Research Article

THE EFFECT OF INTRODUCING ADULT KHOULA EARLY WARNING SYSTEM (KEWS) AS AN IN-SERVICE IMPROVEMENT STRATEGY IN KHOULA HOSPITAL

[1,] *Mayya Mansoor Saud Al Siyabi, [2,] *Dr.T.S.Bheemaraju, [3]Mona Abdullah Al Omoori, [4]Fatma Said Al Manji, [5]Prof. Mrs. Devi Nanjappan

[1]Director of Nursing Affairs, Directorate General of Khoula Hospital: Ministry of Health: Sultanate of Oman.
[2]Professor in Psychiatric Nursing. Smt Nagarathnamma College of Nursing, Bangalore, India.
[3]Senior Adult Critical Care Staff Nurse, Nursing Administration- Auditing & Benchmark Department, BSN.
[4]Senior Adult Critical Care Staff Nurse, Nursing Administration- Auditing & Benchmark Department, BSC in Nursing Practice, Adult Critical Care Nursing Post Basic.
[5]Prof. Mrs. Devi Nanjappan : Smt. Nagarathnamma College of Nursing, Bangalore, India.

ABSTRACT

Introduction & Aims: This article emphasis on the aim of Khoula Hospital- Muscat to implement and increase staff awareness about the importance of KEWS in early identification and timely management of survival rate of deteriorated patients admitted in general wards. As a result, this will reduce the number of transfer- in and readmission within 24-48 hrs cases to ICU, the Length of Stay (LOS) and the number of cardiac arrests that lead to death. **Methodology:** A pilot (Descriptive) study (Phase One) was conducted for a period of one month (between March to April 2016) among adult inpatients of Male Neuro Surgical ward and Female Orthopedic Unit- 1. After tools and charts (Adult KEWS Observation Chart, Adult KEWS Escalation of Care, Adult KEWS Key, Adult KEWS Guidelines and i-SBAR Verbal Communication Tools) reviewed and approved from hospital HODs, training of all the staff in both wards was ensured. Then, the observation charts were distributed to all admitted patients in daily bases. The observational charts were collected daily for maintaining the KEWS statistics. Data analysis were undertaken with descriptive and inferential statistics. After approval of phase 1,the system was run manually for other five wards in phase two and three. Then the charts and tools being computerized in al Shifa 3 Plus, allowing the system to be generalized for other five wards. Currently, the system covered in a total of 12 adult general wards. **Results:** There was a total of 2292 of deteriorated cases which were attended by PART in 2017 in comparison to only 217 cases in 2016.The total number of the Trans In cases to the ICU from the targeted wards (which are applicable to KEWS) was 86 cases in 2017, making overall percentage of the trans- in adult patients to ICU from targeted general wards by the end of 2017 as 3.75%, compared to 26% in 2016. In addition, the number of cardiac arrest reduced from 7 cases in 2016 to 0 in 2017.**Conclusion:** The key message from this project is the potential for the adult 'KEWS' to drive a step change of improvements in quality of care, patient safety and clinical outcomes for acutely ill patients in Khoula hospital by standardizing the assessment and scoring system.

Keywords: Early Warning System (EWS), Deterioration, Sudden Adverse Events (SAEs), Adult Patient, Death, ICU, Cardiac Arrest, Monitoring, Length Of Stay (LOS).

INTRODUCTION

Most of the hospitalized patients in general wards experience a deterioration of their vital signs for a long period of time before being managed by the assigned nurses (Johns, B. G. 2013). Duncan et. al. (2012), added that events of cardiac arrest in general wards usually preceded by alternations in patient's vital signs (VSs) or level of consciousness. Throughout Khoula Hospital general wards, many patients experience a sudden deterioration in their health status. Nurses sometimes are unaware about such events and unfortunately anesthetist will reach to the ward when the patient is already at a stage to transfer to the ICU. In this, a special attention should be sought for these events and introducing of a system to save these patients as early as possible. Early Warning System (EWS) helps to detect early warning signs of any deteriorated patient to implement early management (Evidence Base Synthesis Program, 2014). Therefore, Adult KEWS has increased staff awareness about such events and maximized the survival rates of deteriorated patients in the wards.

*Corresponding Author: Mayya Mansoor Saud Al Siyabi,
1Director of Nursing Affairs, Directorate General of Khoula Hospital: Ministry of Health: Sultanate of Oman.

*Corresponding Author: Dr.T.S.Bheemaraju,
2Professor in Psychiatric Nursing. Smt Nagarathnamma College of Nursing, Bangalore, India.

Objective

Adult Khoula Early Warning System (KEWS) was developed in Khoula Hospital on the 1st of January 2016. It was initiated as a project and it was leaded by a Special Project Team senior nurses, who have a critical care background/ experience. Adult- KEWS targets all adult inpatients in general wards, excluding the critical care areas, maternity and Peadiatric clients. It attempts to capture Sudden Adverse Effects, so early and timely interventions will be taken to reduce further adverse outcomes for the deteriorated patients. As a result, this will reduce the number of transfer- in and readmission within 24-48 hrs cases to ICU. Moreover, it aims to reduce the length of stay (LOS) and reduce the number of cardiac arrests that lead to death. In addition, KEWS targets bedside staff to increase their awareness about the importance of frequent monitoring of patient's KEWS variables and strict adherence to its escalation of care.

background

In 1997 Morgan et al, (The United Kingdom) developed and published the first Early Warning System (EWS), which was composed of five physiological parameters. The implementation of EWS emphasizes the management and caring strategies of Sudden Adverse Effects (SAEs). Globally, hospitals are actively following this system, which shows a significant decline in the rates of cardiac arrests and length of stay especially in ICU. In addition, 1500 hospitals in the United States are implementing rapid response teams (Smith et. al. 2014).

Moreover, the concepts of EWS introduced by the department of health in UK since 2000. Additionally, different health care institutions are following a paper based tool, which allows nurses to monitor patient's VSs and level of consciousness thoroughly (Johns, B. G, 2013). Some of these institutions started to implement a computerized tool, so the calculation of total score can be done electronically, which can reduce the workload of the assigned staff (Johns, B. G, 2013). Other hospitals also followed standardized EWS to ensure the consistency of communication of the tool score between health care providers (Royal College of Physician, 2012). In 2016, Khoula Hospital developed a standardized adult Khoula Early Warning System (KEWS) observation chart, to provide timely management for the deteriorated patient in general wards and ensure the consistency of communication between health care providers.

REVIEW OF LITERATURE

Ward Nurses Experience and Awareness of SAEs within their Clinical Practice.

In general and consistently with the findings in other health care settings, most of deteriorated events occur within general wards (McNeill, G. and Bryden, D. 2013). Moreover, Kyriacos et al., (2011) added that almost half of unexpected hospital death happened in general wards. Specifically, there are some studies discussed and examined the incidence of that events and nurse experience and awareness to them. A descriptive data based study carried out by Fuhrmann et al., (2008) aimed to examine the incidence of death among patients with abnormal vital signs in Danish University Hospital. Descriptive research study involves describing of situations and experiences and figuring out reasons behind that experience and it is most common research design used in nursing to solve such issue (Borbasi and Jackson 2012). In addition, this type of research design allows the participant to answer a simple questions which give a valid answers in nursing research (Boyle 2014). The sample involved two surgical wards and three medical wards in which a total of 877 patients were monitored for two months. Out of these patients, 155 (who had abnormal vital signs) had a mortality rate of 13% compared to 5% mortality rate of those with normal VSs monitoring. At the same time, the finding highlighted staff nurse were not aware about 67 cases among 155 patients with abnormal VSs. Furthermore, the finding also indicates that further strategy should be formulated to reduce mortality rate and to increase staff awareness about deterioration events. Additionally, an observational retrospective study conducted by Ludikhuizeet et al., (2012) among 2004 patients, who being admitted in surgical and medical wards. The study aimed to describe the practice of ward nurses in documenting of VSs by introducing a modified EWS (MEWS) tool. The tool allows measuring of VS s and its variables as it consists of: temperature record, systolic blood pressure, heart rate, respiratory rate, oxygen saturation (SPO2), supplemented oxygen (FIO2) and response level (Ludikhuize et al., 2012). In addition, to the large sample and the accurate measuring tool, the validity of the study increased as the project team members illustrated the results of the study in tables and charts for the purpose of the clarity in distributing the statistical findings of the study. The findings highlighted that ward nurses awareness of SAEs was less and the total score of MEWS tool was incomplete and that respiratory rate and SPO2 were only documented in 30% to 66% of the tools. Furthermore, a quantitative performance review implemented by Cooper at. al (2011) to assess ward nurse awareness of SAEs. The study implemented for 35 ward nurses who completed a knowledge based questionnaire and two video recorded simulated scenarios. Patient actors simulated to have two types of SAEs: Acute Myocardial Infarction and Chronic Obstructive Pulmonary Disease. The level of situation awareness was measured

by the end of each scenario. The findings illustrate variation in knowledge level which was range from 27 to 91 with a medium score of 67 and the level of awareness measured as low as 50% only. In addition staff could not identify deterioration and they failed in implementing a systematic approach of patient assessment. They were just focusing on a single parameter. In general, the overall literatures indicate that most of ward nurses are still unaware about SAEs.

Management Strategies Of Saes In The Wards.

Generally, there are many studies being conducted to find out a different strategies to manage SAEs. In addition, the studies aimed to explore the effectiveness of each strategy to achieve that outcome.

Implementing of a Multi-Interventional Method.

A study conducted by Mitchell et. Al, (2010) to explore the most recent literature about management strategies of deterioration events for nurses who are working in four medical and surgical wards. The study aims to examine the effects of a multi- interventional method in decreasing the rate of a number of adverse outcomes in a deteriorated patient. The interventions included the implementation of a: new ward observation chart, trigger system and educational programs. The total number of patients being assessed was 1157 patients and were monitored for four months. The outcomes measured were included: number of unplanned admissions to the ICU, Medical Emergency Team (MET) reviews, unexpected mortality events and frequency of VSs monitoring. The findings of the study illustrates a significant "p" value in all the outcomes after the interventions being implemented. There was a significant drop in the number of ICU unplanned admissions (p= 0.006) and unexpected death (p= 0.03). Additionally, there were a significant increase in the number of MET reviews and frequency in VSs recording (both presented with p value of 0.001). Fain (2009) states that a score equal or less than .05 of P value, demonstrates a significant results. In this, the findings of the study indicated the effectiveness of multi-interventions method in the management of deteriorations. Similarly, another study conducted by Robb and Seddon (2010) in a large hospital in New Zealand in which a Physiologically Unstable Patient (PUP) program applied for 16 general wards over 15 months. The program used four main interventions which were: new design VSs observation chart, introduction of EWS, implementation of a nurse-led response team and conduction of a ward education program. As a result, the PUP program scores were increasing in all four dimensions. This indicates the effectiveness of the program in the management of unstable patients. Moreover, a study undertaken by Gao et al., (2007) to explore the most recent literature about the best Track and Trigger (TT) systems used for early recognition of deteriorated patients. The reviewer was clearly identified the inclusion criteria of the study. Therefore, the researcher reviewed the articles that correlated to nursing perspective and he included all published articles about TT from 31 hospitals in England and Wales. After 36 papers being reviewed, the project team members could not outline a major management strategy of deterioration as there were a little evidence of the validity and sensitivity of the studies. However, some of these literatures outline the importance of the role of the bedside nurses in frequently monitoring of VSs. Furthermore, Smith, G. B (2010) summarizes the multi-faceted interventions as the "chain of prevention" of cardiac arrest and deterioration in general wards. The chain consists of five main rings: staff education, monitoring, recognition, the call for help and the response.

Frequency of Monitoring and Recording of VSs.

A study carried out by Endacott et al., (2008) to identify the methods in which doctors and nurses using while caring of deteriorated

patients. The study was about a case studies for 220 patients who being admitted to the ICU unexpectedly. The data collected for these cases from 24 hours patient's charts before being transferred to the ICU and founded that doctors and nurses were relaying on the documentation of VSs to decide about deteriorated status. However, the study also highlights inappropriate communication between nurses and doctors about informing and the time of early interventions and management for such cases was not ensured. Therefore, the study implicates the importance to document VSs and to establish a communication system/tool to facilitate understanding between health care professionals during these situations. Additionally, the results of Fuhrman et al., (2009) study and Cuthbert one et al., (2007) emphasized on the essential to monitor VSs frequently. The study, which being carried out by Bellomo et al., (2012) suggests introducing of an automated electronic VSs monitor is more effective for early detection of deterioration. The validity of the study lies on the large sample being taken. A total of 349 beds from 12 general wards in United States, Europe and Australia included. Furthermore, the validity increased when the project team members used "before and after control trial" design for the clarity of the findings.

Education and Training Activities.

Looking for management strategies from knowledge and skills perspectives, the studies undertaken by Mitchell et al., (2010) and Robb and Seddon (2010) emphasized on the significance in conducting educational programs to increase staff awareness about SAEs and this will help in the management of such events. However, the study which conducted by Fuhrmann et al., (2009) to examine the effect of a multi-educational activities on the management of patient at risk shows that there is no significant "p" value seen after the implementation of these activities. There were no differences seen between the pre and post intervention periods in the incidence of patient's with abnormal VSs and in the evaluation of staff awareness. Although, the above project team members did not encourage a paper based educational activities, they implemented a simulation based course to educate doctors and nurses in another study. The study rolled among 50% of hospital doctors and 70% of nurses for five months and it involves a one day full scale simulation based educational program. The results of the study demonstrate a highly rated relevant course and it was useable and applicable also. Therefore, the project team members encourage a simulation based course rather than paper wise educational activities. Simulation can be defined as "an educational technique in which elements of a real world are appropriately integrated to achieve specific goals" (Buykx. et al., 2011). Another study conducted by Buykx et al., (2011) supports the use of a simulation based learning activities to increase staff awareness about SAEs. The study used a "FIRST 2 ACT" educational model for undergraduate and registered nurses. The model combines evidence-based elements of assessment, simulation, self-review and expert feedback. The findings showed a high degree in satisfaction, self-knowledge and confidence.

Summary of Management strategies of SAEs in the Wards.

Overall, the implications and the suggestions of the above studies indicate the importance to implement a different strategies to ensure a proper management and care of patient at risk in the wards. In addition, the review of the literature reinforce our believe on the value of VSs and the essential to frequent document of VSs and therefore, developing of a standardized tool or an EWS to ensure accurate monitoring, assessment and communication of SAEs is needed. The next theme will critically discuss the effectiveness of EWS in the management of SAEs.

EFFECTIVENESS OF EWS

Several studies examined the effectiveness of EWS to reduce SAEs among ward patients. Furthermore, the studies examined many strategies to use within this system to manage patient at risk. A systematic review, which being carried out by the Evidence Base Synthesis Program (2014) to evaluate the impact of EWS. Out of 13595 articles, 129 studies discussed the impact of EWS. These studies demonstrated a significant p value of EWS on decreasing the number of cardiac arrest incidence, mortality rate and resource utilization. The same above outcomes taken into consideration in another systematic review study conducted by McNeill, G. and Bryden, D. (2013). The findings of a total of 43 studies being reviewed, illustrated the importance to present anesthetist as a leader of the system for most effective interventions. Smith et al., (2014) also reviewed a 11183 studies to evaluate the ability of EWS in the prediction of early deterioration events. For the prediction value of EWS, 8 observational studies shows a good prediction in the seven parameters of EWS. In general, the prediction of the system of death for the first 48 hours was high in all studies. The studies also founded a good predicting score for EWS in the rate of cardiac arrest. Drowre et al., (2013) carried out a pre and post prospective study to examine the impact of EWS in reducing the incidence of cardiac arrest at one tertiary hospital in New Zealand. The study covered 24 months between 2009 to 2011, in which the rate of cardiac arrest within the hospital assessed and the tool of EWS developed (Named as Adult Deterioration Detection System- ADDS). The incidence of cardiac arrest captured by the hospital resuscitation audit scored by the attendance staff. The rate was 4.67 during the first year of the study and 2.99 for the second year, with a mean difference 1.77 for the whole period. This reveals a 38 % reduction in the rates of cardiac arrest with a significant p value of 0.05. Similarly, Johnson and Nileswar (2015), conducted a prospective study for a total of 118, 986 adult patients who being admitted in a tertiary hospital in South India. Out of that, 1955 patients who sustained a cardiac arrest incidence at the hospital being selected for the study which aims to evaluate the effectiveness of a modified EWS from the period of September 2009 to May 2013. A tool of EWS got oriented and distributed to all nurses who were scoring their patients based on five physiological parameters and calculating the final score for each patient. An action plan can be taken according to the final score. In addition, they assessed Return of Spontaneous Circulation (ROSC), Cerebral Performance Category (CPC), survival at discharge, alive at 6 months and independent in Activities of Daily Living (ADL) by using a statistical analysis of software version 16. As a result, there were more patients who had ROSC after EWS period compared to the pre EWS period. This in turn resulted in reducing the number of death due to cardiac arrest by 618 cases compared to 907 cases in the pre EWS period. Furthermore, 138 patients had effective CPC in the post EWS compared to 59 patients only in the pre period. The survival to hospital discharge was 138 compared to 59 patients in the pre EWS. Total of 110 patients survived for 6 months period compared to 51 patients before the EWS used and 99 patients were able to perform ADL in the post EWS period compared to only 45 patients who were independent in ADL prior to the study. Additionally, Mathukia et al., (2014) carried out an observational prospective study to examine the impact of an Easton Hospital modified EWS form on the rate of mortality secondary to cardiac arrest. The form distributed among all nurses in three adult medical surgical wards in which they have to score and calculate a total of seven physiological parameters and to classify their patients as mild, moderate or high deteriorated accordingly. Based on that, an escalation of care which might involve RRT or cardiac arrest code can be activated. During the period of the study, a monthly b asis of the number of RRT/ 100 Patient- Days (PD) (100 PD was calculated by dividing the number of patients per day by

100), the number of Cardiac Arrest Activations (CAAs)/100 PD and the mortality rate were calculated. The findings illustrated increased the number of RRT/ 100 PD from 0.24 in 2011 to 0.38 in 2013. There is a decreased number of CAAs/ 100 PD from 0.05 in 2011 to 0.02 in 2013 and a decline in overall mortality rate from 2.3% in 2011 to 1.5 % in 2013. Overall, the importance to introduce EWS for the management of SAEs can be summarized from all above studies. Therefore, an evidenced- based EWS is essential for the improvement of local health care.

Plan of Action/ Suggestions for Improvement for the Local Practice.

In general, EWS tools, mostly using VSs monitoring, apply a significant role in the prediction of SAEs. Although the impact of EWS on health outcomes at local practice remains uncertain, efforts to implement and assess the effectiveness of the tool will be needed as it's usage becomes widely spread.

METHODS AND MATERIAL

In January 2016, Khoula Hospital was initiated the Adult Early Warning System, formulated and heads by Nursing Team consists of three ICU- senior staff nurses.

Research approach: An experimental quantitative research study.

Study design: A pilot (Descriptive) study (Phase One) was conducted for a period of one month (between March to April 2016) among adult inpatients of Male Neuro Surgical Ward (MNSW) and Female Orthopedic Unit- 1 (OU1) of Khoula Hospital. After tools and charts (Adult KEWS Observation Chart, Adult KEWS Escalation of Care, Adult KEWS Key, Adult KEWS Guidelines and i-SBAR Verbal Communication Tools) reviewed and approved from hospital HODs, training of all the staff in both wards was ensured. Then, the observation charts were distributed to all admitted patients in daily bases. The observational charts were collected daily for maintaining the Adult KEWS statistics. Data analysis were undertaken with descriptive and inferential statistics. After approval of phase 1, the system was run manually for other five wards in phase two and three. Then the charts and tools being computerized in al Shifa 3 Plus, allowing the system to be generalized for other five wards. Currently, the system covered in a total of 12 adult general wards.

Population of the Study:

Inclusion: all adult in-patients who are admitted in Khoula Hospital general wards.

Exclusion: all critical areas, pediatrics and maternity in-patients. The method:

Forming the Team.

Assemble a team that has critical care unit experience and has the opportunity for improvement. After recruiting team members, identify the roles and responsibilities, set timelines, and establish meeting schedules.

Setting Aims.

(1)To introduce the KEWS for inpatients service improvement. (2)To have an effective management of deteriorated patients and reduce the rates of serious adverse events in general wards. (3)To reinforce appropriate nursing action based on KEWS escalation protocol. (4) To introduce PART nurses in the hospital field for supporting the ward staff in the delivery of care to critically ill patients requiring high

level of care. (5) To develop critical thinking skills and self-confidence among the nursing staff.

ESTABLISHING MEASURES

Development Process of Tools/ charts.

The tools were developed by considering factors like: Recent evidence (Based on literatures from 2013-2016), characteristics of Adult Omani population, the ranges of the seven physiological parameters and consideration of some exceptional cases. For this, the ranges of the seven physiological parameters of adult KEWS were developed and reviewed by Khoula Hospital Head of Departments-HODs of different specialties.

Adult "KEWS" score key

The new system is designed as a simple, color coded structure that used, green to indicate the values within a safe target range and blue, yellow and red to indicate caution and danger, respectively, depending on the degree of deviation from the target range.
For example: the normal pulse rate (between 51 and 100 beats per minute) is within the target green zone. The goal of the Adult KEWS is to get the patient's total score into the green zone. Refer to Fig 1.

### Clinical Escalation Protocol.

More attention should be paid to patients exhibiting physiological abnormalities as this is a marker of patient deterioration or increased mortality. Clinical escalation protocol was developed for managing these physiological abnormalities. It is a protocol that sets out the timely nursing response and the frequency of observations required for different early warning scores identified or other observed deterioration. This helped to link with PART and other teams in escalation for the appropriately skilled assessment and management of deteriorated patient.

Mechanisms

By assessing and scoring the patient, the nurse will determine timely interventions through following Adult- KEWS escalation protocol (Triggering System). If the patient's KEWS score is 4 and above or a single variable score is 3, Patient at Risk Team (PART) nurses will take the role in assessing, implementing, advocating and supporting the ward nurses for timely management of the deteriorated case. Moreover, PART is "a group of nurses who are highly experienced, Senior Critical Care trained nurses. They are leading and supporting ward nurses who are caring for deteriorated acutely ill inpatients/24 hrs/7 days" (Khoula Hospital, 2016).

Pilot Study Results:

During piloting of adult KEWS in two wards, there were a total of 1510 KEWS scoring charts initiated in OU1 (853) and MNSW (657). Of those 1510 charts 75 were not maintained. 792 or 55.19% were scored as normal and 224 (15.61%) patients, were classified as low risk by the nurse and managed in the ward. From both wards around 427 patients were categorized as moderate risk, out of these 415 patients were from MNSW and 12 patients from OU1. Out of 15 patients scored as high risk, 14 of them were from MNSW. A total of 33 patients were seen and managed by PART and only 2 patients were shifted to ICU as per escalation protocol.
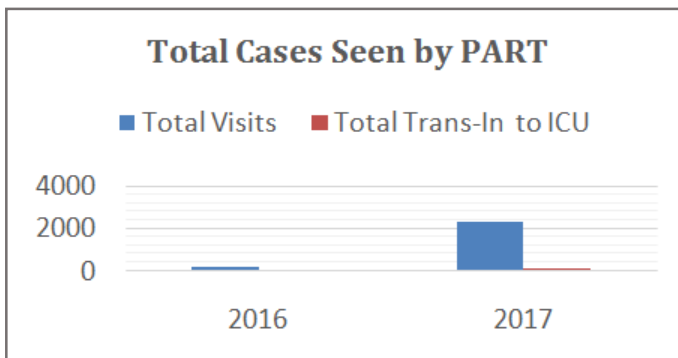
RESULTS AND DISCUSSION

Implementing & Generalizing of Adult- KEWS in Adult General Wards.

Initially, the system was run manually for seven wards and all staff were documenting Adult- KEWS findings manually in the observation charts provided. After the system being computerized, it was generalized for other five wards. Currently the system covered in a total of 12 adult general wards.

Significant Increased in PART Visits/ Follow up, which Reduced Number of Cardiac Arrest and ICU Trans- In Cases.

There was a total of 2292 of deteriorated cases which were attended by PART in comparison to only 217 cases in 2016.The total number of the Trans In cases to the ICU from the targeted wards (which are

applicable to KEWS) was 41 cases in 2016 and 86 cases in 2017, making overall percentage of the trans- in adult patients to ICU from targeted general wards by the end of 2017 as3.75 %, compared to 26% in 2016. In addition, the number of cardiac arrests reduced from 9cases in 2016 to 0 in 2017. Moreover, the patient's LOS reduced to (1-7 days).

Utilization of the hospital resources

2359 (135 in 2016 and 2224 visits in 2017) is the total number of patients who were managed and shifted to higher level of care (HD) in their same beds, and followed by PART frequently. Thus, resulted in increasing staff confidence and satisfaction in dealing with the deteriorated patients.

Officially Involvement of PART.

105 total ICU staff were trained to be as PART member in order to ensure full coverage and rotation present. Officially involvement of 25 ICU staff after basic training as PART under a team leader and ICU-Anesthesia department also involved to be part from the PART team.

Automated adult KEWS in Al Shifa 3 Plus.

The computerizing process of the system beings developed in Al Shifa 3 Plus on 28th March 2017. Currently, the computerized system providing the following charts:

- Adult KEWS Observation Chart
- Adult KEWS Dashboard Screen.
- PART nurse Record form with Pop-up feature for the bedside nurse to view the PART Current Situation, Assessment and Recommendation.
- Adult KEWS Escalation Protocol and KEWS Key.
- Adult KEWS Monthly Statistics Sheet

CONCLUSION

The study concluded that the key message from this project is the potential for the adult 'KEWS' to drive a step change of improvements in quality of care, patient safety and clinical outcomes for acutely ill patients in our hospital by standardizing the assessment and scoring system. In addition, it enhanced a standardized way of communication between nurses and other health care professionals and it was welcomed by all staff nurses, as it is a changing strategy for quality care and patient safety.

Recommendation

We believe that once KEWS implemented in our institution the followings will be highly appreciated:

- PART should be highly trained ,critically Skilled and should undertake basic advance training courses like BLS, ACLS, ECG interpretation, IV cannulation etc
- Involvement of physician with PART which will help to provide timely management and best quality of care to the patient, (National Institute of Clinical Excellence, 2013).
- Develop Maternity Khoula Early Warning System and Pediatric Khoula Early Warning System.

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