Evaluation of the Significance of Vital Signs in the Up-Triage of Patients Visiting Emergency Department from Emergency Severity Index Level 3 to 2

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Abstract- The Emergency Severity Index (ESI) is a five-level triage system that has shown promising reliability and validity. According to ESI algorithm, in the presence of danger zone respiratory rate (RR), heart rate (HR) or Oxygen (O2) saturation, patients should be up-triaged from ESI level 3 to 2 Hence, the current study aimed to investigate the value of the measurement of vital signs in predicting the up-triage of patients from ESI level 3 to 2. Patients who visited the emergency department at Imam Khomeini Hospital Complex, Tehran, Iran, and were categorized into ESI level 3 were investigated. RR, HR, and O2 saturation were recorded by the triage nurse, and the rates of abnormalities in these three variables were evaluated. Out of 551 cases who were up-triaged from ESI level 3 to 2,489 (88.7%) had an increased RR, and 539 (97.8%) had an increased RR or HR. Only 12 cases (2.2%) had normal RR and HR, who were up-triaged only due to abnormal O2 saturation. Out of these 12 cases, 10 had O2 saturations <92% at common health status, 1 had acutely altered mental status and should have been triaged into ESI level 2 in the first place and 1 could not be located for further investigations. In conclusion, compared to O2 saturation, the abnormal findings during the assessment of RR and HR seem to much more commonly result in the up-triage of patients from ESI level 3 to 2.

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Introduction

Triage is an initial and essential step in the evaluation and management of patients at the emergency department and aims to categorize patients based on the priority of their health problems and detect those who need life-saving interventions (1). An increase in the annual number of patients who visit emergency department has been observed during the recent years, a condition that does not seem to change anytime soon (2). Moreover, it is estimated that about half of the visits to the emergency department are for minor medical problems (3). Hence, the need for an effective triage system has become increasingly apparent due to limitations in available resources, including medical personnel, hospital beds, and medical equipment.

Different triage systems have been used in the emergency departments of various countries. Of these methods, the Emergency Severity Index (ESI)-which is a five-level triage system has shown promising reliability and validity (4,5). Several studies have shown a significant association between the ESI level and the outcome of the visit to the emergency department, including future admission, duration of hospital stay, resource consumption and the outcome of the disease, most importantly, mortality (4,6). It has been estimated that 30-40% of those who visit the emergency department are categorized into ESI level 3 (1,6). This level of triage includes those cases with less acute medical conditions needing two or more different types of resources. Patients primarily categorized into ESI level 3, will be considered for up-triage to ESI level 2 in the presence of danger zone heart rate (HR), respiratory rate (RR) and Oxygen (O2) saturation (7).

The results of several studies have indicated that RR may predict the severity of disease more accurately in comparison with other physiological measurements (8,9). On the other hand, to the best of our knowledge, the value, and priority of these elements have not been evaluated yet. The current study aims to investigate the

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value of the vital signs in up-triage of patients from ESI level 3 to 2 in order to achieve a more rapid and simpler approach.

Materials and Methods

The current cross-sectional study was performed between November 2013 and March 2014 at the emergency department of Imam Hospital Complex affiliated to Tehran University of Medical Sciences. This department has good access to other medical facilities as well as aerial transport for critically ill and traumatic patients with approximately 40,000 annual visits most of whom are self-referred. The ethics committee of the Tehran University of Medical Sciences reviewed and approved the process of the study. The need for obtaining informed consents from patients was also ruled out by the ethics committee since no intervention was made in the process of diagnosis and treatment of patients. Individuals who aged more than 18 years and were up-triaged from ESI level of 3 to 2 according to the ESI version 4 triage algorithm as previously described by Gilboy *et al*., (10) were enrolled in the study. Figure 1 demonstrates ESI triage algorithm version 4, which was the standard method of triage in our department prior to the timeline of the current study. A minimum sample size of 370 cases was calculated with a type I error of 5% and an absolute error or precision of 0.02% using the standard sample size calculation method for qualitative method (11) and the estimations provided in a previous study by Goldhill *et al*., (9).

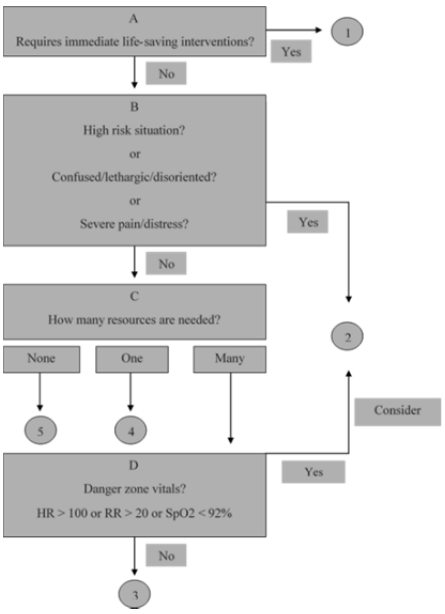

Figure 1. Emergency Severity Index, version 4 triage algorithm

Using a consecutive sampling method, all cases were initially evaluated by experienced nurses who were trained by means of ESI triage algorithm. If indicated patients' HR, RR, and O2 saturation were measured at the time of visiting the emergency department by triage nurses. HR and RR were measured during one minute, and the measurement of both HR and O2 saturation was performed by digital monitoring using the same device for all cases. The decision to up-triage the patient was made by the triage nurses. All data were analyzed using SPSS software package for Windows, Version 11.5. (SPSS Inc, USA,). Categorical variables are presented as number (%) and quantitative variables as mean±standard deviation (SD).

Results

During the study period, a total number of 2179 cases were categorized as ESI level 2. Out of these cases,551 including 240 (43.6%) females and 311 (56.4%) males who had been up-triaged from ESI level 3 to 2 due to danger zone RR, HR or O2 saturation were enrolled in the current study. The mean±SD age of the patients was a 55.7±19.2 year ranging from 18 to 98 years. Out of 551 cases, 489 (88.7%) had an RR of >20 breaths per minute, and 62 (11.3%) had an RR of ≤20 breaths per minute at the time of admission. Out of 551 cases, 342 (62.1%) had an HR of >100 beats per minute, and 209 (37.9%) had an HR of ≤100 beats per minute at the time of admission. O2 saturation was <92% in 99 cases (17.9%) and ≥ 92% in 453 (82.1%).

Out of 489 cases who had an RR of >20 breaths per minute, 292 (59.7%) also had an HR of >100 beats per minute while the remaining 197 (40.3%) had an HR of ≤100 beats per minute. Out of 62 cases who had an RR of ≤20 breaths per minute, 12 (19.4%) also had an HR of ≤100 beats per minute while the remaining 50 (80.6%) had an HR of >100 beats per minute. The measurement of RR in combination with HR could predict the up-triage in 539 (97.8%) cases. The remaining 12 cases (2.2%) had normal RR and HR and were up-triaged due to abnormal O2 saturation. Table 1 shows the distribution of RR in comparison with HR in the study population.

Out of 489 cases who had an RR of >20 breaths per minute, 82 (16.8%) also had an O2 saturation of <92% while the remaining 407 (83.2%) had an O2 saturation of ≥92%. Out of 62 cases who had an RR of ≤20 breaths per minute, 46 (74.2%) also had an O2 saturation of ≥92% while the remaining 16 (25.8%) had an O2 saturation of <92%.the measurement of RR in

combination with O2 saturation could predict the up-triage in 505 (91.7%) cases. Moreover, out of 12 cases who had a normal RR and HR but an O2 saturation of <92%, 9 (75%) had a history of chronic obstructive pulmonary disease (COPD) and 2 (16.7%) had a history of chronic cor pulmonale disease while the remaining 1 patient (8.3%) left the emergency department before being visited by a physician and could not be accessed for further investigations. out of these 11 cases with an underlying disorder, 10 (9 with COPD and 1 with cor pulmonale) also had an O2 saturation <92% measured during their stable condition at common health status while one patient with cor pulmonale had acutely altered mental status at the time of admission and should have been triaged into ESI level 2 in the first place. Table 2 shows the distribution of RR in comparison with O2 saturation in the study population.

Table 1. Distribution of Respiratory Rate (RR) in comparison with Heart Rate (HR) in the study population.

	HR >100 beats per minute	HR ≤100 beats per minute	Total
RR >20 breaths per minute	292 (53%)	197 (35.8%)	489 (88.8%)
RR ≤20 breaths per minute	50 (9%)	12 (2.2%)	62 (11.2%)
Total	342 (62%)	209 (38%)	551 (100%)

Data are presented as number (%).

Table 2. Distribution of Respiratory Rate (RR) in comparison with O2 saturation in the study population.

	O2 saturation <92%	O2 saturation ≥92%	Total
RR >20 breaths per minute	82 (14.9%)	407 (73.9%)	489 (88.8%)
RR ≤20 breaths per minute	16 (2.9%)	46 (8.3%)	62 (11.2%)
Total	98 (17.8%)	453 (82.2%)	551 (100%)

Data are presented as number (%).

Discussion

According to the findings of the current study, abnormal RR was the cause of up-triage from ESI level 3 to 2 in 489 out of 551 cases (88.6%). Among the remaining 62 cases (11.3%), 50 (9.1%) were up-triaged due to abnormal HR. The ESI level was changed from 3 to 2 in only 12 cases (2.2%) due to the sole finding of abnormal O2 saturation. Considering the fact that a total number of 2179 patients were categorized as ESI level 2, only 2.3% and 0.5% of cases were placed into this ESI level due to abnormal HR and O2 saturation, respectively. Most importantly, out of 12 cases that were up-triaged from ESI level 3 to 2, 10 had an underlying disorder that could explain the chronic low blood O2 saturation, 1 should have been triaged into ESI level 2 in the first place, and the remaining 1 case could not be investigated further. As a result, the observation of low O2 saturation seems to be of lesser importance compared to RR and HR in determining the level of triage and may even be unnecessary in deciding the triage level of these patients.

During the past two decades, several studies suggested an increase in RR as an important indicator of mortality and poor outcome. In one study performed by Fieselmann *et al*., in 1993, the observation of at least one episode of RR>27 breaths per minute during a 72-hour period could predict cardiopulmonary arrest with a sensitivity of 54% and a specificity of 83% (12). The authors suggested that monitoring RR accompanied by appropriate medical interventions might decrease the incidence of cardiopulmonary arrest and prevent further morbidity and mortality. In another study by Hodgetts *et al*., in 2002, it was also suggested that RR could be considered one of the predictors of cardiac arrest (13). In accordance with the results of these studies, Goldhill *et al*. reported a higher rate of admission to intensive care unit (ICU) in patients with increased RR (8). In another study, again performed by Goldhill *et al*., in 1999 on the important physiological values that may predict the severity of illness among critically ill patients, the authors reported that RR and HR are more likely to predict future ICU admission compared to other physiological values (8). Moreover, RR would significantly worsen over the last 24 hours before needing an ICU admission. The authors suggested that while an increased HR may be an indicator of the severity of illness, increased RR may be a good sign indicating to the imminent requirement of ICU admission (8).

One other study investigated the incidence of abnormalities in various physiological factors, including

temperature, HR, RR, systolic blood pressure, the level of consciousness and urinary output and their association within hospital mortality rate (14). Not surprisingly, increased RR and HR were the first and second rank abnormalities to be strongly associated with a higher mortality rate (14). The findings of the abovementioned studies are all in agreement with our findings that indicate a near-complete prediction of up-triage from ESI level 3 to 2 by using the measurement of RR in combination with HR. Moreover, an increased RR was by far the most prevalent physiological abnormality in such patients.

Based on the findings of these studies, it may be suggested to first measure RR in patients categorized in ESI level 3. If RR is normal, HR should be measured, and the assessment of O2 saturation could be delayed until the results of these two vital signs turn to be normal and maybe even unnecessary. The assessment of O2 saturation in those with an ESI level 3 may be omitted in the case of severe overcrowding of the emergency department.

The current study had some limitations. The outcome of disease after being transferred out of emergency ward was not investigated. The investigation of long-term outcome, including the probable future need for admission to ICU, should provide a more accurate estimation regarding the value of RR measurement in the assessment of patients with ESI level 3.

In conclusion, compared to O2 saturation, the abnormal findings during the assessment of RR and HR seem to be much more commonly resulting in the up-triage of patients from ESI level 3 to 2. Further studies in order to evaluate the efficacy and priority of the assessment of O2 saturation in the triage of patients referring to emergency department may result in the development of a more rapid and simpler approach.

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References

1. Wuerz RC, Travers D, Gilboy N, Eitel DR, Rosenau A, Yazhari R. Implementation and refinement of the emergency severity index. Acad Emerg Med 2001;8:170-6.
2. Adams JG, Biros MH. The Endangered Safety Net Establishing a Measure of Control. Acad Emerg Med 2001;8:1013-5.
3. Wuerz RC, Milne LW, Eitel DR, Travers D, Gilboy N. Reliability and validity of a new five-level triage instrument. Acad Emerg Med 2000;7:236-42.
4. Tanabe P, Gimbel R, Yarnold PR, Kyriacou DN, Adams JG. Reliability and validity of scores on The Emergency Severity Index version 3. Acad Emerg Med 2004;11:59-65.
5. Worster A, Gilboy N, Fernandes CM, Eitel D, Eva K, Geisler R, et al. Assessment of the inter-observer reliability of two five-level triage and acuity scales: a randomized controlled trial. Can J Emerg Med 2004;6:240-5.
6. Eitel DR, Travers DA, Rosenau AM, Gilboy N, Wuerz RC. The emergency severity index triage algorithm version 2 is reliable and valid. Acad Emerg Med 2003;10:1070-80.
7. Travers DA, Waller AE, Bowling JM, Flowers D, Tintinalli J. Five-level triage system more effective than three-level in the tertiary emergency department. J Emerg Nurs 2002;28:395-400.
8. Goldhill D, White S, Sumner A. Physiological values and procedures in the 24 h before ICU admission from the ward. Anaesthesia 1999;54:529-34.
9. Goldhill D, McNarry A. Physiological abnormalities in early warning scores are related to mortality in adult inpatients. Br J Anaesth 2004;92:882-4.
10. Gilboy N, Tanabe T, Travers D, Rosenau AM. Emergency Severity Index (ESI): A triage tool for emergency department. Rockville, MD: Agency for Healthcare Research and Quality. (Accessed March 08, 2016, at http://www. ahrq. gov/professionals/systems/hospital/esi/esi1.html.2011.
11. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? Indian J Psychol Med 2013;35:121-6.
12. Fieselmann JF, Hendryx MS, Helms CM, Wakefiels DS. Respiratory rate predicts cardiopulmonary arrest for internal medicine inpatients. J Gen Intern Med 1993;8:354-60.
13. Hodgetts TJ, Kenward G, Vlachonikolis IG, Payne S, Castle N. The identification of risk factors for cardiac arrest and formulation of activation criteria to alert a medical emergency team. Resuscitation 2002;54:125-31.
14. Goldhill D, McNarry A, Mandersloot G, McGinley A. A physiologically-based early warning score for ward patients: the association between score and outcome. Anaesthesia 2005;60:547-53.