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Triage quality control is missing tools—a new observation technique for ED quality improvement

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Abstract

Objective: Correct assessment of patient urgency is critical to ensuring patient safety in emergency departments (EDs). Although significant time and effort have been devoted to developing triage systems, less attention has been paid to the development of quality control. The aim of this study is to introduce and test observation technique, which enables identifying of patient groups at risk of erroneous assessment in triage. The introduced technique is aimed to be less laborious to use than existing triage quality control methods.

Design: The study developed an observation technique for identifying patients with possible erroneous assessments in triage. Data sample for the observation technique is carried out with survey form filled in by nurse.

Setting: Hospital ED with ~74,000 patient visits annually.

Participants: Consecutive adult patients in an ED for baseline study period of 14 days (1774 patients) in 2010 and control study period of 4 days (541 patients) in 2012.

Intervention: Triage observation technique for continuous improvement of triage performance.

Main Outcome Measures: Primary measures of triage improvement were triage accuracy and nurses’ ability to predict patient admissions.

Results: With the observation technique the ED staff was able to identify patient groups at risk for erroneous triage. Under-triage related mostly to patients with chest pain, shortness of breath, collapse, stomach pain and infections. Instead injures and muscular skeletal symptoms were seldom undertriaged even though they are common.

Conclusions: EDs can control triage quality with simple observation technique. The usability of observation technique and triage quality improvement process were good.

Key words: emergency care < setting of care, quality management, quality improvement < quality management, patient safety

Background

A primary goal of emergency department (ED) triage is to identify patients needing immediate care. Different triage systems are used for this task [1]. Correct assessment of patient urgency is critical to ensuring patient safety. If the urgency is classified too low (under-triage), it can have serious clinical consequences [2]. If urgency is
classified too high (over-triage), scarce resources are wasted [3]. Studies on different patient groups have revealed the limits of triage models and no ideal triage system exists [4–7]. This emphasizes the responsibility of ED for controlling the quality of the triage practices, regardless of the triage system chosen. Many studies concerning accuracy and reliability of triage methods have used experts [8, 9] or patient vignettes [10]. These methods are important to validate triage system, but they are too laborious for continuous quality control. There is a need for less laborious but still efficient methods to identify erroneously assessed patients in triage and improve the quality of triage practice.

A fundamental principle of quality control is the recognition, analysis and elimination of variation [11]. Especially, the control of quality of practices involving decisions on urgency or level of care provided (i.e. triage) is highly important because of patient safety requirements. The EDs should have possibility to use quality control observation techniques and activities to fulfill requirements of quality control. Quality control needs to be a continuous procedure as the practices and staff of ED are changing. Continuous Quality Improvement refers to the practice of continually improving processes. Fernandes et al. [12] introduced Continuous Quality Improvement use in triage improvement, and a few ED applications have been described in the literature since (e.g. [13–17]).

The aim of this study is to introduce and test quality control observation technique, which enables identifying of patient groups at risk of erroneous assessment in triage in each ED. The study conducted a triage Continuous Quality Improvement program in an ED using new observation technique and analysed the results of the program.

Methods

Setting
The study was conducted in the Hospital ED, which is located in the Southern Finland. Other emergency clinics within 15 km radius manage major trauma, thrombolytic treatment for stroke and primary angioplasty for myocardial infarction. The case ED is in charge of both primary and special healthcare patients and it has ~74 000 visits per year (2013). Research approval was obtained following the approval protocol of the university hospital.

The most common triage system used in Finland is ABCDE-triage, which is used by 17 out of 20 biggest EDs in Finland (3 out of 20 use Emergency Severity Index (ESI)). The 5-level ABCDE-triage includes the following urgency categories: A–immediate care; B–doctor care within 10 min; C–doctor care within 1 h; D–doctor care within 2 h; E–non-acute patient, who must wait till patients from groups A–D are treated [18].

Data collection
Survey data were collected for development of the observation technique during two time periods, in November 2010 and March 2012. The questionnaires were filled in by nurses for consecutive patients for whole study period. To relate the hospital patient information system’s data to the questionnaires, the study created a key between anonymized patient IDs and the questionnaires. The process followed Continuous Quality Improvement program which was based on a Define – Measure – Analyse – Control quality circle [19].

The aim (Define phase) of the Continuous Quality Improvement program, was to control and improve triage performance at the ED. In the measure phase the current process was measured with a cross-sectional study with consecutive adult patients in the ED during a continuous 14-day period, on November 2010. The possible patients at risk of erroneous triage were identified using the new identification technique and were further analyzed.

In the analysis phase, the specialist in charge of triage instructions at the case ED reviewed all the patient cases identified and listed patient groups for which the triage practices needed to be reminded/updated and nurses further trained (improvement phase). Many improvements were implemented, such as more detailed instructions for evaluation of risky patient groups, more careful recording of vital signs and contact teaching program of triage nurses.

In the control of triage performance in 2012, the authors controlled again triage quality. The control extended over a 4-day period on March 2012. It followed the same protocol as in the baseline.

For the study purposes, specialist reviewed the patient cases of both studies without knowing how (with which method) or when (in which year) each case had been identified. Only the data available and entered in the patient record at the time of the triage was used for review. Specialist assessed each patient case separately by comparing the patient’s actual triage classification to the updated version of the triage instructions and medical knowledge on critical situations. A case was assessed to more urgent classes, if some uncertainty existed in classification. A case was assessed severe if the true urgency of the case should have been A or B, but was classified C, D or E, or if it was classified E instead of C.

In addition to the Continuous Quality Improvement program, the collected data were exploited to monitor and improve other aspects of the ED.

Observation technique
To find cases of possible under-triage, the study needed methods to identify the patients at risk of erroneous assessment. The technique included two methods that were designed and tested. In the first method, a physician (for primary care patients) or a nurse (for secondary care patients) filled a survey questionnaire at the point of patients’ discharge with a following question: ‘What would have been the right triage class if evaluated afterwards?’. The original triage class and this post-evaluation of triage class were compared, and if a patient had more urgent triage value in the post-evaluation than in the original evaluation, he/she was included in the sample as a possible case of under-triage for further analysis.

In the second method, triage nurse filled a questionnaire at the point of triage with a question: ‘Nurse’s preliminary opinion about follow-up care?’. The nurse’s intuition whether the patient will be discharged or admitted to hospital was compared to the realized outcome. Patients who are originally assessed to be discharged from the ED but who are admitted were included for further analysis as possible cases of under-triage.

A critical and inter-related part of the both methods is also to analyze the cases which are identified. The analysis should concern has there been erroneous evaluation in triage. If there have then next step is to define corrective tasks and implement them. Quality of the new practices should be evaluated on the next round of observation.

The use of the observational method is illustrated in Fig. 1. The average time to fill the questionnaire per patient was less than a minute. The nurses responsible to fill the questionnaires felt the burden of the survey light and did not report any occasions where it would have caused delays in patients’ care.

Data analysis
Analyses of the data were conducted using MS Excel 2010. Analyses focused on differences between baseline and control studies in terms
of the number of patients identified by the methods and serious deviations. In addition, the positive predictive value (PPV), negative predictive value (NPV), sensitivity, specificity and their confidence intervals (95%) are calculated for the triage values.

A random sample of 100 visits were also analyzed to identify the level of randomly caught patients. MS Office Excel 2010 established randomization.

Results
In the baseline study, there were 1774 consecutive adult patient visits (mean age 50.9) at the ED. In the control study, there were 541 consecutive adult patient visits (mean age 49.9). Patient age, urgency and sex distributions were similar in the two studies. Patients with incomplete data were excluded from the study. Figures 2 and 3 present the numbers of visits and patients identified with the methods. In the baseline study, triage evaluations were completed from 1304 patients, of which 73 patients (5.6%) had their urgency evaluated more urgent at the end of their visits than at the beginning. Two of the patients had their urgency under evaluated by two categories (from C to A). One hundred and eleven patients were assessed at the beginning of their visits to be discharged post-ED but were admitted. That is 9.2% of the sample. With random method identification rate of deviations in triage is 1.0%. This is over 10 times less than the result with identification Method 1.

In total 26 serious deviations were identified in the baseline study and 7 serious deviations in the control study. These amounted 1.6% and 1.3% of the sample. The decrease between study periods was insignificant. Both identification methods provided significantly better performance in the baseline study than randomly evaluated method.

Comparison of two study phases
In baseline, several patients had been assigned a triage Score D when it should have been C. However, there is a remarkable

![Observation method flow chart](image1.png)

*Figure 1 Observation method flow chart.*

![Number of patients included to the review and number of serious deviations identified in the initial study](image2.png)

*Figure 2 Number of patients included to the review and number of serious deviations identified in the initial study.*
difference in the numbers of C and D urgent patients between baseline and control studies. Share of C urgency in the baseline study was 15.2% of all triage values and for D 69.0% and in the control study the respectively 32.5% and 52.1%. The transition from D to C urgency is in line with the new triage instructions. Table 1 presents comparison of age and triage levels between the study phases.

Deviations were the most common among patients presenting at the emergency clinic with stomach pain, chest pain, pulmonary embolism, neurocirculatory problems or a severe infection. There was overlap of 3 serious deviations between identification methods and altogether there were 18 serious deviations found.

Analysis of the control study uncovered further quality deviations. The triage of patients arriving because of chest pain, shortness of breath or collapse had clearly improved, but deviations were still found among patients with stomach pain or infections. Seven serious deviations were detected, all by the triage evaluation method. However, the deviations uncovered were clearly less serious than before.

### Performance of observation technique

Table 2 presents the results of triage values of the patients in baseline and control phase collapsed to non-urgent (C+D+E) and urgent patients (A+B). Sensitivity (true positive rate) measures the proportion of actual positives (urgent patients) which are correctly identified as such. Specificity (true negative rate) measures the proportion of negatives (non-urgent patients) which are correctly identified as such. For both measures 100.0% is optimal score, i.e. no over-triage and under-triage. There are no statistically significant changes in comparison between baseline and control studies but the increase of sensitivity is a positive indicator.

Table 3 presents the predictive values, sensitivity and specificity for the nurses’ intuition about admission. There was a significant decrease in the sensitivity (P < 0.01), which indicates poorer performance in the identifying admitted patients in the beginning of ED process.

### Discussion

In this study, the authors were able to develop simple methods to identify risk patient groups in triage, to plan and implement the improvements, and to control triage performance with further suggestions for improvements. The most important consequence of the Continuous Quality Improvement program was that the personnel had practical methods to develop the triage to avoid under-triage. In addition, the opportunity to discuss difficult patient groups and create advanced instructions has built a new basis for future improvement and a patient safety culture. Even though the ambitious
success criterion was not achieved, there was decrease in the number of the patients identified as potential cases of under-triage.

Using the methods described in the present study made it possible to detect serious deviations and systematic shortcomings in the instructions. The combination of triage re-evaluation and nurses’ intuition about patients’ admission forms an effective screen to identify risk patient groups. Obviously, no method will pick up all cases with risk of serious under-triage unless each patient case is reviewed, and this is too laborious for regular quality control. Serious deviations are so rare that if a random sample is selected for analysis, it will not necessarily contain any such cases.

What became apparent in applying the quality control methods was that the baseline situation in triage was far from satisfactory. Even though overall situation in triage seemed to be on acceptable level, with PPV 57.9% (patient with a A or B triage is really A or B) and NPV 99.2% (patient with a C, D or E triage is not A or B) the analysis of serious deviations revealed major problems. As the result of an extensive improvement phase focusing on expertise and training, triage has been improving, but quality control is continuously required. Although a large number of significant and serious deviations in triage were found, the quality control assessment did not identify any cases in which the patient had suffered obvious harm as a result at the emergency clinic. Patient cases were not followed up beyond the first visit to the emergency clinic, and it was clear that, in most cases, harm could not be identified in the ED, or even later, in the cases of individual patients.

Due to small number of urgent cases there were no significant changes in the triage performance in the comparison of baseline and control study results. There was good direction in the progress of the sensitivity to the under-triage cases (increase from 68.8 to 78.6% in identifying urgent patients correctly as such). In the same time, there was slight decrease (0.5 p.p.) in the specificity of the triage, i.e. identifying non-urgent patients correctly as such. It seems that the state of zero under-triage (sensitivity 100%) would only be achieved in the price of over-triage. A realistic optimum probably lies in the between current and zero under-triage states.

Interestingly, in the comparison of nurses’ intuition method figures there was significant decrease in the sensitivity (73.7 to 61.0%). The finding is alarming and further education or tools are needed for nurses to estimate the condition and risks of patients.

The triage system validation study found under-triage, against the reference standard, in 11–20% of the cases depending on the triage system. Seiger et al. [2] found 0.9% of children under-triaged. However, they considered only half the cases severe after expert panel evaluation. This study found that the most problematic are those patient groups, which have a broad spectrum of severity,

| Table 2 Predictive values, sensitivity and specificity of identification Method I for the baseline and control studies |
|---|---|---|
| | Post-triage | Predictive values |
| | A+B | C+D+E |
| Original triage | A+B | 22 | 16 | 57.9% (0.422, 0.736) |
| | C+D+E | 10 | 1295 | 99.2% (0.988, 0.997) |
| Sensitivity and specificity | 68.8% (0.527, 0.848) | 98.8% (0.982, 0.994) |

| Table 3 Predictive values, sensitivity and specificity of identification Method II for the baseline and control studies |
|---|---|---|
| | Realized | Predictive values |
| | Admission | Discharge |
| Nurse’s evaluation | Admission | 325 | 126 | 72.1% (0.679, 0.762) |
| | Discharge | 116 | 642 | 84.7% (0.821, 0.873) |
| Sensitivity and specificity | 73.7% (0.696, 0.778) | 83.6% (0.810, 0.862) |

| | Realized | Predictive values |
| | Admission | Discharge |
| Nurse’s evaluation | Admission | 94 | 45 | 67.6% (0.598, 0.754) |
| | Discharge | 60 | 320 | 84.2% (0.805, 0.879) |
| Sensitivity and specificity | 61.0%** (0.533, 0.687) | 87.7% (0.843, 0.910) |
from mild to serious cases. This is highlighted in patients with sepsis, where early recognition is essential [22]. Allergic reactions also fall into this category. Identifying urgent cases from among such patients was clearly problematic in the baseline situation before training had been introduced. The control study revealed practically no undertriage among injuries and musculoskeletal symptoms, accounting for 20–30% of the presenting complaints at the case ED, apart from one case of neck trauma and one case of a misaligned fracture.

Limitations
In the study setting, ABCDE-triage was used as the triage evaluation method. Even though currently it is a standard method in many EDs in Finland, it has not been used outside Finland. Yet, the Continuous Quality Improvement program presented in the study is not dependent on the triage system and can be applied to most similar triage systems like ESI and Manchester. The study material did not include child patients and the methods are not directly applicable to pediatric EDs.

Missing data affected the reliability of the results. However, the sample still represents the actual situation well enough. Small number of urgent patients in the baseline and control samples prevented identification of statistically significant changes. However, the aim of the study was rather in the development of simple enough methods for triage monitoring and improvement.

The study provided Continuous Quality Improvement approach to triage development. It followed the essential methodological features for recognizing quality improvement, which are identified in the study by Rubenstein et al. [23]. These include that the study (i) is based on systematic data guided activities, (ii) designed with local conditions in mind and (iii) it follows iterative development and testing.

Conclusions
Although it is very important to select a validated system for triage classification, problems exist in the validation of triage methods [24]. Whatever the triage method, continuous quality control and critical approaches are necessary to improve operations and to improve patient safety. Identifying and learning from the problem cases is critical for the quality improvement of triage. The method presented in this study offers a simple and practical way to control the quality of triage.

Authors’ contributions
T.M. and R.M. designed the study, organized data collection and are guarantors of the study. T.M. drafted the manuscript. V.P.H., S.K. and R.M. reviewed the patient cases. V.P.H. and S.K. also revised the draft paper. P.T. helped in the study design, data analysis and he also revised the draft paper. All authors read and approved the final manuscript.

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References
19. Oakland JSS. Statistical Process Control [Internet]. Routledge; 2012 [cited 2012 Oct 11]. Available from: http://books.google.com/books?hl=en&lr=&id=ZjAP5yMgsC&oi=fnd&pg=PP2&q=%E0%8A%94%EF%BC%8C%E6%9D%B6%E6%9C%BA%E5%85%8D%E8%B7%AF%E5%A4%87%E6%8A%A5%E5%AE%B6%E5%AD%A6%E5%8D%AB&ots=u5t1RtgKHxK&s sig=h1PN9PgLgfLcaRf-Rf3nIoY0.