

Evaluation of the Early Warning Sign System in adult Anorexia Nervosa inpatients: A validation of the MARSIPAN-based Modified Early Warning Sign System - A preliminary report

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SUMMARY ABSTRACT

We aimed to evaluate the validity of the MARSIPAN-guidance-adapted Early Warning Sign system (MEWS) that is currently in operation in the inpatient ward for Adult Eating disorders and compare it to the National Early warning sign System and the PREDIX instrument, to ascertain whether current CPFT practice is comparable to best-practice standards. In this preliminary report in about 45% of the final sample, the MEWS system showed higher ROC AUC compared to the other instruments, indicating that is more suitable for use in the particular inpatient eating disorder population. We discuss the challenges of creating an appropriate and valid Early Warning Sign System (EWS) and determining 'caseness' in such validation process. We also discuss the next steps for completion and dissemination of our project and the expected impact.

INTRODUCTION

The National Early Warning Signs system (NEWS) was developed in 2012 to provide "a basis for a unified and systematic approach to the first assessment of acutely ill patients and a simple track-and-trigger system for monitoring clinical progress for all patients in hospitals" (National Clinical Effectiveness Committee). However, those guidelines were tailored for the general populations who have markedly different physiological responses compared to the severe anorexia nervosa patients of the inpatient eating disorders setting. Across the UK it has been repeatedly observed that recognition of deteriorating patients is weak, while the importance of physical observations in the inpatient settings is often underestimated (National Institute of Health and Clinical Excellence, 2007). In an attempt to develop such specialized guideline the MARS MEWS were created by the PRIORY group (McCluskey and Robinson, 2015), based on the Guide for medical management of eating disorders (Treasure, 2009) and the Physical Risk in Eating Disorders Index (PREDIX) (Jones et al., 2013). The MARS MEWS were consecutively adopted by S3 Eating Disorders Service of Cambridge and Peterborough NHS Foundation Trust as best practice and replaced the NEWS. While CPFT have adopted the MARS MEWS guideline there still remains the question of whether the tool is valid and whether it is appropriate for use in an Eating disorder inpatient setting. An evaluation of the system current in operation (MARS MEWS) as well as the comparison with the nationally validated instruments is required to assess if current CPFT practice is keeping in line with clinical safety standards and whether there is room for improvement with the use of an alternative track-and-trigger system.

METHODS

We collected observations and clinical anonymised data from S3 Ward during 1 year period of 1st May 2017 to 30th April 2018 inclusive. We made no new measurements for the purposes of this project; all measurements were performed for the routine care of the patients. Data collection was done retrospectively in two rounds. In the first round, we collected physiological parameters i.e. Body-mass index (BMI), Pulse Rate/Heart rate, systolic blood pressure (BP), Blood glucose measurement (BM), Respiratory Rate (RR), oxygen saturation (SO₂%) Temperature (T), alertness (AVPU) and postural BP drop that enabled the MEWS scoring. We also collected scores of blood investigations already done for clinical purposes including: Full Blood Count (FBC), Liver function tests (LFTs), Urea and Electrolytes, Bone profile, Muscle CK. We collected a total of 4049 observations from 36 individuals. No case of non-alertness was identified (VPU) and this parameter was not further examined in the analysis. At the second round of data collection, we gathered independent clinical rates of the patients' medical risk for that period to use as gold-standard guide for critical 'caseness', defined as the requirement for medical review indicating a medically deteriorating case. Three independent experienced raters (all three at Consultant level, two Eating Disorder Specialists and one General Adult Psychiatrist with experience in EWS) accessed the patient RIO electronic records and scored 'caseness' as a binary outcome for each time point of each observation made in the 1 year period. Ultimate 'caseness' for the analysis was determined by majority vote between the three raters. The comparative analysis between EWS systems was done by measuring the Area Under the Curve of the Receiver-Operating Characteristic curve for determining 'caseness'. For this report, a total of 1819 rated observations was used (45% of sample total). We also calculated inter-rater reliability by the use of Inter-class correlation between raters. Analysis and plotting was done in statistical software R with the use of packages "pROC", "irr", "ROCR" and "ggplots". The project was approved by the CPFT Quality Improvement Committee as a service evaluation project.

RESULTS

In this preliminary sample (45% of total) the MEWS (ROC AUC 0.96) outperformed the other systems. The performance of NEWS was similar to the expected national standard (ROC AUC 85 vs 89) (Royal College of Physicians). The PREDIX instrument performed the worst. The results from comparing the different systems are presented below:

Table 1 – Receiver Operating Characteristic Area under the Curve for different systems

	Majority vote	Rater 1	Rater 2	Rater 3
MEWS	0.963	0.971	0.938	0.852
NEWS	0.848	0.823	0.865	0.713
PREDIX	0.774	0.755	0.773	0.700

Legend: All scores are Receiver Operating Characteristic Area under the Curve

We also performed an exploratory analysis of our different physiological parameters in relation to BMI; we were able to visually demonstrate a variability of physiological parameters in relation to body weight (Figure 1); thus altered physiology (BP and HR) was demonstrably shown in our population.

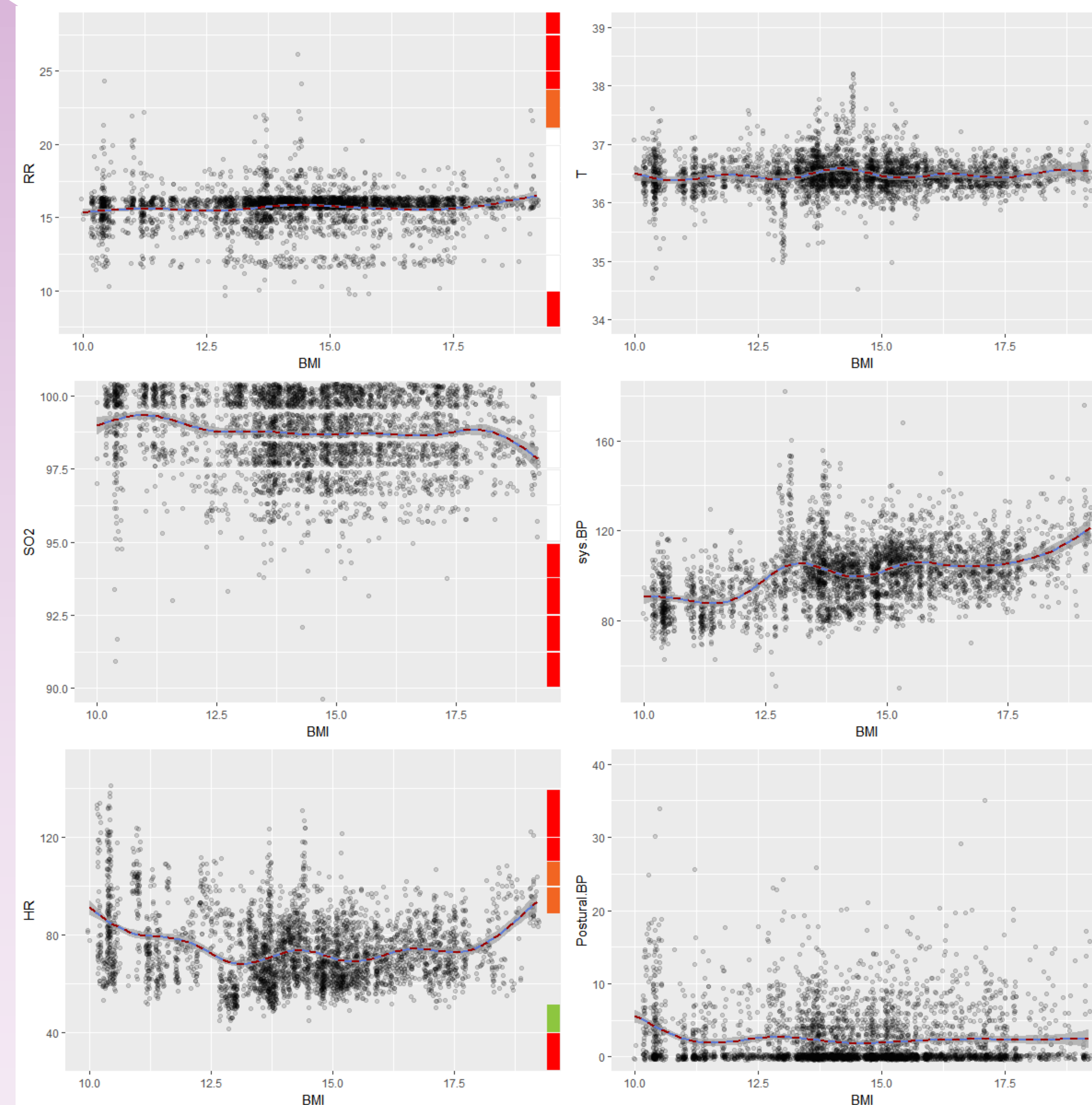


Figure 1—Physiological parameters correlated with BMI; colour coding on the right side indicates MARS MEWS scores; those exploratory plots are demonstrating physiological adaptations of monitored parameters in response to starvation and low BMI. The dotted lines are *general additive models* (no assumption of linear correlation) with confidence intervals (grey shaded areas). Jitter and alpha (opacity) parameters were used to optimize the visualization of data. RR = Respiratory rate; SO₂ = Oxygen Saturation; HR = Heart rate; T = Temperature; sys.BP = systolic blood pressure; Postural BP = Blood pressure postural drop

Receiver-Operator Curve of Early Warning sign Systems

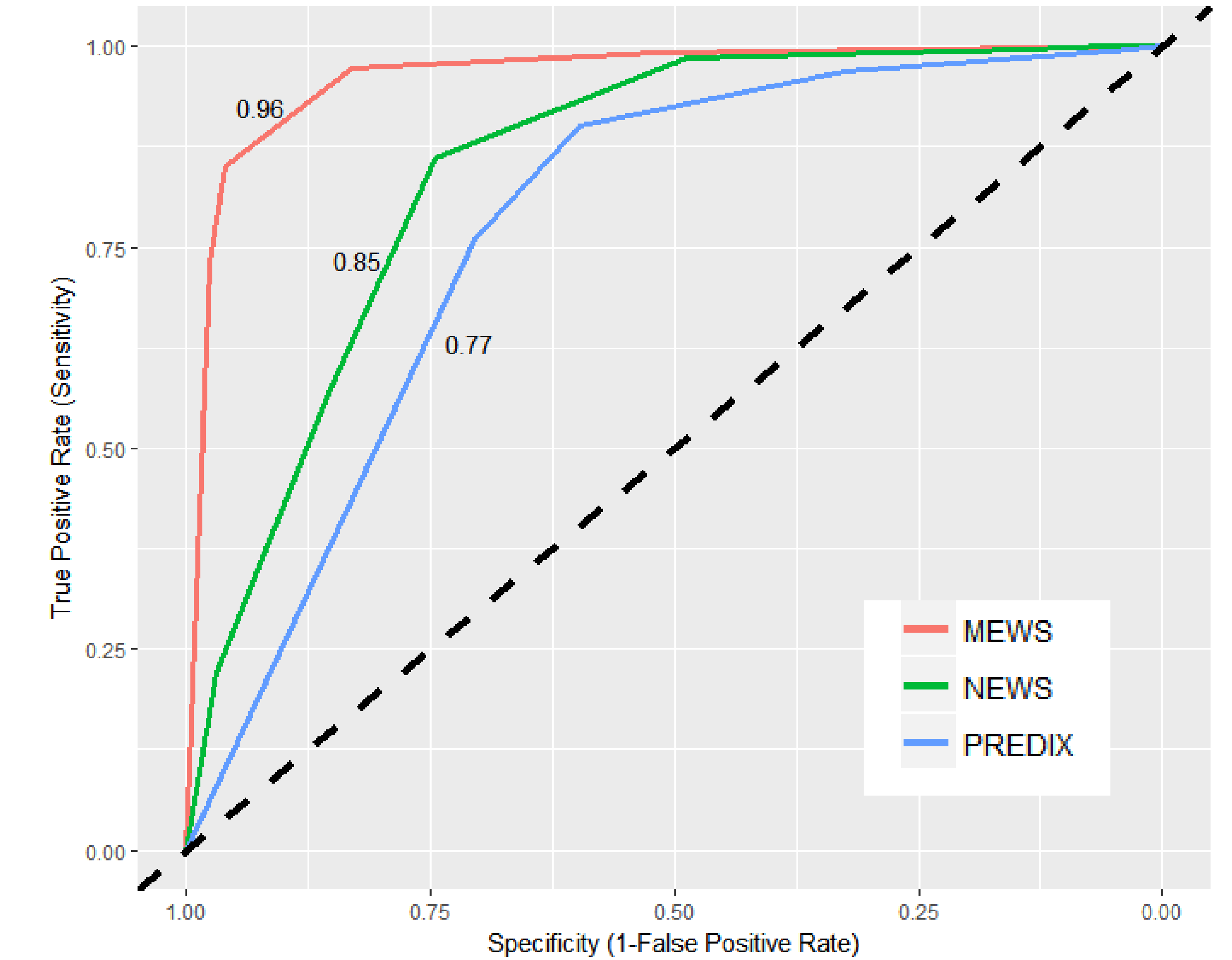


Figure 2—ROC curves: preliminary results from 1819 rated observations

DISCUSSION

This is the first study to ever examine the validity of an Early Warning sign system in a Specialised Eating Disorder inpatient treatment facility. Our preliminary results indicate that the MEWS system currently in operation on the ward produces a higher AUC compared to the national standardised tools. This is suggestive that the MARSIPAN based adapted system could be a valuable tool for eating disorder units nationwide. The low performance of PREDIX might be due to the fact that the tool was developed for determining medical risk in the community. The moderate inter-rater reliability is a limitation for the study, however, MEWS outperformed NEWS and PREDIX even when individual ratings (not majority vote) was used for 'caseness'. Another limitation comes from our definition of 'caseness' (see methods); while previous work on EWS utilized patient death within 24h as 'caseness' outcome, this would not be feasible in our study, as death occurrences within eating disorder units are a massively rare event. While the results need to be confirmed at the full sample, the preliminary report is highly encouraging that this work can operate as a springboard for the development of a valid EWS system that can be used nationally in Eating Disorder inpatient services and more widely.

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