

Is computer-assisted telephone triage safe? A prospective surveillance study in walk-in patients with non-life-threatening medical conditions

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ABSTRACT

Background Patients often establish initial contact with healthcare institutions by telephone. During this process they are frequently medically triaged.

Purpose To investigate the safety of computer-assisted telephone triage for walk-in patients with non-life-threatening medical conditions at an emergency unit of a Swiss university hospital.

Methods This prospective surveillance study compared the urgency assessments of three different types of personnel (call centre nurses, hospital physicians, primary care physicians) who were involved in the patients' care process. Based on the urgency recommendations of the hospital and primary care physicians, cases which could potentially have resulted in an avoidable hazardous situation (AHS) were identified. Subsequently, the records of patients with a potential AHS were assessed for risk to health or life by an expert panel.

Results 208 patients were enrolled in the study, of whom 153 were assessed by all three types of personnel. Congruence between the three assessments was low. The weighted κ values were 0.115 (95% CI 0.038 to 0.192) (hospital physicians vs call centre), 0.159 (95% CI 0.073 to 0.242) (primary care physicians vs call centre) and 0.377 (95% CI 0.279 to 0.480) (hospital vs primary care physicians). Seven of 153 cases (4.57%; 95% CI 1.85% to 9.20%) were classified as a potentially AHS. A risk to health or life was adjudged in one case (0.65%; 95% CI 0.02% to 3.58%).

Conclusion Medical telephone counselling is a demanding task requiring competent specialists with dedicated training in communication supported by suitable computer technology. Provided these conditions are in place, computer-assisted telephone triage can be considered to be a safe method of assessing the potential clinical risks of patients' medical conditions.

INTRODUCTION

In Switzerland the shortage of physicians in primary healthcare, rising expectations on the part of the general public regarding the availability of medical resources and the general trend to centralise healthcare are leading to a restructuring and reorganisation of emergency outpatient care. Emergency services are being merged, walk-in clinics are being established and telephone-based medical triage services are being introduced in order to optimise the use of scarce medical resources.^{1–3} Telephone triage is a care process by which the degree of urgency of a patient's clinical problem and

the subsequent care needed are determined on the telephone. Quality-orientated medical call centres in Switzerland use computer-based expert systems to support healthcare professionals in the triage process.^{4 5}

There is good evidence that telephone triage can reduce the workload of primary care physicians dealing with emergencies, and that nurse-led software-supported medical triage does not appear to be inferior to contact with physicians in terms of counselling outcome.⁶ Many investigations suggest that appropriate medical and communication training of the staff involved is essential for the quality of the service. Furthermore, suitable information technologies appear to be important to support the guidance and documentation of the triage process.^{7–10} Moreover, the clinical backgrounds and length of professional experience of individual nurses affects decision-making.^{11 12} Research in Switzerland shows that lay people find it very difficult to self-assess the severity of their health concerns. This can result in an inappropriate use of medical resources.^{4 5}

There are only a few studies evaluating the safety of medical telephone triage.^{8 9 13–17} The methods of these investigations do not rely on a direct clinical assessment of the triaged patients. Our study methodically applied a direct clinical assessment of the urgency of care by hospital physicians shortly after patients were triaged on the telephone and subsequent follow-up by primary care physicians who were aware of the situation. The paper aims to contribute to a better understanding of the safety aspects of medical telephone triage.

METHODS

Study population, setting and procedure

The study was performed at the interdisciplinary Adult Emergency Centre (AEC) of Bern University Hospital. Data were collected from the beginning of December 2005 to the end of March 2006. The AEC is open 24 h a day, 365 days a year, and treats about 30 000 patients annually. All German-speaking walk-in patients (WIP) attending the AEC between 08.00 h and 22.00 h were eligible. Patients were physically pre-triaged by a nurse of the emergency department. If there were signs or symptoms of an immediate life-threatening disease or injury they were excluded from the study. After giving informed consent, the study participants telephoned the medical call centre and were assessed by a nurse.

The call centre involved in the study triages around 50 000 patients annually. The staff consists of 40 nurses with an average job experience of 15 years in various healthcare institutions. They undergo 6 weeks of full-time special training prior to starting their job in the call centre. The nurses are supported 24 h a day by eight board-approved general practitioners and internists. For the triage, the nurse is assisted by a computerised decision support system (TAS, Plain Software Company, UK). The study patients' clinical conditions were assigned to the urgency grades shown in table 1. The grading was predetermined by the decision support software.

Following telephone triage the patients were examined and treated at the emergency ward of the hospital. After completing the medical evaluation at the AEC (eg, history, physical, laboratory tests, treatment), the hospital physicians (registrar and/or senior house officer) retrospectively assessed the urgency of treatment according to the same grading system. Moreover, they defined a bandwidth of urgency assessments which in their view would also have been appropriate for each study patient.

After the patients had left the hospital the primary care physicians responsible for the follow-up were informed in writing about the study and asked to assess urgency on the basis of the hospital report without re-examining the patient. The primary care physicians were also required to state the urgency grade which they considered correct together with a bandwidth of possible appropriate grades.

The urgency assessments given by the various types of personnel were not communicated to the study patients or to the other personnel involved.

Study design

This prospective surveillance study compared the urgency assessments of three different types of personnel (call centre nurses, hospital physicians, primary care physicians) involved in the care process. In a first phase, a range of appropriate responses was established based on the urgency assessments of the hospital and primary care physicians. The lower limit was defined by the lower grade and the upper limit by the upper grade of the urgency assessment given by the two types of personnel. Cases which were under-triaged by the call centre compared with the urgency assessment given by the hospital and primary care physicians were classified as avoidable hazardous situations (AHS). The expression 'avoidable hazardous situation' is a term used in general medicine to describe clinical conditions whose health-damaging or even fatal consequences can be averted by timely medical intervention.¹⁸

In a second phase the medical records of patients exposed to a potential AHS were analysed and discussed by a panel of experts. To minimise institutional and professional bias, panel-

lists were recruited from different organisational and institutional settings. The panel of experts comprised an emergency physician, a physician of the call centre and two primary care physicians. The panel assessed the clinical safety of the triage decision based on all available information documented in the hospital report (patient's clinical condition, results of examinations, diagnosis). Panellists were first asked to classify the urgency of treatment themselves according to the urgency grades shown in table 1. The urgency assessments given by the various types of personnel were then communicated to the panellists. In a next step the panellists independently had to decide whether they considered the advice of the call centre nurse to be life-threatening or harmful. The possible answers were 'unlikely', 'rather unlikely', 'rather likely' and 'likely'. If the answers were 'rather likely' or 'likely', a potential risk to life and health was assumed. Moreover, they had to write down the reasons for their decision. The individual decisions and the reasoning were discussed in the group.

Finally the panellists had to vote. If there was no consensus that the advice given by the nurse was 'unlikely' or 'rather unlikely' to have been life-threatening or harmful, a risk to life or health was considered to be present.

Analysis of data

The correspondence between the urgency assessments of two types of personnel was calculated by determining Cohen's κ coefficient and the weighted Cohen's κ coefficient. In addition, the probability that the urgency assessment given by the call centre would be lower (over-triage) or higher (under-triage) than the appropriate urgency assessments and that the call centre assessment would be within the range of appropriate responses was estimated. A more detailed description of our statistical evaluations is given in our online publication.¹⁹

RESULTS

During the study period 309 German-speaking WIP were eligible. Two hundred and seventy-two of them were invited to participate; 27 were excluded because of the pre-triage procedure and 37 because informed consent was lacking (figure 1), leaving 208 who were enrolled in the study and subsequently triaged by the medical call centre and assessed by the hospital physicians (122 men (58.7%) and 86 women (41.3%)). More than 70% of the patients were aged <45 years. One hundred and eighty-nine WIP (90.9%) were treated as outpatients, 12 (5.7%) required admission to hospital and no information was available for 7 (3.4%). For 153 WIP, urgency was additionally assessed by the primary care physicians in charge of the follow-up based on the hospital report.

Table 1 Grading of urgency recommendations

Triage step	Name	Recommended action
1	Immediate hospital	Immediate need for action (0–2 h) with recommendation for continued inpatient care. If necessary, referral to regional emergency medical service 144
2	Immediate primary care physician/emergency physician	Immediate need for action (0–2 h) with recommendation for immediate outpatient emergency consultation by the primary care physician or his/her deputy
3	Urgent	Urgent need for action (2–6 h) with recommendation for urgent outpatient emergency consultation by the primary care physician or his/her deputy
4	Moderately urgent	Moderately urgent need for action (6–24 h). Recommendation for consultation with primary care physician or his/her deputy within 24 h
5	Routine consultation (primary care physician)	Recommendation for primary care physician consultation within 2–7 days
6	Self-treatment	No medical consultation. The health counsellor gives suggestions for self-treatment

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Figure 2 shows the urgency assessments of the various types of personnel. In 13.5% (hospital physicians), 12% (primary care physicians) and 6.9% (medical call centre nurses) of the cases, the healthcare professionals considered immediate care at a hospital to be necessary. In more than 86% of cases they would have referred the patient to an outpatient setting (general practice emergency service, regular consulting hours or self-treatment). The correspondence of the urgency assessments between the different personnel was low throughout the triage categories. The inter-rater variabilities (κ and weighted κ values) are shown in table 2.

The probability that the urgency assessment given by the call centre is within the range of appropriate responses was 0.807 (95% CI 0.746 to 0.859), the probability that the call centre over-triages was 0.139 (95% CI 0.094 to 0.194) and the probability that the call centre under-triages in comparison with the primary care and hospital physicians was 0.055 (95% CI 0.028 to 0.095).

Seven of 153 cases (4.57%; 95% CI 1.85% to 9.20%) were classified as potentially AHS and were assessed by the panel of experts for a risk to health or life (table 3). In one case (0.65%; 95% CI 0.02% to 3.58%) one of the four panellists found a risk to health and life to be 'likely'. This case (case 79) was a 59-year-old woman who had been receiving topical treatment with a steroid- and antibiotic-containing ointment because of eczema of the auditory canal. On attending hospital she was suffering from an increasing pruritic rash on the face and neck. The patient also complained of burning and itching of the scalp and increasing reddening of both eyes with lacrimation. According to the panellist, in the worst case the previous local reaction could have exacerbated to cause an anaphylactic reaction. In this case, the call centre nurse advised self-treatment, whereas the hospital and primary care physicians would have recommended at least a medical consultation within 24 h.

DISCUSSION

Study limitations

The study population is not fully representative of the patients seen in an interdisciplinary university emergency ward for the

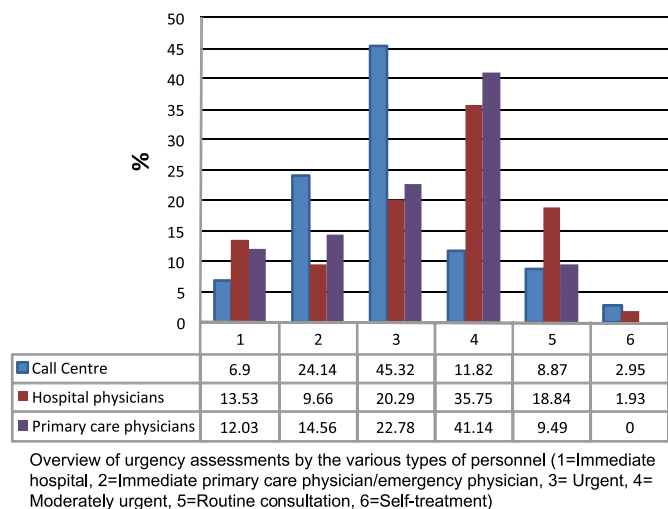


Figure 2 Overview of urgency assessments by the various types of personnel.

following reasons. First, only German-speaking WIP were enrolled in the study. The language restriction was imposed to minimise bias associated with the study question resulting from language barriers on the telephone. Second, the patients were recruited only during the period 08.00 h to 22.00 h. WIP attending the emergency ward between 22.00 h and 08.00 h were not included. This may have influenced the case mix. Data were collected only in the winter months which could have introduced a seasonal bias.

To avoid exposing patients with immediate life-threatening health complaints to risk, a pre-triage was performed at the AEC. This precautionary measure may have excluded several cases with non-life-threatening conditions from the study.

The call centre installed a dedicated telephone number for the study. The health counsellors were therefore able to recognise that these were study patients who were already on the emergency ward. This could have influenced the urgency assessment of the call centre nurse.

Figure 1 Flowchart of patient recruitment and assessment.

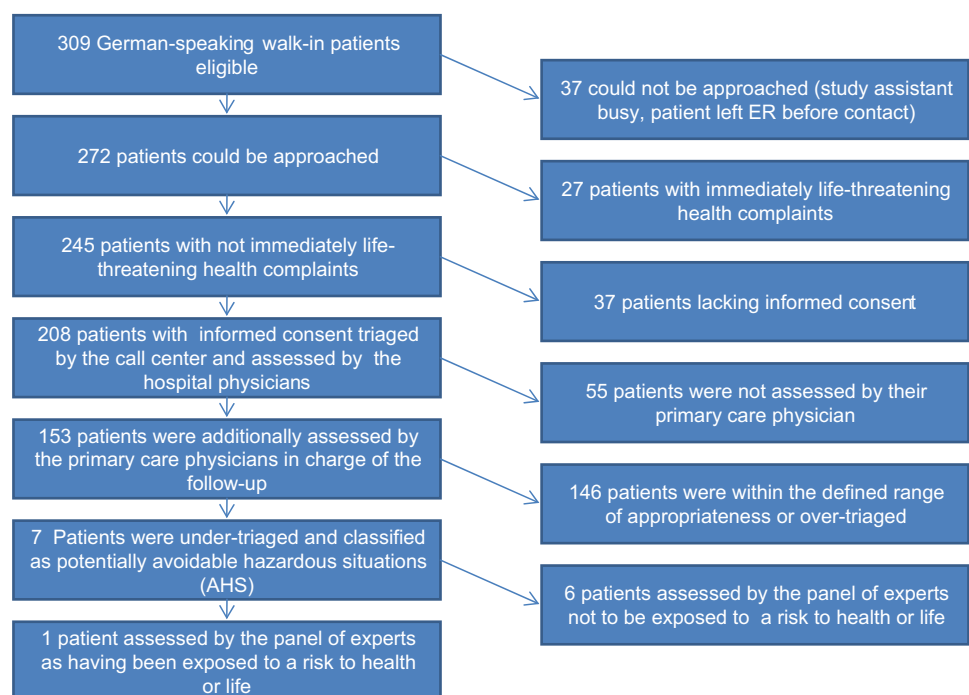


Table 2 κ Values (with 95% CI) of the various inter-rater reliabilities

Comparison	κ	κ weighted	n
Hospital physicians vs medical call centre	0.092 (0.025 to 0.157)	0.115 (0.038 to 0.192)	208
Primary care physicians vs medical call centre	0.080 (0.005 to 0.152)	0.159 (0.073 to 0.242)	153
Hospital physicians vs primary care physicians	0.191 (0.095 to 0.286)	0.377 (0.279 to 0.480)	153

The primary care physicians made their assessments based on the hospital reports and did not see or speak to the patient. This might reduce the validity of their judgement.

Interpretation of findings

In addition to availability, efficiency, effectiveness and patient orientation, safety is an essential quality attribute of a medical service.²⁰ Appropriate care is good quality care, while inappropriate care may lead to unsuitable or even dangerous healthcare delivery. The concept of appropriateness hence includes a wide-spread range of quality aspects of which safety is only one.

The difficulty of assessing appropriateness in healthcare and of gaining agreement between clinicians on acceptable and safe care is highlighted by different authors.^{17–21} In this context it is important to ask the right questions and to pose the questions correctly. When assessing the appropriateness of medical telephone triage, the question ‘was the decision right’ suggests that there is a single correct triage decision. This question does not appropriately reflect the complex interaction of clinical, social and environmental factors in medical decision-making, which usually leads to a widespread variation of possible and right decisions. The low inter-rater reliability of our investigation was in line with other comparable studies^{14–15–22–24} and reflects the inherent variations when asking the question ‘was the decision right’. For that reason, determining inter-rater reliability is not a suitable method for measuring the appropriateness and safety of medical telephone triage.

On the other hand, the question ‘was the decision wrong’ leads to a range of appropriate triage decisions which are defined by not all possible decisions being wrong. In our study this range was defined by the urgency assessments of the hospital and primary physicians along the patients’ trajectory. The urgency

assessments of the call centre deviated from the hospital and primary care physicians, with a tendency towards over-triage. The comparatively lower κ value of the call centre compared to the hospital and primary care physicians is therefore due mainly to this deviation.

Our study applied only to those patients who judged their condition was severe enough to attend the emergency unit of a hospital. For this reason our sample might have included more patients who were particularly anxious and unsure. Hence, the tendency to over-triage of the call centre might be due to the personal situation of the patients and not so much for medical reasons. In our study the assessment of the call centre was made at the beginning of the patient’s trajectory and, in contrast to the decisions of the physicians, was based only on medical history details supplied over the telephone. This justifies more cautious recommendations. The call centre nurses used a computerised decision support system. If these systems are used properly, they lead the nurse in the counselling process and can guide her towards more cautious triage decisions. It was shown that there are large differences in outcome between nurses using various software systems to triage the same calls.²⁵ The guidance provided by this computerised decision support system is always a compromise between efficiency, quality and safety. A shift towards more cautious urgency assessments must be demanded in the interest of ensuring the safety of the service. On the other hand, over-triage leads to inefficiency and unnecessary referrals.

Seven of 153 cases were identified as being under-triaged. With regard to safety, this could lead to AHS. In contrast to the idea of appropriateness, the concept of safety focuses on the risk of a specific conduct. When asking about the safety of telephone triage, we have to take a risk-based approach and the question

Table 3 Potentially avoidable hazardous situations

Case no.	Triage CC	Appropriate urgencies			Age, M/F	Diagnosis	Relevant secondary diagnoses	Clinical symptoms	Treatment
		HP	PC	P					
8	3	1–2	1–2	3–4	81 years, M	Status post epistaxis	Arterial hypertension Arteriosclerosis	No active bleeding BP 170/90 mm Hg Facial exanthema Eyelid oedema	Cauterise, tamponade
79	6	4	1–3	2–3	59 years, F	Allergic reaction			Antihistamine
86	6	4–5	3–5	3–5	24 years, F	Otitis externa Suspected otitis media R	Status post tympanoplasty R	Tragus otalgia Auditory canal and eardrum reddened	Antibiotics, decongestant nasal drops, analgesia
91	6	1–4	2–4	6	28 years, F	Rhinitis Acute lymphadenitis		Influenza symptoms Headache	Decongestant nasal drops, analgesia
106	5	1–2	1–4	4–5	55 years, M	Lower abdominal pain of uncertain aetiology DD urolithiasis with spontaneous passage of stone	Status post extracorporeal shockwave lithotripsy	Mild DD lower abdominal L	Analgesia
141	6	3–5	1–5	3–5	53 years, F	Tinnitus, bilateral		Increasing tinnitus	Tranquilliser
167	5	1–4	4	4–5	24 years, M	Abdominal symptoms of uncertain aetiology DD coprostasis, gastritis (on NSAID)	Status post extracorporeal shockwave lithotripsy Status post appendectomy	Slightly debilitated general condition. Positive Murphy’s sign	Analgesia, laxatives

CC, call centre; HP, hospital physicians NSAID, non-steroidal anti-inflammatory drug; PC, primary care physician; P, panellist.
Case 79 (in bold): according to the panel the call centre’s advice could have led to a potential risk to life and health.

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about safety will be a matter of assessing what is an acceptable risk. Since we have no objective way to do this, we must assemble an expert panel for a subjective view as to whether the triage decision leads to a risk to life or health.

The panel identified one case (0.65%) in which the patient might have been exposed to a potential risk to health or life during medical telephone triage. This was in line with other literature on the safety of telephone consultation.^{10 13 23} Dale *et al*¹⁰ investigated the safety of computer-assisted telephone triage among callers to two medical emergency call services in the UK. Based on all available documents, an interdisciplinary panel of experts assessed 239 cases for a potentially life-threatening situation which could have arisen as a result of the urgency recommendation given on the telephone. The panel adjudged such a risk to have been present in only two cases (0.84%). In a study by St George *et al*,²³ three primary care specialists who were blinded to the actual advice given by the nurse examined 90 call records from a New Zealand health line. All three physicians considered the triage advice of the nurse to pose some risk to the patient in only one case (1.1%).

Healthcare always comprises a certain risk of objectionable side effects. Our study design was not suitable to compare the risk of telephone triage with the risks run by a control group without intervention. In a block randomised controlled trial, Lattimer *et al*¹³ investigated the safety of a nurse telephone consultation service integrated within a general practice cooperative in Wiltshire, UK. Of 97 229 registered patients, 10 134 contacted the out-of-hours service in the trial year. Statistical equivalence was observed in the number of patients who died in the control arm and the intervention arm. The authors of the above cited studies concluded that computer-assisted medical triage is safe.

Conclusion

Medical telephone counselling is a demanding task requiring competent specialists with dedicated training in communication supported by suitable computer technology. Provided these conditions are in place, we consider computer-assisted telephone triage to be a safe method of assessing the potential clinical risks of patients' medical conditions. In order to find an optimal trade-off between efficiency and safety of medical telephone triage, more research is needed on the design and implementation of computerised decision support systems.

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Competing interests None.

Ethics approval This study was conducted with the approval of the Bern Cantonal Ethics Committee.

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