



From pen-and-paper questionnaire to a computer-assisted instrument for self-triage in the ophthalmic emergency department: Process and validation



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ABSTRACT

Background/Aims: The ISET (Instrument for Self-Triage) is a validated pen-and-paper instrument for patient self-triage in ophthalmic emergency departments. The aim of the present study is to develop a validated computer-assisted ISET (ca-ISET) with a touch screen.

Methods: In the emergency department of the Eye Hospital Rotterdam, the Netherlands, successive computer-assisted versions of the ISET were tested by patients visiting the emergency department. The versions were developed by iteratively prototyping, testing, analysing and refining the computer-assisted ISET. In three test cycles, 16, 53 and 75 patients ≥ 18 years old, visiting the emergency department for the first time with their ophthalmic complaint, were monitored while using the ca-ISET. They were debriefed, and their input was used to adapt the computer-assisted ISET. To validate the ca-ISET, a sensitivity outcome of .80 and a specificity of .70 was required (CI=95%). The ca-ISET sensitivity and specificity were tested by comparing ca-ISET triage outcome to triage outcome as decided by the regular triage assistant.

Results: ISET accuracy increased from 0.69 in the first test to 0.79 in the third test. Sensitivity increased from 0.66 (CI 0.13–0.98) to 0.80 (0.51–0.95). Specificity increased from 0.69 (0.39–0.90) to 0.78 (0.65–0.88). To improve validity and usability, several adjustments were made in the text and the flow chart of the computer-assisted ISET.

Conclusions: A ca-ISET prototype was developed, with minor textual modification of the pen-and-paper version. The new ca-ISET was validated by comparing against triage decided by the regular triage assistant.

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1. Introduction

In our previous study the pen-and paper instrument of patient self-triage (ISET) was presented as a validated, sensitive and specific tool for the ophthalmic emergency department [1]. In the current study we use the pen-and paper version to develop a computer-assisted and touch screen controlled ISET.

Emergency departments are often overcrowded so to ensure that the most urgent patients are treated in time, triage systems are used by trained staff [2,3]. However, these generic triage systems do not suffice for the Rotterdam Eye Hospital, the only specialised hospital in the Netherlands. Therefore the Rotterdam Eye

Hospital triage standard is used; a flowchart based on the Manchester Triage System [4] and adapted for ophthalmic emergency departments. The triage is performed by trained staff during office hours. In response to a shortage of trained triage staff in the Rotterdam Eye Hospital outside of office hours, the possibility of self-triage was investigated by developing and validating the pen-and-paper ISET [1]. The pen-and-paper ISET enables patients to perform triage themselves by filling in the ISET questionnaire. Triage outcome is the preferred waiting-time as defined in the Rotterdam Eye Hospital triage standard. However, the triage outcome is calculated manually. This complicates implementation since the staff needs extra time to calculate triage outcome and this will immediately affect handling time for each patient. A computer-assisted ISET was therefore needed to automatically calculate triage outcome.

Computer-assisted triage has been described in literature in several studies. One example is found in Canada, where a Web-based triage

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Fig. 1. Ca-ISET with touch screen in a test setting.

decision support tool was developed and validated that was based on the Canadian Triage and Acuity Scale [5,6]. In a study in a Swiss university hospital emergency unit, computer-assisted telephone triage was studied and considered a safe method for walk-in patients with non-life-threatening medical conditions [7]. Another example of computer-assisted triage comes from Australian dental emergency care, where computer-assisted triage was shown useful in response to workforce shortage and funding constraints in the public health sector [8]. However, the implementation in the previous examples was always on medical professionals providing the input in general emergency departments. So far, there has not been any report about computer-assisted triage with the patients themselves providing the input. Self-administered computer-assisted interviewing has been shown a valuable tool for emergency department diagnosis [9], but it was not tested for the purpose of triage.

Changing from pen-and-paper administration mode to computer-assisted administration not always generates the same outcome [10–12]. Consequently we cannot assume that the validity of a computer-assisted ISET is the same as the validity of the pen-and-paper version. The aim of the present study is to develop and validate a computer-assisted ISET with a touch screen.

2. Methods

2.1. Study design

Successive computer-assisted versions of the ISET (ca-ISET) were developed by iteratively prototyping, testing, analysing and refining the ca-ISET. Changes made in the resulting 11 versions are described. In three iterations the validity of the ca-ISET was tested by comparing ca-ISET triage outcome to triage outcome as decided by the regular triage assistant. The patients were monitored and debriefed, and their input was used to adapt the ca-ISET.

2.2. Computer-assisted ISET

The ca-ISET is a touch operated software application, its content was based on a pen-and-paper ISET that was developed and validated in our previous study [1]. The ca-ISET was developed by Delft Dimensions, a company specialized in technical and scientific software development and Interaction Design. It is designed as a 'dynamic application' [13], which make the instrument easy to

adapt to the intended testing cycles. The pen-and-paper ISET was translated into a specially developed XML based configuration file from which the application generates the screens and which dictates the flow through the questionnaire. These screens are optimised for readability and touch operation. In the prototype a 21" touch screen was placed on a wheeled trolley to use for patients visiting the emergency department (Fig. 1). The application runs on standard Windows-based computer hardware with touch capabilities. The prototype interface background was white with black and dark blue letters to maximise contrast and readability. Depending on the routing of the patient in the flowchart ca-ISET version 1.4 has 3–23 questions and version 1.11 has 4–24 questions. If patients have chemical substance injuries, wounds, foreign bodies, recent ophthalmic surgical intervention or ophthalmologist's referral, they are selected and routed in the first five items. The subsequent 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.

After the patient completed the questionnaire, the triage colour code of the patient was calculated and logged. Each colour code referred to a maximum predefined allowed waiting time in minutes, namely red (0 min), orange (10 min), yellow (30 min) and green (120 min). As with the pen-and-paper ISET, the algorithm for triage came from the REH triage standard, which is based on the Manchester Triage System and is adapted for ophthalmic emergency departments [1].

2.3. Reference standard

The regular triage procedure at the emergency department of the REH is a trained triage assistant. To validate the results of the ca-ISET, triage outcome were compared to regular triage outcome. The triage assistant first decided on the triage colour code of every patient presenting in the emergency department. After this standard triage procedure, the patient filled in the ca-ISET.

2.4. Statistics

We investigated ca-ISET ability to discriminate between high urgent (0–30 min maximum allowed waiting time) and low urgent (30–120 min allowed waiting time) patients, as indicated by the triage assistant. At three stages in the iterative development process of the ISET this validation check was performed. We used accuracy, sensitivity and specificity statistics to monitor progress in validity. Uncertainty was quantified using 95% confidence intervals. The study was approved by the Institutional Review Board of the Rotterdam Eye Hospital (REH 2009-03). No medical ethical permission was required for this study.

2.5. Patients

Patients visiting the emergency department of the REH were only included when the researcher (ESVE) was present. After patients had presented themselves to the triage assistant, and after the triage assistant decided on the colour code, patients were invited to participate in the study and informed consent was obtained. Patients under 18 years old, patients with recurring complaints and patients who could not read the Dutch language were excluded. While patients filled in the ca-ISET the researcher did not give any additional instructions but made observations and afterwards debriefed the patients.

3. Results

Patient characteristics are presented in Table 1. The distribution of triage decisions is represented in Table 2. In Table 3 it can be

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