European Journal of Ophthalmology / Vol. 17 no. 3, 2007 / pp. 413-417

Triaging and coding ophthalmic emergency - The Rome Eye Scoring System for Urgency and Emergency (RESCUE): A pilot study of 1000 eye-dedicated emergency room patients

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PURPOSE. *Ophthalmic emergency (OE) triage is essential for prompt recognition of urgent cases. To date, no formal eye-dedicated triaging system has been widely accepted. The purpose of the present study is to propose a fast, accurate, and reproducible coding scale called the Rome Eye System for Scoring Urgency and Emergency (Rescue).*

METHODS. *Phase 1 of the study is a retrospective analysis of electronic medical records (EMR); phase 2 is a prospective consecutive series. Phase 1 included 160,936 patients. Phase 2 included 1000 consecutive patients referred to the emergency department (ED) of our institution. In phase 1, the authors retrospectively analyzed EMRs of patients presenting to the ED, listing signs and symptoms most frequently associated with hospitalization. Redness, pain, loss of vision, and the risk for an open eye were identified and assigned a score ranging from 0 to 12. Color coding was assigned based on increasing scoring: 0–3 white, 4–7 green, 8–12 yellow code. In phase 2, 1000 consecutive ED patients were enrolled and prospectively coded according to RESCUE. After diagnosis and proper treatment, EMRs were retrospectively reviewed by a masked physician and patients recoded (Retro coding) according to clinical course. Correlation between Rescue and Retro coding was calculated.*

Main outcome measures: Prospective and retrospective ED color coding correlation.

RESULTS. *A total of 160,936 EMR were retrospectively analyzed; 2407 (1.4%) patients required hospitalization. Loss of vision (90%), redness (76%), and pain (47%) were the most frequent complaints. Rescue significantly correlated to Retro coding ($p<0.01$): 841/1000 patients coded exactly the same color, 45/1000 were overestimated by one color class, none by two, 107/1000 underestimated by one, and 6/1000 by two classes. The 32/1000 hospitalized patients in the prospective cohort had a Rescue score significantly higher than non-admitted patients ($p<0.01$) and color coding among admitted and dismissed patients was significantly different as well ($p<0.01$).*

CONCLUSIONS. *The Rescue system seems promising in terms of usefulness and ease of implementation. The high correlation between Rescue code assigned prospectively and the post-diagnosis coding, as well as the prompt discrimination of cases that eventually required hospitalization, may lead to a wider use of the Rescue system. Further testing on larger samples and different institutions is warranted. (Eur J Ophthalmol 2007; 17: 413-7)*

KEY WORDS. *Emergency department, Coding, Ophthalmic emergency triage, Ocular trauma*

Accepted: November 26, 2006

 1120-6721/413-05$15.00/0

INTRODUCTION

Emergency and urgency in ophthalmology represent a small but significant number of cases treated in the emergency departments (ED) of general hospitals, or in the emergency departments of eye hospitals, where they exist. Although only a few ocular conditions require immediate treatment to avoid permanent vision loss and should therefore be regarded as real emergencies, numerous minor ailments can mimic serious diseases. Redness, pain, and foreign body sensation or even tearing can bother the patient enough to bring him or her to the ED for evaluation, crowding ophthalmic EDs (1). Prompt recognition of the most urgent cases is therefore critical and largely depends upon fast, accurate, and reproducible triaging (2).
To date, no established and worldwide recognized triaging system dedicated to ophthalmic emergency (OE) has been developed. The purpose of the present study is to propose an ophthalmic prioritization scale based upon simple signs and anamnesis in order to accurately and timely grade OE.

METHODS AND MATERIALS

The Ophthalmic Hospital of Rome is a tertiary referral center for central and southern Italy, exclusively dedicated to ophthalmology. Regardless of subspecialty training, all ophthalmologists on staff rotate in the ophthalmic emergency room, open 24 hours/365 days. Given the high volume of patients (over 70,000 a year; >200 patients/day), the hospital enforced a triaging system similar to general hospitals EDs.
Incoming patients immediately undergo triaging and receive a color code based on estimated severity: white for less urgent, green for intermediate, and yellow for the most urgent cases. Red code, according to international standards, means endangerment of vital functions and is exceptionally assigned in our hospital. Red code patients are immediately transferred to a nearby general hospital for treatment and have been therefore excluded from the present study.
The study was divided into two separate phases: in the first we conducted a retrospective analysis on electronic medical records (EMR) and elaborated the coding system. In the second phase we tested the proposed coding scale on a prospective consecutive cohort of patients.

Phase 1: Retrospective EMR analysis

In an effort to provide a sensitive and specific assessment tool, we retrospectively analyzed all ED EMRs between June 1, 2003, and June 30, 2005, selecting signs, symptoms, and anamnestic data more often associated with hospitalization. Hospitalized patients' EMRs were isolated and data reported in Tables I and II.
On the basis of frequency and clinical relevance, we identified the most clinically significant parameters: redness, pain, loss of vision, and the risk for an open eye (referred to as coding parameters throughout the rest of the article). Each coding parameter had been subsequently assigned a score according to the grade of severity as exposed in Table III. As the sum of assigned scores ranges between 0 and 12, patients have been divided into three different color classes of increasing severity: white, green, and yellow codes (Tab. IV).
We attributed a score ranging from 0 to 2 to redness and pain and arbitrarily doubled it (0 to 4) for vision loss and risk of open eye in order to weight differently parameters with a different prognostic value.

Phase 2: Prospective cohort study

The second part of our study was aimed at testing this coding system, which we named Rescue (Rome Eye Scoring System for Urgency and Emergency), in the field.
We prospectively analyzed 1000 consecutive patients reporting to the ED of our hospital and instructed the triage nurse to assign color coding according to Rescue. After the physician on call made the final diagnosis and prescribed appropriate treatment, one of us (T.R.) revised EMRs while masked to assigned color code and retrospectively recoded all patients based on the examination, diagnosis, and follow-up when available. This retrospective, post-treatment coding (Retro coding) served as a control to Rescue prospective coding since the effective grade of urgency was thoroughly estimated post-diagnosis and treatment.
Agreement between Rescue and Retro coding has been calculated in order to verify correlation between the two and therefore evaluate RESCUE efficacy and usefulness.

Statistical analysis

Statistical analysis used SPSS software (version 12, SPSS, Chicago, IL, USA). For comparison between Res-

cue and Retro coding, colors have been converted into numbers (1 = red; 2 = yellow; 3 = green; 4 = white) in order to obtain ordinal, non-normal continuous data and bivariate correlation (both Spearman and Pearson correlation coefficient). Rescue scoring differences between hospitalized and non-hospitalized patients have been compared by means of variance analysis while color coding difference used Mann-Whitney and chi-square tests. p values less than 0.05 have been considered significant although in many cases p reached the 0.01 level.

RESULTS

Phase 1: Retrospective EMR analysis

Between June 1, 2003, and June 30, 2005, 160,936 patients presented to the ED of the Ophthalmic Hospital of Rome; 2407 (1.4%) of them required hospitalization and 31,544 (19.6%) were asked to return for follow-up or review. Referring signs and symptoms and anamnestic data of admitted patients are reported in Tables I and II, respectively.

Phase 2: Prospective cohort study

The second part of our study prospectively analyzed data from a cohort of 1000 consecutive ED patients. Demographics are shown in Table V. No significant difference was found for age, sex, or proportion of hospitalized patients between phase 1 and 2 patients.

Correlation between Rescue and Retro coding is highly significant (Pearson coefficient 0.720, p<0.01; Spearman rho 0.714, p>0.01). Correlation between Rescue scoring and Retro coding was also significant (Pearson correlation coefficient –0.672, p<001; Spearman rho –0.642, p<0.01).

Color coding difference between Retro and Rescue was calculated as the difference in class of coding between the two methods and therefore as an integer number between –2 and +2. A total of 841/1000 (84.1%) patients coded exactly the same, 46/1000 (4.6%) were overestimated by one class, none by two, 109/1000 (10.9%) underestimated by one class, and 4/1000 (0.4%) by two classes (Fig. 1).

The 32/1000 hospitalized patients' Rescue score was significantly higher than non-admitted patients (mean 5.75±2.55 for admitted patients vs 2.77±1.42 for dismissed patients; independent sample *t*-test: p<0.01). Color coding among admitted and dismissed patients was significantly different as well (Mann-Whitney test: p<0.01). The number of coding parameters scoring higher than zero was significantly higher for admitted patients with a mean of 3.32±0.77 positive parameters vs 1.73±0.75 for non-admitted patients (*t*-test: p<0.01; Pearson chi-square: p<0.01).

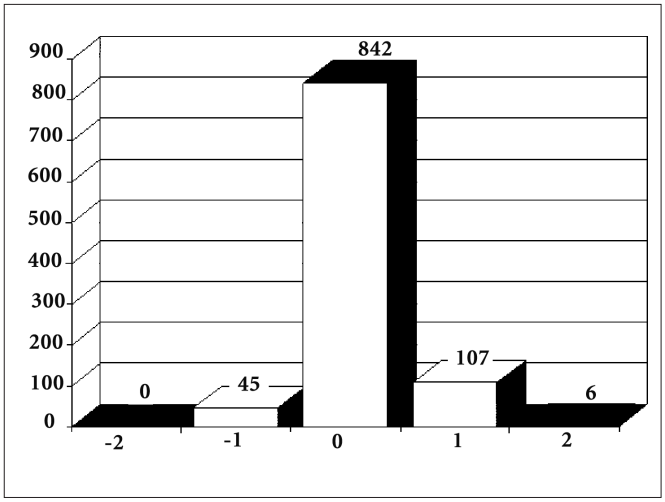

Fig. 1 - *Bar chart representing color coding difference between retrospective coding and Rome Eye Scoring System for Urgency and Emergency (Rescue). A total of 842 patients (84.2%) were coded exactly in the same class by the two methods, 152 missed by one class (107 underestimated and 45 overestimated), and only six underestimated by two classes.*

DISCUSSION

Appropriate screening is vital for timely treatment of OE and efficacious ED triaging is the golden standard to achieve this result. To date, no formal, eye-dedicated ED triaging system has been widely accepted, although it would be a valuable tool for all health care professionals involved in ED care, including ophthalmologists, general practitioners, and triage nurses (1, 3).

Fast assessment based upon few, minimally technical, and easily elicited parameters is frequently used in diverse fields of medicine: for example, the Apgar index and the Glasgow Coma Scale. The Rescue proposal is based on this same philosophy.

We conducted a retrospective analysis of all signs and symptoms associated with hospital admittance in the past 2 years in order to point out the most clinically relevant ones to be used as cornerstones of Rescue.

TABLE I - PRESENTING SIGNS AND SYMPTOMS OF THE 2407 ADMITTED PATIENTS

Presenting signs and symptoms	No.	%
Vision loss	2188	90.9
Redness	1851	76.9
Pain	1131	47.0
Tearing	773	32.1
Foreign body sensation	602	25.0
Phospenes/myodesopsias	323	13.4
Discharge	246	10.2
Itching/burning	212	8.8
Other	664	27.6

The sum of lines does not equal the overall number of patients because many referred more than one sign and/or symptom

TABLE II - ANAMNESTIC DATA OF ADMITTED PATIENTS ON PRESENTATION TO THE EMERGENCY DEPARTMENT

Anamnestic data on presentation	No.	%
Penetrating/perforating injuries	771	32.0
Hystory of retinal problems	435	18.1
Use of contact lenses	306	12.7
Contusion	245	10.2
Hystory of infection	188	7.8
Agle-closure glaucoma	76	3.2
Exposure to chemicals/radiation	39	1.6
Other	347	14.4
Total	2407	100.0

TABLE III - RESCUE SCORING EXAMINES EACH PATIENT ON FOUR CODING PARAMETERS, ATTRIBUTING VALUES BETWEEN 0 AND 2 FOR REDNESS AND PAIN OR 0 AND 4 FOR LOSS OF VISION AND THE RISK FOR AN OPEN GLOBE*

	None	Moderate	Severe
Redness	0	1	2
Pain	0	1	2
Loss of vision	0	2	4
Open eye risk	0	2	4

*The triage nurse, therefore, assigns patients a score between 0 and 12 adding each individual parameter.
Rescue = Rome Eye Scoring System for Urgency and Emergency

TABLE IV - RESCUE SCORING IS OBTAINED AS THE SUM OF SCORES ASSIGNED TO EACH CODING PARAMETER SHOWN IN TABLE III

Scoring	Color coding
0–3	White
4–7	Green
8–12	Yellow

After the addition is made, color coding is conventionally attributed following the above scheme.
Rescue = Rome Eye Scoring System for Urgency and Emergency

TABLE V - DEMOGRAPHIC AND CODING DATA OF PROSPECTIVELY ANALYZED SAMPLE POPULATION

	No.	%
M/F	609/391	60.9/39.1
Age, yr	54.31± 30.33	—
White/green/yellow codes	654/324/22	65.4/32.4/2.2
Hospitalized	32	3.2

Admittance and follow-up rates of our population are similar to Fenton et al's data (3), who reported over 1% of hospitalized patients and 23% returning for further control.
Redness, pain, and loss of vision were the most frequent signs/symptoms in our study (Tab. I). In order to increase Rescue sensitivity to traumatized eyes (4), we added one anamnestic data point present in virtually all trauma-related hospitalizations as well as in a number of severe corneal infections: the risk of open globe (Tab. II). Under this definition we were able to fit both penetrating/perforating, ruptured globes and corneal infections/degenerations threatening immediate perforation.
Although symptom reporting is largely subjective and suffers by definition from several educational, emotional, and cultural biases, we nonetheless elected to rely on pain and loss of vision as they are often present and can be graded with some degree of consistency. In other words, we believed most patients could reliably tell whether they were in a lot of pain or had a moderate loss of vision. Redness is a fairly consistent sign and could be established by the nurse while the risk of an open eye can be readily assessed in most cases through a detailed anamnesis.
Scoring assignment (Tab. III) was arbitrarily weighted on

what we believed was the clinical relevance of each coding parameter. Redness and pain were assigned 0 to 2 points while loss of vision and risk of an open globe scored 0 to 4 in order to properly differentiate between a mildly red and painful eye (1+1+0+0 = 2) and a total loss of vision (0+0+4+0 = 4) or a high risk of penetrating injury even in the absence of external signs (0+0+0+4 = 4).

Prospective testing of Rescue on 1000 patients yielded encouraging results with a highly significant correlation between retrospective assessment (Retro) and both Rescue scoring ($p<0.01$) and coding ($p<0.01$). Since coding is a consequence of scoring, it is not surprising that its significance level followed scoring, testing significantly correlated to Retro.

Eighty-four percent of patients fell in the same color code after Retro and Rescue coding with underestimation in about 11% of cases and overestimation in 5% (Fig. 1).

RESCUE proved capable of successfully discriminating the 32/1000 hospitalized patients whose mean scoring and coding was significantly higher than non-admitted patients. The choice of coding parameters is also strengthened by the significantly higher proportion of positive parameters in hospitalized patients. Admitted patients, in fact, had an average of 3.32 positive (i.e., >0) coding parameters vs 1.72 for non-admitted patents.

In both our and Fenton et al's series (3) the proportion of patients hospitalized or deemed worth a follow-up visit (less than ¼) is surprisingly low. Non-urgent disease, in fact, accounts for the remaining 75% of patients who should receive medical attention in a primary care setting. Partial resolution to this specific problem could be nurse management through strict guidelines and medically approved flow algorithm. Banerjee et al (5) reported on 301 consecutive patients, 50 (16.6%) of whom were appropriately managed exclusively by a nurse. Buchan et al (6) reported a similar experience with 1976 patients, 440 of whom saw a triage nurse with a 96% appropriateness of treatment. This management strategy may not be feasible in all countries and under diverse legal authorities; in Italy, for example, all ED patients are to be seen by the physician on duty, regardless of severity, pending legal responsibilities.

The present study has some flaws, including the relatively low numbers in the prospective cohort, the limited number of health care personnel who actually tested Rescue, and their high expertise and long experience in the field of ophthalmology, which could have introduced a bias in the interpretation of patients' symptoms and signs, as well as the presence of a single EMR reviewer assigning Retro coding and the limited amount of scientific literature for comparison. Testing on one center only should be considered a limitation as well and testing on a much larger scale by other institutions is warranted. We nonetheless believe that an eye-dedicated ED triaging system should be pursued and hope that Rescue might prove useful.

ACKNOWLEDGEMENTS

The authors thank Vittorio Fioravanti, RN, Gaetano Marino, RN, Alessandra Di Cola, RN, and Italo Lovardi, RN, for their help with this study, and Rocco Mileo for computer assistance.

None of the authors has any proprietary interest in the subject matter.

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