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The impact of introducing the Modified Early Warning Score 'MEWS' on emergency nurses' perceived role and self-efficacy: A quasi-experimental study

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ABSTRACT

Background: Early warning Score is a bedside track and trigger system used to facilitate early detection and management of deteriorating patients. Although emergency department nurses are the key to implement this task, their interaction and contribution to provide an estimate of patients' severities is still suboptimal and neglected.

Aim: This study aimed to introduce an educational programme using the Modified Early Warning Score (MEWS) to nurses working in the emergency departments and to assess the programme impact on nurses' self-efficacy and perceived role.

Methods: This non-equivalent, multi-centre, quasi-experimental study, assigned two groups of emergency nurses into intervention and control. The intervention group received three interactive educational sessions totalling 12 h relevant to the application of MEWS in emergency situations using a validated programme called 'COMPASs'. The other group received no intervention. Both groups were assessed for self-efficacy and perceived role in the pre-test, immediate post-test, and three months later follow-up phase.

Results: A total of 232 participants were divided into intervention and control groups (118 and 114, respectively), having no variations in age, gender, or experience as registered nurses. The intervention group showed a significant improvement in the self-efficacy scores for the nurses (F: 152.21, df: 2, $p < 0.001$). Similarly, the intervention nurses exhibited a significant improvement in the perceived role scores after the intervention (F: 121.20, df: 2, $p < 0.001$). The control group showed no changes in either variable across the three phases. While older nurses with longer experience showed higher self-efficacy after the programme, the perceived role explained an additional 57.0% of the variance in self-efficacy after controlling these two demographics (Beta: 0.743, $p < 0.001$, CI: 1.18–1.66).

Conclusion: The existence of an early warning system in the emergency department is able to enhance nurses' self-efficacy and perceived role coinciding with nursing interactions with the multidisciplinary team.

1. Introduction

It has become increasingly evident that many health care providers are unable to manage Emergency Department (ED) patients' deterioration in an appropriate and timely manner [1–3]. Common physiological signs and side effects associated with a patient's deterioration might be disregarded, ignored, as well as inadequately assessed by ED nurses leading to poor recognition of patients' danger in acute illness [4,5]. Thus, the severity of patients' illness and the risk of deterioration is under-estimated [6,7]. Delaying resuscitation; due to inability to recognize deterioration and other essential emergency treatment increases the likelihood of organ failure leading to unpredicted cardiac arrest and unplanned admissions to the intensive care unit or even unexpected death [8,9]. To facilitate early recognition of the deteriorating hospitalized patients, Early Warning Score (EWS) has been developed, this is also known as 'track and trigger' systems [10,11]. While the role of nursing in the ED is multidimensional, ED nurses should demonstrate competent levels and higher self-efficacy when contributing to clinical judgments [1,12].

This study aimed to introduce the Modified Early Warning Score (MEWS) to nurses working in the emergency departments and assess its impact on nurses' self-efficacy and perceived role.

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2. Background

In 2012, the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) revealed that 68% of observed ED patients (394/583) stayed in hospital for longer than 24 h prior to cardiac arrest. About 75% of the warning signs for cardiac arrest were recognised poorly, assessed infrequently and were seldom escalated to senior doctors [13]. A prospective controlled trial by Mitchell et al. [14] assessed the effect of applying an intervention on early recognition and intervention of patients' deterioration in the EDs (COMPASS). Approximately 50% of participant nurses were assigned to the intervention group they received training in early recognition and intervention in deteriorating patients. Those participants in the control group did not receive any training. Nursing practice was reflected in patients' outcomes in which 1157 control patients were compared with 985 intervention patients. The study found unplanned ICU admissions was higher among the control group patients compared to intervention group (1.9% vs. 0.5%, respectively). In addition, unexpected hospital deaths were higher among the control than the intervention group patients (11 vs. 2 cases, respectively). Another retrospective study conducted in the UK by Gallagher et al. [15] over 24 months showed that there was a decline in the complications of patients (45%–75%) after the introduction of EWS.

MEWS is made up from a cumulative score, ranking the patient's severity based on physiological variables like systolic blood pressure (SBP), heart rate (HR), respiratory rate (RR) and oxygen saturation (SpO2) [16,17]. The main purpose of applying EWS is to provide timely recognition of all patients with potential or existing critical illness using a consistent triggering system [18–21]. The National Institute for Clinical Excellence in the UK (NICE) [8] and the Health Information and Quality Authority (HIQA) [22] recommended various EWS and clinical handover systems which enable a graded response through a multiple-parameter scoring systems.

The application of the MEWS would, therefore, enhance the EDs' self-efficacy which is the belief in the ability to effectively perform a task within a specific situation [23,24]. Self-efficacy is viewed as an important indicator of an individual's confidence and job performance in addition to the certain levels of success after the completion of particular tasks [9,25]. Bandura postulated that an individual with greater self-efficacy had more confidence in their abilities to perform well and succeed compared to those with lower self-efficacy [25]. Competent nurses who are able to deal effectively with critically and acutely ill patients can attain better perception and support the competency of the advanced nurse practitioner roles [20,26]. In order for nurses to improve their identification of deteriorating patients, they should first learn to recognise and treat any abnormal vital signs [20,24].

3. Methods

This non-equivalent, multi-centre, quasi-experimental study aimed to introduce the MEWS to ED nurses working in different health care sectors in Jordan. The impact of introducing MEWS was examined through assessing nurses' self-efficacy and their perceived role. The study protocol encompasses a series of consecutive phases including pre-test, intervention immediate post-test phase, and three months later follow-up phase. The participants were divided into intervention and control groups. Both groups were assessed for their perceived role and self-efficacy in pre and post tests phases.

Because randomisation among ED nurses within the same hospital would be ineffective due to the possibility of cross-contamination between groups [27], randomisation was applied on a hospital basis, some hospitals were assigned to the intervention group and the other to the control group. Each group contained at least four hospitals selected according to specific criteria which were; referral hospital with capacity exceeding 100 beds, availability of most specialities, receiving the majority of patients presenting with emergencies.

Nurses working in the EDs were the target population. The inclusion criteria included ED nurses who had a minimal clinical experience in the ED for one year and who provided direct bedside care. Nurses occupying solely managerial roles were excluded from the study.

Prior to data collection, the study protocol was approved for ethics by participated parties including the Ministry of Health Institutional Review Board (IRB) committee and the IRB committee of each private hospital included in the study. Eligible participants were identified in collaboration with each unit's head-nurse. All eligible participants had received the study package which contained a form for written consent and the information sheet which contained all measures undertaken to ensure participants' rights, confidentiality, and voluntary participation. Data collection took place between April-August 2018.

3.1. Study intervention

The intervention group received the study programme which was conducted in three consecutive sessions with a total 12 h face-to-face interactive sessions. These were conducted individually for each selected hospital by two researchers (M.K and K.S). Sessions were conducted at different venues; some were located at the same hospital and others in the university nursing labs.

The study adopted the 'COMPASs' programme which is an interdisciplinary education programme designed to enhance health care practitioners' understanding of clinically deteriorating patients. This programme was developed by the Australian Health Service Executive (HSE) [28]. It aims to improve communications between health care professions, adopt a patient-centred care and quality-based approach in addition to promoting timely management of acutely ill patients [28]. This education programme was developed in conjunction with the development of the MEWS. MEWS is an EWS which was subject to specific modifications from the earlier version NEWS (National Early Warning Score) [10,13]. MEWS considers the patient's entire recorded parameters together, not a single parameter in isolation. It integrates parameters of respiratory rate, oxygen saturation, temperature, blood pressure, heart rate, AVPU score and urine output to obtain the total score which is translated clinically into various patterns of responses [29].

Using the 'COMPASs' programme, the study intervention included various activities as follows: one introductory PowerPoint presentation about MEWS, one explanatory software presentation using a guided demonstration about MEWS parameters, role-play scenarios of selected case studies, and short quizzes.

3.2. Instruments

The following instruments were used to assess both intervention and control groups in the three study phases (pre-test, post-test, and follow-up):

1. Demographic questionnaire: this included gender, age, education, position, clinical experience, and history of previous training in the ED.
2. Clinical Nurse Leader Self-Efficacy Scale (CNLSES). The CNLSES aims to assess self-efficacy of the practitioner in various health care settings. This tool consists of 56 items adapted from the Performance Evaluation Tool of the Practice Setting: Cross-Setting Expectations which was established by the American Association of Colleges of Nursing [11]. The survey assesses the respondent's self-efficacy using a 5-point Likert scale (1 = not at all confident through 5 = extremely confident) with higher scores indicating higher self-efficacy. This newly developed tool was found valid and reliable after testing its psychometric properties including a construct discriminatory validity and internal consistency [23].
3. Perceptions of the nurse practitioner service tool. This tool is part of

the Nurse Practitioner's Research Toolkit developed by the Australian Nurse Practitioner Study [30]. This tool aims to evaluate the perceived role of nurse practitioner in 25 items. The responses range from 1 (Strongly Disagree) to 5 (Strongly Agree) with higher scores indicating an adequate perception of the emergency nurse's role and vice versa. Validity and reliability were examined in previous research also national reports among ED nurses [30–32]. Permission to use these tools was granted by the tools' developers.

3.3. Data analysis

Preparation and managing the data included transferring questionnaire responses into the Statistical Package of Social Sciences (SPSS version 20). Missing data which did not exceed 3% of the total data in any variable was replaced with the mean score of the values [33] (p.334). Outliers were minimal and treated by re-checking the original hardcopy forms.

Descriptive statistics were used for demographics and study variables which included: means, percentages, and standard deviations (SD). Fishers' Exact Test and *t*-test were used to examine variations in demographics between the intervention and control groups. These tools do not have definable cut-off mean scores, the total scores were calculated to compare changes in respondents' perspectives across the study phases. Analysis of the variance (ANOVA) test was used to examine changes in self-efficacy and perceived role scores within each group. The *t*-test was used to examine differences between intervention and control groups in each study phase. The test of internal consistency was also measured using Cronbach's alpha statistics for all variables in each group separately. The Hierarchical Multiple Regression was used to assess factors affecting self-efficacy after the study intervention. The level significance (α) was set at 0.05.

4. Results

A total of 232 volunteers participated in the study in the pre-test phase and were divided into intervention (118 = 59.9%) and control (114 = 49.1%) groups. Attrition across the three phases was acceptable for the intervention group (10%) and acceptable with caution for the control group (15%) [34]. Table 1 shows participants' distribution over various demographical sub-categories. It was evident that more females than males participated in both groups. However, this did not involve any significant difference between both groups. The mean of participants' ages was roughly equal in both groups; around 30 years old.

Table 2
Change in Self-efficacy Scores in Intervention and Control Groups across study phases.

Study phase	Intervention Group		Control Group		t-test: comparisons between groups		
	Obs	Mean (SD)	Obs	Mean (SD)	**t**	**df**	**Sig.**
Pre Test	118	161.4 (40.4)	114	199.8 (28.4)	**8.36**	**230**	**< 0.001**
Post Test	115	230.4 (30.3)	107	202.9 (29.2)	**6.89**	**220**	**< 0.001**
Follow-up	106	228.8 (30.9)	97	197.7 (26.5)	**7.64**	**201**	**< 0.001**
ANOVA: comparisons within group	***F***	**152.21**	***F***	**0.881**	**Cronbach's Alpha:** - Control: 0.97 - Intervention: 0.985		
	df	**2**	**df**	**2**			
	Sig.	**< 0.001**	**Sig.**	**0.416**			

-Obs: Number of the available sample, SD: Standard Deviation, *F*: F statistics, df: Degree of freedom, Sig.: significant value of *P*.
-Total self-efficacy scores ranged from 56 to 280: (56–130 Low), (131–205 Moderate), (206–280 High).
-*t*-test was used to compare means of intervention and control groups at each study phase.
-ANOVA test was used to compare of pre test and post tests within each group separately.

Regarding staff positions the majority of nurses (69.0%) from both groups were solely responsible for bedside care followed by 22.4% who were bedside care nurses together with their in-charge role. Nurses from both groups showed no significant variations in the length of clinical experience as RNs (mean = 7.85 years). However, nurses in the control group had longer clinical experience in the ED compared to the intervention group (means: 5.95 vs. 3.49, respectively, p = 0.001). More nurses in the intervention group received training on patient assessment and emergency care than did the control group (p = 0.009, 0.006, respectively). However, the majority of nurses from both groups did not receive any training on the specific patients' scoring system in the ED (Table 1).

4.1. Change in self-efficacy scores

Firstly, the assessment of self-efficacy scores between the intervention and control groups at pre-test phase showed that nurses in the control group scored higher in the self-efficacy scale compared to the

Table 1
Demographic characteristics of the study sample (N = 232).

Variable	Categories	Intervention (n = 118)	Control (n = 114)	Total (N = 232)	Sig.
Gender, n (%)	Male	38 (32.2%)	51 (44.7%)	**95 (40.9%)**	0.793
	Female	80 (67.8%)	63 (55.3%)	**137 (59.1%)**	
Age (years), mean (SD)		30.03 (6.9)	30.0 (4.9)	**30.0 (5.9)**	0.99
Position, n (%)	RN	85 (72.0%)	75 (65.8%)	**160 (69.0%)**	**0.001**
	In-charge	16 (13.6%)	36 (31.6%)	**52 (22.4%)**	
	Head nurse	12 (10.2%)	0 (0.0%)	**12 (5.2%)**	
	Other	5 (4.2%)	3 (2.6%)	**8 (3.4%)**	
Education, n (%)	Associate	6 (5.1%)	1 (0.9%)	**7(3.0%)**	**0.001**
	Bachelor	89 (75.4%)	108 (94.7%)	**197 (84.9%)**	
	Postgraduate	23 (19.5%)	5 (4.4%)	**28 (12.1%)**	
Years of experience as a RN, mean (SD)		8.47 (5.9)	7.21 (4.7)	**7.85 (5.4)**	0.075
Years of experience as an ED nurse, mean (SD)		3.49 (3.12)	5.94 (3.9)	**4.70 (3.7)**	**0.001**
Previous attendance of patients' assessment training course, n (%)	Yes	42 (35.6%)	20 (17.5%)	**62 (26.7%)**	**0.009**
	No	76 (64.4%)	94 (82.5%)	**170 (73.3%)**	
Previous attendance of patients' scoring training course, n (%)	Yes	25 (21.2%)	22 (19.3%)	**47 (20.3%)**	0.896
	No	93 (78.8%)	92 (80.7%)	**185 (79.7%)**	
Previous attendance of emergency care training course, n (%)	Yes	45 (38.1%)	22 (19.3%)	**67 (28.9%)**	**0.006**
	No	73 (61.9%)	92 (80.7%)	**165 (71.1%)**	

N: Sample size, n: Number, %: Percent, Sig.: Significant level, RN: Registered Nurse, ED: Emergency Department.
Significant level was calculated using Fishers' Exact Test for all categorical variables and *t*-test for all continuous variables.

Table 3
Change in Perceived role Scores in Intervention and Control Groups across study phases.

Study phase	Intervention Group		Control Group		*t*-test: comparisons between groups		
	Obs	Mean (SD)	Obs	Mean (SD)	t	df	Sig.
Pre Test	118	76.9 (21.3)	114	93.6 (13.4)	**7.2**	**230**	**< 0.001**
Post Test	115	105.8 (12.1)	107	94.2 (13.1)	**6.87**	**220**	**< 0.001**
Follow-up	106	104.7 (12.5)	97	92.2 (12.6)	**7.04**	**201**	**< 0.001**
ANOVA: comparisons within group	***F***	**121.2**	***F***	**0.574**	**Cronbach's Alpha:**		
	df	**2**	**df**	**2**	- Control: 0.968		
	Sig.	**< 0.001**	**Sig.**	**0.564**	Intervention: 0.942		

Obs: Number of the available sample, SD: Standard Deviation, *F*: F statistics, df: Degree of freedom, Sig.: significant value of *P*.
-Total self-efficacy scores ranged from 25 to 125: (33–58 Low), (59–92 Moderate), (93–125 High).
-*t*-test was used to compare means of intervention and control groups at each study phase.
ANOVA test was used to compare of pre test and post tests within each group separately.

intervention group ($p < 0.001$). As shown in Table 2, self-efficacy scores increased significantly across the study phases among the intervention group from moderate to high level, leading to a statistically significant difference at $p < 0.001$. When Bonferroni Post Hoc statistic test for multiple comparisons was performed, there were statistical differences in the self-efficacy scores between pre-test and both post-test and follow-up phases ($p < 0.001$, and $p < 0.001$, respectively). However, participants in the control group revealed no statistical difference in the self-efficacy scores across study phases ($p = 0.416$). Testing the internal consistency of self-efficacy scores using the Chronbach's alpha test indicated high reliability above 95% for both intervention and control groups.

4.2. Change in perceived role scores

Congruently with self-efficacy; the control group scored higher in the perceived role scores in the pre-test phase than the intervention group. Changes of the perceived role scores are presented in Table 3. It was apparent that nurses in the intervention group showed a statistically significant improvement in their perceived role from moderate to high level ($p < 0.001$). Bonferroni Post Hoc statistic test for multiple comparisons revealed statistical significant differences in the perceived role between pre-test and both post-test and follow-up phases ($p < 0.001$, and $p < 0.001$, respectively). However, participants in the control group sustained their perceived role scores at the moderate level, showing no statistical significant difference after the implementation of the study programme ($p = 0.564$). The internal consistency of the perceived role using the Chronbach's alpha test has indicated a high reliability coefficient above 94% for both intervention and control groups.

Fig. 1 summarizes changes in self-efficacy and perceived role scores for both intervention and control groups across the study phases.

4.3. Factors affecting self-efficacy

Prior to the assessment of the factors affecting ED nurses' self-efficacy, a number of variables were examined to identify their correlation with self-efficacy. These variables included age, gender, education, position, experience as RN, experience as ED nurse, and perceived role. Based on the correlation coefficient and mean differences three variables showed a significant correlation with self-efficacy as follows: age, experience as RN, and perceived role. Thereafter, Hierarchical Multiple Regression was conducted to assess the effect of the perceived role on self-efficacy (Dependent variable). The regression model included two main blocks; the first block included age and experience variables, while the second block included the perceived role variable. This regression model allowed for identifying the relationship between self-efficacy and perceived role after controlling the other correlated variables (age, experience). As shown in Table 4, Model I shows that about

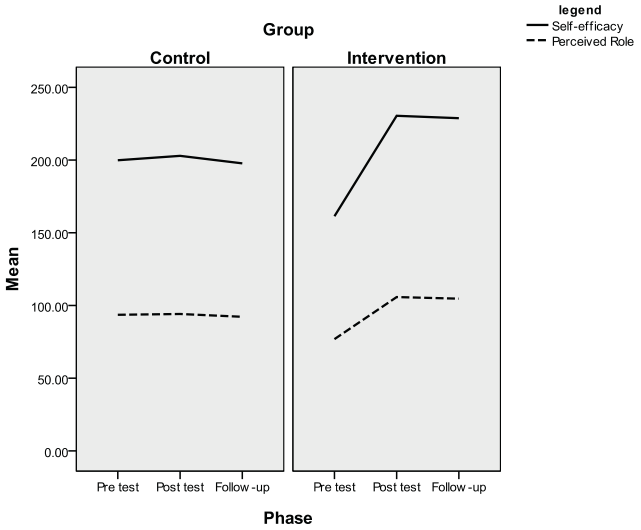

Fig. 1. A summary of self-efficacy and perceived role changes across the study phases.

7.0% of the variance of self-efficacy was explained by both age and experience. However, Model 2 revealed that the perceived role explained an additional 57.0 per cent (0.570×100) of the variance in self-efficacy, even when the effects of age and experience are statistically controlled.

5. Discussion

This study supported the effectiveness of introducing an educational training programme concerned with MEWS for ED nurses. ED nurses who participated in the intervention group exhibited prominent changes in their self-efficacy and perceived role after receiving the study programme. It was also evident that those nurses who received the MEWS educational programme maintained their attained self-efficacy and perceived role levels evidenced by subsequent scores after receiving the programme. While older nurses with longer clinical experience showed higher self-efficacy after receiving the programme, the study shed light on the positive relationship that existed between self-efficacy and perceived role and most of the higher self-efficacy (> 50%) was explained by the higher perceived role.

The results gained from this study are consistent with previous studies which found that educating nurses by EWS can enhance nurses' confidence and role perception, support interdisciplinary correspondence, promote feelings of confidence when communicating with physicians, in addition leading to increased nurses' knowledge and ability in forecasting patients' clinical impairment and deteriorations [3,35,36].

Table 4
Hierarchical Multiple Regression.

	Variables	Adjusted R Square	SE	R Square Change	Standardized Coefficient	t	Sig*	CI
					Bata			
Model 1	Age	0.055	39.6	0.072	0.022	0.193	0.848	−1.19–1.44
	Experience				0.053	0.474	0.636	−1.15–1.87
Model 2	Perceived role	0.570	26.7	0.509	0.743	11.67	< **0.001**	1.18–1.66

SE: Standard Error, CI: Confidence Interval.
* Significant value was drawn from the coefficients table indicating that the two models were statistically significant (Sig < 0.05) in F change and ANOVA results.

Various theoretical backgrounds approved the premise that individuals' self-efficacy is reflected in their performance in new situations or professional transitions [12,23,25]. This is implied in this study's findings which indicated that the ability of ED nurses to deal critically with acutely ill patients has impacted on nurses' self-efficacy. This result is also congruent with a previous study which indicated that adopting an EWS can enhance coordinated teamwork and self-efficacy of health care providers resulting in expanded trust and cooperation between staff [9]. Ludikhuize et al. [36] conducted a prospective quasi-experimental trail in the Netherlands to evaluate the ability of nurses to recognize deteriorating patients after introducing MEWS using Situation-Background-Assessment-Recommendation (SBAR) tools. The results showed that trained nurses assess patients immediately following admission more than do non-trained nurses (77% vs. 58%, respectively). Similarly, the respiratory rate was measured twice as frequently (53% vs. 25%, respectively) and subsequent notification of a physician was also more frequent (67% vs. 43%, respectively). De Meester et al. [37] found that the nurses' perceptions of the importance of vital signs estimation including oxygen saturation, consciousness, and respiratory rate, increased following the implementation of EWS.

Nurses scores regarding their perceived role and self-efficacy prior the study intervention were at moderate level. This issue was explained in a qualitative study by Petersen et al. [3] who explored barriers preceding the implementation of an EWS escalation protocol. The results of this study revealed that nurses' excessive work load could result in low adherence to the necessary frequent patient assessment, which could be attributed to their negative attitudes towards using EWS. In addition, because of low confidence levels difficulties could occur in communications and collaboration with medical staff. Another study found that nurses' roles are not acknowledged, and their assessment of patients' irregular signs and deterioration are not regarded [20]. Therefore, detecting and managing deteriorating patients optimally in the EDs is an inter-professional collaborative task that requires diverse technical and non-technical skills accompanied with effective interpersonal communications [3,6,38].

Although the sample size recruited for this study is statistically sufficient, another study which included nurses from other health care sectors and settings in Jordan, such as the military health services, would be an advantage. It is also recommended a further assessment of self-efficacy and the perceived role after a prolonged period of more than three months to ensure sustainability of an individual's improvement. Future studies are recommended to examine ED nurses' performance in relation to their actual clinical practice including direct observation on adherence to the MEWS track and trigger escalation procedure as well as patient outcomes.

6. Conclusion

Introducing an educational training programme in the light of MEWS has enhanced ED nurses' self-efficacy and perceived role. Since the impact of MEWS on early detection of patients' deterioration was established, increasing nursing competency in this sphere does promote nursing confidence, improve nursing performance, and enhance better understanding of described roles in emergency situations. Implementing MEWS in the EDs would not be possible without multidisciplinary team work accompanied with mutual contributions from all health care professionals.

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Conflicts of interest

Authors have no conflicts of interest to declare.

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