Towards patient self-triage in the ophthalmic emergency department: sensitivity and specificity of a self-triage instrument

Eva S.V. Eijk,1,2 Jan J.V. Busschbach,2 Helma Monteban,3 Reinier Timman2 and Marijke Wefers Bettink-Remeijer4

1Rotterdam Ophthalmic Institute, Rotterdam, The Netherlands
2Department of Psychiatry, Section of Medical Psychology & Psychotherapy, Erasmus MC, Rotterdam, The Netherlands
3Monteban Value Services, Amerongen, The Netherlands
4Rotterdam Eye Hospital, Rotterdam, The Netherlands

ABSTRACT.
Purpose: Trained ophthalmic triage staff may not constantly be available in the emergency department of a specialized ophthalmic hospital, particularly at night. To support the current triage process, the aim of this study was to develop an ophthalmic instrument of patient self-triage (ISET).
Methods: A preliminary ISET, in the form of a pen-and-paper questionnaire, was refined and validated in a two-step procedure. In a first explorative step, we compared the results of the ISET with the results of the regular triage process during the day, that is, triage by a trained triage assistant in a specialized ophthalmic hospital. As several patients needed guidance completing the questionnaire, the ISET was subsequently refined. The second step was to test the validity of the refined ISET by again comparing the outcome of this triage with that of the triage assistant in the emergency department.
Results: The first explorative step involved 279 patients and the final validation step 298. During the validation step, sensitivity of the ISET was 94.3% and specificity 76.4%.
Conclusion: The results show that the ISET is a sensitive and specific instrument for ophthalmic triage compared with a trained ophthalmic triage assistant.

Key words: emergency department – ophthalmology – self-assessment – self-triage – triage

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Introduction

Several triage systems are available for general hospitals (Ganley & Gloster 2011; Storm-Versloot et al. 2011; Granstrom et al. 2012; Weyrich et al. 2012), but these generic triage instruments may not apply to specialized hospitals such as the Rotterdam Eye Hospital (REH). In the REH, around 25 000 unique acute ophthalmic cases are presented at the emergency department annually. The emergency department is open 24 hr a day. During office hours, triage is conducted by a triage assistant who is trained to perform ophthalmic triage. During night and weekend shifts, triage is performed by the resident on duty together with less trained personnel. Especially when large numbers of patients are present during night and weekend shifts, the quality of triage may not always be guaranteed as the resident is often occupied treating patients.

To improve our triage process, we found inspiration at the origin of triage. Baron Dominique Jean Larrey, Surgeon in Chief of Napoleon’s Imperial Guard, decided around 1792 in the battlefields to let a medical team sort surgical patients to handle the great number of casualties more effectively (Robertson-Steel 2006). The role of the surgeon was to focus on treating patients. In our study, we further developed the idea that the physician primarily needs to focus on treating patients. Because triage is based on chief complaints of the patient, we aimed to delegate the decision-making process of triage to the chief complaint expert, namely the patient. If self-triage could be accurately performed by the patient, we could improve the quality of care, especially the rapid treatment for true urgent disorders. To support the patient in this process and to increase the efficiency and standardization of the triage process, an instrument of self-triage could be a solution. Such proposal would not only be unique in ophthalmology, but also in medicine in general, as we did not find any examples of comparable ophthalmic self-triage methods reported in the literature.

The aim of this study was to develop a paper-and-pencil self-triage instrument for the ophthalmic emergency department of the REH. Our instrument
had the following requirements: (1) patients should be able to use the instrument without assistance, (2) the sensitivity should be at least 0.80 and (3) the specificity should be at least 0.70.

**Methods**

Previously, we developed a preliminary instrument of patient self-triage that we called the prototype instrument of self-triage (ISET). This prototype ISET was validated in the current study following a prospective two-step procedure. In the first explorative step, we compared the results of the ISET with the results of a regular triage assistant in the emergency department. Next, the ISET was refined due to the fact that several patients needed guidance while filling in the ISET. In the final validation step, we tested the validity of the refined ISET using the same validation method.

**Questionnaire**

The final ‘prototype pen-and-paper questionnaire’ is presented as an electronic supplement. The questionnaire was developed as follows. Ophthalmologists generated a preliminary 18-item questionnaire. Next, patients completing this questionnaire were observed, and the accuracy of self-triage outcome was compared with regular triage outcome. The results were discussed at several meetings with ophthalmologists, and items were selected for their appropriateness for patient self-triage until a concise questionnaire was obtained. The resulting 11-item instrument in the form of a flowchart enables patients to reveal their ophthalmic chief complaints. Specific characteristics of the chief complaints indicate different levels of urgency, ranging from need for immediate care to a safe waiting time of a few hours. Patients with chemical substance injuries, wounds, foreign bodies, recent ophthalmic surgical intervention or ophthalmologist’s referral were selected and coded by the first five items. The subsequent six items were dedicated to the level of deterioration of sight, moving spots in the visual field, pain in the eyes, headache and other eye-related chief complaints. Completion of the questionnaire resulted in an urgency category colour-code classification, each colour referring to a maximum predefined allowed waiting time in minutes, namely red (0 min), orange (10 min), yellow (30 min) and green (120 min). This colour coding is similar to the coding used by our reference standard, the triage assistant.

**Patients**

At days the researcher was present, all patients over 18 years visiting the emergency department of the REH with an acute ophthalmic problem during office hours were asked to participate in one of the two validation studies. Patients who previously visited the emergency department with the same chief complaints and unaccompanied patients who did not speak/read fluently Dutch were excluded from the study. When patients were unable to read due to an ophthalmic disorder, their companion was asked to complete the questionnaire.

**Study procedure**

In both steps of the two-step procedure, patients presenting in the emergency department with an acute ophthalmic disorder were first registered by the triage assistant and were given an urgency colour code, which was documented by the researcher. While waiting to see a doctor, participants were asked to fill in the ISET. The self-triage colour code resulting from the ISET was calculated and documented afterwards. In the first explorative step, patients filled in the questionnaire in the presence of the researcher, who documented irregularities and ambiguities in the questionnaire. These documented irregularities and ambiguities were later used to fine-tune the ISET for the final validation step. In case of questions by the patients, the researcher had standard instructions on how to answer these questions. Patients were not helped in answering. In the final validation step, participants filled in the questionnaire individually or with the help of their companion, but without any assistance of the researcher. In both study steps, researcher and participants were blind to the opinion of the triage assistant. Patient characteristics were registered from their medical records. The protocol was approved by the Medical Ethical Commission of the Erasmus MC. Patients were informed about the aim and nature of the study by means of an accompanying patient information folder.

**Reference standard and requirements**

To define the sensitivity and specificity of the ISET in both the explorative step and the final validation step, we compared the self-triage outcome to the triage outcome by the regular triage assistant. The triage assistants are trained in a modified form of the Manchester Triage System, appropriate for the ophthalmic emergency department. After presenting to the emergency department, patients were classified by a triage assistant to one of the four urgency colour codes.

For a self-assessment instrument such as the ISET to be useful, it should be designed in a way patients can fill it in without further instructions. As the most important feature of the ISET is the detection of high-urgent patients, misclassification of high-urgent cases as low urgent should be minimalized. In these patients, waiting too long might lead to further deterioration. Misclassification of low-urgent cases as high urgent is also undesirable but accepted as long as the percentages can be handled in daily practice in the emergency department. We know from our records at the ophthalmic emergency department that a high-urgency proportion of 0.20 is common. Therefore, we wanted the ISET to meet the following requirements: (1) patients should be able to use the instrument without assistance of the staff; (2) a sensitivity of at least 0.80 is considered acceptable and (3) a specificity of at least 0.70 is considered acceptable in clinical practice.

**Statistical analysis**

In both steps, we calculated the sensitivity and specificity for the ISET to investigate its capacity to discriminate between high-urgent (0–30 min maximum allowed waiting time) and low-urgent (30–120 min allowed waiting time) patients. Sensitivity and specificity were analysed with the statistical calculator http://ktlearnhouse.ca/cemb/practise/ca/calculators/statscalc. Uncertainty was quantified using 95% confidence intervals. In VassarStats (http://www.vassarstats.net/), z-scores were calculated to measure a difference in proportions of sensitivity and specificity in the two validation study steps, and linear-weighted kappa was calculated.
to determine inter-rater reliability. We followed the Standards for Reporting of Diagnostic Accuracy (STARD) initiative in conducting this study (Bossuyt et al. 2003, 2004). Binary logistic regression was used to investigate whether the following factors influenced the accuracy of the questionnaire: age, gender or assisted completion of the questionnaire. After applying the procedure described by Buderer (1996) to these values, a minimum sample of 173 patients was needed.

**Results**

In the first explorative step, between September and December 2009, 296 patients filled in the ISET. Seventeen patients were excluded because they needed extensive help from the researcher. Age of the 279 analysed patients (52% women) ranged from 18 to 96 years. Mean age was 54 years. In the final validation step, between October and November 2011, 298 patients filled in the ISET. No patients were excluded. Age of the patients (43% women) ranged from 18 to 97 years. Mean age was 54 years. In both study steps, some patients needed their companion to fill in the questionnaire. In the explorative step, 35 companions filled in the questionnaire (12.5% of the cases), compared with 36 in the validation step (12.1% of the cases).

Table 1 shows that in the first explorative step, the prototype ISET classified high-urgent cases as high urgent in 14% of the cases and low urgent as high urgent in 13% of the cases. Seven high-urgent patients (3%) were missed by the prototype ISET and were instead classified as low urgent. After refinement of the prototype ISET, we found an increase in the number of low-urgent cases categorized by the ISET as high urgent (21%), and a decrease in the number of high-urgent cases categorized as low urgent (1%).

A similar pattern can be seen in Table 2: in the explorative step, sensitivity and specificity are both 0.84. In the final validation step, sensitivity increased significantly from 0.84 to 0.94 (z = −3.93, p < 0.0001), whereas specificity decreased from 0.84 to 0.76 (z = 2.21, p < 0.0135).

Linear-weighted kappa was calculated to test inter-rater reliability between the ISET and regular triage. In the explorative step, kappa = 0.54 (95% CI 0.43–0.66). Due to a skewed data set, the maximum obtainable kappa was 0.69. In the validation step, kappa = 0.41 (95% CI 0.30–0.51). Here, the maximum obtainable kappa was 0.44.

None of the factors investigated influenced accuracy significantly, apart from when the questionnaire was completed by the patient. Table 3 shows the results of the logistic regression analysis when 'completion by patient' was entered as a single factor.

**Discussion**

In this article, we presented two steps towards the development of a self-triage instrument to support ophthalmic triage in the emergency department of a specialized eye hospital. In our final validation step, the ISET met our predefined requirements: (1) all patients were able to fill in the questionnaire without guidance from the researcher; (2) the sensitivity was well above 0.80 (94%) and (3) the specificity was above 0.70 (76%). Compared with the first explorative step, in the final validation step, the sensitivity of the ISET increased and the specificity decreased. This indicates that the ability of the final version of the ISET to detect high-urgent patients has improved, at the expense of classifying more low-urgent patients as high urgent. This is the trade-off we are willing to accept to make sure that patients with high-urgent disorders have the least chance to deteriorate due to under-prioritization.

In the explorative step, we found moderate agreement between the ISET and regular triage (kappa of 0.54). In the validation step, kappa declined to 0.41, which is still moderate. This decline can be explained by the fact that we aimed for a higher sensitivity in the development of the ISET.

In general medicine, the term ‘self-triage’ often refers to the process by which patients evaluate their health to determine whether or not to see their doctor. Patients often adopt ineffective strategies in this process: they "wait and see" which can be dangerous, or visit a physician multiple times without the detection of a disorder, which unnecessarily consumes healthcare resources.
(Safer et al. 1979; Barsky et al. 1986; Cameron et al. 1995). Patient self-assessment in the triage process has only been studied before in a general healthcare setting (Miyamichi et al. 2012). In that particular study, in which patients were asked to evaluate the urgency and severity of their condition, researchers concluded that self-triage seemed to supplement the regular triage process for hospitalization. However, our study results demonstrate that patients are able to perform an accurate triage themselves using a structured questionnaire. Questions could arise whether patients would exaggerate their complaints to get faster treatment, but our results show that patients are almost three times more accurate in performing self-triage than if their companion would perform the triage. This suggests that the ISET can be used as a stand-alone self-triage instrument.

A next step in the development of the ISET will be to digitalize the pen-and-paper ISET so the questionnaire can be presented in the emergency department with a touch screen. Another step in refining the ISET is to translate the questionnaire into different languages. A significant group of non-Dutch speaking patients could perform self-assessment in their preferred language, for example English, Turkish or Spanish, thereby optimizing triage for this specific group. We did not quantify Dutch language skills of the included patients in this study, so we have no data on the effect of language skills on self-assessed triage results. Because we validated a Dutch version of the ISET in this study, results only apply to patients who speak and read Dutch.

It is possible that we have missed some patients with high-urgency levels, as they have shorter waiting times and accordingly less chance of inclusion in this study. This could lead to a biased selection. We tried to partially compensate for this selection bias by including more patients in this study than was required according to our power calculation.

Many emergency rooms have more urgency categories than we have used in our study. The Rotterdam Eye Hospital theoretically works with five urgency codes, based on the urgency codes of the Manchester Triage System. However, in practice, one of the five codes is never used, that is, the blue urgency code referring to 240 min of waiting time. Furthermore, policy in the Rotterdam Eye Hospital dictates that all patients visiting the emergency department should be seen by an ophthalmologist or a resident. Because we developed the questionnaire primarily for the emergency department of the Rotterdam Eye Hospital, we validated the questionnaire with the four urgency codes as used in practice by the emergency department.

A further limitation, tasted upon before, is that we can only estimate the validity of the ISET to the reference used, in this case the regular triage assistants. In the next developmental step, when the ISET is digitalized, prospectively by a physician-determined ‘real urgency’ will be considered as the ultimate ‘gold standard’. This would be a combined validation of the ISET triage and regular triage to triage by the physician.

Conclusion

The aim of our study was to make a first step in developing an instrument of patient self-triage. In this two-step validation study, our results suggest that the ISET is a promising, sensitive and specific instrument for triage in the emergency department of an ophthalmic hospital.

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Contributors

JJVB, ESVE, HM and MWBR contributed to conception and design, analysis and interpretation of data, revised paper for important intellectual content and final approval of the version submitted for publication and RT revised the paper for important intellectual content and final approval of the version submitted for publication.

Competing interests

None declared.

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Correspondence:
Eva S.V. Eijk
Schiedams Vest 160d
3011 BH Rotterdam
The Netherlands
Tel: 0031(0)104023438
Fax: 0031(0)4023455
Email: e.vaneijk@oogziekenhuis.nl