nairobi (14) but showed poor calibration amongst all
255 adult patients admitted to Rwanda's two public ICUs (15). These findings highlight the similar treatment
256 protocols and interventions between two sister hospitals located in different geographical regions.

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259 In this retrospective study we also aimed to identify patient demographics, disease patterns, clinical
260 outcomes as well as factors associated with higher risk of mortality in patients admitted to the ICU of the
261 Aga Khan Hospital, Dar –es Salaam. Based on this retrospective observational cohort, the in-hospital
262 mortality of critically ill patients was 16.1%, which is far less than the reported mortality among all other
263 tertiary referral hospitals in Tanzania, 41.4% (21) but slightly exceeds rates reported in western Europe
264 and North America (1). This disparity is not surprising since the intensive care unit at our setting has
265 access to more resources than similar units in the country and comparable in various ways to facilities in
266 HICs. The ICU cohort studied in the four tertiary referral hospitals in Tanzania was younger (median age
267 34 years, IQR 21-53) compared to our study population (median age 58 years, IQR 43–71). This variation

268 could be due to the exclusion of patients aged less than 18 years in our study. However both the cohorts

269 had male predominance of 57.5% and 62.8 % respectively (21). The bulk of admissions in our cohort

270 were those suffering from neurological disease, sepsis, respiratory and cardiovascular related conditions.

271 Mortality was highest among those admitted due to sepsis. Our results are in parallel with a large

272 intercontinental database that emphasized the association of sepsis with high mortality rates in all

273 countries (1).The median length of ICU stay is similar to reports from tertiary hospitals in Sub-Saharan

274 Africa (21, 22).

275

276 Prolonged length of stay (LoS) in the ICU and patients transferred from the general ward to the ICU

277 were factors associated with higher adjusted odds of mortality among critically ill patients. Prolonged

278 LoS in the ICU may be attributed to development of multi- systemic complications necessitating

279 continued organ support. There are no laws and guidelines in Tanzania with regards to withdrawal of

280 support, hence we hypothesize that significant fraction of patients with a prolonged course of illness and

281 with expected poor outcomes are admitted for extended intervals before succumbing to death. Our study

282 findings are comparable to several studies done in well-equipped ICUs that concluded patients with

283 multiple diseases and having organ dysfunction were key factors that prolong the LoS in ICU (23, 24).

284 Contrasting results have also been published that LoS in ICU is not an independent risk factor for in-

285 hospital mortality (25). Those patients transferred from the general ward to the ICU also had higher

286 adjusted odds of mortality; this is not surprising since it is a mere reflection of deteriorating physiological

287 and clinical condition. Few studies have demonstrated early transfer to the ICU for treatment to have a

288 substantial impact on in-hospital mortality and LoS (26, 27).

289

290 We identified several limitations in our study. Firstly, this was a single center study and as such the

291 findings may not be valid across all patient populations in Tanzania. Secondly, since our study was a

292 retrospective design it restricted us the ability to follow up outcomes after ICU discharge and doesn't

293 provide the same level of evidence as a prospective study design.

294 ## CONCLUSION

295

296 In summary, this is the first and largest study to report on performance of predictive scoring models in

297 Tanzania. Our study concluded both SAPS 3 and MPM_0-III perform well among critically ill patients

298 admitted to the ICU of the Aga Khan Hospital, Dar es Salaam, Tanzania. We found our mortality among

299 critically ill patients to be much lower compared to other tertiary referral hospitals in Tanzania. Amongst

300 out cohort, patients with sepsis had the highest mortality rate. Thus clinical research targeting infection

301 prevention efforts and early implementation of targeted interventions would be important to improving

302 outcomes. Prolonged ICU stay and transfer from general wards to ICU were key factors of mortality. Of

303 note, the performance of predictive scoring models tend to deteriorate over time; termed as worsening of

304 discrimination and calibration and resulting in overestimation of mortality (17). Thus periodic updating is

305 crucial for sustaining accuracy of these predictive models. .

ABBREVIATIONS

307 - APACHE: Acute physiology and chronic health evaluation

308 - SAPS: Simplified acute physiology score

309 - MPM: Mortality probability models

310 - LoS : Length of Stay

311 - ICU :- Intensive care Unit

DECLARATION

313

Ethics approval and consent to participate

315 The study was approved by the Aga Khan University Ethical Research Committee (AKU-ERC, EA). The

316 National Institute for Medical Research (NIMR) mandates the AKU-ERC to approve health research

317 conducted by Tanzanian staff and students under the Act of Parliament No. 23 of 1979 and its

318 amendments in 1997.

Consent for publication

320 Not Applicable

321

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323

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Figure 1

Receiver operating curve for predicting mortality according to SAPS 3 and MPM$_0$ III models

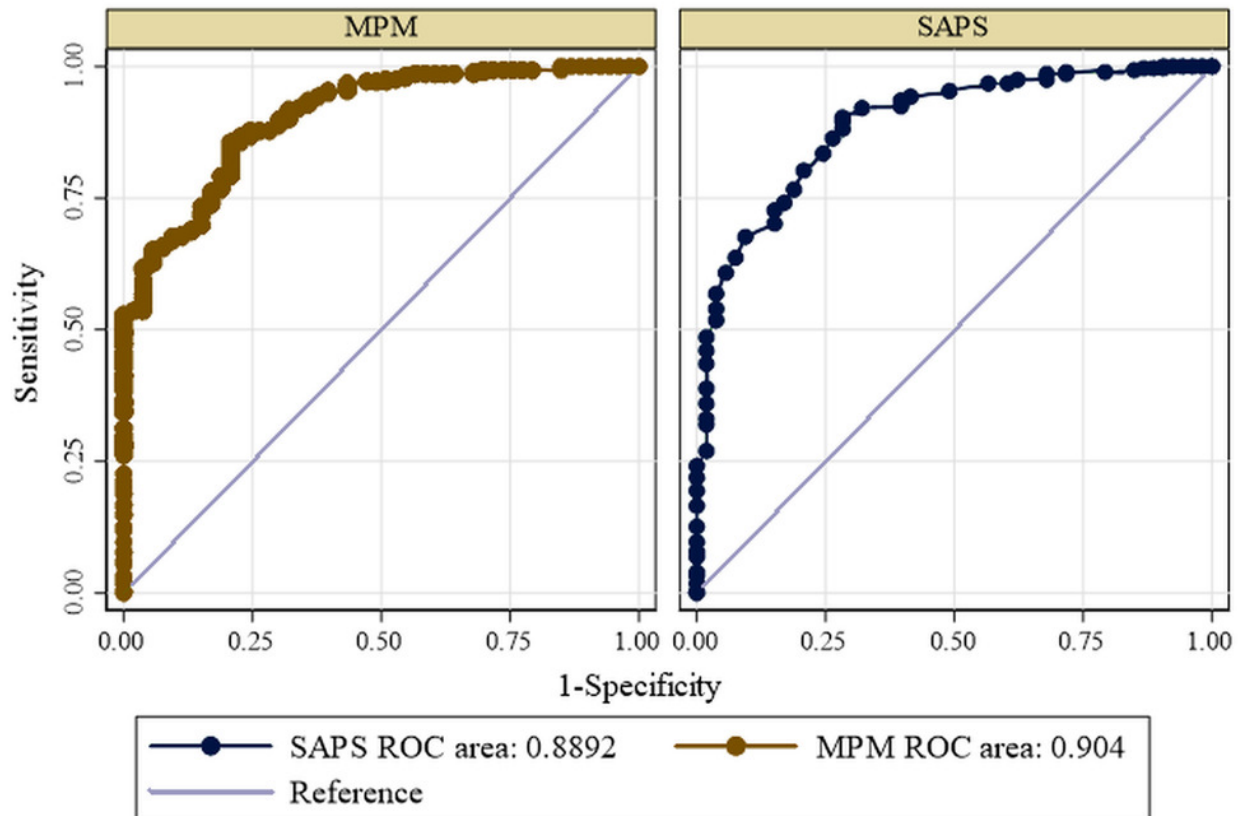
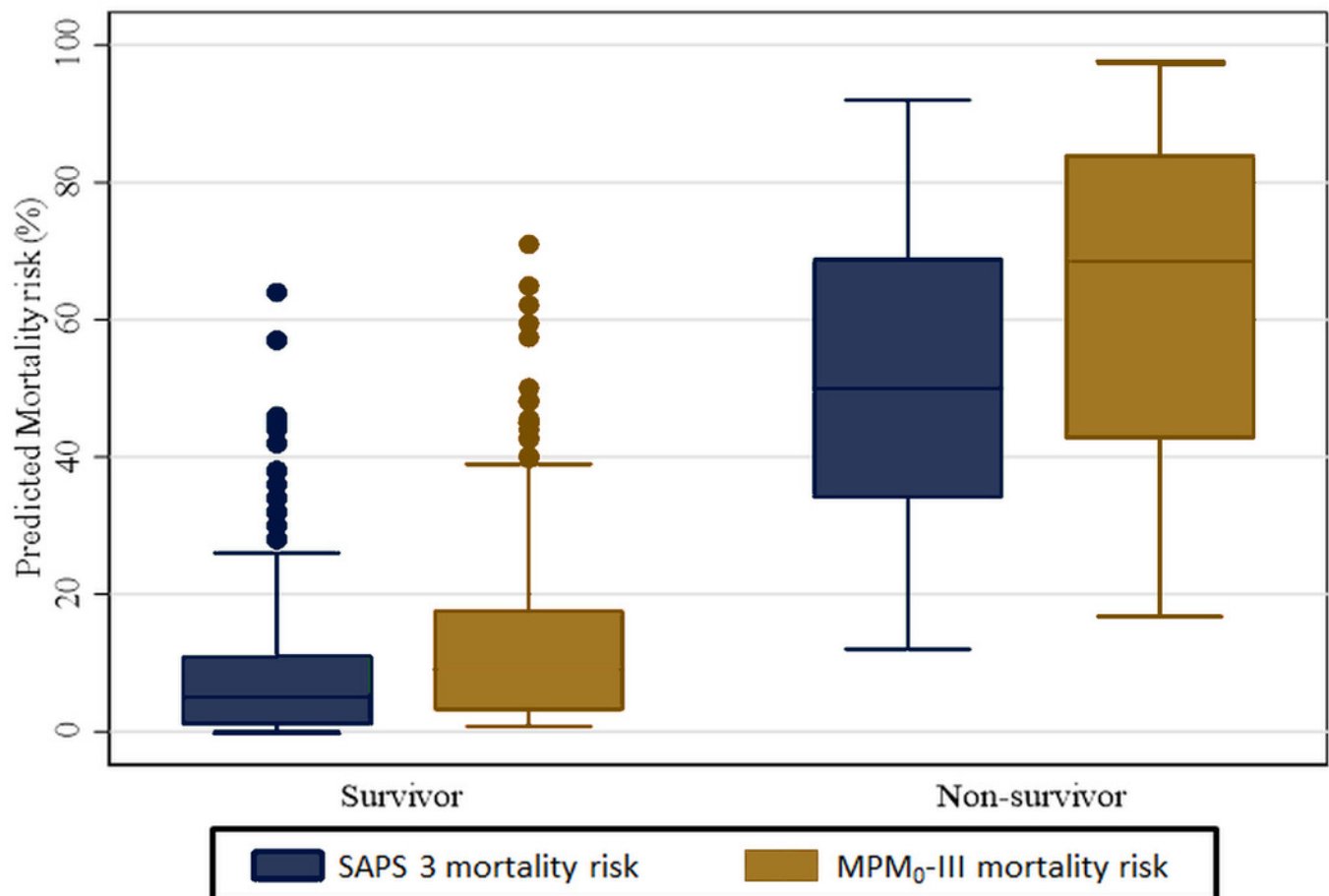



Figure 2

Median predicted mortality rates for SAPS 3 and MPM$_0$-III

![Box plot showing predicted mortality risk (%) on the y-axis from 0 to 100, with two groups on the x-axis: Survivor and Non-survivor. Each group has two box plots: SAPS 3 mortality risk (dark blue) and MPM$_0$-III mortality risk (gold/brown). Legend at bottom indicates SAPS 3 mortality risk (dark blue) and MPM$_0$-III mortality risk (gold).]

General and clinical characteristics of patients (N=331)

1 **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				0.014
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)	
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$_0$III 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‡**

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

Type of support received in the first hour of ICU admission

1   **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

3   *Data presented in n (%)*

Comorbid conditions among critically ill patients admitted to the ICU

1 **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

3 *Data presented in n (%)*

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

1   **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 3	4.61	0.7980

Area under curve and 95% confidence Intervals for the models

1 **Table 5: Area under curve and 95% confidence Intervals for the models**
2

Variable	Cut-off	AUC	LL	UL	P-value
MPM 0- III Score	4	0.904	0.864	0.944	0.2418
SAPS 3	54	0.8892	0.8440	0.935	

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

Factors associated with increased odds of mortality among critically ill patients

1   **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