Effectiveness of Implementing Emergency Severity Index Triage System in a Selected Primary Health Care Center in Oman: A Quasi-Experimental Study

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Contribution to Emergency Nursing Practice

- The current literature on the effectiveness of Emergency Severity Index (ESI) triage system in the general practice (GP) setting indicates the limited scientific knowledge and application of ESI, especially in Oman.
- This article contributes to ESI knowledge, suggesting that ESI can reduce the length of stay and waiting time and improve patient flow and satisfaction.
- Key implications for emergency nursing practice found in this article are as follows: (1) ESI can be an effective triage system in the GP setting, (2) the ESI triage system can reduce crowding in the GP setting and improve patient throughput, and (3) training nurses on implementing an ESI system may reduce negative patient outcomes related to crowding in the GP setting.

Abstract

Background: Because most primary health care centers in Oman do not use a formal triage system, there are no available data on the effectiveness of implementing this system.

Purpose: To assess the effectiveness of implementing an Emergency Severity Index triage system in primary health care centers in Oman.

Methods: A pretest/posttest quasi-experimental design was used. The sample comprised 187 patients before Emergency Severity Index implementation and 102 patients after implementation. Waiting time, length of stay, patient satisfaction, and accuracy of classification were compared across the 2 groups.

Results: The mean time (hour:minute) from registration to triage was reduced in the post-Emergency Severity Index group (mean = 0:18, SD = 0:14) compared with the pre-Emergency Severity Index group (mean = 0:23, SD = 0:19) ($t = 2.59$, $P = 0.01$). Furthermore, the mean length of stay was reduced in the post-Emergency Severity Index group (mean = 1:09, SD = 0:37) compared with that of the preimplementation group (mean = 1:24, SD = 0:41) ($t = 3.10$, $P = 0.002$). Patient satisfaction in the postimplementation group was improved (mean = 66.95, SD = 8.33) compared with that of the Emergency Severity Index group (mean = 65.01, SD = 8.73), but it did not reach statistical significance ($t = -1.83$, $P = 0.07$). The inter-rater agreement of triage level in post-Emergency Severity Index implementation markedly improved in the postimplementation group (Cohen's kappa = 0.910, $P < 0.001$) compared with that of the preimplementation group (Cohen's kappa = 0.082, $P = 0.005$).

Conclusions: Although this is a single-setting study, the results have shown that the Emergency Severity Index system can contribute to a decrease in the negative crowding outcomes in primary health care centers in Oman.

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Background

Worldwide, the rising number of patients being treated in emergency departments is causing crowding, which is a major concern for most hospitals,[1] and has been an international issue for some time.[2-4] In the United States in 2003, about 114 million patients visited an emergency department.[5] By 2014, this figure had increased to 141

million.[6] In the United Kingdom in 2017, the number of patients who visited an emergency department was estimated to be more than 23.7 million.[7] Numerous studies have shown that crowding affects patient waiting time, length of stay (LOS), and satisfaction.[2,8,9] Furthermore, various studies have reported that crowding in emergency departments causes delay in treatment,[10,11] patients leaving without being seen,[11,12] incorrect diagnoses,[11,13] poor-quality care,[13] reduced physician productivity,[10] increased violence against staff members in emergency departments,[10] and increased stress and anxiety among ED staff members.[11] Furthermore, there's growing evidence suggesting that crowding in emergency departments is a major contributing factor for the increased ED mortality rate.[2,9,11,14] Therefore, efficient policies and interventions are required to reduce this crowding.[14] The implementation of a standardized triage system was suggested to overcome the negative consequences of crowding.[8]

Crowding in emergency departments can affect the decision-making of emergency nurses, which leads to inaccurate triage owing to limited contact time with patients.[15] An example of improper triage practice is the provision of care and selection of patients on a first-come-first-serve basis, regardless of their condition or triage guideline. First-come-first-serve triage leads to either under- or overtriage.[16] Inaccurate triage leads to delays in receiving the appropriate treatment at the proper time, which decreases the quality of care and threatens patient safety.[15,16] Several studies have reported that undertriage leads to negative outcomes,[17-19] including dangerous complications of diseases, prolonged suffering,[20] and increased mortality rate.[21] Furthermore, improper triage can affect not only patients but also family members and staff.[15,16] In developing countries, informal triage has mostly taken the place of formal triage systems in health care settings at all levels (ie, primary, secondary, and tertiary).[22]

The Emergency Severity Index (ESI) triage system was originally developed in 1998, and initially implemented in 1999 in 2 university hospitals in the US.[23] In 2005, the American College of Emergency Physicians and the Emergency Nurses Association published a report that recommended using the ESI based on sound evidence that supported its reliability and validity.[24] The ESI is well known as a valid and accurate system in terms of patient priority.[25] According to Aloyce et al,[22] the ESI triage system can be used in all types of emergency departments. Various studies in the US and Canada have examined the reliability and validity of the ESI.[24,26,27] However, limited information is available on the efficacy of the ESI in the health care system in Oman and other Middle East countries.

In Oman, according to the *2013 Annual Statistical Report of the Ministry of Health*, there were 195 health centers and 32 health complexes in Oman.[28] In 2013, the Ministry of Health reported that 10,349,781 visits had been made to health centers compared with 9,743,701 visits in 2012, representing an increase of 6%.[29] A tertiary hospital in Oman, Sultan Qaboos University Hospital also reported that about 60,000 patients visited its emergency department annually.[30]

In Oman, a primary health care center (PHC) visit is required as the first step to accessing tertiary health care settings and acts as a link between the local communities and the available health services, which reduces the load of using unneeded resources on tertiary health care settings. This condition leads to increased demand on PHCs and crowding at most times given that the provided services are free of charge for all Omanis.[29] However, PHCs in Oman still implement an informal triage system in which patients are triaged based on personal experiences of the health care staff and the first-come-first-serve approach.

To the best of our knowledge, no studies have been conducted to assess the effectiveness of the triage system in the primary and secondary health care settings or in emergency departments in Oman. Although the ESI has been widely tested in tertiary health care settings, information is limited regarding the effect of the system on primary health care settings. Therefore, the purpose of the current study is to assess the effectiveness of implementing the ESI triage system in the PHC setting in Oman.

Research Questions

This practice improvement study is intended to answer the following research questions:

1. What is the difference in patient waiting times before and after implementing the ESI in a general practice (GP) clinic in a selected PHC in Oman?
2. What is the difference in patient LOS before and after implementing the ESI in a GP clinic in a selected PHC in Oman?
3. What is the difference in patient satisfaction with the care provided before and after implementing the ESI in a GP clinic in a selected PHC in Oman?
4. What is the difference in triage acuity level accuracy before and after implementing the ESI in a GP clinic in a selected PHC in Oman?

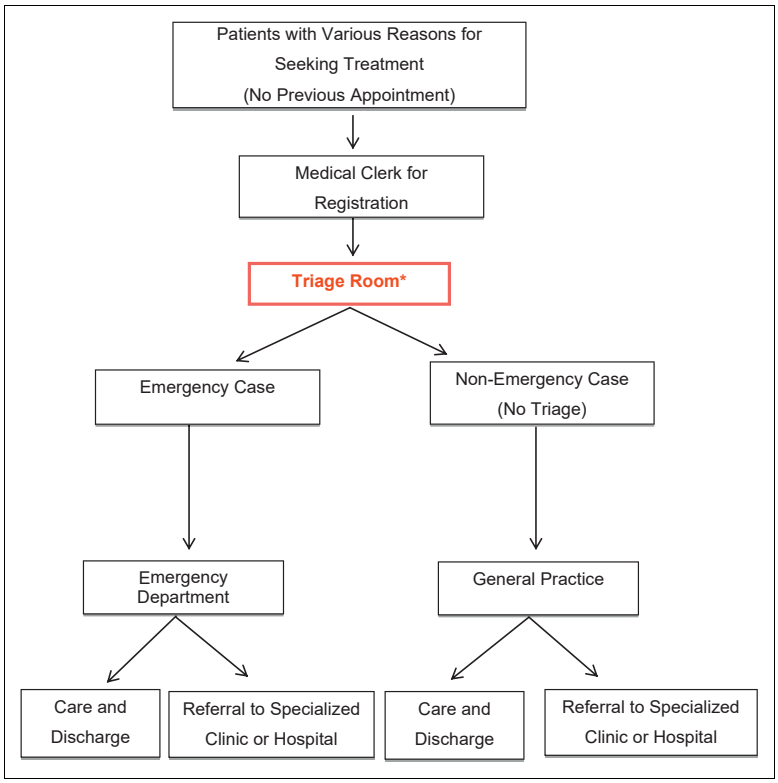

FIGURE 1

The workflow before implementing Emergency Severity Index (ESI). *The setting where the patients are classified based on their acuity level.

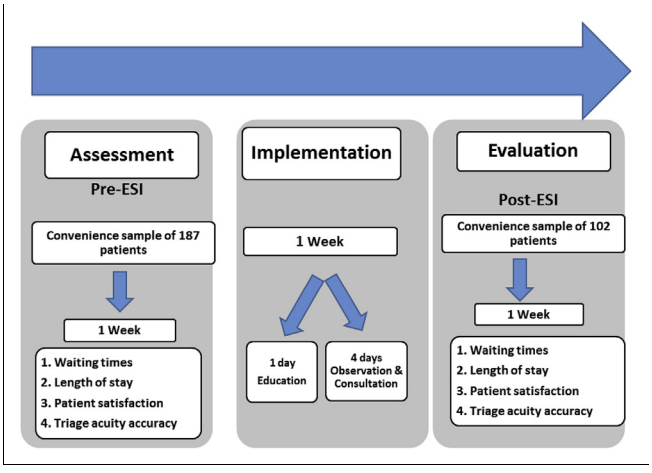

FIGURE 2

Study design and data collection procedure. ESI, Emergency Severity Index.

Method

STUDY SETTING

This study was conducted at the GP department in a selected PHC located in Muscat Governorate, Oman. On average, about 184 outpatients visit the GP department at the center daily. The health center comprises mainly 2 departments: the GP department and the emergency department. All patients who attend the GP department come without an appointment. At the GP department, patients are seen in the triage room and are classified as either emergency or nonemergency cases. The classification decision is made based on the patient's vital signs and the nurse's personal experience. The emergency cases are referred directly to the emergency department. However, nonemergency cases are seen based on their registration time without any triage to further the acuity level. The emergency department is located in the same building as the health care

center. All patients classified as nonemergency cases are treated at the same acuity level (Figure 1).

RESEARCH DESIGN

This study is a quality improvement project based on a prospective pretest/posttest quasi-experimental design with nonequivalent, historical control group. The researcher compared the effects of the existing triage system (informal triage) with those of the ESI triage system (standardized triage) on patient waiting time, LOS, satisfaction, and triage accuracy. The study protocol was ethically approved by Sultan Qaboos University institutional review board (Protocol no. 11/2017) as well as by the participating institution. Figure 2 is a schematic presentation of the study design and data collection procedure.

STUDY VARIABLES AND INSTRUMENTS

For the purpose of this study, the implementation of the ESI triage system is considered the main interventional variable. According to the ESI, patients are classified into 1 of 5 acuity levels. Outcome variables are patient waiting time (from registration to triage, from triage to seeing physician, and from registration to seeing physician), LOS (from registration to discharge), satisfaction, and accuracy of triage nurse classification of the patients' acuity level. Data related to waiting time and LOS were collected from the computerized registration system. Data on patient demographics, satisfaction, and triage accuracy were collected using structured data collection sheets.

Triage accuracy was evaluated by the inter-rater agreement between the decisions of the triage nurses and the ESI experts. The triage acuity accuracy was chosen as the outcome variable because inaccurate triage can lead to delays in receiving appropriate treatment at the proper time, which threatens patient safety.

Patient satisfaction was measured using the Brief Emergency Department Patient Satisfaction Scale. The Brief Emergency Department Patient Satisfaction Scale is validated and has previously been used to measure patient satisfaction in the emergency department.[31] The tool consists of 20 items in 5 domains regarding triage nurse care, ED environment, physician care satisfaction, general patient satisfaction, and satisfaction of the patient's family. The items are rated on a 4-point Likert scale, ranging from completely agree = 4 to completely disagree = 1. The maximum score of the tool is 80, and the minimum score is 20. A higher score indicates a higher level of satisfaction. For the original tool, the overall Cronbach alpha was 0.94, and the range was between 0.75 and 0.88 for the 5 domains.[31] The tool was translated into Arabic and validated for content, readability, and usability in the GP setting by 3 experts in emergency care. In the current study sample, the overall Cronbach alpha was 0.925.

SAMPLING PROCEDURE

The convenience sampling technique was used to recruit the study participants. Patients who attended the health center were directly approached by the research team after they had registered, but before seeing a physician in any of the departments. Patients who had developmental delays or intellectual disability, were mentally incompetent, and/or unable to read or understand Arabic or English were not asked to participate in the study.

Data Collection and Study Procedure

This study was conducted over 3 phases: the assessment phase (pre-ESI), implementation phase (ESI education), and evaluation phase (post-ESI implementation). After registration into the health center system, patients were asked whether they wanted to voluntarily participate in the study. Informed consent was obtained after full explanation of the study's purpose and procedures. In the assessment phase, outcome variables were assessed while using the informal triage system. The triage accuracy variable was assessed by comparing the triage nurse's decision on sending the patient to the GP or emergency department with the decision of the ESI triage expert. The latter was a physician specialized in emergency medicine (emergency room doctor) with extensive experience in emergency medicine (>7 years). Furthermore, the expert had finished a training course on the ESI system and had been previously certified as an ESI trainer. Patients were asked to complete the satisfaction survey after receiving care and being readied for discharge from the health center. Blind and independent evaluation of the triage decision for the ESI expert and the triage nurse was conducted. The triage nurse used a data collection sheet designed specifically for the research purpose, while the clinical data were documented on the patients' records for treatment purposes. During the assessment phase, there was no communication or discussion between the nurse and the ESI expert regarding patient classification.

The ESI education phase consisted of 1 week of education, 1 day of instructional education on the ESI, and 4 days of implementation with observation and

consultation. In instructional education, full orientation on the ESI triage system followed the ESI Interactive Web-Based Training Course.[23] The educational content was based on the *ESI Implementation Handbook* and the training DVD, "Everything You Need to Know," produced by the Agency for Healthcare Research and Quality.[24] At the end of the program, competency cases were used to enhance the triage nurses' ability to accurately assign the triage level. The educational program was delivered by the researcher, who is a nurse with master's degree and extensive experience in emergency nursing and who had previously been well trained on the use of the ESI system. The educational program was attended by 4 triage nurses. All nurses were diploma educated with at least 2 years of triage experience.

The evaluation phase started immediately after the end of the training week. Triage nurses were asked to classify patients in the triage room according to ESI acuity levels. The nurse classification was compared with the classification of the ESI expert. The acuity level given by the ESI expert was documented independently and blindly of nurse classification. The same procedure of data collection was followed in the assessment phase. The inter-rater agreement between the decisions of the triage nurses and the experts was used to assess the accuracy of the triage acuity. Other outcome variables were assessed in the same way during the pre-ESI phase. The evaluation phase lasted for 1 week.

Data Analysis

Data were analyzed using SPSS (version 23; Armonk, NY) statistical software. Frequencies, mean, and standard deviation (SD) were used to describe the study sample as well as the outcome variables. The inter-rater agreement (Cohen's kappa agreement test) and Spearman rho were used to assess the accuracy of triage-level classification between the triage nurses and ESI experts. An independent t test was used to test for the significant difference between pre- and post-ESI implementation for the outcome variables. Furthermore, Pearson's correlation was used to test for significant correlations between the satisfaction and waiting times of patients.

Results

A total of 289 patients participated in the study; of these, 187 were pre-ESI, and 102 post-ESI. Of the total participants, 66% were women. The mean age was 32.57 years (SD = 9.97). More than half (54.7%) of participating patients were employed, and half of them (49.5%) were educated to at least high school level. Most patients (60.6%) had not received any conventional treatment before visiting the center, and only 1.7% took herbal medication at home. Most patients in this study (82.4%) had no comorbidities; they were aged between 19 and 45 years in both the pre- and post-ESI groups: 151 (80.7%) and 87 (85.3%), respectively. In this study, women presented the highest percentage, with 119 (63.6%) in the pre-ESI and 72 (70.6%) in the post-ESI groups. Finally, most patients in the pre-ESI implementation group (58.8%) were assigned by the ESI expert to level 5 on the ESI acuity levels. No patients were classified at levels 1 and 2 in the pre- and post-ESI study phases by the ESI expert. Therefore, no patients were sent to the emergency department, and all patients who participated in this study were treated in the GP clinic (Table 1).

PRE- AND POST-ESI COMPARISONS IN RELATION TO OUTCOME VARIABLES

The results have shown that the pre-ESI group waited a longer time (hour:minute) from registration to triage (mean = 0:23, SD = 0:19) compared with the post-ESI group (mean = 0:18, SD = 0:14, $t = 2.59$, $P = 0.01$). Furthermore, patients in the pre-ESI group waited longer from triage to seeing the physician (mean = 0:31, SD = 0:26) compared with the post-ESI group (mean = 0:29, SD = 0:28). However, this difference did not reach statistical significance ($t = 0.46$, $P = 0.65$). Patients in the pre-ESI group recorded significantly longer total mean LOS (mean = 1:24, SD = 0:41) than those in the post-ESI group (mean = 1:09, SD = 0:37, $t = 3.10$, $P = 0.002$). Finally, patients in the post-ESI group reported a higher level of satisfaction (mean = 65.01, SD = 8.73) than those in the pre-ESI group (mean = 66.95, SD = 8.33), although this difference did not attain statistical significance ($t = -1.83$, $P = 0.07$) (Table 2).

COMPARISON OF OUTCOME VARIABLES ACROSS DIFFERENT ESI LEVELS

We examined the outcome variables across different ESI levels. The results have shown that ESI was most effective at level 4. They also showed that the total time from registration to seeing the physician was statistically shorter for the post-ESI group (mean = 0:41, SD = 0:28) than the pre-ESI group (mean = 0:53, SD = 0:25, $t = 2.13$, $P = 0.036$). In addition, the time of LOS was statistically shorter for the

TABLE 1
Description of demographic characteristics of study sample in pre- and post-ESI implementation (N = 289)

Characteristics	Pre-ESI (n = 187) n (%)	Post-ESI (n = 102) n (%)	Group difference
Mean age (SD)	32.8 (10.0)	32.2 (9.9)	$t = 0.42$
Age (years)			
13-18	12 (6.4)	5 (4.9)	$\chi^2 = 0.94$
19-45	151 (80.7)	87 (85.3)	
46-65	24 (12.8)	10 (9.8)	
Sex			
Male	68 (36.4)	30 (29.4)	$\chi^2 = 1.42$
Female	119 (63.6)	72 (70.6)	
Occupation			
Unemployed	81 (43.3)	50 (49)	$\chi^2 = 0.87$
Employed	106 (56.7)	52 (51)	
Level of education			
No formal education	7 (3.7)	16 (15.7)	$\chi^2 = 18.5$*
High school or below	106 (56.7)	37 (36.3)	
College level or above	74 (39.6)	49 (48)	
Last time visited the center			
None	21 (11.2)	14 (13.7)	$\chi^2 = 2.67$
Within the last month	62 (33.2)	34 (33.3)	
2 months ago or more	104 (55.6)	8 (7.8)	
Any conventional treatment before visiting the center†			
None	118 (63.1)	57 (55.9)	$\chi^2 = 0.76$
Self-medication	68 (36.4)	41 (40.2)	
Comorbidities			
No comorbidities	154 (82.4)	84 (82.4)	$\chi^2 = 5.56$
Diabetes	12 (6.4)	6 (5.9)	
Hypertension and CVD	7 (3.7)	5 (4.9)	
Thyroid disorders and dyslipidemia	9 (4.8)	3 (2.9)	
Others	5 (2.6)	4 (3.9)	
Final diagnosis according to ICD-10			
Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified	72 (38.5)	39 (38.2)	$\chi^2 = 9.19$
Endocrine, nutritional, and metabolic diseases	7 (3.7)	6 (5.9)	
Diseases of the eye and adnexa	5 (2.7)	4 (3.9)	
Diseases of the respiratory system	20 (10.7)	9 (8.8)	
Diseases of the digestive system	9 (4.8)	3 (2.9)	
Diseases of the skin and subcutaneous tissue	23 (12.3)	18 (17.6)	

continued

TABLE 1
Continued

Characteristics	Pre-ESI (n = 187) n (%)	Post-ESI (n = 102) n (%)	Group difference
Diseases of the genitourinary system	19 (10.2)	7 (6.9)	
Factors influencing health status and contact with health services	26 (13.9)	16 (15.7)	
Others	6 (3.2)	-	
ESI triage level by ESI expert			
Level 3	28 (15)	4 (3.9)	$\chi^2 = 20.05$
Level 4	49 (26.2)	51 (50)	
Level 5	110 (58.8)	47 (46.1)	

ESI, Emergency Severity Index; CVD, cardiovascular disease; ICD, International Code of Diagnosis; SD, standard deviation.
* $P < 0.001$.
† Five cases were not reported for any conventional treatment before visiting the center.

post-ESI group (mean = 1:06, SD = 0:38) than the pre-ESI group (mean = 1:31, SD = 0:46, $t = 2.95$, $P = 0.004$). Finally, patients in the post-ESI group reported significantly higher satisfaction (mean = 64.33, SD = 10.68) than those in the pre-ESI group (mean = 68.39, SD = 8.27, $t = 2.13$, $P = 0.035$) (Table 3).

PATIENT SATISFACTION, WAITING TIME, AND LOS

The results of Pearson's correlation between patient satisfaction and waiting time demonstrated a significant negative relationship between patient satisfaction and waiting time 2 ($r = -0.231$, $P < 0.001$) and waiting time 3 ($r = -0.233$, $P < 0.00$). Moreover, there is an inverse correlation between patient satisfaction and LOS ($r = -0.175$, $P = 0.003$).

TRIAGE ACCURACY

Agreement between nurses' usual triage level and ESI expert judgments was analyzed to assess the possible discrepancy between before and after implementing the ESI. The results showed an increased correlation in the accuracy of triage decisions in the post-ESI group (Spearman rho = 0.979, $P = 0.000$) compared with the pre-ESI group (Spearman rho = 0.206, $P = 0.005$), indicating significant improvement of agreement in the post-ESI group. The triage accuracy in the pre-ESI phase was determined after assessing the agreement of the nurses' decisions to classify patients as either emergency or nonemergency cases with the decision of the ESI expert. Likewise, Cohen's kappa agreement test demonstrated significant improvement in the post-ESI group with almost perfect agreement (Cohen's kappa = 0.910, $P = 0.000$, weighted kappa = 0.918, $P = 0.000$)

TABLE 2
Overall, pre- and post-ESI comparison of waiting times, length of stay, and patient satisfaction

Outcome variable	Pre-ESI Mean (SD)	Post-ESI Mean (SD)	*t* (*df* = 287)	95% CI
Waiting time 1	0:23 (0:19)	0:18 (0:14)	2.59*	0:01 to 0:10
Waiting time 2	0:31 (0:26)	0:29 (0:28)	0.46	−0:05 to 0:08
Waiting time 3	0:55 (0:31)	0:48 (0:32)	1.85	0:00 to 0:14
Length of stay	1:24 (0:41)	1:09 (0:37)	3.10*	0:0.05 to 0:25
Patient satisfaction	65.01 (8.73)	66.95 (8.33)	−1.83	−4.0 to 0.14

ESI, Emergency Severity Index; SD, standard deviation; *df*, degree of freedom; CI, confidence interval; waiting time 1, registration to triage; waiting time 2, triage to seeing physician; waiting time 3, registration to seeing physician.
Note. Time is expressed as hour:minute.
* $P \leq 0.05$.

TABLE 3
Comparison of mean waiting times, length of stay, and patient satisfaction with ESI triage level 4 between pre- and post-ESI

Outcome variable	Pre-ESI Mean (SD)	Post-ESI Mean (SD)	*t* (*df* = 98)	95% CI
Waiting time 1	0:22 (0:18)	0:18 (0:16)	1.03	−0:03 to 0:10
Waiting time 2	0:31 (0:25)	0:23 (0:22)	1.67	−0:01 to 0:17
Waiting time 3	0:53 (0:25)	0:41 (0:28)	2.13*	0:00 to 0:22
Length of stay	1:31 (0:46)	1:06 (0:38)	2.95*	0:08 to 0:41
Patient satisfaction	64.33 (10.68)	68.39 (8.27)	2.13*	−7.80 to 0.28

ESI, Emergency Severity Index; SD, standard deviation; *df*, degree of freedom; CI, confidence interval; waiting time 1, registration to triage; waiting time 2, triage to seeing physician; waiting time 3, registration to seeing physician.
Note. Time is expressed as hour:minute.
* $P \leq 0.05$.

compared with the pre-ESI group with slight agreement (Cohen's kappa = 0.082, P = 0.000, weighted kappa = 0.082, P = 0.005).

Discussion

To the best of our knowledge, this is the first Omani study to evaluate the effectiveness of the ESI triage system in the PHC setting. The findings of this study are crucial to the health care system in Oman and similar countries, especially in the PHC setting. Health care research in Oman is still in its infancy, despite many recent efforts to embark on studies of patient care and management. At present, no research has been conducted on the triage system in Oman. Furthermore, this study is one of the earliest to evaluate the ESI in the GP department in Oman. Thus, the findings from this study shed light on the need for formally structured triage systems in health care centers in Oman and similar countries. The information generated from the current study can be used by health care educators and those involved in the training of the nursing and medical students in Oman and other similar countries. The study has answered the question about the effectiveness of ESI in the GP settings.

The results of the current study have shown that implementation of the ESI in the PHC setting was effective in reducing the waiting time from registration to triage by 22%, which indicates consistency in rapid triage decisions. Moreover, there was a reduction in the waiting time from triage to seeing the physician and in the waiting time from registration to seeing the physician by 3 and 7 minutes, respectively, indicating an improvement in patient flow in the GP setting after ESI implementation. This result was consistent with previous research[32,33] in which the ESI was effective in reducing the waiting time in the emergency department in acute care settings. However, the findings from the current study add new evidence for the efficacy of the ESI system in PHC settings.

On analysis, the results have shown substantial reduction in ESI waiting time. Within ESI level 3, the results have shown that waiting time from triage to seeing the physician decreased significantly by 12 minutes (40% reduction) and 4 minutes (26% reduction) for ESI level 4 in the post-ESI group compared with that in the pre-ESI group. This suggests that patients with ESI levels 3 and 4 saw the physician in a shorter time than those with the informal triage system. These results are well supported by previous studies[33,34] in which patients with higher acuity complaints (ie, lower ESI levels) waited for a shorter time to receive care. However, in ESI level 5, the waiting time from triage to seeing the physician increased by about 7 minutes (18.4%) within the post-ESI group compared with the pre-ESI group. This is because the patients in level 5 ESI are triaged to be seen last, whereas in the pre-ESI group, the patients in level 5 can be seen before those in level 4 because the triage is based on the first-come-first-serve approach. The findings from the current study are congruent with a large-scale US study by Horwitz et al,[34] which was conducted in 364 nonfederal hospitals. These researchers reported a shorter waiting time in levels 1 through 4 than in level 5.

The results of the current study suggest that the LOS decreased by 15 minutes (18% reduction) after ESI implementation compared with the informal triage system. The practical implication of this reduction can be translated into new vacant slots for other patients and, hence, a reduction in crowding. In addition, there was a significant reduction in LOS with levels 3, 4, and 5, which demonstrated improvement in patient flow through the GP department and rapid triage decisions taken by the

triage nurse. Similar results were reported in a study from Taiwan,[35] in which the researchers reported a substantial reduction of LOS across different acuity levels.

Prolonged LOS leads to crowding in the emergency department, which can affect quality of care and delay in treatment at the appropriate time.[36] The findings from the current study are important because they demonstrate that the ESI triage system is an effective evidence-based tool for reducing crowding in the GP department in PHC settings. Therefore, the ESI triage system can be considered to be one of the strategies that can be used in PHC settings in Oman to reduce waiting time, LOS, and crowding.

The findings of the current study show that overall patient satisfaction slightly improved after the implementation of the ESI. These results are comparable with those of a previous study[37-39] that demonstrated high patient satisfaction with the triage nursing care. Furthermore, the current results are congruent with those of other Omani studies[40,41] in which patients reported a high level of satisfaction with the provided care. In the current study, the major reasons for high patient satisfaction were probably reduced waiting time and shorter LOS. Indeed, the findings show a negative relationship among waiting time, LOS, and patient satisfaction. Similar results were gained in a large US study[42] in which prolonged waiting time negatively affected patients' satisfaction.

The inter-rater agreement between the decisions of the triage nurse and the ESI expert was used to evaluate the dimension of triage accuracy. The accurate assignment of the triage levels is clearly an advantage for patient safety and care.[43] The current study suggested a marked improvement in accuracy of the assignment of patient acuity level. The inter-rater reliability agreement between triage nurses and ESI expert was high: Cohen kappa ($\kappa = 0.91$) in the post-ESI implementation compared with the inter-rater slight agreement for the pre-ESI implementation ($\kappa = 0.08$). The findings from this study are in line with those of Wuerz et al,[44] who found a weighted kappa of 0.80 for reliability in triage assignments. Furthermore, in a meta-analysis study of 19 studies with a total of 40,579 cases, the inter-rater reliability checked for ESI triage scale using weighted/unweighted kappa statistics showed substantial nurse/expert agreement (0.732; 95% confidence interval [CI], 0.625-0.812), and higher expert/expert agreement (0.900; 95% CI, 0.570-0.980), particularly when testing the adult version of the ESI (0.815; 95% CI, 0.753-0.862).[45] It is worth mentioning that this meta-analysis included studies that were mostly conducted in North America (14), Europe (3), and the Far East (Korea), with only 1 from the Middle East (Iran). Therefore, the results from the current study will add value to the available international body of knowledge related to the reliability of an ESI triage system.

Limitations

Although this study possesses numerous strengths, it has a few limitations that are worth mentioning. First, the study was conducted in a single setting. For future research, larger-scale studies should be considered using multiple sites and larger sample sizes to generate more generalizable findings. The second limitation is that the study was conducted over 1 week for the pretest phase and only 1 week for the posttest phase. This short period might have biased the findings. In future research, a longer assessment and testing period should be considered. The other limitation of this study is the use of 1 ESI expert to judge the accuracy of the classification of the triage nurses of the acuity level. Ideally, a panel of 3 or more experts who have worked previously with ESI would garner more valid results related to the classification. Finally, although this study demonstrated process improvements by using ESI in the study setting, we did not collect feedback from the health care professionals (nurses and physicians) who implemented the system. Future research is warranted to collect data on the health care professionals' perspective on the ESI implementation in Oman.

Conclusion

This study documents process improvements associated with implementing the ESI triage system in the PHC setting in Oman. The implementation of the ESI not only decreased waiting time and LOS but also improved patient satisfaction and triage acuity accuracy. These results demonstrate that the ESI system improved the patient flow through the health care center. Indeed, this shows that more patients could be seen in the same time duration through the implementation of the ESI system in the study setting. Moreover, the study highlighted that continuing to use the informal triage system is not efficient and that resources can be better used through implementation of a formal triage system.

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