Confusion Matrices To Refine A Novel Scoring System For Cardiovascular Instability In Intensive Care

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Introduction

Cardiovascular instability is common in intensive care. It can be as a result of the primary disease process or secondary to therapeutic interventions e.g. sedation. It is often described in the literature yet is poorly defined and difficult to quantify. We have devised novel qualitative and quantitative scores for cardiovascular instability. Charting of clinical information at Glasgow Royal Infirmary is now done electronically. This allows the analysis of significant quantities of physiological data at frequent intervals on a scale which would have previously been impractical.

Methods

We have devised a numerical rule base which subsequently categorises patients from A (stable) to E (highly unstable) according to the degree of derangement of a range of physiological parameters taking into account the amount of sedation or inotropic support[1].

The parameters include heart rate, mean arterial pressure, central venous pressure, inspired oxygen concentration and oxygen saturation. A computer programme has been designed to interrogate a patient record of parameters and predict a level of stability based on the rule system. Time points are hourly throughout the patient stay in intensive care.

Clinicians (without any knowledge of the numerical rules) have been asked to score the same patient record from A to E at the same time points.

Results

The results have been incorporated into a confusion matrix which compares the scores given by the clinician with the scores predicted by the computer programme. A diagonal line from top left to bottom right in an example of a matrix (see figure 1) represents complete agreement between the predicted score and the expert clinical opinion.

Time points where discrepancy exists are subsequently analysed and if they occur frequently then a refinement is made to the rule base and the data set interrogated again the aim being to produce a rule base which can as accurately as possible predict the expert opinion.

Conclusions

When validated this tool will be able to be used at the bedside to give an indication as to the cardiovascular stability of a patient in intensive care.

Fig.1 Example of a confusion matrix

	Expected: A	Expected: B	Expected: C	Expected: D	Expected: E	Expected: (none)
Observed: A	90 % 181 of 202	4 % 9 of 202	1 % 3 of 202	(none)	0 % 1 of 202	4 % 8 of 202
Observed: B	0 % 4 of 1053	96 % 1014 of 1053	2 % 22 of 1053	0 % 4 of 1053	0 % 2 of 1053	1 % 7 of 1053
Observed: C	(none)	4 % 22 of 533	87 % 462 of 533	6 % 34 of 533	0 % 1 of 533	3 % 14 of 533
Observed: D	(none)	2 % 6 of 360	8 % 29 of 360	83 % 297 of 360	2 % 6 of 360	6 % 22 of 360
Observed: E	(none)	4 % 20 of 540	2 % 11 of 540	12 % 67 of 540	78 % 423 of 540	4 % 19 of 540
Observed: (none)	(none)	22 % 16 of 73	4 % 3 of 73	8 % 6 of 73	1 % 1 of 73	64 % 47 of 73

References

[1] Moss L., Sleeman D., Kinsella J. and Sim M.A.B. ACHE: an Architecture for Clinical Hypothesis Examination. Proceedings of CBMS 2008: 21st IEEE International Symposium on Computer-Based Medical Systems.