

“EARLY WARNING SYSTEMS: A COMPREHENSIVE APPROACH TO IMPROVING PATIENT DETERIORATION AT A TERTIARY HOSPITAL”

A study at Medanta Hospital, Gurugram

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A photograph of a large, modern hospital building with multiple wings and glass facades. In the foreground, there is a well-manicured garden with a circular hedge maze and several trees. The sky is overcast.

Organizational Profile

- **Medanta- The Medicity**
- A multi-speciality tertiary care hospital founded by Dr Naresh Trehan in 2009
- Mission: to deliver advanced and affordable healthcare and to build an institution that focuses on technology and research.
- Centres of excellence include the Heart Institute, Institute of Neurosciences, Bone & Joint Institute, Kidney & Urology Institute, Cancer Institute and Division of Medical Oncology and Haematology.
- The hospital is both NABH and NABL accredited
- , the hospital is furnished with 45 operation theatres, 1250 beds and over 350 critical care beds under 20 specialties.
- Medanta launched India's first Air Ambulance known as 'Flying Doctors India', in 2013.

A decorative graphic on the left side of the slide featuring a stylized ECG (heart rate) line in blue and purple, set against a light blue background with a grid pattern.

Early Warning Signs System: Introduction

- a set of physiological indicators that healthcare providers monitor to identify patients who may be at risk of deteriorating or experiencing clinical deterioration
- These signs may include changes in a patient's vital signs, such as:
 - heart rate
 - respiratory rate
 - blood pressure
 - temperature
 - level of consciousness
 - oxygen saturation
 - urine output
- William, Wright and Morgan developed first EWS system in 1997 incorporating six parameters, viz., Heart rate, blood pressure, respiratory rate, temperature, and oxygen saturation and AVPU response.
- Several modified early warning signs (MEWS) are used in hospitals as per their emergency response policies.

Significance of MEWS in preventing patient deterioration

- Patients show a clear change in several physiological signs hours before collapsing into a cardiac arrest or other fatal conditions.
- Prevention of code blue situations or ICU admission
- Timely intervention leading to better prognosis and treatment outcomes
- Enhanced patient safety
- Facilitation of communication and interdisciplinary collaboration



Rapid Response Team

- It is a team of nurses and other health care professionals (respiratory therapists, pharmacists, emergency department personnel, and others) who bring critical care expertise to the bedside.
- The key goal is to act before “failure to rescue” occurs and a patient has suffered a cardiac or respiratory arrest.
- Rapid Response Team Composition
 - For Adult Patients
 - a)Critical Care on Call – Team leader
 - b)Nursing Supervisor
 - c)Security Personnel
 - For Paediatric Patients
 - a)Paediatric ICU Doctor on Duty – Team leader
 - b)Nursing Supervisor
 - c)Security Personnel



MEWS score calculation

MEWS Modified Early Warning Score (MEWS)

Score	3	2	1	0	1	2	3
Respiratory rate		< 9		9 - 14	15 - 20	21 - 30	> 30
Saturation rate (with therapy)	< 90						
Heart frequency		< 40	40 - 50	51 - 100	101 - 110	111 - 130	> 130
Systolic blood pressure	< 70	70 - 80	81 - 100	101 - 200			
Temperature		< 35.1	35.1 - 36.5	36.5 - 37.5	> 37.5		
Consciousness				A	V	P	U
Urine production	< 75mL in the last 4 hours						
Nurse being worried	1 point						

A = Alert V = Response to verbal stimulation P = Response to painful stimulation U = Unresponsive

RIT protocol

1. Determine MEWS → MEWS ≥ 3 contact clinician on duty
2. Clinician on duty assess patient < 30 min and draft a plan for treatment
3. Effect of treatment is analyzed < 60 min
4. If no effect of treatment → clinician on duty contacts RIT
5. If not complied with 2,3,4 → clinician on duty or nurse contacts RIT
6. Document aberrant parameters in the patient' charts

Source: Adapted from A Protocolised Once a Day Modified Early Warning Score (MEWS) Measurement Is an Appropriate Screening Tool for Major Adverse Events in a General Hospital Populatio. PLOS ONE. 2016 August; 11(8).

MEWS KEY		0	1	2	3	Modified Early Warning Score (MEWS)														
		TIME	8	10	12	14	16	18	20	22	24	2	4	6	Score					
RESPIRATORY RATE (BREATHS/ MINUTE)	≥ 25														3					
	21 - 24														2					
	12 -20														0					
	9 - 11														1					
	≤ 8														3					
SP02 (%)	≥ 96														0					
	94 - 95														1					
	92 - 93														2					
	≤ 91														3					
TEMP (F)	≥ 102														2					
	99.1 - 101.9														1					
	97 - 99														0					
	95.1 - 96.9														1					
	≤ 95														3					
BLOOD PRESSURE (MMHG)	≥ 220														3					
	201 -219														2					
	181 - 200														1					
	101 - 180														0					
	81 - 100														1					
	71 - 80														2					
	≤ 70														3					
HEART RATE (BEATS PER MINUTE)	≥ 140														3					
	111 - 139														2					
	101 - 110														1					
	51 - 100														0					
	41 - 50														1					
	≤ 40														3					
Supplimental O2	Yes														2					
	No														0					
Glasgow coma scale	15														Best Response					
	13 -14														Mild					
	9 - 12														Moderate					
	3 - 8														Severe					
Total score																				
Pain Score																				
RBS																				
Verified by TL/ Incharge (with ID No.)																				

Source: Adapted from Medical records(IPD flowsheet), Medanta Hospital

Criteria to activate code orange

DECIPHERING MODIFIED EARLY WARNING SCORE (MEWS)

- MEWS Score not applicable for below mentioned group:
1) Children below 18 years 2) COPD Patients 3) Pregnant woman
- Sudden deterioration in Neurological status as per GCS, CODE ORANGE to be announced
- Systolic BP should be taken for MEWS score calculation.

Aggregate MEWS score	Clinical risk	Response	Action	Frequency of monitoring
Aggregate score 0-4	Low	Ward based response	Inform to Floor doctor, TL	4 hourly
Red score 3 (score of 3 in any individual parameters)	Low-Medium	Urgent ward based Response	Inform to Doctor on call from treating team, Floor doctor, TL, Nursing Supervisor	1 Hourly
Aggregate score 5-6	Medium	Key threshold for urgent response	Inform to Doctor on call from treating team, admitting doctor if possible. Announce CODE ORANGE immediately.	30 Minutes
Aggregate score 7 or more	High	Urgent or emergency Response	CODE BLUE	Continues

Source: Early Warning Signs policy document at Medanta Hospital

Methodology



Problem statement: There was an increase in the number of emergency ICU admission by activation of code orange in wards.

● Study duration:

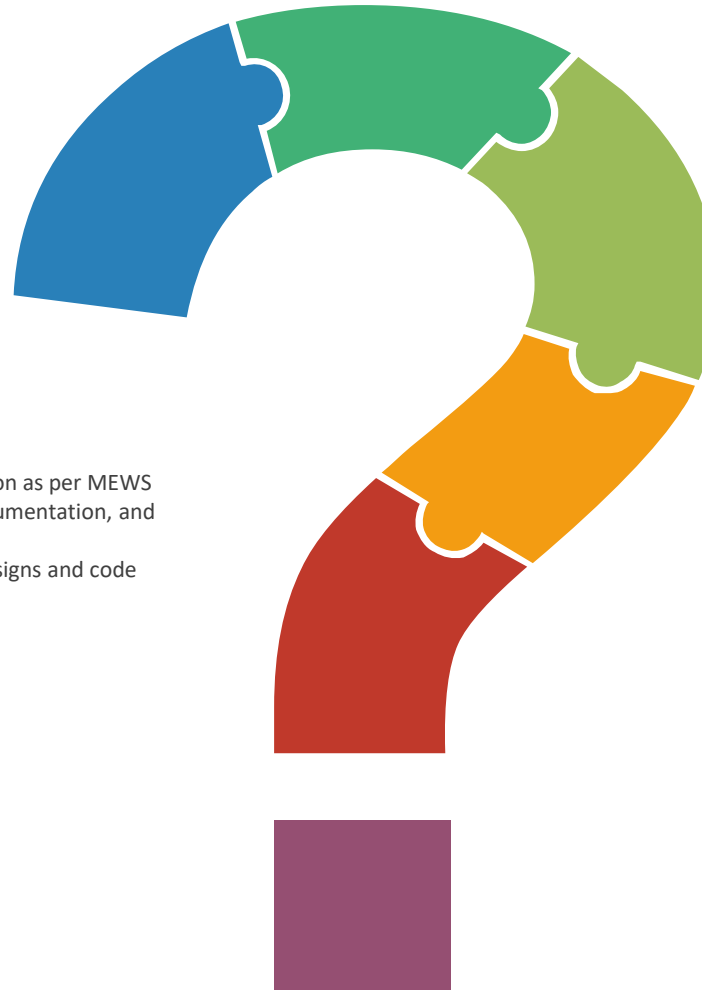
March 2023- April 2023.

● Objectives:

To determine the compliance of Code orange activation as per MEWS and adherence to protocol in pre and post event documentation, and compliance to arrival of RRT within 15 minutes
To assess the level of awareness about early warning signs and code orange activation among nurses deployed in wards

● Sample size

- 56 cases of code orange
- 132 nurses deployed in wards



● Inclusion Criteria

- All cases of code orange activation in wards and day care.
- Nurses deployed in wards and day care

● Exclusion Criteria

- . Code orange cases that progressed to code blue, mock drills
- Nurses deployed in ICU and OPD

● Problem Statement

- Medical Record (IPD Flowsheet, eHIS)
- Questionnaire

Methodology



Data was collected for following parameters:

- Demographics (Age, Sex)
 - Time of activation of code orange
 - Time of arrival of the RRT (Rapid Response Team)
 - MEWS score
 - Reason for code activation
 - Final outcome of treatment
 - ALOS (Average Length of stay)
- Sample size calculation:
 - $n = N / (1 + Ne^2)$
 - where n= number of samples, N= Total population, e= error tolerance)
 - By using 95% confidence level (margin of error= 0.05)

Result

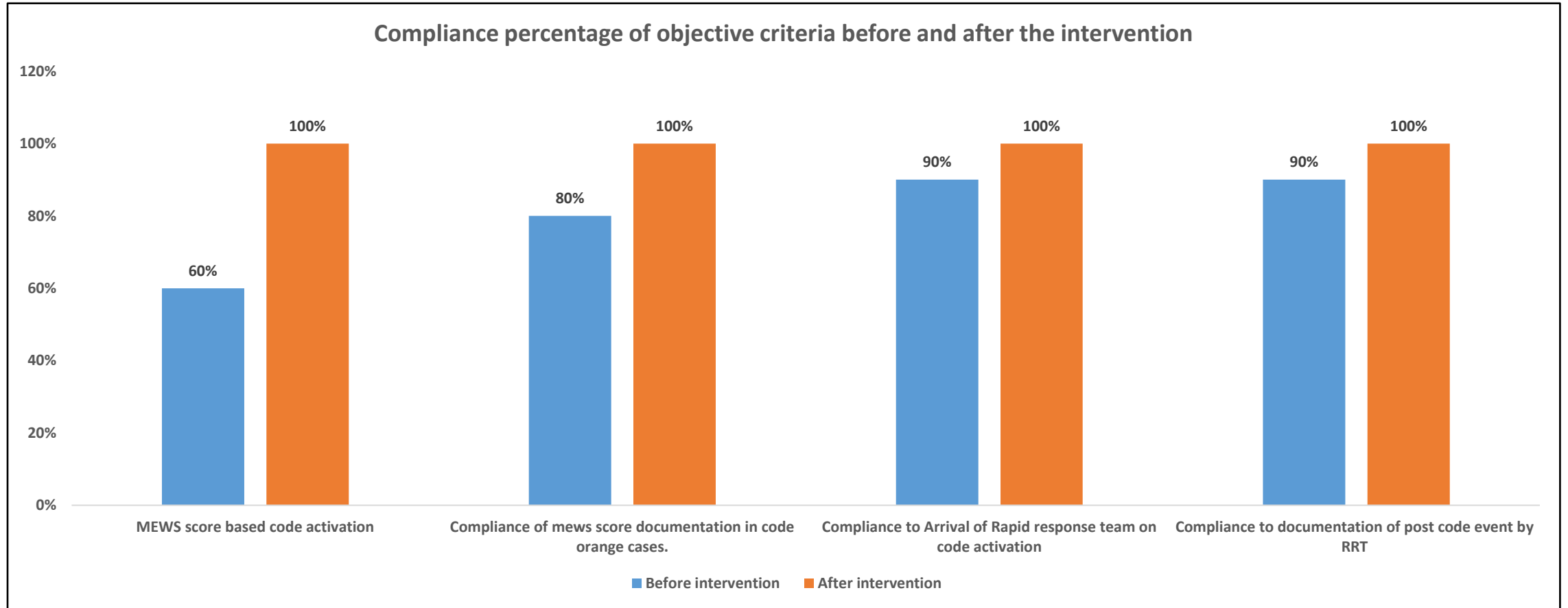


Figure 1: compliance percentage of objective criteria before and after intervention

Result

- **Demographic Profile of patients (Age and Sex)**
- Mean age of the patients was 62.6 years with a standard deviation of 14.54
- It was also observed that the age group of 50-60 years had more chances of fatal outcomes like death
- **Average length of stay (ALOS)**
- The mean of ALOS was 17.02 days with a standard deviation of 27.14
- Most of the patients had an ALOS of 9 days

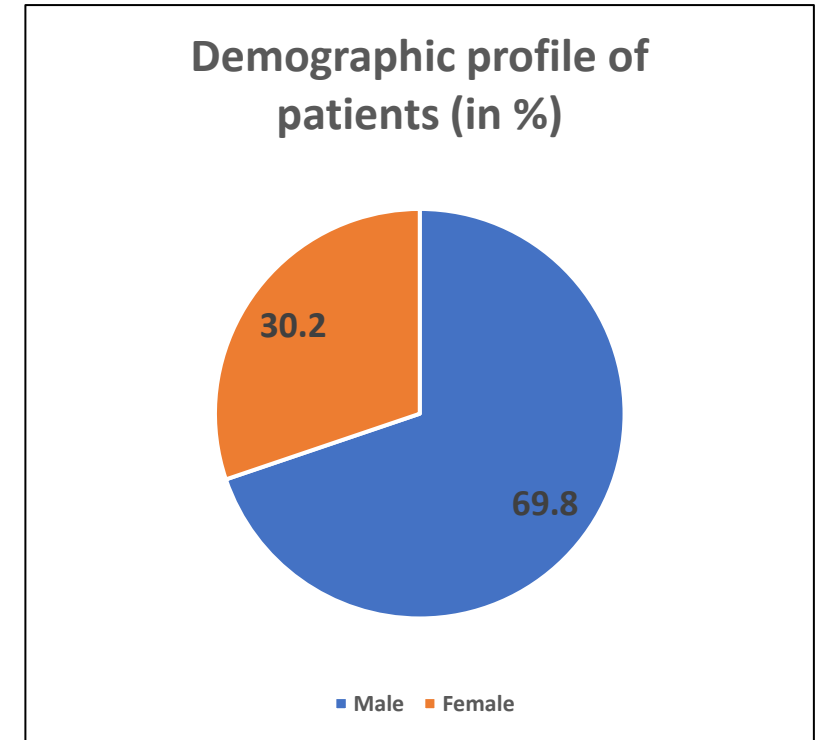


Figure 2: Age distribution of patients (n=56)

Result

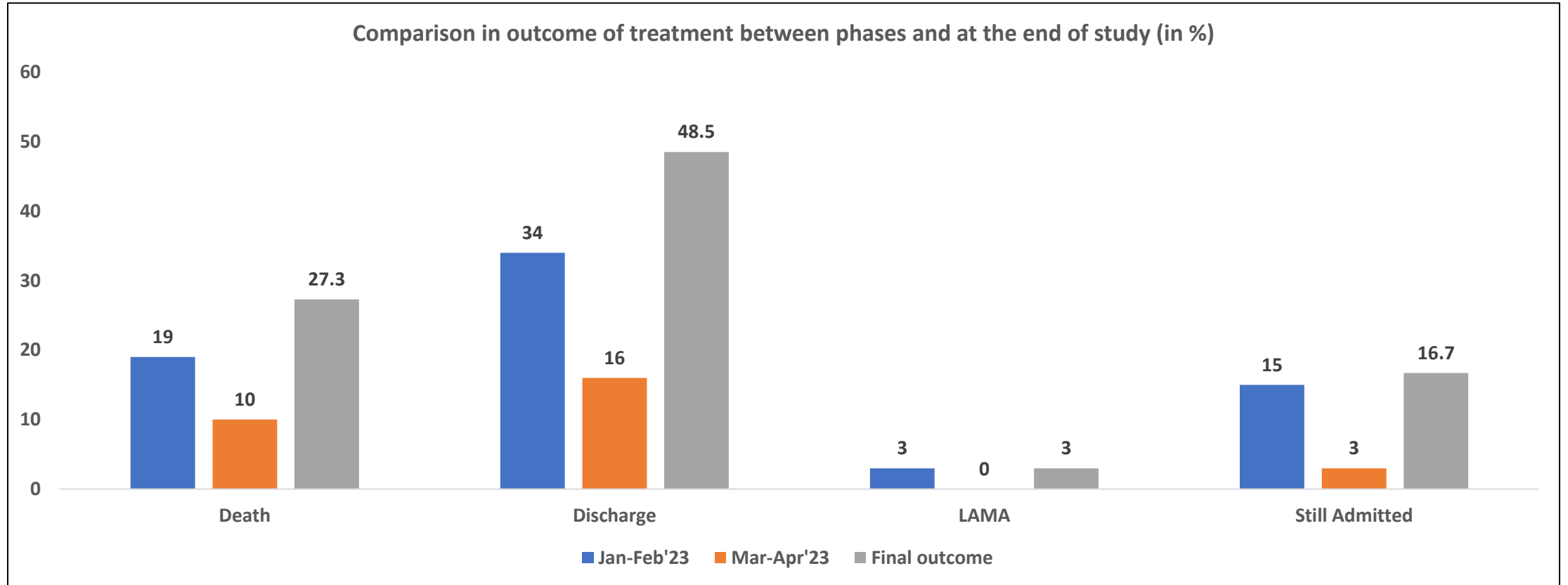


Figure 3: Final outcome of treatment (n=56)

Result

- Level of Awareness among nurses

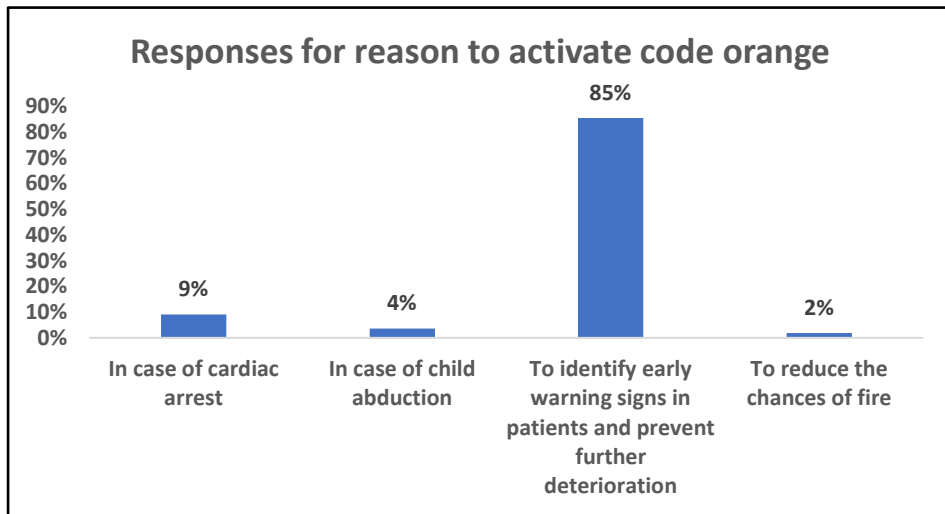


Figure 4: Response for reason to activate code orange (n=132)

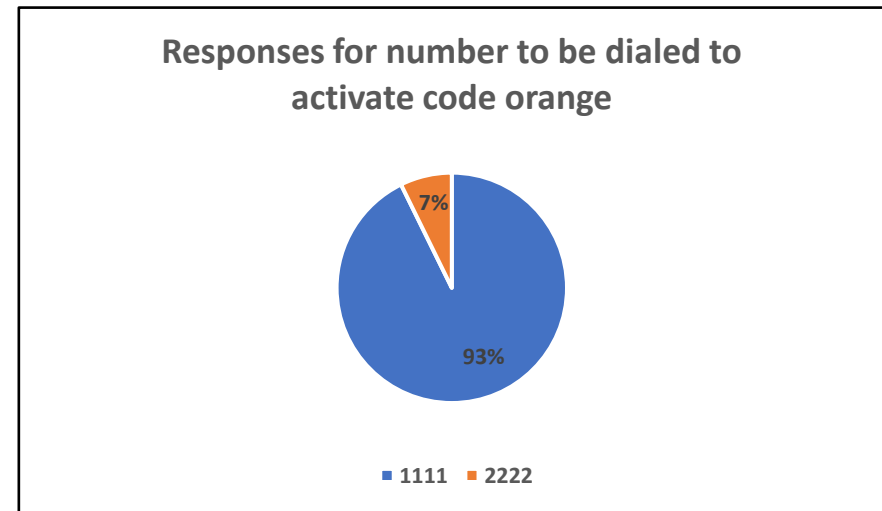


Figure 5: Response for correct number for code activation (n=132)

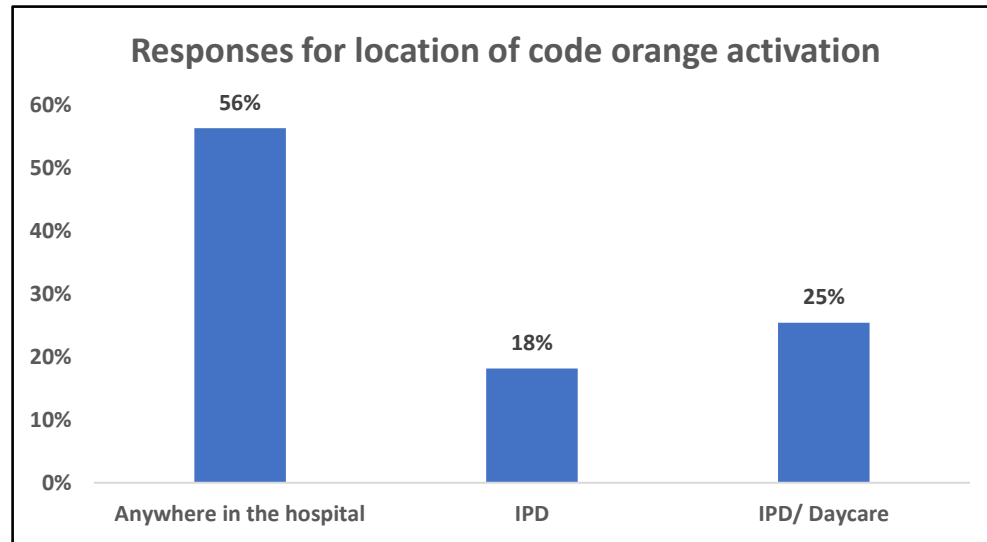


Figure 6: Response for location of code as per policy (n=132)

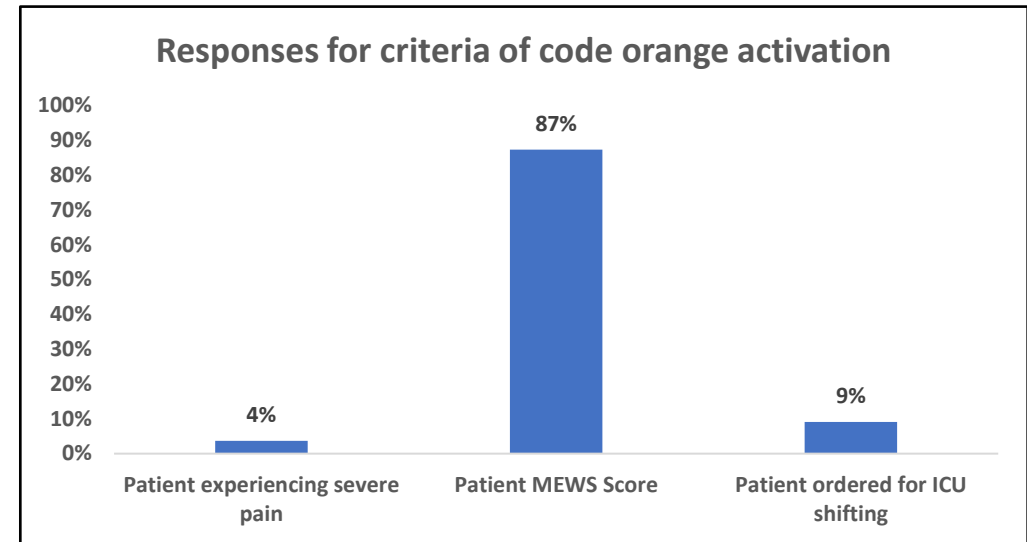


Figure 7: Response for Criteria of code activation as per policy (n=132)

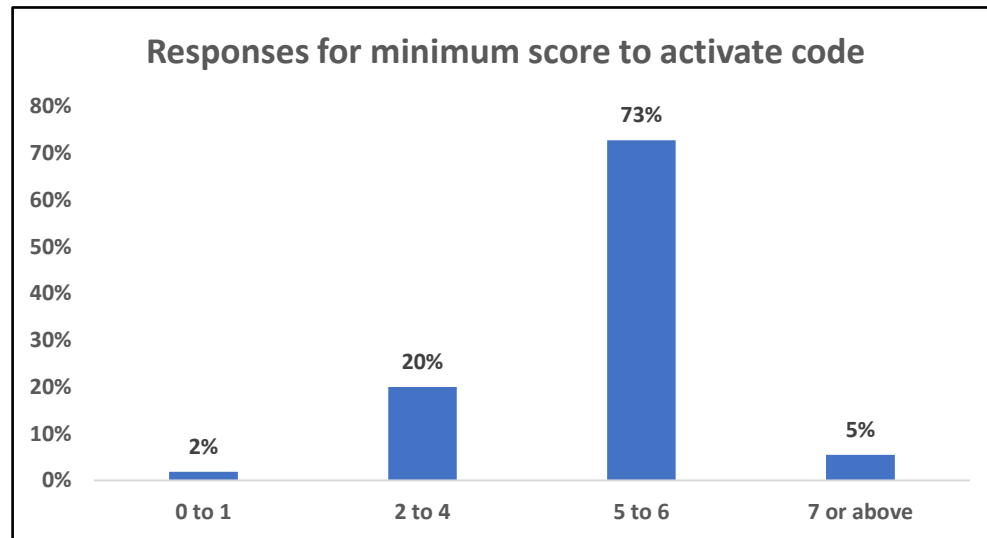


Figure 8: Response for minimum score for code activation as per policy (n=132)

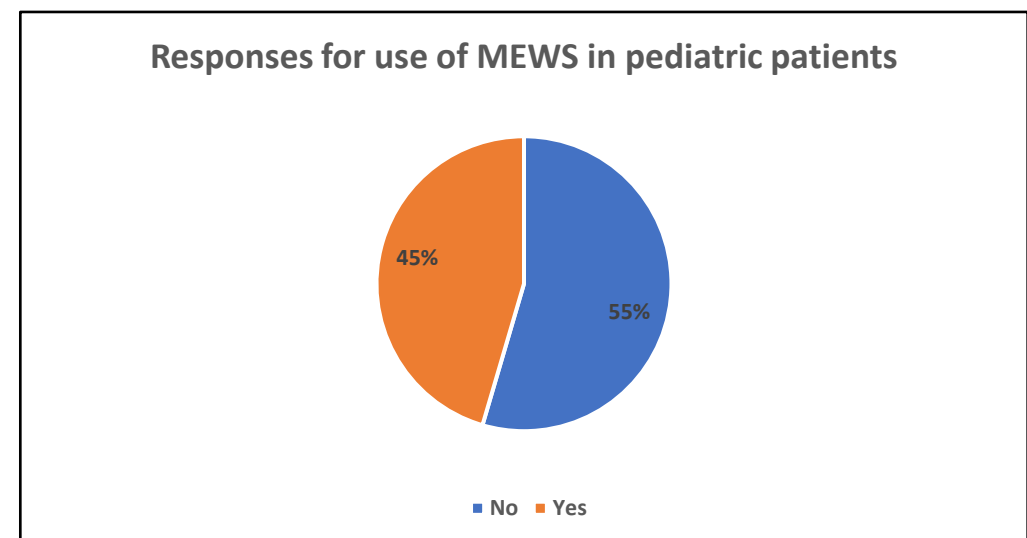


Figure 9: Response for use of MEWS in paediatric patients (n=132)

Response for scoring system used in paediatric patients	Percentage
APGAR score	2
FLACC	4
NEWS	6
PEWS	33
YES	2
Cannot Recall	55

Table 2: Response for scoring system to be used in children (n=132)

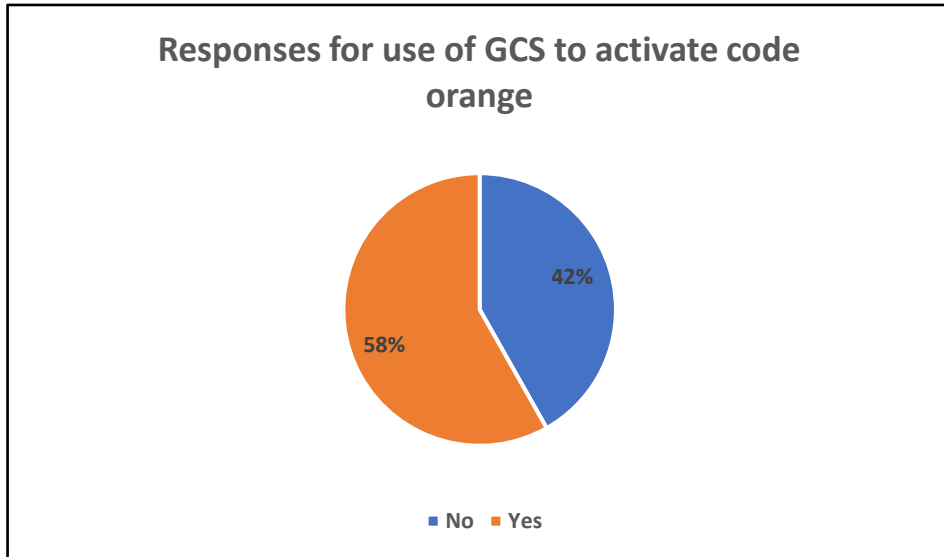


Figure 11: Response for use of GCS to activate code as per policy (n=132)

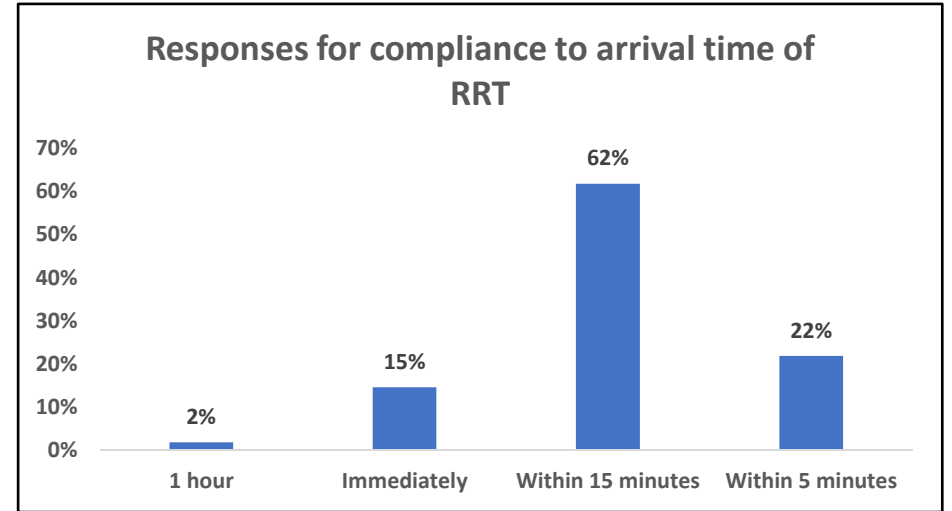


Figure 10: Response for compliance to arrival time of RRT as per policy (n=132)

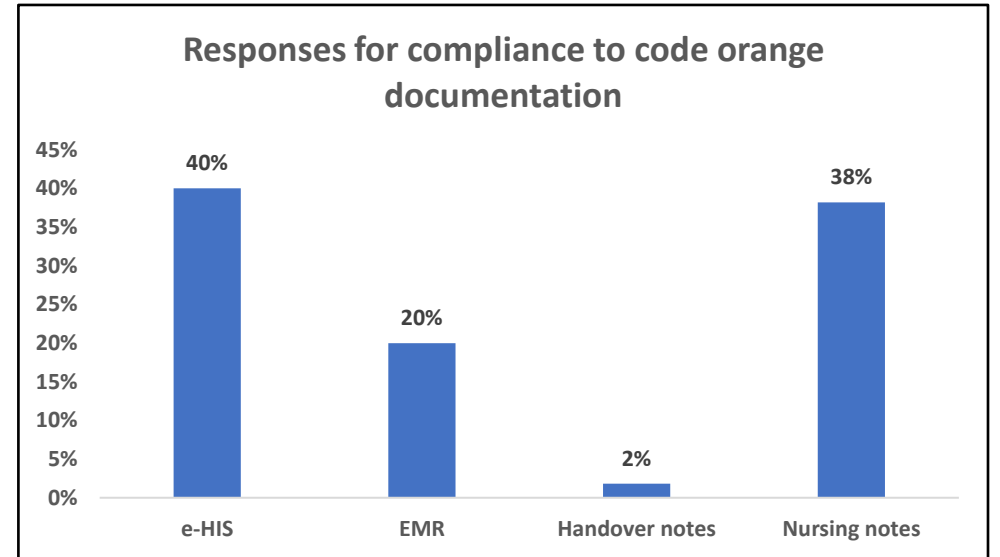


Figure 12: Response for compliance to code documentation as per policy (n=132)

Discussion

- It was suggested by Chirag Mathukia et al, that a timely identification of vital signs can lead to a decline in the progression of an event to code blue and subsequent death of the patient. It can similarly be observed in this study that a decline in death as an outcome was seen over the months when MEWS score-based code activation and compliance to arrival of RRT on time increased to a hundred percent.
- In a study by Mohammed Fayyaz Rashid et al, it was observed that timely arrival of Rapid Response Team (RRTs) lead to a decline in code blue activation by 2.44 percent and a decline in in-hospital mortality rate by 4.88 percent.
- Conversely, in another study by Armando D et al, it was observed that implementation of Early warning Signs system had no effect on the number of cases of ICU admission or ultimate outcome as death. However, it can be attributed to poor practise and lack of skills among the deployed nurses. Similarly in this study it was observed that implementation of EWS and timely arrival of RRT led to a decline in the cases of death and other adverse events.

Discussion

- It was observed that the nurses at the study setting were not at par with the knowledge required to identify early warning signs and protocol for rapid response activation. Similarly, according to Mohmoud Al Kaladeh et al, on implementation of an educational programme for the nurses, it was seen that the nurses in the interventional group showed significant improvement in identification of early warning signs
- However, the control group appeared to remain same without any change.
- Finally, it was observed that Early warning system can prove to be a beneficial bed side tool to prevent deterioration of patients and improves clinical management as well prognosis of the treatment.

Conclusion

- Objective wise conclusion:
 - **The percentage of cases of code announced as per MEWS Score more than 4 during code.**
 - It was seen that on improvement of the overall compliance of adherence to code activation based purely on MEWS score and proper documentation led to reduced fatalities and better management of patients. A code activation based on proper threshold score not only makes it easier for the rapid response team to reach the patients within due time but it also helps in optimisation of the resources as it can lead to prioritization of the patient and resource allocation to the patient who is in actual need of critical care.
 - **The compliance of percentage of cases of code announced with correct per and post event documentation**
 - It was found that an improvement in the documentation process of the adverse event as well as code led to a decline in death as well as helped in better prognosis of patients. Documentation before an event is important as it helps in deciding the need for a code orange activation based on the condition and vital signs of the patients before an adverse event occurs. Similarly, post code documentation not only leads to better communication among team members but also helps in taking a correct course of action to decide the further line of treatment. It also serves as a record in case of death and any legal formalities.

Conclusion

- **The compliance to Arrival of RRT on code activation time of the code orange team within 15 mins.**
- As per the hospital protocol, it is determined that once a code orange is activated following an adverse event with a patient, the rapid response team should reach the site within 15 minutes. Time plays a crucial role in progression of a fatal event and every single minute is of importance to save a patient from falling into a code blue and subsequently a cardiac arrest. Hence, it was observed that on improvement in the number of code orange cases where the RRT reached within 15 minutes, the final outcome improved as well leading to a decline in death as well in number of ICU admissions.
- **The level of awareness about Early Warning Signs and code orange activation among nurses deployed in IPDs and Day care.**
- It also evaluates the level of knowledge among the nurses as they are mostly the first point of contact a patient has while being admitted in a ward and are majorly responsible in day-to-day care of the patients. Hence, it is extremely important for them to be thorough with the identification and recording of early signs. A lack of knowledge among them as suggested by this study should not be overlooked as it brings out the importance of the implementation of frequent trainings and workshops that any organization can provide in order to not only improve the efficiency of their workforce but also add to better healthcare delivery in a hospital.

Recommendation

- **The percentage of cases of code announced as per MEWS Score more than 4 during code.**
 - Implementation of Regular training and educational programmes for not only nurses but other health care providers on various ways of identification of early signs of deterioration as well as the correct scoring method.
- **The compliance of percentage of cases of code announced with correct per and post event documentation.**
 - There should be occasional audits to evaluate the performance of nurses and doctors concerning the adherence to the hospital protocol.
- **The level of awareness about Early Warning Signs and code orange activation among nurses deployed in IPDs and Day care.**
 - Implementation of Regular training and educational programmes for not only nurses but other health care providers on various ways of identification of early signs of deterioration.
 - There should be a module on hospital policy regarding code orange activation criteria during the induction period of new nursing staff.
 - Introduction of digital devices that can be easily worn by patients in the form of rings, wrist bands, etc to monitor patient vital signs along with nurses for an effective management.

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