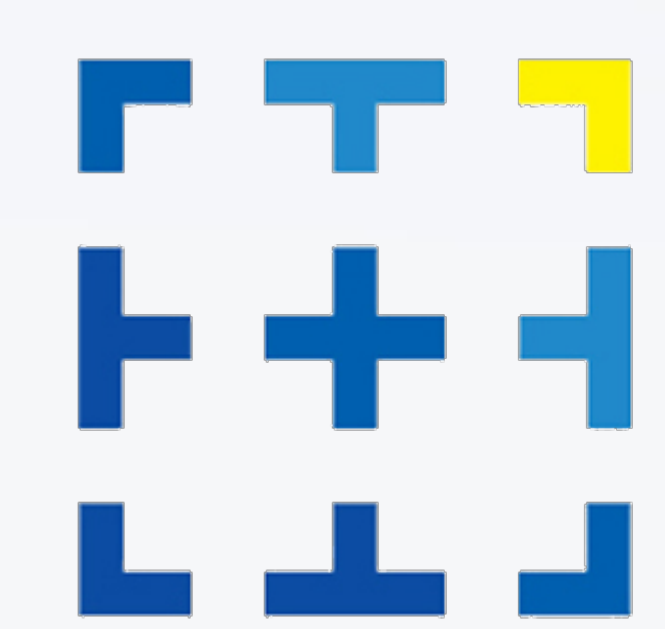




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An innovative electronic method of monitoring patients - **MEDIWARN**



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INTRODUCTION

The progress of patients in hospital is monitored by a form of an Early Warning Score (EWS) in most centres. This is done manually by nurses, and is limited by human factors such as errors, subjectivity, fatigue, costs etc. Furthermore, the score needs proper interpretation, usually by young inexperienced doctors.

AIM

We aim to develop an electronic system that both captures and analyses patient clinical data in order to predict better which patients would deteriorate. This system has been termed as 'MEDIWARN', as part of an INTERREG Italia-Malta 2014 – 2020 project.

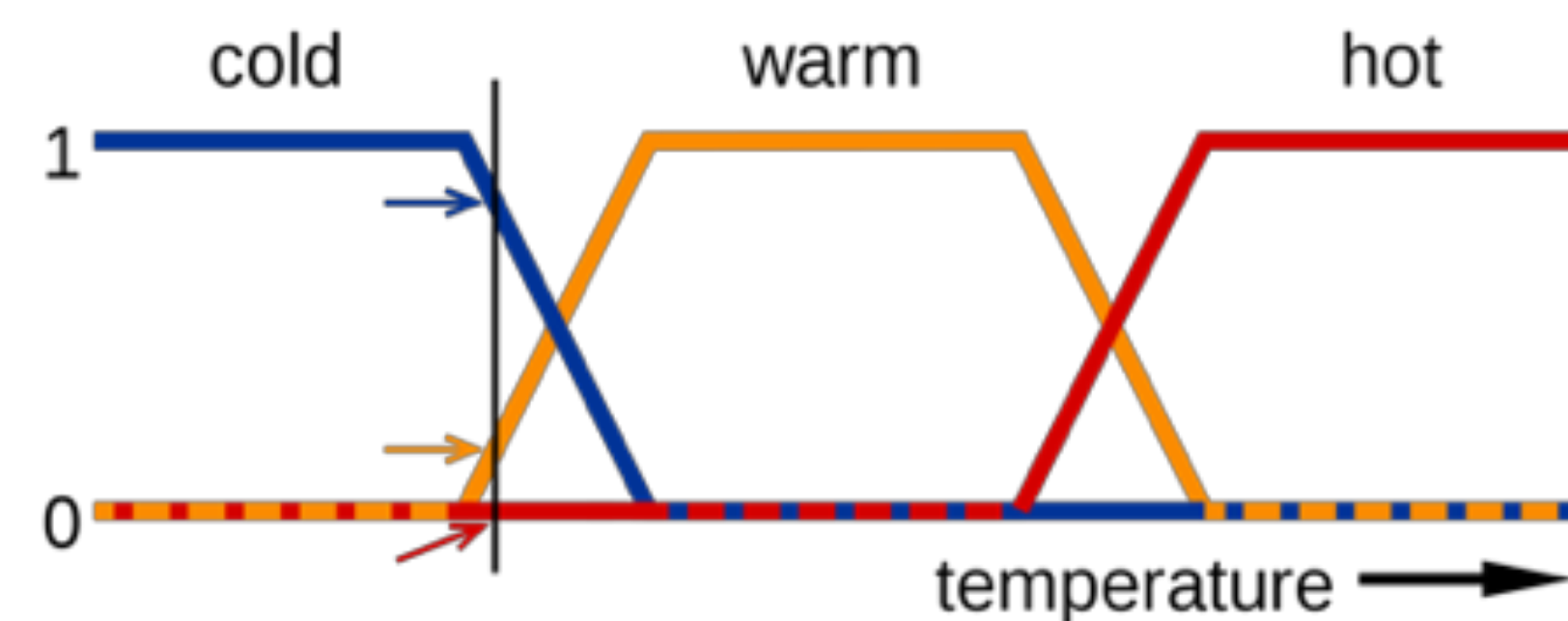
METHOD

The MEDIWARN algorithm was developed with the use of fuzzy logic. Fuzzy logic is an approach to computing based on "degrees of truth" rather than the usual "true or false" (1 or 0) Boolean logic on which the modern computer is based. Hence, parameters are weighted, and this weighting depends on a set of rules. It is based on the observation that people make decisions based on imprecise and non-numerical information. (Figure 1)

Phase I of the project involved setting up such rules for interpretation of the clinical parameters of the patient, and testing these on a simulator (SimMan 3G, Laerdal, Norway).

Phase II of the project involved using testing MEDIWARN against clinical data. Data is being collected with the use of Philips MP5 Intellivue patient monitors, interfaced to a Raspberry Pi 4. Data is being analysed with LabVIEW™, and compared to a traditional EWS (Figure 2).

Figure 1: Basics of Fuzzy logic



RESULTS

Both simulations and validation against clinical data show that MEDIWARN is able to predict events in a timely manner, whilst also reducing false alarms.

During Phase I of the study, five parameters were chosen: Heart Rate variability, Systolic Blood pressure, Respiratory rate, and temperature.

The fuzzy logic rules were constructed by matching pairs of these parameters (Figure 3, 4), so that the output reflects the interaction of these parameters (Figure 5).

During Phase II, which is still ongoing, two clinical centres are using the MEDIWARN to collect data for clinical validation. So far, data from batched of 200 patients are being analysed in order to optimise the algorithm.

One case that shows the use of MEDIWARN is shown in Figure 6, for patient 29. The EWS was persistently high, due to a respiratory rate of 26. The MEDIWARN score was lower, as it integrated the respiratory rate with saturation, and with heart rate and blood pressure. It only rose when the respiratory rate kept increasing, and saturation dropped.

Figure 2: An example of an Early Warning Score system

National Early Warning Score (NEWS)*									
PHYSIOLOGICAL PARAMETERS	3	2	1	0	1	2	3		
Respiration Rate	≤8		9 - 11	12 - 20		21 - 24	≥25		
Oxygen Saturations	≤91	92 - 93	94 - 95	≥96					
Any Supplemental Oxygen		Yes		No					
Temperature	≤35.0	35.1 - 36.0	36.1 - 36.0	36.1 - 36.0	36.1 - 36.0	≥39.1			
Systolic BP	≤90	91 - 100	101 - 110	111 - 219			≥220		
Heart Rate	≤40	41 - 50	51 - 90	91 - 110	111 - 130	≥131			
Level of Consciousness				A			V, P, or U		

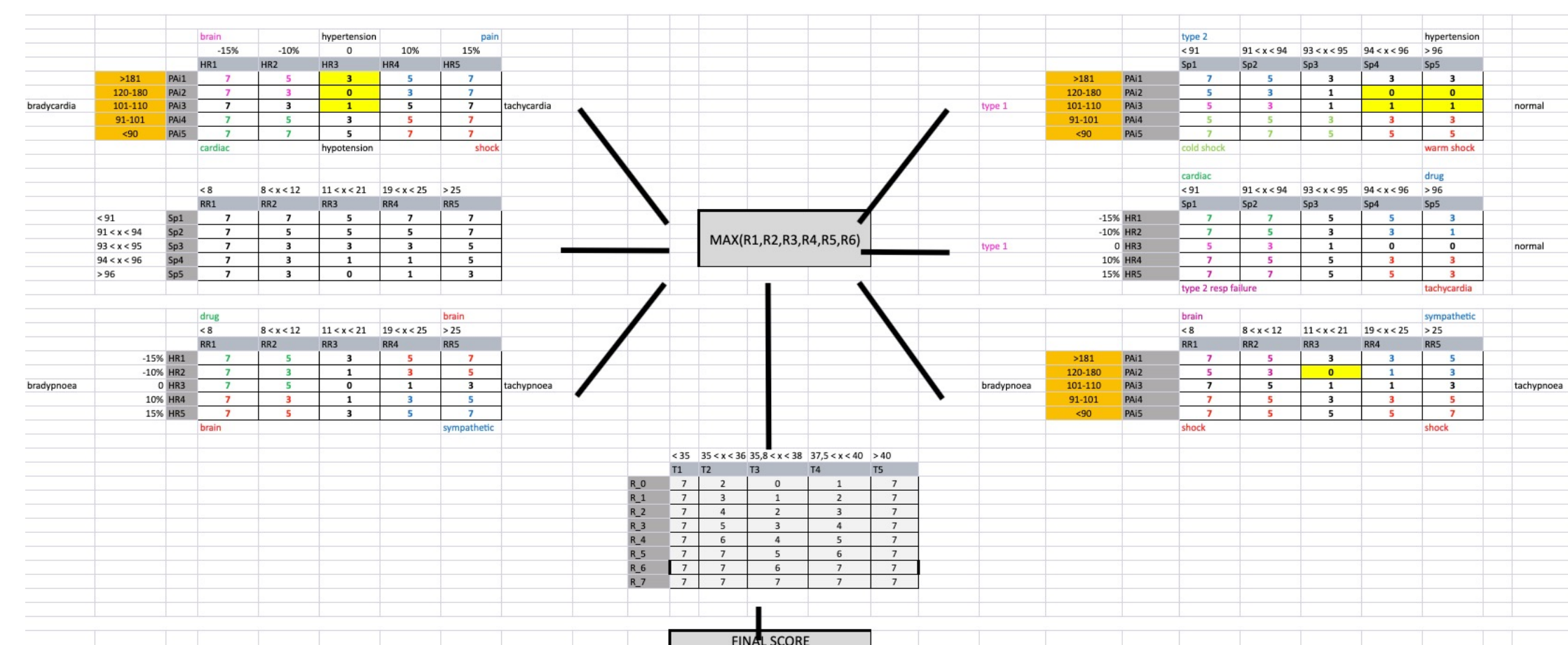


Figure 4: Fuzzy logic tables used in in MEDIWARN

Figure 3: Fuzzy logic as prepared in LabVIEW™

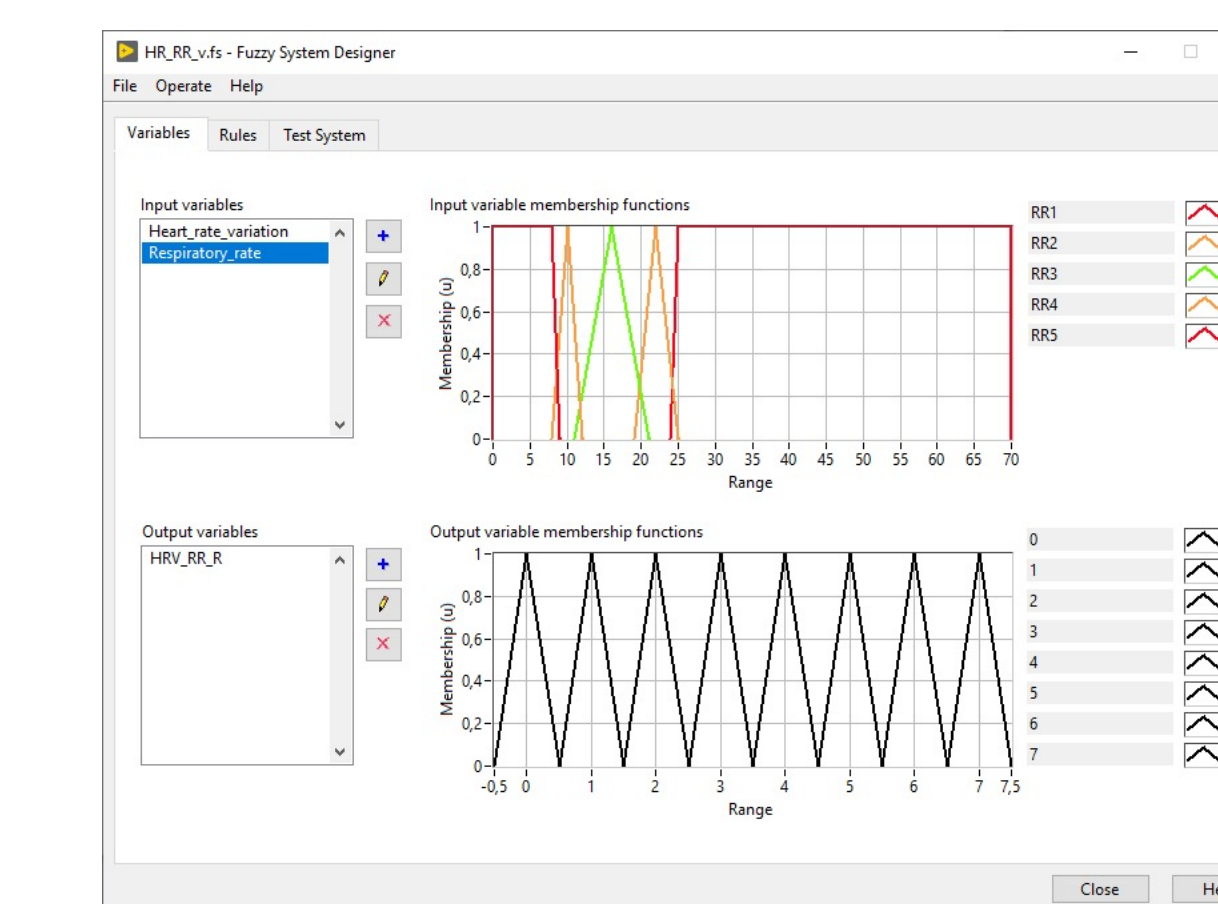
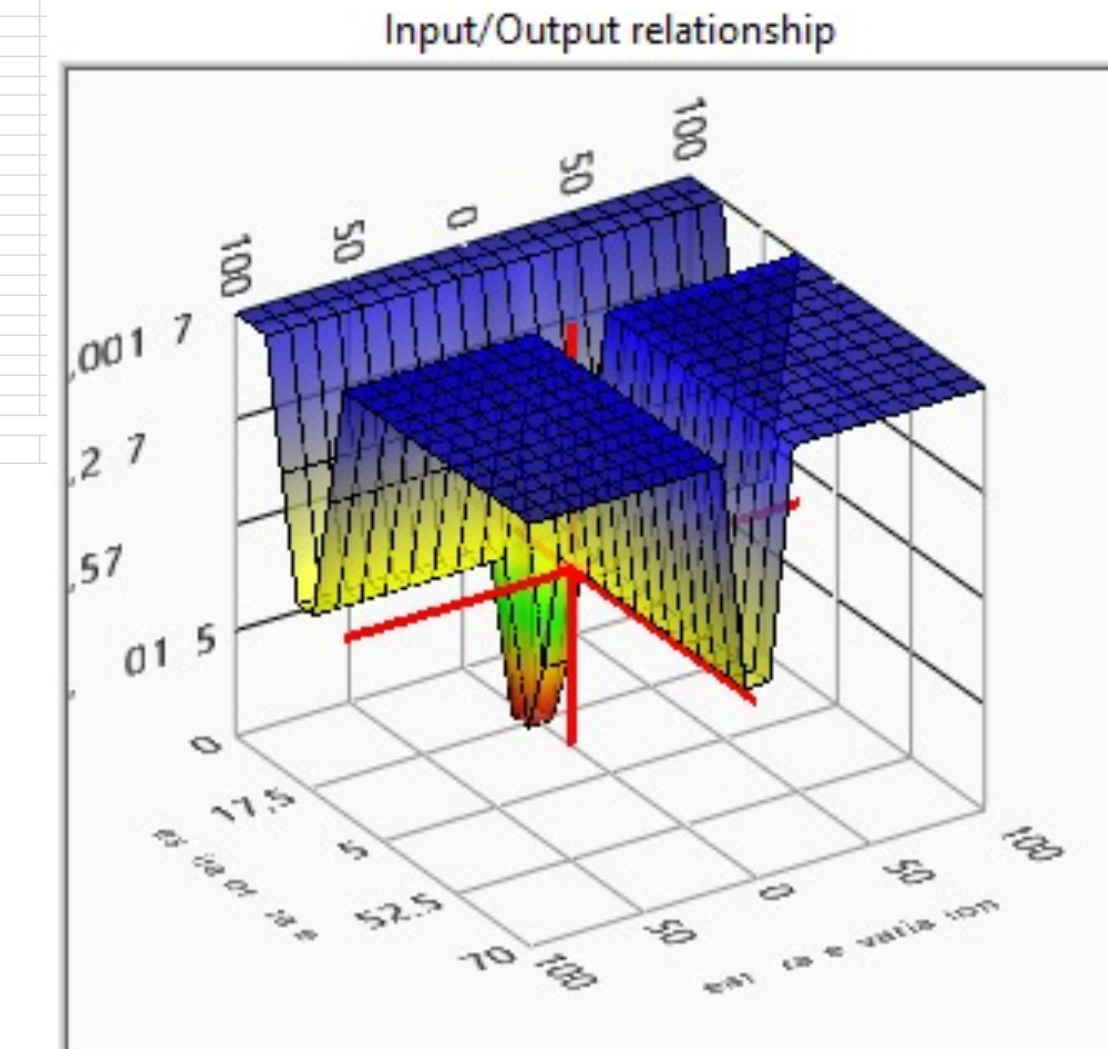


Figure 5: Output of interaction between pair of parameters in MEDIWARN



Progression of MEDIWARN vs EWS in actual case study

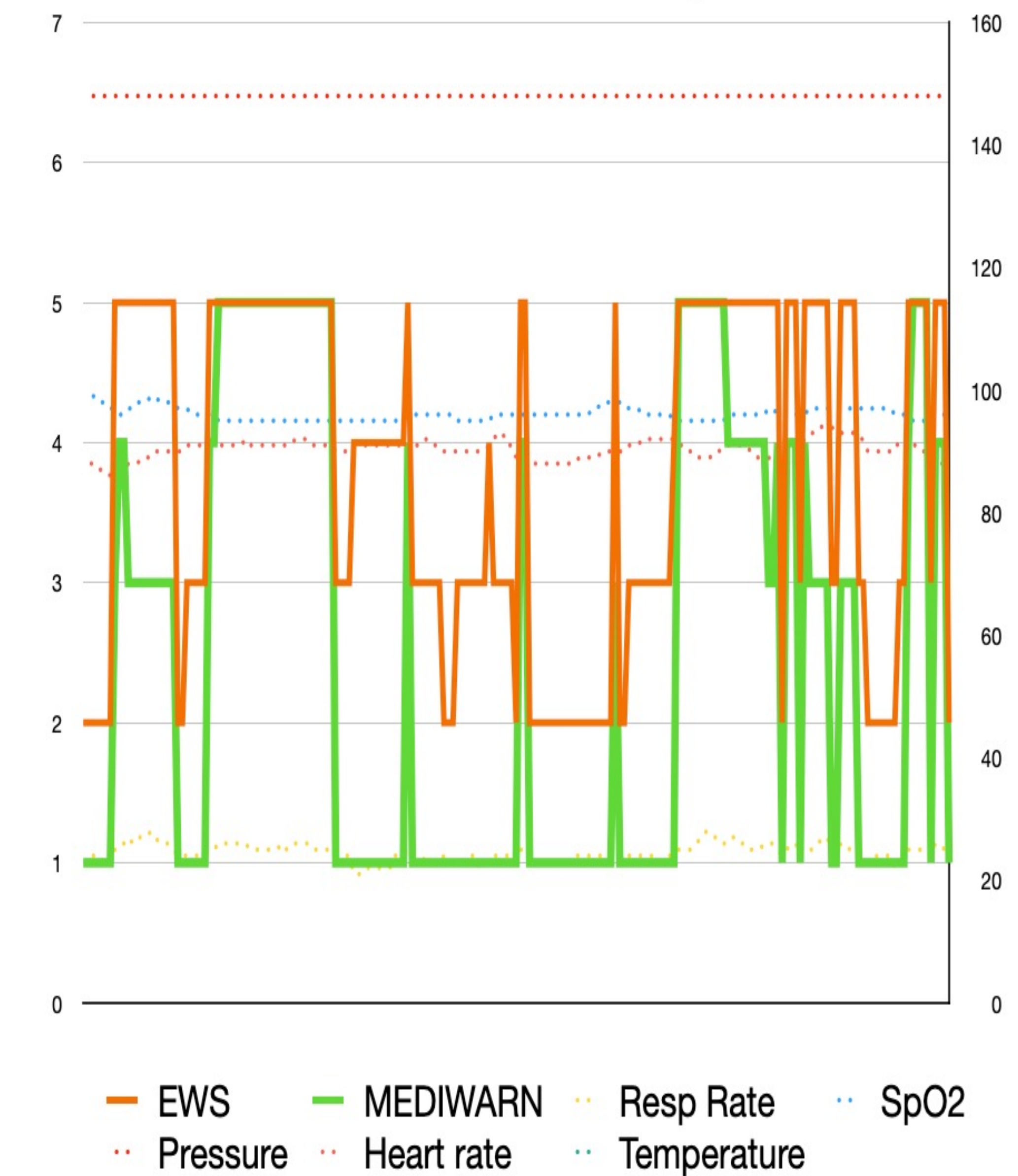


Figure 6: Comparison of EWS and MEDIWARN

CONCLUSIONS

This innovative project will be advantageous to traditional methods to detect timely intervention in deteriorating patients, in acute medical and surgical wards. This quasi automatic system will also help in reducing staff and medical costs.

More research is needed to optimise the algorithm, and to elucidate which patients would benefit more from such a system.

FUNDING

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https://mediwarn.net