Simple Mortality Predictive Models for Improving Critical Care in Resource-Limited Settings: An Insight on the Modified Early Warning Score and Rapid Emergency Medical Score

Abstract

Mortality rate among critically ill patients admitted to the Intensive Care Unit is high, particularly in low-income countries (LIC). Many scores have been developed to predict these fatal outcomes. In LIC, the applicability of scoring systems is precluded by the unavailability of resources to compile all the parameters of these scores. Herein, we highlight the advantages of two models: the Modified Early Warning Score (MEWS) and the Rapid Emergency Medical Score (REMS). The REMS and the MEWS have the advantage of being accurate, simple, inexpensive, and practical for LIC.

Keywords: *Critical care, low-income countries, mortality, predictive scores*

**Mazou Ngou Temgoua[1,2],
Joel Nouktadie Tochie[3],
Valirie Ndip Agbor[4],
Frank-Leonel Tianyi[5],
Ronni Tankeu[1],
Celestin Danwang[3]**

Departments of [1]Internal Medicine and Specialties, [2]Public Health, [3]Department of Surgery and Specialties, Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Yaounde, [4]Ibal Sub-divisional Hospital, Oku, North West Region, [5]Department of Internal Medicine, Sub-Divisional Hospital of Mayo Darle, Mayo Darle, Cameroon

Introduction

In contrast to high-income countries, the burden of the Intensive Care Unit (ICU) mortality is more significant in low-income countries (LIC) due to lack of essential drugs, limited health infrastructures, and understaffed and underfunded health-care systems.[1] Predictive mortality scores permit the identification of patients requiring special attention on admission.[2,3] The most commonly used scores are the Acute Physiology and Chronic Health Evaluation (APACHE), the Prince of Wales Emergency Department Score,[2] the Simplified Acute Physiology Score, the Modified Early Warning Score (MEWS), the Rapid Emergency Medicine Score (REMS), the Sequential Organ Failure Assessment,[3] the Mortality Probability Model (MPM),[4,5] and the Logistic Organ Dysfunction Score (LODS).[6] Several studies assessing the various performances of these models in predicting of ICU mortality have showcased the LODS, APACHE, and MPM models to have the highest predictive potentials.[3,4,6,7] However, in LIC, the use of these scores is complex and requires supplementary financial and technical resources (such as serum bilirubin, prothrombin time, partial pressure of arterial oxygen, fraction of inspired oxygen, and arterial pH), hence, limiting their use

for a large scale of critically ill patients.[1,6,8] Resource-challenged settings need simple, feasible, and cost-effective clinical scores which can ensure the rapid identification of patients requiring critical care.[9] To this effect, clinical scores assessing routine vital signs have been proposed as feasible options to identify critical illness, monitor treatment in critically ill patients, triage those in need of intensive interventions, and to predict in-ICU mortality in these resource-constrained environments.[9]

The MEWS was designed for the early detection of basic physiological dysfunctions in respiratory rate, heart rate, systolic blood pressure, urine output, temperature, and the neurological state, which are often observed before cardiac arrest[10] [Table 1]. The MEWS has been shown to have a good correlation with mortality as patients with a score of zero, four, and five have an in-ICU mortality of 5.2%, 16%, and 26%, respectively.[10,11] In a more recent study carried out in 2016 in Uganda to evaluate the prognostic performance of the MEWS system, a MEWS ≥5 was found to be an independent predictor of in-hospital mortality (odds ratio: 5.82; 95% confidence interval: 2.420–13.987; *P* < 0.0001) among critically ill patients.[12]

Furthermore, the REMS is relatively simple and highly applicable to resource-poor settings, because its input variables which

Address for correspondence:
Dr. Joel Nouktadie Tochie,
Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Yaounde, Cameroon.
E-mail: joeltochie@gmail.com

Access this article online

Website:
www.ijabmr.org

DOI:
10.4103/ijabmr.IJABMR_15_18

Quick Response Code:

How to cite this article: Temgoua MN, Tochie JN, Agbor VN, Tianyi FL, Tankeu R, Danwang C. Simple mortality predictive models for improving critical care in resource-limited settings: An insight on the modified early warning score and rapid emergency medical score. Int J App Basic Med Res 2018;8:199-201.

Table 1: The Modified Early Warning Score

Parameters	3	2	1	0	1	2	3
SBP (mmHg)	<70	71-80	81-100	101-199		≥200	
HR (bpm)		<40	40-50	51-100	101-110	111-129	≥130
RR (bpm†)		<9		9-14	15-20	21-29	≥30
Temperature (°C)		<35.0	35.1-36.0	36.1-38.0	38.1-38.5	≥38.6	
Conscious level (AVPU)				Alert	Reacting to voice	Reacting to pain	Unresponsive
4 h urine output		<80 ml	80-119 ml		120-800 ml	>800 ml	

†bpm: Breaths per minute. SBP: Systolic blood pressure; HR: Heart rate; RR: Respiratory rate; MEWS: Modified Early Warning Score; AVPU: Alerte, Verbal response, Pain response, Unconscious. Adapted from prediction of critical illness in general surgery using the MEWS by Stenhouse *et al*.[10]

Table 2: The Rapid Emergency Medical Score

Parameters	Finding	Points
Age (years)	<45	0
	45-54	2
	55-64	3
	65-74	5
	>74	6
MAP (mmHg)	>159	4
	130-159	3
	110-129	2
	70-109	0
	50-69	2
	≤49	4
Heart rate (bpm)	>179	4
	140-179	3
	110-139	2
	70-109	0
	55-69	2
	40-54	3
	≤39	4
Respiratory rate (bpm)	>49	4
	35-49	3
	25-34	1
	12-24	0
	10-11	1
	6-9	2
	≤5	4
POS (%)	75	4
	75-85	3
	86-89	1
	>89	0
GCS	3-4	4
	5-7	3
	8-10	2
	11-13	1
	14-15	0

MAP: Mean arterial pressure; POS: Peripheral oxygen saturation; GCS: Glasgow Coma Scale

are readily available in most intensive care settings.[13] It is based on five physiological parameters, namely: the mean arterial pressure, respiratory rate, blood pressure, peripheral oxygen saturation, and the Glasgow Coma Scale. Except for the age (0–6 points), each parameter is graded from 0 to 4 and the maximum score is 26 [Table 2]. With area under the receiver operating characteristic curve (AUC) values of 0.74 in developed countries[13] and 0.71 in developing countries,[14] evidence abounds on the external validity of the REMS in the prediction of death. The probability of 30-day mortality increases by 30% for each additional REMS unit.[14] REMS has been shown to be more accurate than MEWS AUC: 0.642 versus 0.568 for MEWS and to have the same predictive accuracy as the APACHE II.[15]

MEWS and REMS are valid scoring systems for in-hospital mortality prediction;[1,14] they have the advantage of being solely clinical, with fewer parameters than others scoring systems. The scarcity of sophisticated laboratories to carry out the necessary investigations (e.g. FiO_2, PaO_2, serum bicarbonate, blood pH, serum creatinine, serum bilirubin, and serum electrolytes), coupled with the high cost of these investigations, makes the MEWS and REMS of invaluable economic and prognostic interests in LIC. Moreover, from a point of view of applicability, only few health personnel are familiar with the use of sophisticated scores such as APACHE and LODS.[8]

Conclusion

The accuracy of mortality predictive models for critically ill patients has been ameliorated in recent years in high-income countries at the expense of their financial cost in low-income settings. Although widely used in high-income countries, their applicability in LIC is limited by a lack of qualified health personnel, sophisticated laboratories to carry out the necessary laboratory investigations, and the issue of cost-effectiveness. The REMS and MEWS have the advantage of being accurate, simple, inexpensive, and practical. With the increasing burden from complications of critical illness in resource-challenged settings, particularly in Sub-Saharan Africa, the generalizability of the REMS and MEWS cannot be overemphasized.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Murthy S, Leligdowicz A, Adhikari NK. Intensive care unit capacity in low-income countries: A systematic review. PLoS One 2015;10:e0116949.
2. Moseson EM, Zhuo H, Chu J, Stein JC, Matthay MA, Kangelaris KN, *et al.* Intensive Care Unit scoring systems outperform emergency department scoring systems for mortality prediction in critically ill patients: A prospective cohort study. J Intensive Care 2014;2:40.
3. Saleh A, Ahmed M, Sultan I, Abdel-lateif A. Comparison of the mortality prediction of different ICU scoring systems (APACHE II and III, SAPS II, and SOFA) in a single-center ICU subpopulation with acute respiratory distress syndrome. Egypt J Chest Dis Tuberc 2015;64:843-8.
4. Sekulic AD, Trpkovic SV, Pavlovic AP, Marinkovic OM, Ilic AN. Scoring systems in assessing survival of critically ill ICU patients. Med Sci Monit 2015;21:2621-9.
5. Lemeshow S, Teres D, Klar J, Avrunin JS, Gehlbach SH, Rapoport J, *et al.* Mortality probability models (MPM II) based on an international cohort of Intensive Care Unit patients. JAMA 1993;270:2478-86.
6. Rapsang AG, Shyam DC. Scoring systems in the Intensive Care Unit: A compendium. Indian J Crit Care Med 2014;18:220-8.
7. Naqvi IH, Mahmood K, Ziaullaha S, Kashif SM, Sharif A. Better prognostic marker in ICU – APACHE II, SOFA or SAP II! Pak J Med Sci 2016;32:1146-51.
8. Murthy S, Adhikari NK. Global health care of the critically ill in low-resource settings. Ann Am Thorac Soc 2013;10:509-13.
9. Asiimwe SB, Abdallah A, Ssekitoleko R. A simple prognostic index based on admission vital signs data among patients with sepsis in a resource-limited setting. Crit Care 2015;19:86.
10. Stenhouse C, Coates S, Tivey M, Allsop P, Parker T. Prospective evaluation of a modified early warning score to aid earlier detection of patients developing critical illness on a general surgical ward. BJA Br J Anaesth 2000;84:663.
11. Burch VC, Tarr G, Morroni C. Modified early warning score predicts the need for hospital admission and inhospital mortality. Emerg Med J 2008;25:674-8.
12. Kruisselbrink R, Kwizera A, Crowther M, Fox-Robichaud A, O'Shea T, Nakibuuka J, *et al.* Modified early warning score (MEWS) identifies critical illness among ward patients in a resource restricted setting in Kampala, Uganda: A Prospective observational study. PLoS One 2016;11:e0151408.
13. Goodacre S, Turner J, Nicholl J. Prediction of mortality among emergency medical admissions. Emerg Med J 2006;23:372-5.
14. Ha DT, Dang TQ, Tran NV, Vo NY, Nguyen ND, Nguyen TV, *et al.* Prognostic performance of the rapid emergency medicine score (REMS) and worthing physiological scoring system (WPS) in emergency department. Int J Emerg Med 2015;8:18.
15. Olsson T, Terent A, Lind L. Rapid emergency medicine score: A new prognostic tool for in-hospital mortality in nonsurgical emergency department patients. J Intern Med 2004;255:579-87.