Chapter 7

Safety of the Manchester Triage System to identify low urgent patients in paediatric emergence care, a prospective observational study

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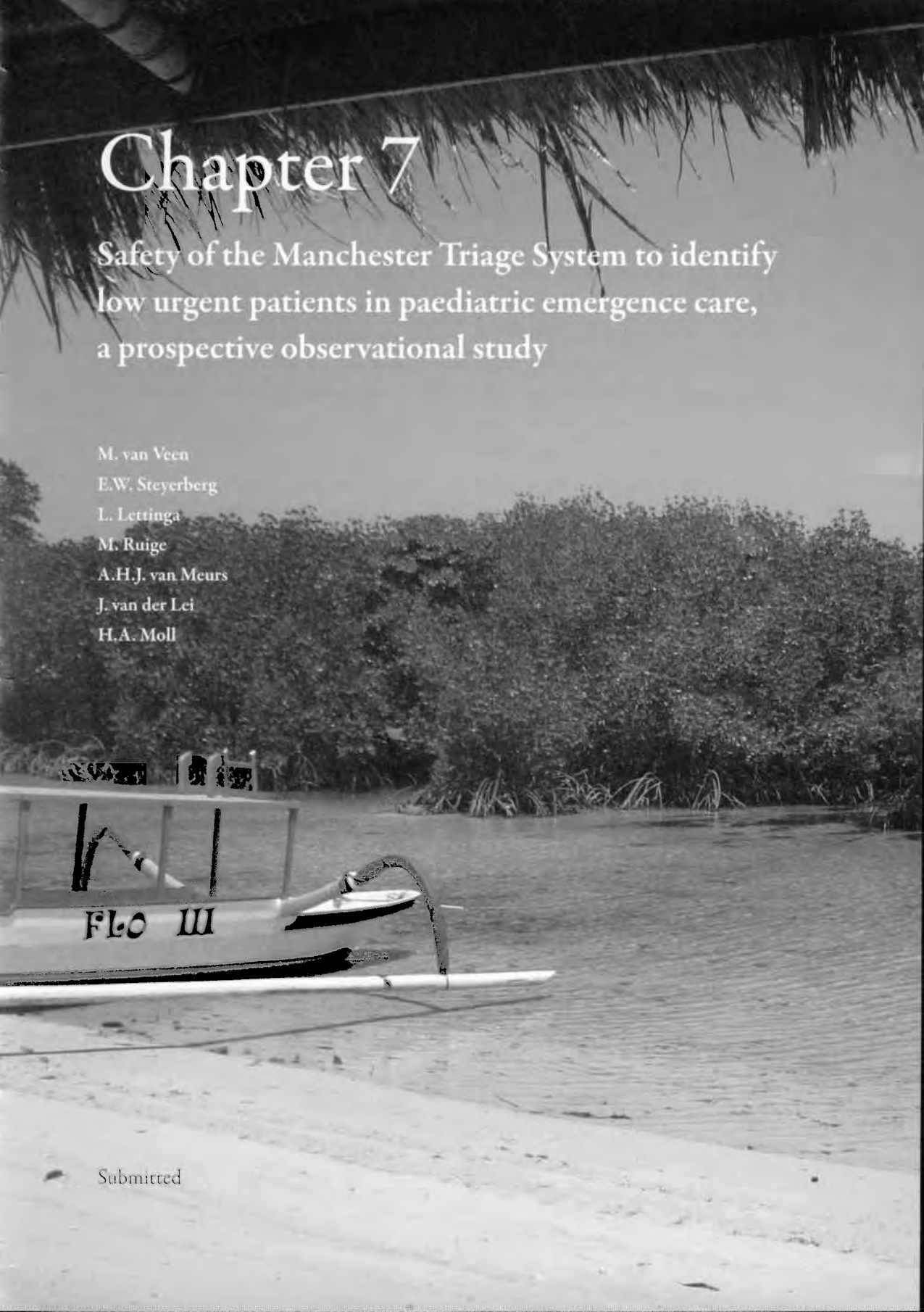

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ABSTRACT

Background Triage systems at emergency departments (ED) are used to identify low urgency patients and refer them to another caregiver. The aim of the study was to assess the safety of the Manchester Triage System (MTS) to identify low urgent patients in paediatric emergency care.

Methods Patients aged 0–15 years visiting the ED of a paediatric university hospital or a large teaching hospital in the Netherlands, were triaged with the MTS. Hospitalization and determinants for hospitalization were assessed for low urgent, self-referred patients (MTS level 4 or 5) using logistic regression analysis. Secondly, discharged patients received a telephonic follow-up 2–4 days after consultation.

Results Among 5,425 patients, 191 (3.5%) were hospitalized. Children under one year old (10%, n=84/848) and children presenting with dyspnea (8%, n=40/310), gastrointestinal problems (8%, n=72/848) and patients with fever without other specific signs (6%, n=5/83) were more likely to be hospitalized. These characteristics remained statistically significant in a multivariable analysis, with odds ratios of 3.0 (95% confidence interval 2.2 to 4.1) for age under one year and 2.5 (1.5 to 4.1) for dyspnea, 3.5 (2.5 to 4.9) for gastrointestinal problems and 2.8 (1.1 to 7.2) for patients with fever without other specific symptoms.

In patients over one year of age without dyspnea, gastrointestinal problems or fever, only 54 of 3,738 (1%) were hospitalized following ED consultation.

3,975 / 5,234 (76%) could be contacted for follow-up after discharge. Six (0.15%) patients were hospitalized after ED discharge.

Conclusion In the MTS low urgency categories, children younger than one year of age or with dyspnea, gastrointestinal problems or fever without other specific symptoms have an increased risk for hospitalization. Therefore, referral from ED to another caregiver may be safe except for these patient groups.

INTRODUCTION

Emergency departments (EDs) are increasingly visited by patients with non-urgent problems. In European countries with a general practitioner (GP) referral system, the number of self-referred patients is high.[1] In the US, especially children use the ED as a regular source of care.[2] This contributes to high costs, increased use of diagnostics, longer waiting times, full waiting rooms, and more work pressure for hospital personnel.[3-5]

Triage aims to identify high urgent patients in an easy and fast way and to prioritize these patients to be seen by a physician. Secondly, triage systems can be used to identify patients with low urgency problems, which can safely wait for a longer time or can be sent to another caregiver such as a GP.[6]

The Manchester Triage System (MTS) is a 5-level triage system. The system provides a specific advice for patients who can be allocated to a primary emergency service instead of being treated at the ED. In general, patients triaged as 'Standard' (level 4) or 'Non-urgent' (level 5), with non-traumatic problems can be referred to primary care. This guideline was developed by expert opinion and the authors state that utility in these processes must be proved rather than assumed.[6]

Referring patients to a GP can be a solution for the increasing overcrowding of EDs by patients who present on their own initiative and have a low prevalence of high urgent problems.[7] Moreover, more diagnostic tests or prescriptions for medication are performed when low urgent patients are seen by an emergency physician compared to a GP.[3] Safety to identify low urgency patients in paediatric emergency care has not been studied before. The aim of this study was to assess the safety of the MTS to identify low urgent patients in paediatric emergency care which can be safely referred to another caregiver.

METHODS

Study design

We performed a prospective observational study. We assessed determinants for hospitalization in low urgent triaged children who visit the ED on their own initiative. Secondly, discharged patients received a routinely performed telephonic follow-up two to four days after their ED consultation. This study is part of an ongoing study on the validity of the MTS in children.[8,9] The study was approved by the institutional Medical Ethics Committee.

Patients

All children between 0 to 16 years who visited the ED of the Haga Hospital-Juliana Children's Hospital in The Hague between August 2007 and May 2008 and the Erasmus MC-Sophia Children's Hospital in Rotterdam between May 2007 and August 2008 were triaged using the MTS.[10]

The ED of the Haga Hospital-Juliana Children's hospital is a mixed paediatric-adult emergency department of a large teaching hospital visited by nearly 30,000 patients per year of which about 15,000 are children. The Erasmus MC-Sophia Children's Hospital is a university hospital with a specific paediatric ED visited by nearly 9,000 patients per year. Both hospitals are situated in the southwest of the Netherlands, which has a population of approximately four million people and an annual birth rate of 47,000 children.[11]

Manchester Triage System

Emergency department nurses performed a short assessment and triaged patients using the MTS.[6,10] The system is a flowchart-based algorithm and consists of 52 flowchart diagrams (49 suitable for children), which are specific for the patient's presenting problem. The flowcharts contain six key discriminators (life threat, pain, hemorrhage, acuteness of onset, consciousness level, and temperature) as well as specific discriminators relevant to the presenting problem. Selection of a discriminator leads to one out of five urgency categories.

We used a modified version of the MTS with specific modifications for children The modifications were developed for patient groups based on an earlier study in which the validity of the MTS was evaluated.[8,12] For the detailed modifications we refer to our previous paper.[12]

The modified MTS was used in 87% to triage patients. The modification led to a shift of patients to lower urgency categories. Patients are more often triaged into the 'Standard' and 'Non-urgent' categories (48%, n=5,347/11,210), compared to the original MTS (41%, n=5,552/13,554). Modifications were shown to improve validity of the MTS in paediatric emergency care compared to a predefined reference standard for urgency.[8,12]

Data collection

Nurses recorded patient characteristics on electronic forms when patients presented at the ED. Triage data and hospitalization were registered using the triage software package. Data on hospitalization were extracted from medical files.

Telephonic follow-up

A nurse and medical students performed follow-up with a standardized telephonic questionnaire. Patients attending without being referred by a GP and who were triaged as 'Standard' (level 4) or 'Non urgent' (level 5), received a telephonic follow up 2-4 days after their ED visit.

We tried to reach parents daily until 96 hours after their ED visit. Language barriers were overcome by inviting an interpreter using a telephonic conference call. When patients could not be reached by telephone, we sent a short written questionnaire. The questionnaire data was registered using SPSS Data Entry Builder/Station (version 4.0).

Data analysis

We categorized the chosen MTS flowchart into eight different present problems categories; skin problems (flowchart Rashes), dyspnea (flowchart Asthma, Shortness of breath in children), upper respiratory tract infection (flowchart Sore throat, Nasal problems, Ear problems), gastro-intestinal problems (flowchart Vomiting, Diarrhoea, Abdominal pain in children, Gastrointestinal bleeding), head injury (flowchart Head injury), extremity problems or wounds (flowcharts Limb problems, Wounds and Limping child) and other. If the MTS 'General' flowchart or the MTS 'Worried parent' flowchart was selected, we used the presenting problem as registered by the nurse and categorized these into one of the categories or to 'fever without other specific symptoms'.[6]

To predict hospitalization using univariate and multivariate logistic regression analysis, we considered age, gender, MTS urgency level and presenting problem as candidate predictors for hospitalization, because they are easily obtainable signs in the triage assessment. Since the relation between age and hospitalization may not be linear, we used a restricted cubic spline (RCS) function to model the relation between age and hospitalization.[13] Restricted cubic splines contain cubic (X^3) terms which are restricted to be linear in the tails.[14] In order to calculate clinical interpretable odds ratios, age was divided in categories (<3 months, 3–11 months, 1–2 years, 2–3 years, 4–7 years, 8–15 years) and odds ratios were shown compared to patients aged 8–15 years.

Presenting problem was shown with odds ratios for the different categories compared to the category 'Extremity problems or wounds'.

Secondly, selection of the presenting problem categories and age group with the highest odds ratios leads to the final model. Odds ratios were shown for the selected presenting problems categories and age group compared to the all other categories. SPSS 15.0 (Chicago, IL) and

R package version 2.9.1 using the Design library (www.r-project.org) were used for statistical analysis.

RESULTS

A total of 5,425 children attended the ED on their own initiative during the inclusion period and were triage as low urgent. Of these patients, 191 (3.5%) were hospitalized (figure 1).

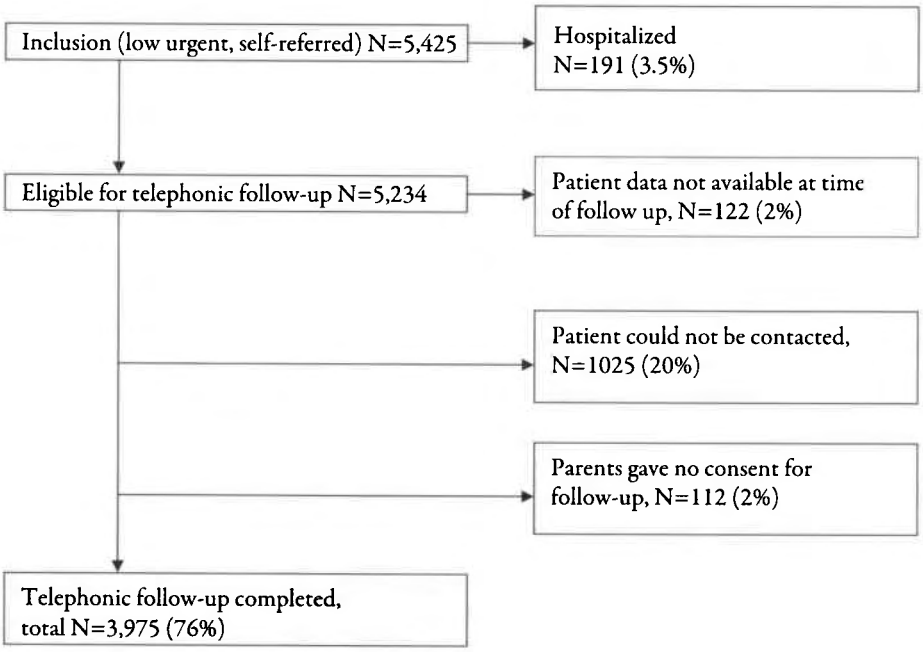

Figure 1 | Flow of patients attending during the study period

Hospitalization

The hospitalized patients had a median age of 1.5 years (Interquartile Range (IQR) 0.4–4.4 years), 45% (n=86) were female, 91% (n=173) was triaged as 'Standard' and 9% (n=17) as 'Non urgent'.

One patient (1%) was admitted to the intensive care unit. It concerned a 12-year-old girl with a history of a catecholaminergic polymorphic ventriculair tachycardia, who presented with a syncope and an irregular cardiac rhythm with a hemodynamically stable condition.
Details of hospitalization could be retrieved for 172 patients (90%). The median length of admission was 2 days (IQR 1–3 days). 45% (n= 78) had a length of stay shorter than 24 hours, 20% (n=34) between 24 and 48 hours and 35% (n=60) longer than 48 hours. The main reasons for admission were at risk of dehydration in 6% (n=31), head injury in 12% (n=20) and Acute Life Threatening Event (ALTE) in 9% (n=15).
Interventions were needed in 63% (n=109) and only observation in 37% (n=63). The interventions included oral medication (n=34) intravenous therapy (n= 24), urgent surgery (n=2) and non urgent surgery (n=28), oxygen (n=1), rehydrated by nasogastric tube with oral rehydration solution (ORS) (n=14), and inhaled medication (n=5).
An urgent intervention (defined as IV therapy, oxygen or urgent surgery) was required or the length of stay was longer than 24 hours in 56% (n=97).

Determinants of hospitalization

Gender and urgency were not associated with hospitalization (OR_{female} 0.98, 95% CI 0.73–1.31, p_{Wald} 0.89, $OR_{urgency\ 4}$, 0.96 95% CI 0.57–1.61, p_{Wald} 0.87).
Patients with gastrointestinal problems (8%, n=72/848), with dyspnea (8%, n=24/310) and fever without specific other symptoms (6%, n=5/83) were often hospitalized. Hospitalization was more likely for young patients (0–2 months 14%, n=33/235, 3–11 months, 8%, n=51/613) (table 1).
Figure 2 shows the multivariate regression model with age and presenting problems as discriminators and hospitalisation as outcome. When adjusted for age, adjusted odds ratios were 6.4 (95% C.I. 3.8–11) for patients with gastro-intestinal problems, 4.7 (95% CI 2.5–9.1) for patients with dyspnea and 5.1 (95% CI1.8–14) for patients with fever without other specific signs compared to patients with extremity problems or wounds. When adjusted for presenting problems odds ratios were 6.6 (95% CI 3.7–12) and 3.2 (95% CI 1.9–5.4) for children aged under 3 months and aged between 3–11 months, respectively, compared to children aged 8–15 years (table 1).

Table 1 | Determinants for hospitalization in low urgent, self-referred patients n=5,407* / 5,425

Variable		N	Hospitalization	OR, univariate	Adjusted OR**
Gender	Male	2,991	102 (3)	1.0†	NA
	Female	2,416	84 (3)	0.98 (0.73–1.3)	NA
MTS Urgency	Standard	4,959	170 (3)	0.96 (0.57–1.6)	NA
	Non urgent	448	16 (4)	1.0†	NA
Presenting problem	Extremity problems or wounds	2,168 (40)	20 (1)	1.0†	1.0†‡
	Gastro-intestinal	848 (16)	72 (8)	10 (6.0–16)	6.4 (3.8–11)
	Head injury	255 (5)	8 (3)	3.5 (1.5–8.0)	2.7 (1.2–6.3)
	Skin	219 (4)	6 (3)	3.0 (1.2–7.6)	1.6 (0.6–4.2)
	Dyspnea	310 (6)	24 (8)	9.0 (4.9–16)	4.7 (2.5–9.1)
	Upper respiratory tract infection	314 (6)	7 (2)	2.4 (1.0–5.8)	1.9 (0.80–4.6)
	Fever without other specific symptoms	83 (1)	5 (6)	7.0 (2.5–19)	5.1 (1.8–14)
	Other	1,211 (22)	44 (4)	4.0 (2.4–6.9)	2.5 (1.4–4.5)
Age	0–2 months	235 (4)	33 (14)	12 (6.8–20)	6.6 (3.7–12)
	3 –11 months	613 (11)	51 (8)	6.5 (4.0–11)	3.2 (1.9–5.4)
	1–2 years	696 (13)	18 (3)	1.9 (1.0–3.5)	1.2 (0.63–2.2)
	2–3 years	608 (11)	21 (3)	2.5 (1.4–4.6)	1.8 (1.0–3.3)
	4–7 years	1,441 (27)	38 (3)	1.9 (1.2–3.2)	1.5 (0.87–2.5)
	8–15 years	1,814 (33)	25 (1)	1.0†	1.0†

*Complete cases on gender, urgency, problem and age
**Odds ratio adjusted for age and presenting problem, respectively
† Reference category
‡ Wald, p<0.001

These characteristics remained statistically significant in a final multivariable analysis with adjusted odds ratios of 3.0 (95% CI 2.2 to 4.1) for age under one year and 2.5 (95% CI 1.5 to 4.1) for dyspnea, 3.5 (95% CI 2.5 to 4.9) for gastrointestinal problems and 2.8 (95% CI 1.1 to 7.2) for patients with fever without other specific symptoms compared to all other patients. In patients over 1 year old without dyspnea or gastrointestinal problems or fever without specific signs, only 54 of 3,738 (1%) were hospitalized after ED consultation. Details of these hospitalizations were available in 52 out of 54. In 19 out of 52 (36%), an

urgent intervention was required (IV therapy, oxygen or urgent surgery) or the length of stay was longer than 24 hours.

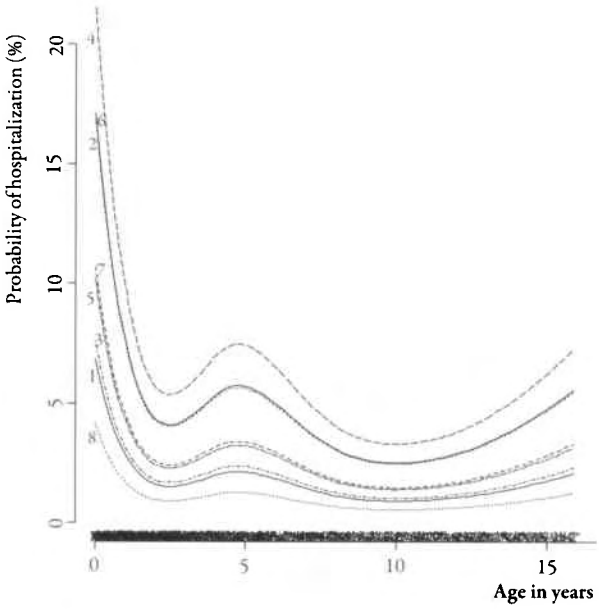

Figure 2 | Probability of hospitalization for patients presenting with skin problems (1), Dyspnea (2), Upper respiratory tract infections (3), Gastrointestinal problems (4), Other (5), Fever without other specific symptoms (6), Head injury (7), Wounds or extremity problems (8) depending on age. The scatter diagram on the x-axis represents the data density of age.

Follow up after ED discharge

Compliance of telephonic follow up was 76% (figure 1).

Patients who could not be reached or who did not want to participate did not differ in median age (No follow-up 4.2, IQR 1.9–8.7 4.4, follow-up performed 4.4, IQR 1.7–9.1, Mann-Whitney U, p=0.75) but differed in presenting problem. (Chi square, p<0.001).

Patients who could not be contacted had more often gastrointestinal (17%, n=218/1,247 versus 14%, n=558/3,974) and fever without other specific complaints (3.8%, n=48 versus 0.7%, n=29) and less often 'other' problems. (19%, n=233 versus 23%, n=934).

301/3,975 patients (8%) had an unscheduled follow-up visit, of which 65% at primary care and 34% in emergency care. Six patients out of 3,975 were subsequently admitted. (0.15%) Details of these six hospitalisations after ED discharge are provided in table 2.

Table 2 | Patients hospitalized after ED discharge (6 out of 3,975 low urgent patients)

1. ♀ 11 months, admitted because of vomiting, diarrhea and dehydration (4%), rehydration with ORS by nasogastric tube, discharge after 5 days, follow-up visit scheduled
2. ♂ 10 months, upper respiratory tract infection with otitis, not drinking, not able to swallow antibiotics*
3. ♂ 5 years old, heavy abdominal pain after fall on abdomen, observation, discharged after 1 day, follow-up visit scheduled
4. ♀ 5 months, suspicion of dehydration, follow-up visit was planned (one day), but patient presented by own initiative on the same day again and was admitted because of rehydration with ORS, discharge after 1 day, follow-up visit scheduled
5. ♂ 2 years old, admitted because of pneumonia and unable to take oral antibiotics, antibiotics by nasogastric tube, discharge after 2 days, follow-up visit scheduled
6. ♀ 6 years old, fever and rash, some petechiae, antibiotics IV, observation during admittance, discharge after 3 days, no scheduled follow-up

*Details of hospitalization were unknown for this patient

DISCUSSION

Self-referred patients triaged as low urgent are rarely hospitalized except for children younger than one year of age (10%, n=84/848) or presenting with dypsnea (8%, n=40/310), gastrointestinal problems (8%, n=72/848) or fever without other specific symptoms (6%, n=5/83).

Follow-up after ED discharge showed only 0.15% (n=6/3,975) hospitalizations. Referring low urgent children to another caregiver may be safely implemented excluding these specific patient groups.

One low urgent patient was admitted at the intensive care unit. This patient presented with an arrhythmia. The MTS does not contain a specific discriminator for patients with arrhythmia.[15] We argue that these children should be considered as high urgent.

The MTS is a common used triage system in and outside Europe.[6] The system showed a good reproducibility in children and a moderate reproducibility when studied in children and adults.[9,16] Our earlier study showed a moderate validity in paediatric emergency care. The system errs on the safe side, with much more over-triage than under-triage compared with an independent reference standard for urgency. Validity was low in young children, in patients with non-traumatic problems and in older children with fever.[8] We developed and implemented modifications to improve validity. It resulted in an improved validity of the MTS, in which especially the specificity improved (79%, 95% CI 79-80% to 87%, 95% CI 86–87%) and more patients were triaged as low urgent.[8,12] The consensus based advice of the MTS working group to refer low urgent patients to the GP could be translated to an evidence based guideline for selected children based on our study.

A study on the Canadian Triage and Acuity Scale (CTAS) showed that low urgent (level 4 or 5) children were hospitalized in 214/2,035 (10%).[17] The authors concluded that the system is therefore not valid to identify low urgent patients in order to send them away from the ED. We found a considerably lower hospitalization proportion of one percent (n=54 of 3,738) for self-referred, low urgent patients with selected problems.

Several solutions are developed to decrease the workload for EDs and were shown to be safe. In the US, out-of-hours call centers function as gatekeepers and screen patients who want to attend the ED, in order to decrease the amount of non urgent patients at the ED, or low urgent patients are seen at a fast track area.[18-20] In the UK, general practitioners are situated at the ED to see low urgent patients.[21,22]

In a randomized controlled trial performed in the US, criteria were defined to identify adults with non-acute conditions. They were randomly assigned to be seen at the ED or to be referred to next day primary care. Patients who were referred to primary care did not demonstrate disadvantages in health status or numbers of physician visits. No patients were hospitalized or died. However, the sample size was too low to detect hospitalization or mortality. (n=72 for usual care and n=68 for next day primary care).[23]

When the MTS is used to refer low urgent patients to the GP, considering our results, we are mostly concerned about the 1% (n=54/3,738) hospitalizations, especially for the 0.51% (n=19/3,738) with interventions or a length of stay of more than 24 hours.

The 1% hospitalization is relatively low when compared to the higher MTS urgency categories. Proportion hospitalization for self-referred patients was 44% (n=28/64) for MTS 1, 31% (n=171/558) for MTS 2 and 10% (n=178/1,836) for MTS 3, respectively. (Based on the data of our previous validation study of the modified MTS).[12]

When low urgent patients are referred to a GP, the 1% hospitalized patients in this study, will probably be referred back to the ED after GP consultation. This might result in a delay in treatment.

However, hospitalization in our selected low risk population is less frequent compared to hospitalization of patients visiting the GP post. A study on characteristics of GP post visits for all ages showed that 7.5% (n=853/11,375) of patients consulting the GP cooperative were referred to the ED and 48% (n=316/664) of the refereed patients were hospitalized. So for patients contacting the GP post, 3.6% (7.5% x 48%) were hospitalized.[27]

Screening patients using a triage system before they enter the ED resulted in a shift of 10-53% of patients from secondary to primary care.[24-26] Patients were seen at integrated GP posts, in which the GP is situated next to the ED. Hospitalizations in all adults and children decreased with 34% and fewer patients were referred to the GP or outpatient clinic follow-up, compared to before the introduction of the integrated GP post. However, this study did not evaluate the effect on unscheduled follow-up visits or hospitalizations after discharge to identify adverse effects, neither was a specific focus on children.[26]

Limitations

In this study we focused on safety of referring low urgent children to primary care. We studied the patient group, which may be referred but which is seen at the ED. We showed that referral might be safe for a selected group. In order to evaluate the actual effect of referral, patients should be referred and the effects on safety should be evaluated.

Telephonic follow-up was performed to trace adverse events due to ED discharge.

76% (n=3,975/5,234) could be contacted for a telephonic questionnaire. Patients were not contacted because the phone number was incorrect or patients were not at home during the several days we tried to call. It is possible that the selection of contacted patient might have influenced the results. Relatively fewer patients with gastro-intestinal problems could be contacted. Since two out of the six hospitalizations after discharge were because of gastrointestinal problems, this selection could have led to a slight underestimation of the percentage unscheduled hospitalizations.

On the other hand, by using a telephonic questionnaire method in stead of using the hospital information system to track revisits, we gathered all revisits, also those to other EDs and general practitioner. Compared to one other study with a telephonic follow up (response 46%) our response rate was high.[19]

CONCLUSION

In the MTS low urgency categories, children younger than one year of age or with dypsnea, gastrointestinal problems or fever without other specific symptoms have an increased risk for hospitalization. Therefore, referral form ED to another caregiver may be safe except for these patient groups.

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