

## **A Cross Sectional Survey of Nurses' Responses to Vital Sign Values in a University Teaching Hospital**

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### **Abstract**

**Background:** *Studies have shown that there were documented evidences of abnormal vital signs, without appropriate clinicians and nurses responses. We thus investigate the knowledge, and how nurses intend to respond to different combinations of vital signs values.*

**Methods:** *This study was carried out in Ladoke Akintola University of Technology Teaching Hospital Ogbomoso. Questionnaires were sent out to nurses to obtain relevant data regarding interpretation of vital sign values.*

**Results:** *Eighty questionnaires were analysed. The mean age of the respondents was 36.4 ( $\pm 5.27$ ) years. Nineteen (23.75%) respondents got correctly the normal range for all the vital signs and oxygen saturation. Seven (8.75%) respondents knew that pulse rate is the earliest vital sign to change in most deteriorating patients. Fifty-nine (73.75%) respondents considered oxygen saturation as reliable indicator of respiratory functions. Most respondents (78.73%) would not consider oxygen support until saturation fall below 90%. Seventy-five (93.75%) respondents could not identify correctly patients at risk of deterioration based on different combinations of set of vital sign values, SpO<sub>2</sub> and level of consciousness. Sixty-seven (83.75%) rated themselves to have good to excellent knowledge on vital signs and its interpretation, however, only 9 (11.25%) respondents have good comprehensive knowledge on interpretation of vital signs.*

**Conclusion:** *Majority of the respondents could not interpret vital sign values correctly. We suggest need for continuous nursing education to bridge this gap.*

**Keywords:** *Vital signs, interpretation, nurses, and responses.*

### **Introduction**

Nurses are traditionally dedicated to measure and monitor patients' vital signs in order to detect early deterioration of patients' clinical condition, when simple measures such as fluid replacement, adjustment of medications will be sufficient to prevent progressive catastrophic events. Early detection of patients at risk of deterioration through vital signs changes will help to recognise patient that requires more frequent monitoring or need for early admission into high dependency unit or intensive care unit and possible need to escalate treatment.

Most adverse outcomes are often preceded by changes in vital sign values [Sax & Charlson, 1994; Lee et al, 1995; Hands et al, 2005; Fagan, 2012] and in up to 80% of time prior to catastrophic outcomes [Ludikhuizen, 2012 8]. Thus, early detection of these changes will help reduce the number of adverse outcomes in hospitals. However, measurement of vital signs and documentation of measured values has been shown not to be necessarily led to appropriate responses and interventions from previous studies. [McGloin et al, 1999; Goldhill et al, 2001; Akanbi et al, 2017] Previous study have shown that patients' vital signs were often documented without corresponding competent clinical

responses [Fagan, 2012] called failure to act as coined by Hillman and reported to be responsible for about 11% of hospital deaths. [ Hillman et al, 2009]

A previous study on vital signs measurement has shown that nurses considered the measurement as overwhelming and time consuming [Rose & Clarke, 2010] but with recent introduction of electronic monitoring in most centres it is expected that the excessive workload imposed on the nurses by measuring vital signs ought to have been improved. Vital signs values are valuable and only useful when measured and interpreted correctly. This study thus investigates the knowledge, how nurses interpret, and intend to response to vital signs values, combination of set of vital sign values and suggest possible solution to overcome this aspect of patients' care.

## Methods

This study was carried out in Ladoke Akintola university of Technology Teaching hospital Ogbomoso over 3 months period. a questionnaire was designed by the authors to obtain relevant data. The data obtained included respondents bio data, year of qualification, years of being in practice as nurse. Information related to vital signs gotten from the respondents included their interpretation of different set of vital sign values and their intending action or response for different set of vital sign values. The data obtained were analysed with SPSS version 20 and were presented in form of table and chart.

## Results

A total of 106 questionnaires were sent out with 97 returned and 80 completed questionnaires were selected for the analysis after editing. The age range of the nurses was 22-59 years with mean age of 36.4 ( $\pm 5.27$ ). Other clinic-demographic parameters of the nurses in the study is as shown in table 1.

Assessment of each component of vital signs revealed that 19 (23.75%) out of the 80 respondents got the correct values of normal range of all the vital signs (Fig. 1)

Seven (8.8%) respondents knew that pulse rate is the earliest vital sign to change that may suggest patients' deterioration while 54 (67.5%), 6 (7.5%), and 13 (16.25%) of the respondents believed that blood pressure, respiratory rate and oxygen saturation ( $SpO_2$ ) were the earliest parameters to change respectively. This shows no statistically significant difference when respondents in different units were compared ( $p=0.2585$ ).

Seventeen (21.3%) out of the 80 respondents got the formula for pulse pressure correctly while 48 (60%) respondents got it wrong and 15 (18.8) respondents were not sure. Only 8 (10%) of the respondents got the interpretation of wide pulse pressure correctly. When the correctness of the interpretation of the pulse pressure were compared among those who got the formula correctly were compared to those who got it wrong or not sure there was no statistical significant difference between them as 5 (29.41%) of those who got it correctly got the correct interpretation as compared to 18 (28.57%) of those who got it wrongly or not sure ( $p = 0.8150$ ).

Fifty-nine (73.75%) out of the 80 respondents believed that oxygen saturation is very reliable indicator of respiratory functions. When nurses in different units were compared there was no statistically significant difference between the units ( $p = 0.1472$ ). Sixty-one (76.3%) respondents will not consider supplemental oxygen support until  $SpO_2$  fall to less than 90% though this shows a statistically significant difference when ICU nurses were compared to nurses in general wards, as all (8) the nurses in ICU will consider oxygen support once oxygen saturation fall below 90 and 93%.

Assessment of the respondents about the concepts of shock index revealed that only 3 (3.75%) of the respondents were able to interpret correctly possibility of presence of shock in a patient with clinical scenario that suggest shock despite normal blood pressure with shock index of 1.23. Correct interpretation of this concept shows no statistically significant difference between the nurses in different unit ( $p = 0.6734$ ).

Further assessment of knowledge of the respondents on interpretation of set of combination of vital signs for possible abnormalities revealed that only 5 (6.3%) out of the 80 respondents were able to identify all patients at risk of deterioration based on vital signs,  $SpO_2$  and level of consciousness. (Fig. 2).

None of the respondents had heard about the concept of Early Warning Scoring System however, 23 (28.8%) of the respondents were able to mention other scoring system to assess patients' risk or patients' risk of mortality in clinical settings. None of the respondents know up to 4 risk assessment scoring system. Only 7 (8.8%) of the respondents (One ICU and six theatre nurses) had previously assessed patients' risk throughout their practice, further analysis revealed that ASA and post-operative score (POS) were the only risk scores previously assessed by this respondent.

Sixty-seven (83.8%) of the respondents rated themselves to have either excellent or good comprehensive knowledge of vital signs and its interpretation however, only seven (8.8%) of the respondents have good comprehensive knowledge of vital signs based on their responses

## Discussion

Our study revealed that majority (91.3%) of the nurses have poor comprehensive knowledge about vital signs and its interpretations, a finding consistent with other previous reports [Van & Mitchell,2008; Soong & Soni ,2013; Chua, 2013] the depth of knowledge among various units shows no statistically significant difference. This failure of statistical significant difference among various units was surprising, as is ordinarily expected that the nurses in emergency department, theatre and ICU units are expected to have a better depth of knowledge and understanding about vital sign values assessment and interpretation as most of the patients in these units are traditionally considered as high risk patients based on their clinic-pathological conditions or emergency nature of their presentations. Emergency patients are considered as patients at risk because their admission is associated with limited background information especially in low- and middle-income countries where record keeping and data system are poor and thus patients' vital signs and its interpretation may be the only reliable data available for decision making. [Society of Critical Care Medicine ,2007] This becomes much more important for unconscious and confused patients.

Majority (76%) of the respondents will not considered oxygen support in patients until oxygen saturation fall below 90%. This finding on use of oxygen support simply reflects deficit of knowledge about oxygen saturation as adequate oxygen saturation has narrow range of normalcy between 95 and 100%. The concept of oxygen saturation is more than just number and the rate of fall does neither follow arithmetic nor geometric pattern of fall as reflected in oxygen haemoglobin dissociation curve. Most experts in critical care setting will consider oxygen support as oxygen saturation is getting below 93% as compared to below 90% most respondents favoured. Further assessment on oxygen saturation and respiratory function revealed that about 74% of the respondents believed that oxygen saturation is a good indicator of respiratory function and considered it to be a reliable marker of respiratory function, a finding similar to a study report [Cretikos ,2008] About 16% also believed that it is the earliest parameters to fall in patient at risk of deterioration. This is a great misconception as SpO<sub>2</sub> has been shown not to be reliable in assessing severity of illness [Goldhill & McNarry, 2004; Hodget,2002] as respiratory rate and depth of respiration may compensate for initial low oxygen saturation with subsequent maintenance of SpO<sub>2</sub> value within the range of normalcy. Respiratory rate and depth of respiration that measured ventilation which may not necessarily correlate with saturation may be more appropriate for assessment of respiratory functions, for early detection of patients at risk of deterioration.

Failure of most of the respondents to correctly interpret concept of shock index appropriately is a cause for concern especially in emergency setting when the only reliable evidence of stage one haemorrhagic shock is elevation of pulse rate secondary to cardiovascular response to fluid loss and thus raising the value of shock index greater than one. The importance of shock index in early recognition of shock is very important more especially in low- and middle-income countries where patients' pre-morbid blood pressures may not be known due to poor hospital record keeping system, as normal blood pressure does not preclude shock. Most of the nurses are more likely to wait for fall in BP prior to notification of the attending physicians as revealed by the study that about 58% of the respondents believed that is the first and earliest vital sign to change in deteriorating patients. A similar finding was previously reported in one study [ISQua ,2012] with little attention and possibly poor response to elevated pulse rate and respiratory rate that may actually signify earliest vital signs to change in patients with tendency to progressive deterioration, a finding in support of previous study

reports [Hillman, 2009; Chua et al, 2013]. Fall in blood pressure that would trigger respondents to call for doctors' attention in our study was also reported by Van and Michell [Van & Mitchell, 2008] as the main reason for calling attention of medical emergency team (MET). Fall in blood pressure level is a late sign as blood pressure is often maintained in initial phase of shock secondary to compensatory mechanisms [Hodget, 2002]. This misconception about blood pressure as the earliest vital sign to fall in patients with tendency to deteriorate, need to be corrected and be taken seriously during our routine ward rounds and at any available opportunity to do so by revisiting teaching on cardio-respiratory response to shock. Failure of recognition and communication has previously been identified as risk factor for failure-to-rescue (FTR) that was associated with increased adverse events in hospitalised patients.

The study further revealed that majority of the respondents were unable to integrate and interpret sets of combination of vital sign values correctly (fig, 2). In depth assessment of clinical scenario of combination of various values of PR, RR, T and BP revealed that about 76%, 59% and 66% respondents were unable to interpret; PR greater than 130/minute, RR greater than 35/minute and patients who responds to voice only without sedation respectively as patients at risk that need closed monitoring. Derangement of a single vital sign parameter beyond certain point has been shown to be significant factors that affect patient's outcomes and thus may indicate need for close monitoring or escalation of treatment. [RCP, 2012].

Interpretation and responses to vital sign values were undoubtedly poor among our respondents a finding associated with failure to identify and rescue patients at risk of adverse outcomes. Vital signs are complex physiological parameters that are often affected by so many factors other than the clinic-pathological condition of the patients. Thus, holistic approach to interpret a vital sign value in context of other vital sign values rather than interpretation in isolation may likely predict patient's outcome as derangement of vital signs rarely occur in isolation and when weighted to calculate a single score value will likely make the interpretation more easier. Recognition of this had led the Royal College of Physicians (RCP) to develop a colour coded scoring system called National Early Warning Score (NEWS) [RCP, 2012] that will help nurses, clinicians and member of emergency medical team to detect early and easily a deteriorating patient through a simple bed side physiological parameters with expected response and timely notification of clinician with appropriate clinical competency as shown in tables 2 and 3.

## **Conclusion**

The study revealed that most of the respondents have poor knowledge on interpretations of vital sign values and limited understanding of pathophysiological changes associated with cardiorespiratory dysfunction. We suggest introduction of professional education for nurses, need for clinicians to individualise patients and make attempt to document vital sign values that require clinician's attention. We also advocate for introduction of modified early warning scoring system in our hospitals.

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## List of tables

**Table 1.** Showing the clinic-demographic characteristics of the nurses

Clinico-demographic parameters	Ward	Emergency	Theatre	ICU
Sex				
M	9	3	3	0
F	49	5	6	5
Duration of practice				
Range	3-27	2-26	4-30	2-22
Mean (SD)	11.9(±7.8)	11 (±9.1)	12.1(±9.7)	7.1 (±6.8)
Status				
NO1 and 2	45	6	5	-
CNO	8	2	1	1
PNO	3	-	2	-
ADNS	1	-	1	-
Qualification				
RN	17	1	-	4
Post basic	13	4	8	1
BNSc	20	3	1	-
MSc	-	-	-	-
Comprehensive				

knowledge	4	1	1	1
Good	46	7	8	4
Poor				

**Table 2.** National Early Warning Scoring System

Parameters	3	2	1	0	1	2	3
Resp. Rate	≤8		9-11	12-20		21-24	≥25
O2 Sat	≤91	92-93	94-95	≥96			
Supp O2		YES		NO			
Temp	≤35.0		35.1-36.0	36.1-38.0	38.1-39	≥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 conciseness				A			V, U, P

**Table 3.** Clinical response to NEWS triggers

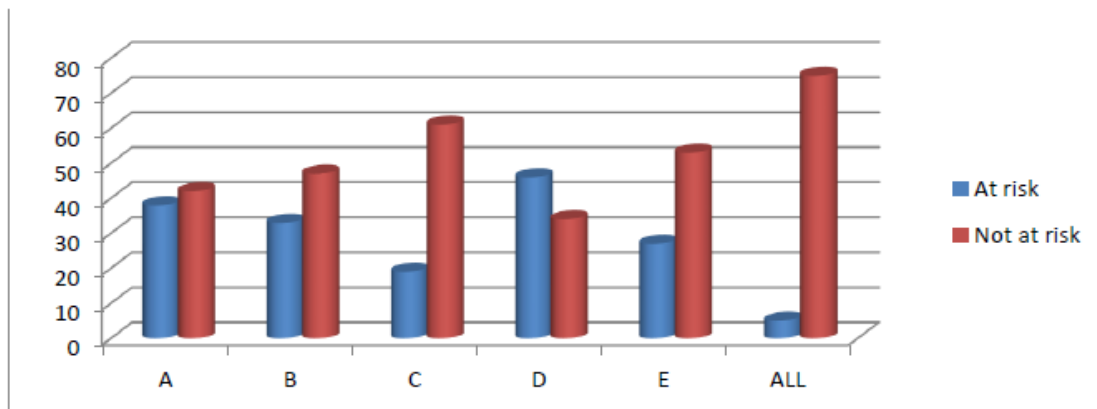
Scores	Clinical risk	Monitoring	Response
0	Low	Minimum 12hourly	Continue routine NEWS monitoring
1-4	Low	4-6 hourly	Inform registered nurse to determine if need for Escalation of care
Individual parameter scoring 3 (Red score)	Medium	Increased to a minimum of 1 hourly	Registered nurse to urgently inform managing team With core competencies Clinical care in environment with monitoring facilities
Aggregate 5-6	Medium	Increased to a minimum of 1 hourly	
Aggregate 7or more	High	Continuous monitoring of vital signs	Need specialist review from managing team Clinican with critical care competencies assessment Consider transfer to higher unit

Adapted from Royal College of Physicians National Early Warning Score.

### Legend of figures



**Figure 1.** Showing the proportion of the respondents that got the normal range of the vital sign value correctly



**Figure 2.** Showing the respondents' interpretation of set of combinations of vital signs values, SpO<sub>2</sub> and consciousness level

- A. PR=74/ min, BP 120/80mmhg, RR 22cpm, T 37.0, SpO<sub>2</sub> 96% and respond to voice only
- B. PR=92/ min, BP 108/80mmhg, RR 11cpm, T 38.5, SpO<sub>2</sub> 93% and alert
- C. PR=72/min, BP 90/60mmhg, RR 35cpm, T 37.1, SpO<sub>2</sub> 96% and alert
- D. PR=134/ min, BP 120/80mmhg, RR 18cpm, T 37.1, SpO<sub>2</sub> 97% and alert
- E. PR=88/ min, BP 40/? mmhg, RR 16cpm, T 36.4, SpO<sub>2</sub> 95% and alert
- F. PR=112/ min, BP 120/80mmhg, RR 22cpm, T 38.2, SpO<sub>2</sub> 93% and alert