

## **A Mixed-methods Investigation of Health Professionals' Perceptions of a Physiological Track and Trigger System**

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### **Abstract**

**Background** Physiological track and trigger systems (PTTSs) regulate the monitoring of patients' vital signs and facilitate the detection and treatment of deteriorating patients.

These systems are widely used although compliance with protocol is often poor.

**Objective** This study aimed to examine perceptions of a national PTTS amongst nurses and doctors and to identify variables that impact upon intention to comply with protocol.

**Methods** A mixed-methods research design was employed. During the initial qualitative phase, 30 hospital-based nurses and doctors participated in a series of semi-structured interviews. During the subsequent quantitative phase, 215 nurses and doctors (24.1% response rate) responded to a questionnaire designed to assess attitudes towards the PTTS and factors that influence adherence to protocol. **Results** Interview data revealed largely positive attitudes towards the PTTS but highlighted a number of barriers to its implementation and indicated that it is sometimes a source of tension between doctors and nurses. Quantitative data confirmed the validity of these findings although nurses appeared to have more positive attitudes towards, and to perceive fewer barriers to, PTTS usage than were reported by the participating doctors. **Conclusions** These findings reveal that non-compliance with PTTS protocol is unlikely to be attributable to negative perceptions of PTTSs. Instead, there are a number of barriers to the implementation of the system. These findings suggest that interprofessional training in PTTSs is essential while increased support for PTTS implementation among senior doctors would also yield improved adherence to protocol.

## Introduction

The incidence of unexpected in-hospital death has been reported to be 9.51 patients per 1000 admissions.<sup>1</sup> Research has shown that abnormal physiological functioning precedes the onset of such critical illness.<sup>2-5</sup> However, audits conducted in the UK have suggested that nurses and doctors often fail to observe or respond to the signs of patient deterioration.<sup>6,7</sup>

Such findings have prompted the development of physiological track and trigger systems (PTTS). PTTSs are monitoring systems intended to facilitate the identification of patients at-risk for worsening outcomes (track) through the monitoring of physiological signs, and to ensure that these patients receive appropriate care (trigger).<sup>8</sup> These systems are widely implemented, with over 85% of UK emergency departments using PTTSs.<sup>9</sup> Findings from a systematic review<sup>10</sup> of research examining the impact of PTTSs were mixed, although a trend towards more positive patient outcomes with PTTS use was noted. These systems have been criticised for low sensitivity and specificity, and frequent misapplication that creates an increased workload for doctors, resulting in an ineffective means of identification of patient deterioration.<sup>11</sup> It is thus perhaps unsurprising that compliance with PTTSs has been found to be poor.<sup>12-14</sup>

A number of research studies have examined the perception of PTTSs among nurses and yielded conflicting findings. Nurses report positive attitudes towards PTTSs and identify benefits such as improved interprofessional communication, and easier prioritisation of deteriorating patients.<sup>15,16</sup> However, other studies have identified negative attitudes towards PTTSs with criticisms including the excessive time

required to comply with protocol, questions about effectiveness, and the exclusion of clinical judgement from patient care.<sup>8,17</sup>

There has been an increased focus on PTTs in the Republic of Ireland recently as a result of widespread national and international coverage of a maternal death in which the non-monitoring of vital signs was identified as a contributor to the patient's death.<sup>18</sup> The current study used a mixed-methods approach to examine health professionals' attitudes towards a PTTs in use in the Republic of Ireland and to identify factors that impact upon intention to use the system.

## **Method**

### **Physiological Track and Trigger System Intervention**

The National Early Warning Score (NEWS) was launched in the Republic of Ireland in 2013. Adapted from the Vitalpac<sup>TM</sup> Early Warning Score (ViEWS; for information on adaptations, see Smith et al.),<sup>19</sup> and distinct from the similarly named system used in the UK,<sup>19</sup> this PTTs requires the observation of a patient's specific vital signs.

These observations are respiratory rate, oxygen saturation and inspiration, heart rate, blood pressure, temperature, and level of consciousness.<sup>20</sup> Clinical guidelines dictate appropriate observation of vital signs, escalation of patient care, and emergency response systems. Higher NEWS values mandate a specific response from nursing and medical staff. For example, a score greater than seven requires immediate review of the patient by a senior doctor and a minimum observation frequency of 30 minutes.<sup>21</sup> NEWS protocol allows for the parameters (i.e., trigger values for specific vital signs) to be adjusted for individual patients by more senior doctors. This flexibility is built into the protocol to account for patients for whom abnormal

baseline vital signs are to be expected (e.g., patients with chronic obstructive airways disease or chronic asymptomatic hypotension) and to ensure that such patients are not continually triggering the PTTS in the absence of deterioration.

Clinical communication is facilitated by a structured communication tool based upon Identify-Situation-Background-Assessment-Recommendation (ISBAR).<sup>22</sup> Doctors and nurses receive formal training in the NEWS- generally as independent professional groups.<sup>23</sup> Attendance at training sessions is not mandatory, and an e-learning education program is also available.<sup>24</sup> Implementation of the NEWS across Irish hospitals is intended to be standardised although there are modifications to the forms made by specific hospitals.

### **Design and Setting**

This study employed a mixed-methods design. During the initial qualitative phase, healthcare professionals from one large Irish teaching hospital (>700 beds) participated in semi-structured interviews.

The subsequent quantitative phase employed a survey design. During this phase, a questionnaire was circulated to staff at two Irish teaching hospitals (both with >700 beds), one of which was the hospital that had participated in the first phase, in order to investigate staff perception of the NEWS more widely. The participating hospitals were selected as they both have an intern education programme, were comparable in terms of numbers and types of patients treated, and were early adopters of the NEWS. These hospitals were considered comparable to, and representative of, other large Irish teaching hospitals.

## **Ethical Consideration**

Ethical approval was obtained from the participating hospitals.

## **Qualitative Phase**

### ***Participants***

Thirty individuals were interviewed during the qualitative phase. The participants included 18 interns (the first year of postgraduate medical training; 10 males; 8 females), two more senior Non-Consultant Hospital Doctors (NCHDs; both male), and 10 nurses (all female). Nurses varied in their clinical experience; two had less than five years of experience, four had between 5 and 10 years of experience, and four had more than 10 years of experience.

### ***Interview Design***

The semi-structured interviews (see Data Supplement 1) were developed based upon the Theory of Planned Behaviour (TPB)<sup>25,26</sup> and piloted with two doctors and one nurse. The TPB is a psychological model intended to explain and predict behaviour. It suggests that engagement in any behaviour is predicted by a person's intention to engage in the behaviour. The model explains behavioural intention as an outcome of the social perception of the behaviour (*subjective norms*), an individual's own perception of the behaviour (*attitude*), and the individual's perception of whether they can perform the behaviour (*perceived behavioural control*). The TPB was considered an appropriate model for use in the current study given that it has been successfully employed in the study of healthcare behaviours in previous research,<sup>27,28</sup> and prior research on perceptions of PTTs has suggested the TPB to be a pertinent model to the analysis of findings.<sup>29</sup>

### ***Data Collection***

Participants were recruited using judgment and snowball techniques. The initial participants were identified by an intern and they were asked to identify other potential participants. Interviews were conducted on-site by an intern and lasted between 15 and 20 minutes. A stopping criterion of two interviews was used per sample group. The stopping criterion refers to the number of interviews to be conducted per sample group without new themes emerging. The sample frame included nurses and NCHDs who were experienced in using the NEWS system.

### ***Data Analysis***

As part of the qualitative data analysis, all interviews were audio recorded and transcribed. The purpose of the analysis was twofold: (1) to carry out qualitative analysis of the content of the interviews using a TPB paradigm; and (2) to provide background data for the construction of a TPB questionnaire for use in the quantitative phase. A deductive content analysis approach<sup>30</sup> was used to analyse the data. Two researchers carried out the initial coding. Both read the transcripts, coded the interviews against the TPB framework, and compared their data until consistent coding was achieved. A researcher who was not involved in the initial analysis then examined the data for potential bias. The final coding was then considered and agreed by all three researchers. Disagreements were resolved by consensus.

## **Quantitative Phase**

### ***Participants***

A total of 215 health professionals completed the questionnaire. The participants included 80 nurses (17.4% response rate), 29 interns (20.3% response rate), 58 senior

NCHDs (23.7% response rate), 31 consultants (68.9% response rate) and 17 respondents who did not specify their position. Respondents worked in a variety of specialties, most commonly medicine (44.7%), surgery (16.3%), and anaesthetics (8.8%). Thirty-nine respondents (18.1%) reported that they had not received training on the NEWS. Of these, two were nurses (5.1%), two were interns (5.1%), 18 were senior NCHDs (46.2%), and 17 were consultants (43.6%).

### ***Questionnaire Development***

The 27-item TPB questionnaire (see Data Supplement 2) was developed from the interview data using the process outlined by Fishbein and Ajzen.<sup>31</sup> The questionnaire was piloted with four doctors and four nurses. Responses to the items were in the form of a five-point Likert scale from 1 (disagree strongly) to 5 (agree strongly). The questionnaire consisted of five subscales: subjective norms (6 items), attitudes (6 items), perceived behavioural control (3 items), behavioural intention (2 items), and perceived barriers (10 items). Information on participants' training in the use of the NEWS, medical speciality, and position at the hospital was also solicited.

### ***Data Collection***

During the quantitative phase, a link to a web-based version of the questionnaire was distributed to a sample of doctors and nurses via a staff email list.

### ***Data Analysis***

For the questionnaire data, Cronbach's alphas were calculated to determine the internal consistency of the subscales. Following this, subscales were scored by calculating the average score per item. Descriptive statistics were used to compare the

responses of nurses, interns, senior NCHDs (senior house officers and registrars), and consultants on each subscale. Following this, a multiple regression was conducted to examine the predictive validity of the TPB variables (i.e., subjective norms, attitudes, and perceived behavioural control) for intention to use the NEWS system (score on the intention subscale).

## Results

### Qualitative Phase

#### *Perceived usefulness of the physiological track and trigger system*

Most participants reported using the NEWS system as intended; to monitor patients for deterioration, to identify sepsis, and, for nurses, to determine when to seek a doctor's consult. Doctors also described using the system to gauge the severity of a patient's condition for triaging:

When I'm contacted to review a patient, I use [NEWS] to prioritise the urgency in which they need to be reviewed. (NCHD 2)

However, some physicians reported rarely using the NEWS and instead relying on their own clinical judgement:

I rarely take the total figure into account...I look at the readings as a whole and automatically develop my own opinion. (Intern 14)

Almost all participants suggested that clinical experience impacted upon the use of the NEWS. Participants suggested that greater experience was associated with use of clinical judgement, exercising discretion about when to seek consult, and less panicked reactions to elevated scores:

Senior nurses might see a high NEWS but use clinical judgement to assess the patient and inform the intern that, even though the NEWS is high, the patient is stable. (Nurse 4)

### ***Perceived impact of physiological track and trigger system on patient care***

Both doctors and nurses reported a positive impact of the NEWS on patient safety. Improvements in the quality of care included more frequent monitoring of patient vital signs, prioritisation of deteriorating patients, detection of ill patients more quickly and reliably, and the increased likelihood of deteriorating patients seeing a senior doctor:

[Patient care is] improved as the [NEWS] makes it very clear when a patient should be reviewed and when to consider transferring a patient to high dependency. (Nurse 5)

However, six doctors highlighted a number of negative impacts including: over-intervention; delays in patient review due to increased workloads; increased sensitivity but reduced specificity; and an increased rate of false positives. To illustrate, it was commented that:

NEWS has increased the number of interventions on patients including possibly unnecessary interventions as [doctors] feel under pressure to do something when called to review. (Intern 5)

### ***Perceived impact of physiological track and trigger system on teamworking***

Interns frequently cited the NEWS as a source of conflict between doctors and nurses. Criticisms of nurses included: the non-adherence to the escalation of care protocol; a focus on a patient's score rather than the full clinical picture; the poor communication

of patient information; the expectation of intervention in response to each call; a lack of understanding of doctors' workload; and the suggestion that nursing staff viewed the NEWS as a way of offloading responsibility. For example, an intern commented that:

Some nurses see [NEWS] as something where they ring you and then wash their hands- They've rung someone, anyone, so their job is now done. (Intern 5)

In contrast, nurses and senior doctors reported a positive impact of the NEWS on teamworking between interns and nurses:

It has resulted in improved communication skills on both sides... I have noticed this particularly when comparing the interns when they first started to now. (Nurse 2)

The NEWS was considered to have had minimal impact on the teamworking between nurses, or between doctors. Doctors reported that they rarely discussed the NEWS when communicating with one another but focused on the pertinent vital signs.

Interns did note, however, that the NEWS was beneficial during handovers and was a useful excuse for contacting more senior doctors:

It gives you a clear cut reason to contact someone more senior... they'll ask you why you called them and if the NEWS is high that can be the reason.

(Intern 6)

### ***Barriers to use of the physiological track and trigger system***

Only three participants did not report any deterrents to compliance with NEWS protocol. The primary barrier identified related to the adjustment of the trigger values for vital signs by registrars and consultants. Participants reported that parameters were

rarely reviewed, or adjusted, and that this was a continual problem for interns and nurses:

If parameters aren't charted you're expected to check the observation and inform the intern more than is necessary. (Nurse 4)

Other barriers included the view that adherence to the NEWS protocol was impaired, or impossible, due to insufficient staffing levels, or that the current protocol was too rigid and did not allow room for clinical judgement:

Particularly when on-call, the intern is often called to all NEWS scores, no matter how high, as the sole responder. If you're having a particularly busy night with reviews there is no real back-up (Intern 4)

Limits the clinical judgement of a nurse, it essentially removes it from the equation. (Nurse 8)

### ***Suggestions for improvement to current physiological track and trigger system***

The primary suggestion for improvements to the current system related to the adjusting of parameters, when required, for patients with recognised disease:

Increase the awareness among registrars/consultants about the need to chart parameters where appropriate. (Nurse 2)

However, participants also highlighted that increased staffing levels would allow for better adherence to the NEWS system:

The availability of staff overnight would improve the situation greatly as it would reduce the amount of reviews you get called to. (Intern 9)

The need for staff members to combine their clinical judgement with the NEWS and to refrain from communicating an isolated score in the absence of clinical information was emphasised. Other suggestions included specific alterations to the current

form/observation sheet and continued training in the NEWS system for all staff members.

***Willingness to comply with physiological track and trigger system***

In spite of the perceived deficits of the NEWS, participants also highlighted a number of variables that contributed to their willingness to use it. These included the effectiveness of the system as a means to monitor patients for deterioration, its pathway for referral to more senior personnel, that it provides easily comprehensible information, its usefulness for the detection of sepsis, the reassurance it provides as to stability of a patient's condition, the legal protection conferred by adherence to protocol, that it encourages the more appropriate review of severely ill patients by senior doctors, and its usefulness for triangulation. Fear was also noted as a reason for compliance with the NEWS system:

If you don't follow the NEWS and something goes wrong then the blame rests on you and you've got nothing to back you up...whereas, once you call you're protected. (Nurse 3)

***Intention to use***

All participants reported that they would continue to use the NEWS, although this intent was primarily attributed to the status of the NEWS system as hospital policy:

I will continue to use it as I'm currently using it unless the protocol changes as it's a requirement of my job and part of the hospital's policy. (Nurse 8)

## Quantitative Phase

Table 1 displays the Cronbach's alpha scores for each subscale and subscale scores separated by respondents' position at the hospital.

Table 1.

*Summary data for the questionnaire subscales*

Sub-scales	Alpha	Nurse		Intern		Senior non-consultant hospital doctor		Consultant	
		Mean per item	SD	Mean per item	SD	Mean per item	SD	Mean per item	SD
Subjective norms	0.63	3.87	.80	3.21	.83	3.02	.71	3.81	.71
Attitudes	0.91	4.22	.82	3.31	.98	2.71	1.06	4.29	.67
Perceived behavioural control	0.82	4.57	.73	4.07	.93	3.32	.99	3.86	1.14
Intention	0.53	4.16	1.03	4.30	.86	2.95	1.20	3.63	1.16
Barrier	0.78	2.77	.79	3.34	.58	3.41	.70	3.11	.81

Nurses expressed more positive attitudes towards the NEWS than doctors, scoring higher on subjective norms, attitudes, perceived behavioural control and intention.

Nurses also perceived fewer barriers to the use of the NEWS than were reported by doctors. Amongst doctors, consultants appeared to have more positive perceptions of the NEWS than were expressed by interns or senior NCHDs.

The multiple regression analysis (see Table 2) revealed that a model including subjective norms, attitude, and perceived behavioural control was a significant

predictor of behavioural intention,  $F(3,205)=54.31$ ,  $p<.001$ , and explained 44% of the variance in behavioural intention.

Table 2.

*Outcomes of Multiple Regression Analysis for Behavioural Intention.*

<b>Behavioural Intention</b>	<b>B</b>	<b>Standard Error</b>	<b><math>\beta</math></b>	<b><math>\Delta R^2</math></b>
1. Constant	.46	.29		
Subjective norms	.04	.10	.029	.44
Attitude	.23	.08	.21**	
Perceived Behavioural Control	.57	.08	.49***	

*Note.* \*significant at  $p\leq.05$ , \*\*significant at  $p\leq.01$ , \*\*\*significant at  $p\leq.001$

## Discussion

A consistent finding in studies addressing quality improvement in healthcare is that change is difficult to achieve.<sup>32</sup> The NEWS was implemented to enhance patient care and facilitate interprofessional communication. Our findings reveal predominantly positive attitudes towards the system, especially among nurses, but highlight that further consideration is required to realise its full potential for improved patient safety and quality of care. Issues with the system that need to be addressed include the impact of false positive scores on workload, the exclusion of clinical judgement from care, a lack of support from senior doctors, and a negative impact of NEWS on teamwork.

### Impact of ‘False Positives’

Interns, particularly those working night shifts, encounter a large number of ‘false positive’ patients when responding to elevated NEWS scores. PTTSs have been criticised previously due to issues of low specificity<sup>11</sup> and insufficient staffing levels

for compliance.<sup>8,33,34</sup> This increase in workload for junior doctors is further compounded by the failure by nurses to use appropriate escalation protocols, and the failure of senior doctors to alter the NEWS parameters for patients with abnormal baseline values who receive high scores in the absence of deterioration.<sup>16</sup> Consultants and registrars must become more proactive in reducing the frequency of such ‘false positive’ patients. The lack of willingness of these doctors to modify parameters has also been found in other research<sup>35</sup> and may stem from the high numbers of registrars and consultants that have not received training in the use of the NEWS and their role in its implementation, or a lack of awareness regarding the amount of time spent by interns responding to ‘false positive’ patients.

### **Clinical Judgement**

The belief that using the NEWS leads to a failure (particularly for nurses) to use clinical judgement is a common criticism of PTTs.<sup>8,17,35,36</sup> Participants in this study suggested that staff sometimes adhered to the NEWS protocol even when it conflicted with their own clinical judgement. The justification for such behaviour was the need to comply with hospital policy and protection in case of adverse events. However, it is stated in the clinical guidelines that the NEWS does not replace competent clinical judgment.<sup>20</sup> This ‘blind’ adherence to protocol is not unique to NEWS implementation, and is also likely related to the need for a ‘just culture’ in which staff are not blamed for ‘honest errors’.<sup>37</sup> A mechanism for encouraging nurses to use their clinical judgment in assessing patients may be to alter the NEWS such that nurses’ perceptions of changes in a patient’s condition contribute to the overall score.<sup>36</sup>

## **Teamworking**

The aim of the NEWS is to facilitate multi-disciplinary teamwork for enhanced patient outcomes.<sup>20</sup> However, as reported by previous research,<sup>8,35</sup> the PTTS appeared to negatively impact upon interns' perceptions of intern-nurse teamwork despite the perception of nurses and senior NCHDs that the system had a positive effect on interprofessional relations. Previous research has also identified discrepant perceptions of teamworking between nurses and doctors.<sup>38,39</sup> The negative perception of the NEWS' impact on intern-nurse teamwork was likely exacerbated by the provision of separate training for doctors and nurses at the induction of the NEWS and a lack of clarity regarding the roles and responsibilities of other team members in relation to the system. In order to foster teamworking, staff should be trained as a multi-disciplinary team rather than as separate groups. Such training may ameliorate interprofessional relations and may also improve nurses' understanding of an interns' workload, a key point of criticism leveraged by many of the participating interns.

## **Support from Senior Doctors**

A lack of participation by senior doctors was repeatedly implicated by participants as a barrier to NEWS compliance. Senior doctors play an essential role in the implementation of PTTSs, or arguably any new hospital protocol. In Irish hospitals, senior doctors are responsible for adjusting physiological parameters for individual patients whose baseline values deviate from norms, for responding to high NEWS scores, guiding the practice of junior doctors, and setting a culture of acceptance and use of the NEWS. Our data suggest that engagement with the NEWS by senior doctors is low, evident in their frequent non-attendance of related training and repeated failures to adjust parameters where appropriate. The low scores on the

subjective norms subscale among interns and senior NCHDs suggest that greater involvement of senior doctors in the support, and implementation, of the NEWS would likely engender greater support among other doctors.

### **Methodological Strengths and Weaknesses**

Strengths of this study are the inclusion of health professionals working in varied positions, across a range of specialities, and with differing levels of clinical experience and the use of a mixed-methods design. Previous research assessing perceptions of PTTSs<sup>8,15-17,29,35</sup> has focused upon nurses and utilised qualitative research methodologies alone. However, doctors play a critical role in the successful implementation of PTTSs and it is essential that the attitudes of these users are evaluated. The use of a mixed-methods approach allowed for the verification of the reliability and validity of data emerging from qualitative research methodologies in the context of a more rigorous experimental design and larger sample. However, there were also limitations to the current study.

First, the non-inclusion of consultants in the qualitative phase may be critiqued. Participation in the semi-structured interviews required 15 to 20 minutes and none of the consultants approached to take part could schedule sufficient time for this. However, almost 70% of consultants invited to partake in the quantitative phase participated and their responses are reported herein.

Next, the total response rate (24.1%) to the questionnaire may be considered a limitation. The average response rate to a web-based questionnaire is 40%,<sup>40</sup> however,

the response rates in the current study are not atypical for questionnaire studies conducted among medical professionals.<sup>41-43</sup>

The use of the TPB to guide interview and questionnaire development may also be critiqued. While the TPB has undergone extensive empirical evaluation, a meta-analysis suggests that the theory only explains 27% of the variance in behaviour and 39% of the variance in intention.<sup>44</sup> Such findings have led to the criticism of the TPB for failing to capture the true complexity of human behaviour. Moreover, additional variables that are not addressed by the theory include past behaviour and contextual or environmental factors (e.g. hospital policy, barriers to action).<sup>45,46</sup> In the current study, the TPB explained 44% of the variance in intention to comply but, given the barriers to compliance (e.g. understaffing, high workload), the relation between intention and behaviour may be less straightforward than predicted by the TPB.

Finally, the low Cronbach's alpha associated with the behavioural intention subscale may be criticised. This low alpha value likely results from the small number of subscale items. However, scholars have suggested that alpha values as low as 0.50 are acceptable and unlikely to impact unduly upon analyses.<sup>47</sup>

### **Future Research**

Future research may wish to target the impediments to compliance with PTTS protocol identified in the current study and to assess the impact of such interventions on compliance, and the sensitivity of the system. The development of normative physiological values (parameters) for patients with particular conditions associated

with atypical physiological functioning would also be a substantial contribution to the effective implementation of PTTSs.

### **Conclusions**

Methods for rapidly identifying deteriorating patients are vital to improving patient outcomes.<sup>34</sup> Although the current study found that doctors and nurses appreciate the potential of PTTSs, there are significant barriers to their implementation. Similar to other patient safety interventions, these barriers are related to the sociocultural aspects of introducing and embedding the new system into the current work practices and hospital culture. If the sociocultural aspects of the implementation of PTTSs fail to be addressed, the risk of failing to recognise deteriorating patients will remain.

**Conflict of Interest**

The authors declare that they have no conflicting interests.

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