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ORIGINAL ARTICLE

Effect of triage nurse-led application of the Ottawa Ankle Rules on number of radiographic tests and length of stay in selected emergency departments in Oman

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Abstract

Aim: Ankle injuries are commonly seen in the emergency department (ED) and contribute to overcrowding. In Oman, injuries are a leading cause of years of life lost, disability-adjusted life years, and pose a burden to the healthcare system. This study aimed to evaluate the effectiveness of ED triage nurse-led application of the Ottawa Ankle Rules (OARs) toward improving the healthcare outcomes of ankle injury patients.

Methods: A quasi-experimental design was used to collect data (demographic characteristics, waiting time, length of stay, and number of radiographic tests) from 96 patients. The intervention group ($n = 46$) received ED triage nurse-led assessment and initiation of radiographic tests based on the OARs. The control group ($n = 50$) received usual care.

Results: The participants' mean age was 26.4 ± 7.90 years. The main causes of ankle injuries were football (36%), falls (31%) and twisting while walking (24%). There was a significant difference in number of ankle X-rays ($t = 6.19$; $p < .001$); length of stay ($U = 549$; $p < .001$); and waiting time ($U = 167$; $p < .001$) between the control and intervention group. The intervention reduced the mean waiting time and length of stay by 25.09 and 41.01 min, respectively.

Conclusion: Application of the OARs by the ED triage nurse can decrease the number of unnecessary radiographic tests, waiting time and length of stay in the ED. Nurses' utilization of evidence-based clinical decision-making tools can improve ED care outcomes of common acute conditions such as ankle injuries.

KEYWORDS

ankle injury, ankle X-ray, emergency department, Ottawa Ankle Rules, triage nurse

1 | INTRODUCTION

The Global Burden of Disease and injury study results showed that annually 973 million people around the world present to the emergency department (ED) with complaints of minor and major injuries that warrant some type of health care (Haagsma et al., 2016). Ankle injuries are one of the common conditions that lead patients to seek healthcare in the ED (Singh-Ranger & Marathias, 1999). The majority of patients present to the ED with complaints and manifestations such as sudden severe pain, swelling, bruising, and inability to walk or bear weight on the injured extremity or joint (Polzer et al., 2011). In cases where the patient has an ankle sprain, the ankle may be stiff, while in ankle fracture

the ankle joint area is usually tender and looks deformed or out of place (Polzer et al., 2011).

The most common category of ankle injuries are ankle sprains, dislocations and fractures (Shah, Thomas, Noone, Blanchette, & Wikstrom, 2016; Singh-Ranger & Marathias, 1999). These injuries require prompt management to reduce pain, and stabilize the ankle sprain or fracture (Murray, McDonald, Archbold, & Crealey, 2011). The management of ankle injuries in all its forms is expensive because it involves diagnostic radiographic tests to make the final diagnosis and different treatment procedures (Murray et al., 2011). The literature shows that the median ED cost per ankle sprain event in the USA is $1,029 (Shah et al., 2016). In the UK, the mean total hospital cost per patient diagnosed with ankle fracture is estimated at $6,196.70 (Murray et al., 2011).

It has been reported that in the USA, strains and sprains account for 36% of all lower extremity injuries, with sprains having the highest incidence of 206 per 100,000 (Lambers, Ootes, & Ring, 2012). Studies conducted in Europe show that the crude incidence rate of ankle sprains is approximately 60.9 per 10,000 patients (Bridgman et al., 2003). In the Middle East region, ankle injuries constitute approximately 7% of all patients who present to the ED (Tadros, Eid, & Abu-Zidan, 2010). There are no published statistics about the incidence of ankle injuries in Oman, but the number of ankle injuries seen in the local ED is very high. The above descriptions indicate the burden brought about by ankle injuries, therefore efforts toward any improvement in their management can result in enhanced ED care outcomes.

The ED plays a major role in the healthcare system and in many countries it acts as an accessible safety net (Asplin et al., 2003), but it is also one of the most overcrowded units in any given hospital (Alavi-Moghaddam et al., 2012). Crowding in the ED is defined as having greater numbers of patients than the number of treatment rooms, or greater numbers of patients than the number of ED healthcare providers (Gordon, Billings, Asplin, & Rhodes, 2001). Literature shows that overcrowding in the ED may occur as a result of prolonged length of stay (LOS) of patients, delayed response to ED consultations and referrals, repeated ED visits (frequent flyers), non-urgent visits and hospital-specific factors (Afilalo et al., 2004; Erenler et al., 2014).

The lack of utilization of evidence-based practice by healthcare providers in the ED can also lead to overcrowding and poor patient outcomes. For instance, in many patient conditions commonly seen in the ED such as ankle injuries, the physicians might request unnecessary radiographic tests to make the final diagnosis (Lambers et al., 2012). The average time required to perform an ankle X-ray is 10 to15 min, then the ED physician takes additional time to read the X-ray which extends the patient's LOS (Sorensen, Keeling, Snyder, & Syverud, 2012). Prior studies have shown that overcrowding in the ED affects the quality of care provided to the patient because it leads to prolonged waiting time, delayed case diagnosis, delayed treatment, and delayed attendance to and treatment for seriously ill patients, unnecessary diagnostic investigations, and all these subsequently increase the cost of care (Erenler et al., 2014).

To overcome the overcrowdedness and the associated poor health outcomes in the ED, many strategies have been suggested and tested. These strategies include increasing the number of healthcare providers, increasing the number of hospital beds, and educating the community about receiving appropriate healthcare services from the appropriate healthcare institutions (Erenler et al., 2014; Sorensen et al., 2012). But all the above interventions are associated with high financial costs (Bucheli & Martina, 2004). Directing patients to alternative sources of care away from the ED, such as walk-in centers, is helpful in reducing ED patient volume, but the evidence about this approach is weak and its cost-effectiveness is not well known (Salisbury & Munro, 2003).

On the other hand, implementation of standing orders by nurses and other health providers working in the ED has been found to be a cost-effective strategy and it reduces patient LOS (Ashurst et al., 2014; Ho, Chau, & Cheung, 2016). Nurses are the largest number of healthcare providers in the ED, therefore they are a reliable resource that can be used to improve the quality of ED care through implementation of standing orders/protocols such as the Ottawa Ankle Rules (OARs) for ankle injuries (Ho et al., 2016; Sorensen et al., 2012). The OARs is an evidence-based approach to assessment and diagnosis of ankle injuries, and it guides the clinician to make decisions regarding the need for radiographic tests (Stiell et al., 1992). The OARs was originally developed to be used by physicians with a goal of improving immediacy of interventions to relieve pain and improve outcomes of patients with ankle injuries (Ho et al., 2016; Lee et al., 2016). The OARs have been mostly used in clinical settings in north America, Europe, and some few countries in Asia (Bachmann, Kolb, Koller, Steurer, & ter Riet, 2003; Curr & Xyrichis, 2015; Meena & Gangary, 2015).

The development, accuracy and the steps of implementing the OARs in clinical practice is widely reported elsewhere (Meena & Gangary, 2015; Stiel et al., 1992, 1993). Literature from other countries shows that the OARs when used to assess and initiate radiographic tests as a standard practice, can improve the healthcare outcomes of patients with ankle injuries (Ho et al., 2016). However, the majority of studies reporting about the OARs outcomes have been conducted in highly developed countries with well-established healthcare systems (Ashurst et al., 2014; Auleley

et al., 1998; Curr & Xyrichis, 2015; Knudsen, Vijdea, & Damborg, 2010; Sorensen et al., 2012).

2 | AIM

The main aim of the study was to evaluate the effectiveness of ED triage nurse-led application of the OARs toward improving healthcare outcomes (waiting time, LOS and number of radiographic test) of patients with ankle injuries.

3 | METHODS

3.1 | Study design

A quasi-experimental design was used to examine the effectiveness of ED triage nurse-led application of the OARs toward improving healthcare outcomes (waiting time, LOS, and number of radiographic tests) of patients with ankle injuries. The study was conducted in the ED of two government-funded hospitals located in Muscat (Oman). The Canadian Triage and Acuity Scale (CTAS) triage system is used in both facilities. CTAS is a five-level triage system used to grade the acuity of the patients' condition (level 1 Resuscitation, level 2 Emergent, level 3 Urgent, level 4 Less urgent and level 5 Non-urgent).

3.2 | Study participants

The participants were adult patients seen in the ED with acute ankle injuries. In order to be included in this study, the participants had to meet the inclusion criteria of: age 18 years and above; seeking health care in the ED within 12 h from the time of injury; presenting with a chief complaint of ankle pain, trauma, injury or inability to bear weight due to ankle injury (based on history reported by the patient); able to speak Arabic or English language. The patients with the following characteristics were excluded: had other isolated injury of the skin of the lower leg; returned for re-assessment of prior ankle injury which was already diagnosed; referred by another healthcare provider or healthcare facility after the ankle or foot radiographs were already taken; pregnant women; and had mental incapacitation and unable to provide informed consent.

A convenience sample ($N = 96$) was recruited and distributed between the control group ($n = 50$) and the intervention group ($n = 46$). Convenience sampling strategy was adopted because of the unpredictable nature of patient visits to the ED. All patients with ankle injuries who were willing to participate in the study were assigned to the control or intervention group based on their choice after explaining the study procedures. In Oman all citizens (Omanis) get free health care in government hospitals and healthcare facilities. Therefore the participants for this study did not pay for any costs since they were all Omanis and eligible for free health care.

3.3 | The intervention

The intervention group received care which started with ED triage nurse-led application of the OARs to assess the ankle injury and initiate radiographic tests. Only one ED triage nurse implemented the intervention for all participants in the intervention group. The nurse had a Bachelor of Science in nursing, 5 years of experience in the ED, attended a 1-week training course in trauma nursing, and was oriented in the use of OARs by a senior ED physician. The ED triage nurse was given privileges to order radiographic tests for the purposes of this study. The patients in the intervention group were triaged by the ED triage nurse, and then assessed and scored using the OARs protocol. The score was then used to make a decision to request radiographic tests (ankle X-ray) or not, as per the recommendations of the OARs protocol.

The control group received the usual care provided by the ED physicians. The usual care is comprised of general assessment by the triage nurse to determine the CTAS level of the patient's condition, waiting to be seen by the physician, being seen by the ED physician who performs a focused assessment, initiation of radiological tests by the physician (based on personal knowledge, experience and expertise) and the formulation of a care plan. The ED physician did not use the OARs to assess or while making treatment plans for patients in the control group.

3.4 | Study instrument

Data about participants' demographic characteristics, events leading to ankle injury, number of radiographic tests (ankle X-rays), ED waiting time and ED LOS were collected. Data for the control and intervention group were collected using a questionnaire comprised of a demographic data sheet, the triage assessment record form, and ankle injury care sheet. The triage assessment record form had information which outlines the steps to follow when assessing a patient in the intervention or control group until the point of making a decision to request for radiographic tests. The steps and decision process outlined for the intervention group are those recommended by the OARs protocol. The ankle injury care sheet was developed by the investigators to record data about events leading to ankle injuries, ED waiting time, LOS, and number of radiographic tests after health care in the ED.

The numbers of radiographic tests used to investigate the ankle injury before a diagnosis was made were recorded for each patient. The ED waiting time was computed as the time

(minutes) spent from the point of registration or triage (whichever was earlier) to the time of consultation (time when patient was seen by a physician to develop a care plan). The LOS was calculated as the total amount of time (in minutes) spent in the ED from the first documented time on arrival (the earlier of triage or registration) to the time when the patient was discharged or admitted as an inpatient. The data about number of radiographic tests and time is automatically recorded by electronic patient medical record once the appropriate step is initiated.

3.5 | Data collection procedures

The investigators worked with the assigned triage nurse at the triage station of each ED to identify patients complaining of ankle injury. These patients were approached at triage or during registration to recruit them into the study and those who were willing to participate were assigned either to the control or intervention group. The participants were requested to provide written informed consent after receiving a full explanation of the study purpose and study procedures. After consent, the participants in the control group continued to receive usual care. The participants in the control group were approached again while waiting for care or just before discharge to complete the demographic data sheet and clarify other data such as events which led to ankle injury.

The patients in the intervention group, once at the triage station, they were assessed by the ED triage nurse implementing the OARs protocol. During this assessment, data about the cause of ankle injury, patient identification number and demographic characteristics were elicited. The rest of the data were obtained from the electronic computer medical record. After triage and assessment using the OARs protocol, the score of the participants in the intervention group was used to make a decision of whether to initiate the radiographic X-rays or not. In cases where the triage nurse decided not to request radiographic tests (according to the OARs protocol), the patient waited to be examined by the ED physician to develop a care plan. All the patients were seen by the physician (the ED physician did not use the OARs, but applied personal knowledge and experience) according to their CTAS level to formulate the treatment and disposition plan.

3.6 | Ethical considerations

The study was reviewed for ethics and approved by the author's University's and the Health Centre's Research and Ethics Committees. The participants were provided with clear information about the study and their rights before consenting to the study. All the participants in the control and intervention groups were examined by the ED physician. The data collection tools were kept anonymous and participant confidentiality was maintained by masking the patient hospital identifying number with a specific study code number.

3.7 | Data analysis

The sample characteristics, common events leading to ankle injuries, number of ankle X-rays, ED waiting time, and LOS were summarized using descriptive statistics (frequency, percentages, means and standard deviations). The t test (independent samples t test), Chi-square and Mann–Whitney U test analysis were used to determine the differences in number of ankle X-rays, waiting time and LOS between the control and intervention groups. Furthermore, agreement Kappa test was used to evaluate the extent of agreement between the ED physicians (control group) and triage nurse (intervention group) in radiographic test requests. The assumptions for each statistical test were verified and the level of significance for all tests was set at $P \leq .05$ (two-tailed).

4 | RESULTS

4.1 | Characteristics of the participants

The participants' characteristics are presented in Table 1. Their mean age was 26.4 ± 7.84 years and the majority in both groups were male. All the participants were assigned to triage level 4 or less urgent on the CTAS (patient can wait for 1 h in the waiting area before being examined by the physician if he/she is not experiencing serious complications). The main complaint on presenting to the ED was ankle injury and the associated pain was rated as moderate (mean pain level = 5.46 ± 1.23). The main events reported as the cause of the injury ($n = 96$) were soccer or football (36%), fall (31%), and twisted ankle or foot while walking (24%). The other causes reported were road traffic accident (3%), other sports (3%), work-related injury (2%), and heavy object falling on the foot (1%). Overall, there were no significant differences between the control and intervention groups in terms of demographic characteristics.

4.2 | Differences in number of ankle X-rays requested

The number of ankle X-rays requested by the ED physicians (based on their experience and knowledge) in the control group and by the triage nurse (based on OARs protocol) in the intervention group are presented in Table 2. The results show that the ED physicians requested ankle X-rays for

TABLE 1 Characteristics of the participants ($n = 96$)

Characteristics	Category	Control ($n = 50$) f (%)	Intervention ($n = 46$) F (%)	χ^2 and P value
Gender	Male	39 (78)	34 (73.9)	$\chi^2 = 0.22$
	Female	11(22)	12 (26.1)	$P = .811$
Age in years	18–40	47 (93.4)	43 (93.5)	$\chi^2 = 0.011$
(mean = 26.4; $SD = 7.84$)	≥41	3 (6)	3 (6.5)	$P = 1.00$
Level of education	Primary school	2 (4)	1 (2.2)	$\chi^2 = 2.82$
	Secondary school	10 (20)	16 (34.8)	$P = .421$
	Diploma	11 (22)	9 (19.6)	
	≥Bachelor's degree	27 (54)	20 (43.5)	
Occupation	Unemployed	4 (8)	7 (15.2)	$\chi^2 = 3.83$
	Student	26 (52)	21 (45.7)	$P = 0.280$
	Medical staff	5 (10)	9 (19.6)	
	Others occupations	15 (30)	9 (19.6)	
Triage category	Level 4	50 (100)	46 (100)	-
Chief complaint on arrival	Injury	42 (84)	44 (95.6)	$\chi^2 = 3.49$
	Pain	8 (16)	2 (4.4)	$P = .09$
Pain rating	Moderate (1–5 rating)	29 (58)	30 (65.2)	$\chi^2 = 0.527$
(M = 5.46; $SD = \pm 1.23$)	Severe (6–10 rating)	21 (42)	16 (34.8)	$P = .532$
Site of pain in the ankle	Malleolar zone	25 (50)	28 (60.9)	$\chi^2 = 1.14$
	Midfoot zone	25 (50)	18 (39.1)	$P = .311$

SD, standard deviation.

TABLE 2 Number of ankle X-rays requested for patients in the control and intervention groups

Variable	Ankle X-ray requested		No. of positive ankle fractures	Mean	SD	*t*	*P* value	95% CI
	No	Yes						
Control group ($n = 50$)	4 (8%)	46 (92%)	8 (17.4%)	1.88	0.40	6.19	<.001	0.37–0.72
Intervention ($n = 46$)	31 (67.4%)	15 (32.6%)	9 (60%)	1.33	0.47			

SD, standard deviation.

almost all the patients in the control group (92%), but only 17.4% of the requests were needed (positive for ankle fracture). In the intervention group ($n = 46$), the triage nurse (using OARs protocol) requested ankle X-rays for only 32.6% (15 patients) and 60% of the requests were needed (positive for ankle fracture). The application of OARs by the triage nurse led to detection of more ankle fractures than the physician's requests based on experience and knowledge. The average number of ankle X-rays requested by the triage nurse using OARs in the intervention group (1.33 ± 0.47) was statistically significantly lower than the average number of ankle X-rays requested by the ED physicians (1.88 ± 0.40) in the control group (t = 6.19; $P < .001$; 95% CI = 0.37–0.72).

4.3 | Agreement between physicians and triage nurse on ankle X-ray requests

The results of the ED physician and triage nurse agreement to request ankle X-ray in the control and intervention groups

are presented in Table 3. The agreement on ankle X-ray requests between the triage nurse in the intervention group and ED physicians in the control group was 34% which was very low and statistically significant at $P < .001$. When ankle X-ray tests were requested, the ED physicians and triage nurse using OARS agreed to request in 27.7% of the cases; and when ankle X-rays were not requested, both the ED physicians and triage nurse agreed not to request the X-ray in 100% of the cases.

4.4 | Difference in waiting time and LOS

The results summarized in Table 4, show the difference in waiting time and LOS between patients in the control and intervention groups. The mean waiting time in the control group was 60.52 min, while the mean waiting time for the intervention group was 35.43 min. There was a statistically significant difference in the waiting time between both groups ($U = 549$; $P < .001$). The mean LOS in the control group was 68.15 min, whereas in the intervention group it was 27.14 min. There was a statistically significant difference in the mean LOS between both groups ($U = 167.5$; $P < .001$). Implementing OARs by the triage nurse reduced the patients' waiting time and LOS by 25.09 and 41.01 min, respectively.

5 | DISCUSSION

This study evaluated the outcomes of the application of the OARs (number of ankle X-rays, ED waiting time and LOS) by a triage nurse. The participants were mostly young males and they reported the main causes/events which led to ankle injury to be soccer or football, falls, and twisted ankle or foot while walking. In Oman, there has been no study which has specifically focused on ankle injuries, but the available literature shows that the most common causes of general injury among patients are falls (40.3%), sports injuries (12.7%), and being struck by or struck against objects (12.4%) (Al-Balushi et al., 2012). This report is consistent with the findings of our study showing that sports (football) and falls are the major causes of ankle injuries. Of the 96 participants (both control and intervention groups) only 17 (17.7%) were found to have ankle fractures. Therefore, it is logical to suggest that most ankle injuries seen in the ED are not associated with ankle fractures.

The findings of the current study show a significantly lower number of ankle X-rays and high number of ankle fractures detected by the triage nurse implementing OARs compared to the ED physicians using usual care for patients with ankle injuries. These results are consistent with those from a recent randomized controlled trail conducted in Hong Kong and other countries (Ho, Chau, Chan, & Yau, 2018; Ho et al., 2016). Furthermore, an interventional study conducted in Denmark in 2010 also found that the use of OARs significantly reduced the number of ankle X-rays from 62% to 57% ($P < .001$) (Knudsen et al., 2010). Therefore, like other studies from developed countries with well-established healthcare systems, our findings show that implementation of the OARs by the triage nurse is effective at reducing the number of unnecessary ankle X-rays for patients with ankle injuries seen in the ED.

In the ED usually patients with ankle injuries are triaged by the nurse and asked to stay in the waiting area for examination by the ED physician. The waiting time in ED can be prolonged (more than 4 h) due to many factors. Prolonged waiting time for patients with ankle injuries and increased number of patients attending ED result in ED overcrowding.

TABLE 3 Agreement between emergency department (ED) physicians (control group) and ED triage nurse (intervention group) on ankle X-ray requests

		Ankle X-ray requested by ED physicians				
Agreement		**No**	**Yes**	χ^2	***P* value**	**Agreement – Kappa (*P* value)**
Ankle X-ray requested by ED triage nurse	No	11 (100%)	60 (72.3)	17.03	<.001	0.34 (<.001)
	Yes	0 (0%)	23 (27.7)			

TABLE 4 Difference in waiting time and length of stay between the control and intervention groups

Variable		n	Median	Mean rank	Sum of ranks	Mann–Whitney *U*	*P* value
Waiting time (in min)	Control group	50	61	60.52	3,026	549	<.001
	Intervention group	46	30	35.43	1,630		
Length of stay (in min)	Control group	50	159	68.15	3,407.5	167.5	<.001
	Intervention group	46	62	27.14	1,248.5		

The ED overcrowding is sustained by three interdependent components of input (unscheduled patients, etc.), throughput (triage, diagnostics, treatment, etc.), and output (waiting time, overall LOS, patient disposition and others) (Asplin et al., 2003). The OARs enhances the throughput component and decreases the waiting time and overall LOS by quickening the initial provider evaluation and diagnostic testing aspects. Subsequently, this contributes to alleviating ED overcrowding by speeding patient disposal from the ED.

To overcome overcrowding in the ED, approaches focusing on expansion of the roles of ED triage nurses to include implementation of evidence-based diagnostic standing orders have been used. These evidence-based standing orders have been used for conditions commonly seen in the ED such as chest pain, abdominal pain and minor lower extremities injuries (Rowe et al., 2011). The current study supports the addition of application of OARs as a standing order that can be implemented by the triage nurse to improve ED patients' health outcomes.

The current study also shows that there was a significant difference in waiting time between the control and intervention groups ($P < .001$). Implementation of the OARs by the triage nurse reduced the mean waiting time by 25.09 min. This finding is consistent with others which have reported a significant reduction in mean waiting time of the intervention group compared to the control group (Ho et al., 2016). The reduction in waiting time in the current study is more than what has been previously reported and this might be due to the fact that more patients in the control group were enrolled during the night shift. During the night shift the ED might be more crowded and with less staff. Most of the patients in the intervention group were recruited during morning shift. Future studies evaluating the effectiveness of the OARs should ensure to recruit patients in both, the control and intervention group, during the same work shift or compare the outcomes of patients only recruited during the same shift.

The study found a significant difference in overall patient' LOS between the control and intervention groups ($P < .001$). The mean LOS was reduced by 41.01 min in the intervention group. This finding is similar to that of other studies. A study conducted in the USA also found a significant difference of 45 min ($P = .030$) in LOS between the usual care and post-test groups who received triage by nurses based on OARs (Sorensen et al., 2010). Further, a prospective randomized controlled trial conducted in Canada showed that the triage nurse initiating radiographic tests using the OARs led to a significant decrease in patient LOS ($P = .003$) between the control and intervention groups (Lee et al, 2016). Therefore, one of the strategies that Oman hospital EDs may consider using to reduce overcrowding is the application of evidence-based and reliable standing orders and protocols such as the OARs.

The OARs overcomes the usual ED waiting after triage to consult the ED physician. When ED physicians see patients with ankle injuries they tend to request radiographic tests for almost all and then reassess them after radiographic test reports are released. As a result, the patients' LOS in ED get prolonged and this can become a major cause of delayed diagnosis and treatment, and overcrowding (Erenler et al., 2014; Pines et al., 2011; Pitts, Pines, Handrigan, & Kellermann, 2012). Moreover, overcrowding in ED has been associated with a decreased quality of care and an increased risk of adverse outcomes, including readmission and death for both admitted and discharged patients (Sun et al., 2013). The triage nurse-led application of OARs to assess and initiate radiographic tests for patients with ankle injuries allows the ED physicians to obtain the results of radiographic tests before their first encounter with the patients, and this reduces patient waiting time and LOS in ED. Reducing LOS benefits the patients by providing them with earlier treatment and discharge, leading to comfort, and more time for the injured ankle to rest and achieve the healing process (Ho et al., 2016).

5.1 | Limitations of the study

This study has some limitations which should be considered. First, the sample for the study was recruited using a convenience sampling strategy (risk of bias) and from only two hospitals in Oman. Therefore, the results may not be generalized to other EDs in Oman. The results were prone to risk of the Hawthorne effect that could have affected the implementation of the OARs by the triage nurse and management of participants because there was no blinding. To minimize this effect all ED staff were kept neutral by maintaining their unawareness of the data collection and outcomes being studied. The physicians caring for the control group may have learned about the OARs during their training, and this might have affected their assessment and decision to request ankle X-rays.

5.2 | Implications for nursing practice

In emergency nursing, timely assessment and care is vital to ensure timely care, and quality patient and unit outcomes. This study shows that the use of evidence-based protocols such as the OARs by triage nurses to assess and initiate radiographic tests for patients with ankle injuries led to a significant improvement in ED waiting time, LOS and number of unnecessary ankle X-rays requested. We recommend implementation of OARs and other evidence-based standing orders by ED nurses as a strategy for enhancing patient and

unit outcomes. The implementation of such standing orders can help to reduce healthcare costs, overcrowding, and other indicators of poor quality care in the ED. Nurses in clinical practice are also called upon to conduct research that leads to development of new, reliable and cost-effective evidence-based protocols and standing orders as a way of enhancing the quality of ED care.

6 | CONCLUSIONS

The triage nurse-led implementation of OARs protocol reduced the percentage of unnecessary ankle X-rays, the ED waiting time and LOS of patients with ankle injuries by 42.6%, 25.09, and 41.01 min, respectively. Therefore, the OARS can be used as a standard standing order that can be implemented by triage nurses. The triage nurses can reliably apply the OARs and this strategy can reduce ED overcrowding and the healthcare costs associated with ankle injuries through reduced LOS and unnecessary ankle and foot radiographic tests. However, further studies should be conducted to evaluate physicians' and patients' perceptions about nurses' abilities to order radiographic tests, and the effect of OARS on other healthcare outcomes.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

F.H.A. and J.K.M. conducted the study; F.H.A., J.K.M., and H.A. contributed to formulation of the research ideas and aspects of the study design, made suggestions regarding the content of the manuscript, and provided advice during the entire study process; they all contributed to the writing of the manuscript. F.H.A. and J.K.M. performed the data analysis. All the authors approved the final version of the manuscript.

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REFERENCES

Afilalo, J., Marinovich, A., Afilalo, M., Colacone, A., Leger, R., Unger, B., & Giguère, C. (2004). Nonurgent emergency department patient characteristics and barriers to primary care. *Academic Emergency Medicine*, 11(12), 1302–1310.

Alavi-Moghaddam, M., Forouzanfar, R., Alamdari, S., Shahrami, A., Kariman, H., Amini, A., … Shirvani, A. (2012). Application of queuing analytic theory to decrease waiting times in emergency department: Does it make sense? *Archives of Trauma Research*, 1 (3), 101–107.

Al-Balushi, H., Al-Kalbani, A., Al-Khwaldi, T., Al-Suqri, S., Al-Maniri, A., Alazri, M., & Al-Hinai, M. (2012). Injuries presented at a primary care setting in Oman. *Oman Medical Journal*, 27(6), 486–490.

Ashurst, J. V., Nappe, T., Digiambattista, S., Kambhampati, A., Alam, S., Ortiz, M., … Greenberg, M. R. (2014). Effect of triage-based use of the Ottawa foot and ankle rules on the number of orders for radiographic imaging. *The Journal of the American Osteopathic Association*, 114(12), 890–891.

Asplin, B. R., Magid, D. J., Rhodes, K. V., Solberg, L. I., Lurie, N., & Camargo, C. A. (2003). A conceptual model of emergency department crowding. *Annals of Emergency Medicine*, 42(2), 173–180.

Auleley, G. R., Kerboull, L., Durieux, P., Cosquer, M., Courpied, J. P., & Ravaud, P. (1998). Validation of the Ottawa ankle rules in France: A study in the surgical emergency department of a teaching hospital. *Annals of Emergency Medicine*, 32(1), 14–18.

Bachmann, L. M., Kolb, E., Koller, M. T., Steurer, J., & ter Riet, G. (2003). Accuracy of Ottawa ankle rules to exclude fractures of the ankle and mid-foot: Systematic review. *British Medical Journal*, 326(7386), 417–423.

Bridgman, S. A., Clement, D., Downing, A., Walley, G., Phair, I., & Maffulli, N. (2003). Population based epidemiology of ankle sprains attending accident and emergency units in the West Midlands of England, and a survey of UK practice for severe ankle sprains. *Emergency Medicine Journal*, 20(6), 508–510.

Bucheli, B., & Martina, B. (2004). Reduced length of stay in medical emergency department patients: A prospective controlled study on emergency physician staffing. *European Journal of Emergency Medicine*, 11(1), 29–34.

Curr, S., & Xyrichis, A. (2015). Does nurse-led initiation of Ottawa ankle rules reduce ED length of stay? *International Emergency Nursing*, 23(4), 317–322.

Erenler, A. K., Akbulut, S., Guzel, M., Çetinkaya, H., Karaca, A., Turkoz, B., & Baydin, A. (2014). Reasons for overcrowding in the emergency department: Experiences and suggestions of an education and research Hospital. *Turkish Journal of Emergency Medicine*, 14(2), 59–63.

Gordon, J. A., Billings, J., Asplin, B. R., & Rhodes, K. V. (2001). Safety net research in emergency medicine proceedings of the academic emergency medicine consensus conference on "The Unraveling Safety Net". *Academic Emergency Medicine*, 8(11), 1024–1029.

Haagsma, J. A., Graetz, N., Bolliger, I., Naghavi, M., Higashi, H., Mullany, E. C., … Phillips, M. R. (2016). The global burden of injury: Incidence, mortality, disability-adjusted life years and time trends from the Global Burden of Disease study 2013. *Injury prevention*, 22(1), 3–18.

Ho, J. K. M., Chau, J. P. C., Chan, J. T. S., & Yau, C. H. Y. Y. (2018). Nurse-initiated radiographic-test protocol for ankle injuries: A randomized controlled trail. *International Journal of Emergency Nursing*, 41, 1–6. https://doi.org/10.1016/j.ienj.2018.04.001

Ho, J. K. M., Chau, J. P. C., & Cheung, N. M. C. (2016). Effectiveness of emergency nurses' use of the Ottawa Ankle Rules to initiate radiographic tests on improving healthcare outcomes for patients with ankle injuries: A systematic review. *International journal of nursing studies*, 63, 37–47. https://doi.org/10.1016/j.ijnurstu.2016.08.016

Knudsen, R., Vijdea, R., & Damborg, F. (2010). Validation of the Ottawa ankle rules in a Danish emergency department. *Danish Medical Bulletin*, 57(5), 41–49.

Lambers, K., Ootes, D., & Ring, D. (2012). Incidence of patients with lower extremity injuries presenting to US emergency departments by anatomic region, disease category, and age. *Clinical Orthopaedics and Related Research*, 470(1), 284–290.

Lee, W. W., Filiatrault, L., Abu-Laban, R. B., Rashidi, A., Yau, L., & Liu, N. (2016). Effect of triage nurse initiated radiography using the Ottawa Ankle Rules on emergency department length of stay at a tertiary Centre. *Canadian Journal of Emergency Medicine*, 18(2), 90–97.

Meena, S., & Gangary, S. K. (2015). Validation of the Ottawa Ankle Rules in Indian scenario. *Archives of Trauma Research*, 4, e20969. https://doi.org/10.5812/atr.4(2)2015.20969

Murray, A. M., McDonald, S. E., Archbold, P., & Crealey, G. E. (2011). Cost description of inpatient treatment for ankle fracture. *Injury*, 42(11), 1226–1229.

Pines, J. M., Hilton, J. A., Weber, E. J., Alkemade, A. J., Shabanah, H. A., Anderson, P. D., … Schull, M. J. (2011). International perspectives on emergency department crowding. *Academic Emergency Medicine*, 18(12), 1358–1370.

Pitts, S. R., Pines, J. M., Handrigan, M. T., & Kellermann, A. L. (2012). National trends in emergency department occupancy, 2001 to 2008: Effect of inpatient admissions versus emergency department practice intensity. *Academic Emergency Medicine*, 60(6), 679–686.

Polzer, H., Kanz, K. G., Prall, W. C., Haasters, F., Ockert, B., Mutschler, W., & Grote, S. (2011). Diagnosis and treatment of acute ankle injuries: Development of an evidence-based algorithm. *Orthopedic Reviews*, 4(1), 5–10.

Rowe, B. H., Villa-Roel, C., Guo, X., Bullard, M. J., Ospina, M., Vandermeer, B., … Holroyd, B. R. (2011). The role of triage nurse ordering on mitigating overcrowding in emergency departments: A systematic review. *Academic Emergency Medicine*, 18(12), 1349–1357.

Salisbury, C., & Munro, J. (2003). Walk-in centres in primary care: A review of the international literature. *British Journal of General Practice*, 53(486), 53–59.

Shah, S., Thomas, A. C., Noone, J. M., Blanchette, C. M., & Wikstrom, E. A. (2016). Incidence and cost of ankle sprains in United States emergency departments. *Sports Health*, 8(6), 547–552.

Singh-Ranger, G., & Marathias, A. (1999). Comparison of current local practice and the Ottawa Ankle Rules to determine the need for radiography in acute ankle injury. *Accident & Emergency Nursing*, 7(4), 201–206.

Sorensen, E. L., Keeling, A., Snyder, A., & Syverud, S. (2012). Decreasing ED length of stay with use of the Ottawa Ankle Rules among nurses. *Journal of Emergency Nursing*, 38(4), 350–352.

Stiell, I. G., Greenberg, G. H., McKnight, R. D., Nair, R. C., McDowell, I., & Worthington, J. R. (1993). A study to develop clinical decision rules for the use of radiography in acute ankle injuries. *Annals of Emergency Medicine*, 21(4), 384–390.

Stiell, I. G., McDowell, I., Nair, R. C., Aeta, H., Greenberg, G., McKnight, R. D., & Ahuja, J. (1992). Use of radiography in acute ankle injuries: physicians' attitudes and practice. *Canadian Medical Association Journal*, 147(11), 1671–1678.

Sun, B. C., Hsia, R. Y., Weiss, R. E., Zingmond, D., Liang, L. J., Han, W., … Asch, S. M. (2013). Effect of emergency department crowding on outcomes of admitted patients. *Annals of Emergency Medicine*, 61(6), 605–611.

Tadros, A. M., Eid, H. O., & Abu-Zidan, F. M. (2010). Epidemiology of foot injury in a high-income developing country. *Injury*, 41(2), 137–140.

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