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Ill during the weekend: to the General Practitioner or to the Emergency Department?

Dissertation for the degree of doctor in Medical Sciences at the University of Antwerp, to be defended by Stefan Morreel

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Jury

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"Because we also knew that we really needed a triage system urgently.
Because the way it was, it just didn't work anymore. We all felt that, though.
Real mistakes were going to happen at those moments."

Triage Nurse, Female, 8 years of experience

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Table of Contents

List of frequently used abbreviations

ED	Emergency Department
eMTS	Extended Manchester Triage System, the tool studied in the TRIAGE trial
GP	General Practitioner or family doctor
GPC	General Practice Cooperative: central location for primary OOH care in a specified region
MTS	Manchester Triage System
OOH	Out-of-hours. Used in the context of medical care provided after office hours.
KCE	Belgian Healthcare Knowledge Centre

Introduction

The problem: I am feeling ill during the weekend, where should I go?

The central problem addressed in this dissertation is the difficulty patients face when choosing the right place of care in case of an unexpected illness: the general practitioner (GP) or the emergency department (ED)? The aim of the studied interventions was to increase the proportion of patients that choose for primary care by helping them to make this choice. This dissertation focusses on out-of-hours (OOH) care because, at the time of writing, there were no formal structures for acute primary care during office hours. Every primary care daytime practice has a different organisational model, making empirical research difficult. During OOH care on the contrary, the organisation of care is much more uniform and a research database (iCAREdata) containing routine reports from GPs and EDs was available.[1, 2]

In Belgium, patients confronted with an unexpected illness during the weekend can choose either to consult primary care (mainly organised in General Practice Cooperatives, GPCs) or secondary care (Emergency Departments, EDs). Sometimes both these services can be found at the same site, in other locations only one service is present.[3] Similar organisational models exist throughout Europe. Almost all countries have implemented changes over the past 10 years, mostly concerning the implementation of telephone triage and a change of organisational model by means of upscaling and centralisation of out-of-hours (OOH) primary care.[4] The Belgian healthcare system is organised into primary, secondary, and tertiary care, with open access for patients to all levels. It is mainly organised as a fee-for-service system.

Patients do not know the characteristics of the different OOH services and find it hard to estimate the urgency of their complaints.[5] Before 2017, there was no help for patients making the choice between these services. They had to make their decision based on previous experiences, ease of access, the anticipated waiting time, anticipated costs, their relationship with their general practitioner (GP), and the perceived nature of the complaint.[6, 7] As a consequence, many patients that did not require urgent attention or specialised input went to the ED.[8] In current literature, such ED visits are called inappropriate. This inappropriateness does not imply a mistake on the patient's part but rather a flaw in the healthcare system. Internationally, the prevalence of inappropriate ED use varies from 20 to 40%.[9, 10] In Belgium, 40-56% are not in direct need of hospital care.[11] This proportion is higher during weekends and bank holidays probably because access to a patient's own primary care facility is limited in these moments.[9, 12] Inappropriate ED utilisation is associated with increased healthcare costs and lower continuity of care while a good relationship with a personal GP is associated with fewer

acute hospital admissions, and a lower mortality.[13-16] Unnecessary ED visits result in additional costs for both government and patient, longer waiting times at the ED, a higher workload for the emergency physicians and in the diversion of resources necessary for time-sensitive and life-threatening situations to minor health problems.[17] The interventions studied in this dissertation aim at helping patients to make the difficult choice between ED or GPC. See Figure 1 for an overview of the Belgian OOH care system before the start of this PhD.

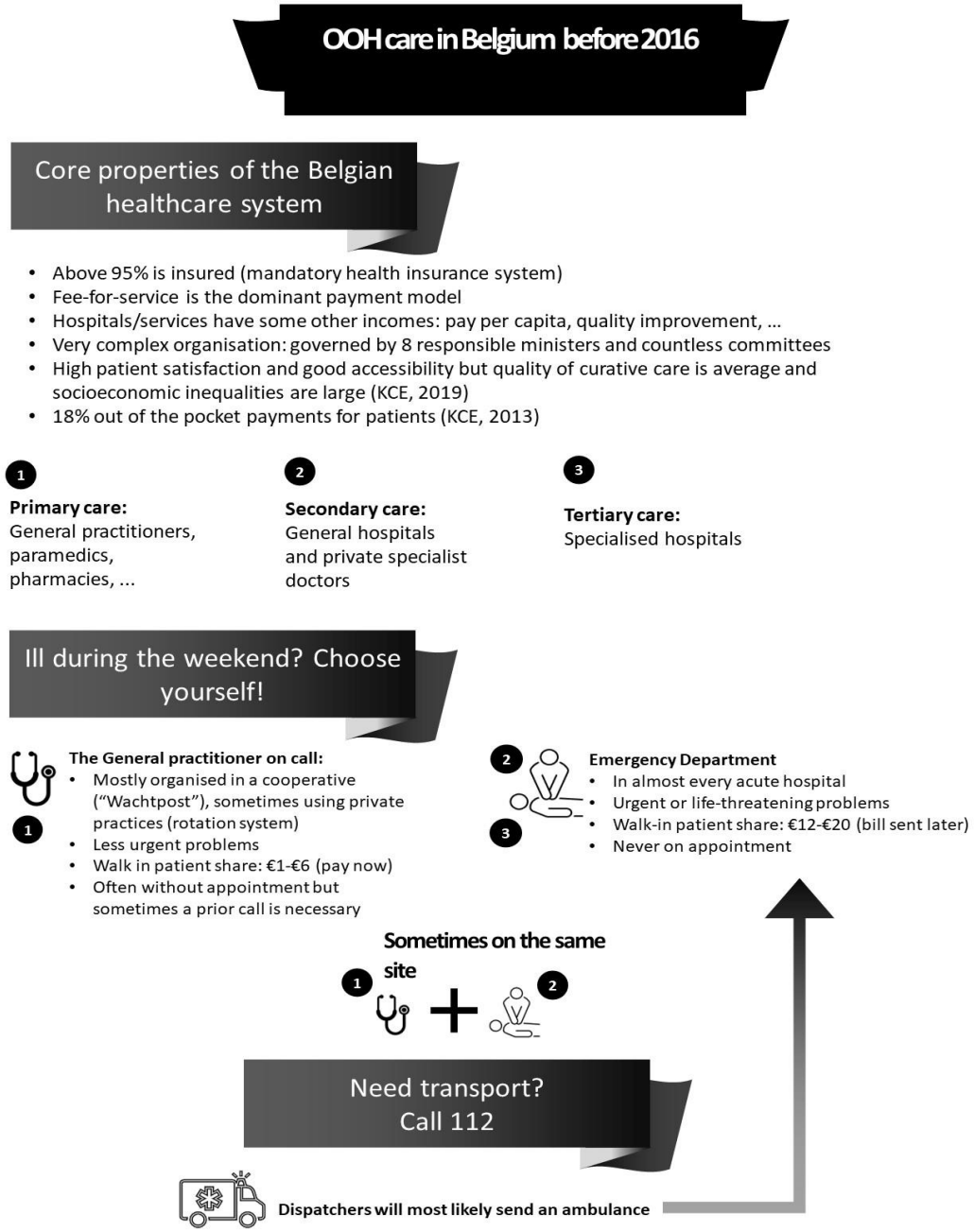

Figure 1. Overview of the Belgian OOH care system before 2016.

Possible solutions: how to help patients to make the choice

Most of the literature on helping patients to choose the most appropriate care during OOH care focusses on the redirection of patients from the ED to the GPC (studies focus on the services, not the patients). In order to help patients to choose for primary care instead of the ED, several interventions have been proposed. A review of reviews concerning interventions to reduced ED utilisations identified six types of interventions of which three involve primary care: strengthening primary care (installing supplementary services or improving access to existing services), pre-hospital diversion (including telephone triage) and education/self-management support.[17]

A first solution to strengthen primary care is to install supplementary primary care services, preferably in the vicinity of an ED. A Cochrane and a systematic review revealed that installing supplementary services does not necessarily result in a reduction of ED visits.[18, 19] Similarly, in the UK, installing primary care services offering increased patient choice may have resulted in provider-induced demand.[20] Some authors argue that the lack of success in this approach is due to unadapted financing which leads to parallel collaboration rather than providing integrated care.[3] Even when studies report a decrease of the ED use after primary care introduction, this change fails to improve throughput of the remaining patients at the ED.[21] Nevertheless, compared with a decade ago, more primary care-oriented organisational models are now dominant. There is a trend towards upscaling and centralisation.[4] A similar approach is to install other primary care services such as walk-in centres (nurse-led services handling low acuity presentations), community centres and an emergency nurse practitioner in residential care. A review reported mixed results regarding the effectiveness on ED use reduction of these initiatives.[22] A second approach is to improve access to after-hours primary care: increasing working hours, offering same day visits, reducing costs, and offering weekends services. A review revealed that improving this access is associated with increased primary care utilisation, but has a mixed effect on emergency department utilisation, with limited evidence of a reduction in non-urgent and semi-urgent emergency department visits. However, extension of clinic hours for existing primary care clinics was effective in reducing ED utilisation which may be related to patient preference for their own personal primary care physician.[19] This dissertation does not study any interventions concerning the strengthening of primary care as these were part of the previous dissertation ‘Out of Hours primary care in Belgium’ by Hilde Philips defended in 2010. Her researched proved that in Belgium, installing supplementary services increased the demand for care both at the ED and GPC.[23] She concluded that further research should focus on effective usage to divert patients flows.[24]

An innovative approach to increase the use of primary care is to influence the patient’s choice earlier on by pre-hospital diversion. The evidence about these pre-hospital interventions such as pre-hospital practitioners providing care at the scene or referring the patient to an alternative healthcare service is limited but promising.[17] These practitioners do not yet exist in Belgium.

Finally, one can try to improve the use of primary care through education and self-management. Although evidence about the effect of educational interventions is contradictory, a large number of studies have shown a potential impact on ED use. These educational interventions seem more effective when they are introduced as a part of a multi-faceted intervention.[17] In Chapter 1 we present the results of a promotion campaign which is an example of an educational intervention.

Triage as a possible solution: we will advise you were to go

Triage, defined as the sorting out and classification of patients or casualties to determine priority of need (urgency classification) and proper place of treatment (assignment to ED or GPC) is another way to help patients to make a choice between ED and GPC.[25] Current literature describes three types of triage: self-triage (using online questionnaires), telephone triage (the patient calls a hotline before going to a service) and physical triage (a short interview and examination).

Although a lot of research regarding the validity and safety of telephone triage is available, the evidence concerning its effect on the use of ED and GPC is limited and contradictory.[26] In Chapter 7 we study a new guideline for telephone triage.

Self-triage, using online tools which give a personal advice on the appropriate care giver, is a more recent development. A review found that most of the studies were observational or only available through grey literature so the authors concluded that major uncertainties surround the probable impact of self-triage.[27] A recent prospective cohort study not included in this review concluded that self-triage was superior to patients in deciding the most appropriate treatment setting for medical issues. This symptom checker could reduce a significant number of unnecessary hospital visits, with accuracy and safety outcomes comparable to existing data on telephone triage.[28] The COVID-19 pandemic speeded up this innovation.[29] It was not possible to incorporate research on this subject into the current dissertation but a research project concerning such a tool (called “moetiknaardedokter”) was being carried out at the time of writing.[30]

The core of this dissertation is research concerning physical triage, in this case a patient is seen by a nurse soon after presentation at the ED. Triage at the ED is widely used to determine priority of need. Adding the function of assignment to ED or GPC is new in Belgium and was previously only done in experimental settings.[31] In such a triage, the nurse has a modern role as a practitioner rather than the old role as the assistant of a doctor.

In 2016, the Belgian Healthcare Knowledge Centre (KCE) proposed a reform of the OOH care system with a major role for telephone and physical triage (see Figure 2).[32] Although this proposal is country specific, most of its elements can be adapted worldwide: telephone

hotlines, common gates for EDs and primary care OOH services, and general practitioners exist to some extent in every country. In this proposal, primary care (GPs and triagists) has a gatekeeping function: patients no longer have free access to the ED. Such a gatekeeping function is new in Belgium but is in use for decades in many other countries.[33] More than half of the member states of the Organisation for Economic Co-operation and Development have established gatekeeping systems, not only for OOH care but often for large parts of the healthcare system.[34]

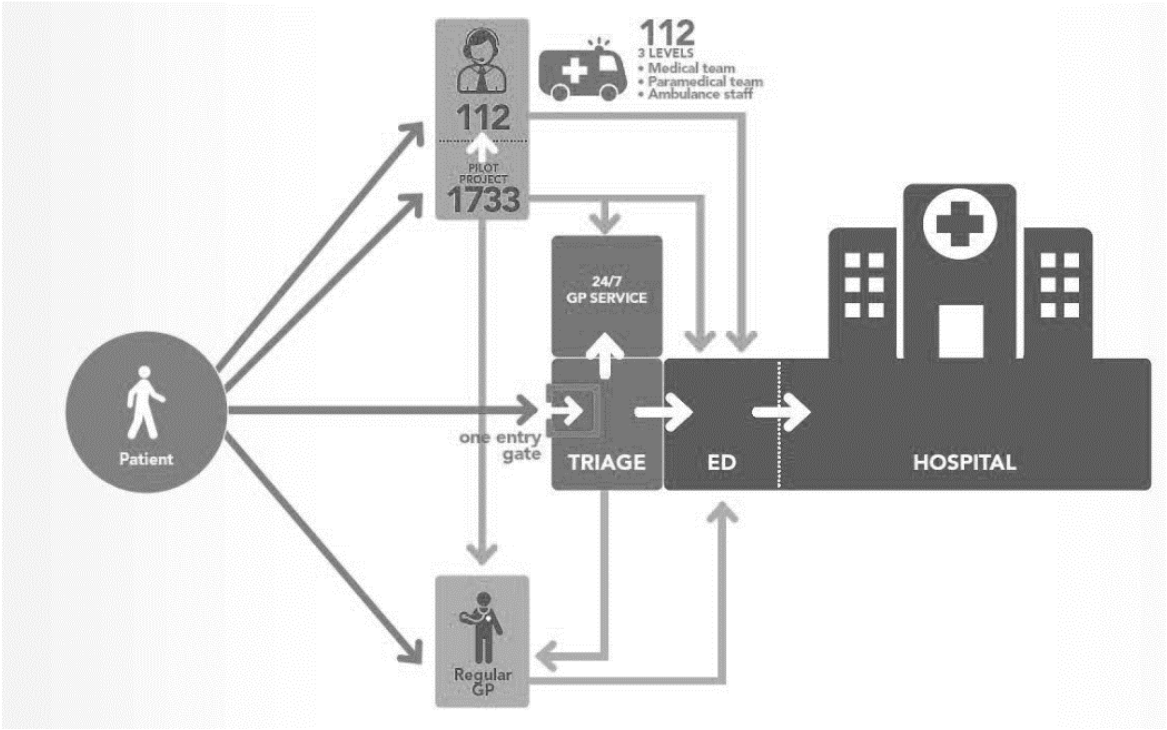

Figure 2. Summary of the Belgian Healthcare Knowledge Centre proposal for reform of the OOH care system.

In brief, patients are asked to call 112 in life-threatening situations. In all other situations, they contact their regular GP and when this GP is not available, they call the 1733 hotline. This hotline advises the patient to go to the ED, to the GPC, or to wait for their regular GP (delay of care, with self-care advice when applicable). Patients can also directly go to a site with an ED and a GPC, in which case they receive physical triage at the common gate of these services. The GP, the GPC and the telephone/physical triagist can refer patients to the ED. This proposition did not mention self-triage.

Both patients and physicians in Belgium are in favour of co-locating EDs and GPCs.[35] Through an online survey in 2018, we found that at least half of the Flemish GPCs were located close enough to an ED to implement a common gate. These common gates barely

existed and there was no financial support to initiate them at the time of writing. On the contrary, at the time of writing it was hard to install them as nurses were legally not allowed to refer a patient to their own GP during office hours (with a maximum delay of 60 hours when a patient shows up on Friday evening) as they were not allowed to advise a delay of care or self-care advice.[36] They were allowed to divert patients from the ED to the GPC if these patients did not have an urgent condition and if the GPC was located close by.[36] Triaging patients who present at the GPC might have two aims: diverting patients with a non-urgent presentation to their own GP (delay of care: legally not allowed) and diverting high urgency patients directly to the ED avoiding waste of time for the patient and unnecessary GP consultations. In a Belgian observational study, only 1.7% of the GPC patients were in need of urgent hospital care so triaging patients presenting at the GPC for this aim only was not studied in this dissertation.[37]

The Manchester Triage system (MTS) is a validated tool for prioritisation of treatment at the ED.[38] It is used by most Belgian EDs although the Emergency Severity Index and locally developed protocols are in use as well.[39, 40] Assignment of patients either to an ED or to primary care was not the goal of its development but became a new focus afterwards. The manual of the MTS contains a methodology to make a local extension with assignment to the GPC or the ED. Within the ED, this system allocates patients to a specific area (e.g., major trauma room).[41] Several studies have assessed the suitability of the MTS for referral to primary care. A prospective cohort study in Germany (N=1122) concluded that the original MTS is unsuitable to safely identify patients for diversion to non-ED based GP care.[42] In a small (n= 115) prospective observational trial in the Netherlands, children within the two lowest urgency categories of the MTS were referred to primary care. The need for extensive treatment and hospitalisation was assessed. The authors concluded that these patients were suitable for primary care referral with some exceptions.[43] In a large (n=3129) prospective observational study in the Netherlands, patients were allocated to the ED according to an extension to the MTS. The authors concluded that low urgent self-referrals with the exception of extremity problems can be treated efficiently and safely by a GP.[44] In a small (n=264) interventional trial in Brazil, patients with less urgent problems were diverted to primary care. The authors concluded that this diversion might be feasible and safe with reasonable patient satisfaction.[45] Although a proof of concept, the above-mentioned research was definitely insufficient to implement the studied systems in Belgium. The only large trial was a non-randomised observational trial without a financial evaluation. The limited number of studies with an economic assessment merely collect costs in the different settings[46] or make use of a hypothetical calculation.[47] The studied healthcare systems differ significantly from the Belgian situation.[46]

In order to implement a triage system with involvement of primary care in Belgium, research concerning telephone and physical triage was necessary.[48] This PhD dissertation covers two precursory studies on telephone triage, a pilot study for the TRIAGE trial, and the TRIAGE trial concerning physical triage (core of this dissertation).

Who should perform this triage?

When designing the studies for this dissertation, the question arose over who should perform this triage: a physician, a nurse or a paramedic? Although the scientific debate has not entirely been completed yet, most researchers agree that a nurse is best positioned to perform triage and performs better than paramedics or doctors.[49, 50] Patients are generally satisfied with the service provided by nurses in EDs.[51] Worldwide, the growth rate of the nursing workforce is now three times that of the workforce for doctors (nine times that for nurse practitioners).[52] When not enough nurses are available, emergency medical technicians can take up this role under the supervision of a nurse but in Belgium, there is no legal framework for these technicians.[53] In primary care, a gradual evolution towards nurses that work alongside primary care doctors is happening worldwide. A Cochrane review concluded (based on low- or moderate-certainty evidence) that care delivered by nurses, compared to care delivered by doctors, probably generates similar or better health outcomes for a broad range of patient conditions. Patient satisfaction is probably slightly higher in nurse-led primary care and quality of life may be slightly higher.[54]. For physical triage, deploying enough nurses is feasible so during the TRIAGE trial, the intervention was executed by highly trained and experienced emergency nurses.

For telephone triage, there will never be enough nurses available so paramedics are often deployed. Many different triage tools are used worldwide and the training of these paramedics ranges from a few days to several years.[55] Research revealed that using trained paramedics (or practice assistants) is efficient but potentially unsafe.[56] For the two precursory studies reported in this dissertation, paramedics working under the supervision of a nurse were selected to carry out a telephone triage intervention.

The TRIAGE trial: the first randomised controlled trial in its field

As argued above, the difficulty patients face when choosing an OOH care setting cannot be solved by implementing supplementary primary care services nor by installing telephone triage; a trial studying physical triage was necessary. Our research group was contacted by the ED staff of AZ Monica and the board of the adjacent GPC Antwerpen Oost with a request for help because they wanted to implement physical triage. Together we decided that a clinical trial was the most logical solution. The TRIAGE trial was an unblinded randomised controlled trial with weekends serving as clusters. The intervention was triage by a nurse using a new extension to the MTS, assigning low-risk patients to the GPC. This extension (called eMTS) was locally developed, based on consensus. See p. 34 Figure 4 for an example of an eMTS flowchart. During intervention weekends, patients were encouraged to follow this assignment while it was not communicated during control weekends (all patients remained at the ED). The primary outcome was the proportion of patients assigned to and handled by the GPC during intervention weekends. The trial was randomised for the secondary outcome: the proportion of patients assigned to the GPC. Additional outcomes

were association of these outcomes with possible confounders (study tool parameters, nurse, and patient characteristics), proportion of patients referred back to the ED by the GPC, hospitalisations, and performance of the study tool to detect primary care patients.[57]

Studying triage: financial and implementation aspects are equally important as the medical aspect

When studying triage, it is incorrect to only study the above-mentioned medical consequences, one also needs to study financial and implementation aspects. Resources are scarce, and therefore it is essential to look at both effectiveness and resource use when introducing new treatments or treatment paths.[58] However, only a limited number of studies already compared costs of patients treated by GPs and ED during OOH. Moreover, the methodology of those studies was weak. Some authors made use of simulations only.[47] Others simply compared the costs of patients treated by a GP or in the ED, without taking into account that patient characteristics might differ between the two settings.[46, 47, 59] For the TRIAGE trial we studied the costs for both government and patient. Because of the complexity of hospital finances in Belgium and because we expected that the impact of the TRIAGE trial would be rather limited, we decided not to measure the impact on the financing of the OOH care system as a whole.

Process evaluation is vital for assessing how external factors influence the implementation of interventions. Research has shown that the adoption of innovation and resistance to change depends on different factors that can be aggregated into three major levels: organisational, group and individual level.[60, 61] Process evaluation can help to explain how an intervention works in a specific context to change the behaviours of specific target groups. This is particularly important in trials of complex interventions in 'real world' organisational settings such as OOH care. Additionally, an implicit objective of the TRIAGE trial was to improve patient care and increase staff satisfaction, so we needed to know their experience with the intervention. We conducted a study concerning the patient perspective, but were confronted with methodological difficulties, illness of a key researcher and a very small sample size so we were not able to deliver a report about that aspect. The relevant findings that did emerge from this study have been summarised in Chapter 8.

When we analysed the medical, financial and process aspects of the TRIAGE trial, we observed two striking findings which needed further analysis and a separate publication. First, the involved healthcare workers asked many questions regarding the patients that refused a GPC assignment (and thus stayed at the ED) so we wanted to know more about their characteristics and costs. Second, we noticed differences in the use of the study tool between the intervention and control group.

Studying triage: research questions and scientific approach for this dissertation

This dissertation covers two precursory studies concerning telephone triage, a pilot study (information campaign), and the TRIAGE trial. See Figure 3 for an overview. Each chapter tries to answer one or several research questions related to emergency triage and primary care. Chapters 1 through 7 are copies of the original papers. Lay-out, subtitles and grammar have been uniformised but the text itself is the same as published. Every chapter is readable on its own. Consequently, information is repeated, especially in the introductions. Additional footnotes have been added to give the reader more insights or to clarify certain statements. Statements regarding financing, competing interests, ethics, acknowledgments and data sharing have been fused at the end of this dissertation. The following paragraphs summarise the aims and methodology of the studies in this PhD, presented in chronological order.

Precursory studies on telephone triage (Chapter 7)

In two precursory studies we tried to answer the same question: is the 1733 telephone guideline ready for implementation in terms of safety and efficiency? Both studies concern a newly developed triage tool called “1733”, named after the telephone number patients are asked to call when confronted with an unexpected medical problem during OOH care. The first article studies this tool using simulated patients. The second article concerns real patients. However, these patients were only virtually assigned to the ED, the GPC, or delay of care. A third study concerning 1733 by our colleagues from Leuven using a cross sectional design has been published afterwards.[62]

Pilot study (Chapter 1)

In a small prospective before and after pilot study, we wanted to determine the proportion of patients diverted from the ED to the GPC using a promotion campaign for the GPC at the ED. We also wanted to test whether a real trial was feasible at the study sites in terms of interdisciplinary collaboration, cooperation with research necessities, data collection through iCAREdata (a research database for OOH care) and consensus among two sites that did not know each other well. Finally, we needed some baseline data concerning the workload and the epidemiology at the study sites in order to prepare an application for an Applied Biomedical Research project at the Research Foundation Flanders (FWO) which was granted so we were able to advance to the TRIAGE trial.

TRIAGE trial, medical analysis (Chapter 2)

This article is the core of this dissertation. It describes the main medical results of the cluster randomised TRIAGE trial. Its main research question is whether a new triage system (eMTS) safely divert a proportion of emergency department (ED) patients to a general practitioner cooperative (GPC).

TRIAGE trial, process analysis (Chapter 3)

We used semi-structured interviews with healthcare professionals in order to explore the main facilitators and barriers when implementing the TRIAGE trial. This study differs from most of the other chapters in this dissertation as it uses a qualitative approach

TRIAGE trial, financial analysis (Chapter 4)

What are the costs of implementing the TRIAGE trial for the government and the patients? What is the influence of the intervention on the revenues for the ED and GPC? These research questions were analysed using a study on invoices using the same cluster randomised design as Chapter 2. Because of the complexity of hospital finances in Belgium and because we expected that the impact of the TRIAGE trial would be rather limited, we decided not to measure the impact on the financing of the entire OOH care system nor the individual ED physician.

Refusing an assignment to the GP (Chapter 5)

What is the profile of patients refusing a GPC assignment and what are the financial consequences of this refusal? For a research internship, Ines Homburg made an in-depth analysis of this specific patient group.

Differences in triage between intervention and control weekends (Chapter 6)

What are the differences in the use of the triage tool between the intervention and control group? What are the differences in costs and hospitalisations for patients assigned to the GPC between the intervention and control group? These questioned arose up during the main analyses and needed further exploration.

	Intervention	Research questions	Chapter	Study design
TRIAGE Pilot	Information campaign at the ED	What is the proportion of patients leaving the ED for the GPC?	1	Prospective before-after
TRIAGE	▪ Intervention group: triage by a nurse with diversion of low-risk patients from the ED to the GPC ▪ Control group: virtual triage by a nurse, advice not given to patients (all remain at the ED)	**Medical:** proportion of diverted patients and the proportion of patients with GPC advice + determinants	2	Unblinded randomised controlled trial with weekends serving as clusters
		Process: the facilitators and barriers as experienced by healthcare professionals	3	
		Financial: total costs, costs for insurance/patients and revenues of the study sites	4	
		Study tool: differences in use of the eMTS between intervention and control group	5	
		Patients refusing a GPC advice: who are they and what are their costs?	6	
1733 de dokter van wacht vind je zo	Triage by a call taker using a newly developed telephone guideline	Accuracy of the 1733 guideline: sensitivity, specificity, correctness of the urgency categorisation and interrater agreement	7	▪ Simulated phone calls ▪ Dry-run: real patients, virtual triage

Figure 3. Overview of the studies/chapters embedded in this dissertation

Chapter 1

Information campaign as a pilot study

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1.1 Abstract

Background

Patients in Belgium needing out-of-hours care have two options: the emergency department (ED) or the general practitioner on call. The latter is often organised in a General Practice Cooperative (GPC). At the ED, there is an overload of patients who could be helped more efficiently by the GPC.

Research Question

What is the proportion of patients switching from the ED to the GPC (called voluntary switchers) with and without an information campaign? What are the characteristics of these patients?

Methods

Single centre prospective intervention trial. The first ten weekends there was no intervention. The next twenty-four weekends, patients in the ED were informed about the out-of-hours care in Belgium. The information contained several topics: characteristics of both services, where to go using examples, practicalities and costs. This information was distributed through leaflets and broadcasted on a screen in five languages.

Results

During the study period, 7453 patients entered the ED of which 330 voluntary switchers. The proportion of voluntary switchers was 1.7% before and 5.4% after the intervention ($p<0.01$). This effect remained stable for ten more months after the study. The average number of patients presenting at the ED per hour was 3.1 whereas on hours with voluntary switchers this was 5.1 ($p<0.01$). The age distribution and epidemiological profile of the voluntary switchers resembles the one of primary care patients. The GPs referred 6% of the voluntary switchers back to the ED.

Conclusion

Co-location of the GPC and the ED and informing patients is a meaningful step towards a more profound collaboration.

1.2 Introduction

Emergency department (ED) utilization has dramatically increased in Belgium as in most developed countries over the last decades. This evolution has been associated with adverse outcomes and increased costs. Effective policies to reduce this utilization are scares. Research about, pre-hospital diversion (including telephone triage), education and self-management support revealed contradictory results whereas interventions aimed at increasing primary care accessibility and ED cost-sharing seem to be effective.[17, 63]

Patients in Belgium needing out-of-hours medical care have two options: the emergency department (ED) of a hospital or the general practitioner on call. A patient must make the choice himself because of the lack of a common triage service (self-triage). Both services have free access and a fee-for-service system. As in the United States, every ED in Belgium needs to give appropriate care to anyone entering the service regardless of citizenship, legal status or ability to pay. All patients get a face to face triage (at the study site the Manchester Triage System[41] is used).

Almost all Belgians are member of the mandatory healthcare insurance. They need to pay 18% of their healthcare expenditures themselves.[64] The cost of a daytime consultation during the weekend at the ED is at least €38 of which the patient needs to pay €11 or €20 depending on his income. At the GP on call this cost is €39 and €1 or €4 respectively. At the studied ED, the final cost is on average €102 due to costs for technical interventions and examinations.

Continuity of care is a legal obligation of primary care in Belgium. In large parts of Belgium GPs have organised on call services themselves through General Practice Cooperatives (GPCs), starting from 2003. Their aim was to increase safety, improve working conditions of the GPs and a more efficient delivery of care.

EDs in Belgium, as throughout Europe, are overcrowded.[65] The rise of GPCs in Belgium did not reduce this overcrowding. On the contrary, there was a rise of contacts for both services.[23] Previous research revealed that only through intensive collaboration on the same location the GPs take a substantially higher proportion of all out-of-hours patients leading to a reduction of about 20% in patient volume at the ED.[44, 66, 67] In Belgium, there is no financial or legal support for such a collaboration. Internationally, the prevalence of inappropriate ED use varies from 20 to 40%.[9] In the UK the proportion of patients that GPs consider suitable for primary care management is 43%.[68] There is some research available about referring patients to the GP after triage at the ED[43, 45] but as far as we know, no previous evidence is available about patients leaving the ED spontaneously to go to the GP. Our hypothesis is that when a GPC is available nearby an ED, a small proportion of patients will safely go to the GPC depending on the information they get and on the current waiting time at the ED.

1.3 Methods

1.3.1 Study setting

In the city of Antwerp, general practitioners have created four GPCs open during weekends and public holidays. The GPC of Antwerp East moved in September 2016 to a location adjacent to the ED of a general hospital. Before this study, there was no formal collaboration. Together the ED and the GPC want to become an Urgent Care Collaboration (UCC).[69] In 2016 the GPC had about 10 000 consultations in the weekend for a population of almost 150 000 inhabitants. All 110 GPs working in the surroundings of the GPC are obliged to work at the GPC on average one shift per month.
The ED treated about 35 000 patients in 2016. It has a twenty-four hours service. The ED does not have a well-described target population. About eight emergency physicians staff the ED. The area surrounded by both services is a mix of middle-income neighbourhoods and ethnically diverse deprived neighbourhoods.

1.3.2 Inclusion criteria

We performed a single centre prospective trial from 01/01/2017 until 31/8/2017. We included all patients going to the GPC after having entered the ED. There were no exclusion criteria.

To identify patients coming from the ED the GPC receptionist asked all patients the same question: “Did you enter the ED before you came here?” We call patients answering “yes” to this question voluntary switchers.

1.3.3 Intervention

The first ten weekends there was no intervention. The next ten weekends we informed patients about the out-of-hours care in Belgium in the waiting room of the ED. To ensure enough patients could be included, this intervention period was prolonged for another fourteen weekends. The information contained several topics: characteristics of both services, where to go using common examples, practicalities and costs. All patients received a leaflet after registering at the reception of the ED. The same information was broadcasted on a screen in the waiting room of the ED. We translated this information in the most common languages of the surroundings: Dutch, Arabic, Polish, English and French. These materials are available as supplementary on-line content (see https://www.uantwerpen.be/nl/personeel/stefan-morreel/dringend-medisch-probleem/).

1.3.4 Outcome measures

Our primary outcome is the proportion of voluntary switchers out of the ED population. Secondary outcomes are sex, age distribution (seven categories), reason for encounter, diagnosis, number of patients presenting at the ED within the last one and four hours (the last two are considered as a proxy for the current crowding at the ED).

1.3.5 Data analysis

We collected all the data using the software of the GPC and the ED itself. In the GPC software, the GP is obliged to fill in a reason for encounter and a diagnosis using a Dutch topic list linking clinical labels to the second International Catalogue of Primary care (ICPC-2). The ED was not able to deliver diagnoses and reasons for encounter for the included patients. The ED could only deliver age and gender for the entire population of 2017 and not specifically for those patients included in this study. The extracted data were analysed using Microsoft Excel 2016 and IBM SPSS 24. We used chi square tests to analyse categorical variables before and after the intervention as well as to compare categorical variables among the voluntary switchers, the total ED population, the GPC population, and the referred voluntary switchers. We used post-hoc standardised residuals with Bonferroni correction to assess differences in between the different patient categories for seven age categories. Mann-Whitney U test was used to assess the number of patients presenting at the ED within the same hour as a voluntary switcher appeared versus hours without any voluntary switchers. We did the same for the number of patients within the last four hours. To assess the long-term effects of the information campaign, the analysis was continued after the intervention. We calculated the extra workload at the GPC due to voluntary switchers from 1/9/2017 until 31/5/2018 using the GPC's standard queries.

1.4 Results

1.4.1 Proportion of voluntary switchers

During the study period 7453 patients entered the ED. Of these patients 330 were voluntary switchers. The proportion of voluntary switchers was 1.7% before and 5.4% after the intervention ($p<0.01$). In total 6177 patients attended the GPC. The extra workload due to voluntary switchers was 2.6% before and 6.1% after the intervention ($p<0.01$). After the study this rate remained stable at 5.9% during at least one year.

The average number of patients presenting at the ED per hour without a voluntary switcher was 3.1 (range 0-13). On hours with at least one voluntary switcher this was 5.1 (range 1-13, $p<0.01$). The average number of patients presenting in a four hours' time frame before an hour without a voluntary switcher was 16 (range 0-43). For the hours with voluntary switchers this was 21 (range 1-39, $P<0.01$). There was no difference before and after the intervention.

1.4.2 Characteristics of the patients

Compared to the overall ED population the voluntary switchers were more often children below fourteen years of age (28.4% versus 17.7%, p<0.01). The voluntary switchers had the same age distribution as the overall GPC population (p= 0.49). Both the voluntary switchers as the rest of the GPC population consisted of 53% women. At the ED, the proportion of women was lower: 48% (p<0.01).

Of the 330 voluntary switchers, nineteen (5.8%) were referred back to the ED. For all other patients presenting at the GPC the referral rate was similar (5.4%, p=0.15). We did not find significant differences between the referred and the non-referred patients for gender and age.

1.4.3 Epidemiology

The ten most common reasons for encounter of voluntary switchers can be found in Table 1. The most common reasons are upper respiratory tract symptoms, fever, and gastrointestinal tract complaints. We see the same presentations as in the overall GPC population, but the order is different: they present more often with headache and abdominal pain and less often with fever.

Table 1.Ten most common reasons for encounter: comparison between the voluntary switchers and the GPC population.

ICPC clinical label	Proportion of voluntary switching patients (%)	Proportion of the GPC population (%)*	Pearson chi square P-value
Abdominal pain/cramps general	8	3	<0,01
Fever	6	10	0,02
Headache	4	2	0,07
Upper respiratory infection acute	4	7	0,04
Cough	4	8	0,01
Teeth/gum symptom/complaint	4	1	<0,01
Back symptom/complaint	4	2	0,01
Abdominal pain epigastric	3	1	0,04
Laceration/cut	3	1	0,04
Pruritus	3	1	0,04

**: only GPC patients that have not entered the ED before entering the GPC*

The ten most common diagnoses can be found in Table 2. They are located in the same organ systems as the reasons for encounter. In the overall GPC population, we see the same diagnoses but more upper respiratory tract infections. The diagnoses of the 19 referred patients can be found in Table 3.

Table 2. Diagnoses: comparison between the voluntary switchers and the GPC population.

ICPC clinical label	Proportion of voluntary switching patients (%)	Proportion of the GPC population (%)*	Pearson chi square P-value
Disease/condition of unspecified nature/site**	7	3	<0,01
Upper respiratory infection acute	5	10	<0,01
Stomach function disorder	4	2	0,01
Tonsillitis acute	3	3	1
Laceration/cut	3	2	0,21
Teeth/gum symptom/complaint	2	0	<0,01
Gastroenteritis presumed infection	2	3	0,29
Just Checking If anybody reads this	4	7	<3.5
Acute bronchitis/bronchiolitis	2	3	0,29
Viral disease other	2	4	0,07
Insect bite/sting	2	1	0,09

**: only GPC patients that have not entered the ED before entering the GPC*

*** including no diagnosis possible (13) and removing sutures (7)*

Table 3. Diagnoses of referred voluntary switchers (N=19).

Diagnosis ICPC-2 code	Diagnoses
R80	Flu
D83	Parotitis
A05	Feeling unwell
A99	No diagnoses could yet be made
P99	Mental Illness
U70	Acute Pyelonephritis
D21	Swallowing problem
K77	Heart failure
K02	Chest pain
R78	Acute bronchitis
A88	Dehydration
T87	Hypoglycaemia
F72	Eye lid abscess
S76	Erysipelas
L76	Unspecified Fracture
R99	Subglottic laryngitis
S12	Insect sting on extremity
N80	Crush trauma of the head
N01	Headache
L76	Rib fracture

1.5 Discussion

In this small single centre prospective pilot trial, we have noticed a small but significant increase of voluntary switchers after a promotion campaign. The voluntary switchers in this study did not need care at the ED. The co-location of ED and GPC has led to a decrease of 5,4% of patients presenting at the ED and thus contributes to a more efficient management of the ED.

This proportion of voluntary switchers is influenced by the waiting time at the ED: patients are more prone to switch when it is busy at the ED. The voluntary switchers have a profile similar to patients presenting themselves directly to the GPC: more women and young children than the entire ED population. This is in line with previous research in the Netherlands and Belgium.[23, 70]

Although the voluntary switchers have less upper respiratory tract infections, they present with typical first line reasons for encounter and diagnoses. The referral rate among these patients was similar to the general GPC population and the current literature possibly

indicating a similar safety profile.[21] The referred patients had more severe and urgent problems. During the study period, there were no reported safety incidents.

Although only a small proportion of ED patients switched to the GPC, this result is relevant. It was obtained with a small effort and without inducing a safety risk. The effect lasted after ending the study, possibly because of an educational effect (patients are more aware of the existence of the GPC). Other urgent care collaborations can easily carry out a similar promotion campaign and study it using already available routine data. It is an easy first small step towards a more profound collaboration using telephone, physical or on-line triage. When doing so the local circumstances and applicable laws must be taken into account. In the US for example, the emergency physician must see all patients after triage regardless of their needs.

As far as we know this is the first study specifically examining voluntary switchers. Its strength lies in its unique design and in the large number of studied patients at both sites. It has got several significant limitations: the short time span between the co-location of the studied services and this study (four months), a short study period, a single centre design and the lack of some relevant variables at the ED such as reason for encounter and diagnosis. This study was not randomised so we do not know whether the increase of voluntary switchers is due to the information campaign. It might be due to more general changes in the behaviour of the ED's staff, informal contacts between patients and staff, increasing brand awareness of the GPC or other yet unknown reasons. The small proportion of referred voluntary switchers does not allow definite conclusions about the safety of the information campaign. We used the number of presenting patients in the last hour and the last four hours because a validated indicator for crowding at the ED such as National Emergency Department OverCrowding Scale (NEDOCS) was not available.[71]

We recommend further research about voluntary switchers in different settings with and without an information campaign and with a longer follow-up period. Especially in other countries with different healthcare organisation, the results might differ. This study serves as a pilot for a cluster randomised trial (ClinicalTrials.gov Identifier: NCT03793972) about nurse-led triage at the same urgent care collaboration. In this trial, a nurse will refer a proportion of the ED patients to the adjacent GPC.

1.6 Conclusion

Patients voluntary leaving the ED to go to the GPC have the same referral rate as the overall GPC population. Most of them have typical primary care reasons for encounter and diagnoses. The odds of going to the ED is influenced by the occupancy rate of the ED. Co-location of the GPC and the ED and informing patients is a first and meaningful step toward a more profound collaboration between primary care and ED. It leads to a lasting switch of 5.9% of the ED patients triaging themselves to the GPC and thus improves the management of the ED. We recommend other collaborations between ED and GPC to start with a promotion campaign as a first small but meaningful step towards more profound collaboration.

Chapter 2 TRIAGE trial: Main results

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The supplementary material that is crucial for understanding this chapter or that substantiates the conclusion has been added to this dissertation. The remaining supplementary material can be found alongside the original article which is freely accessible. See https://doi.org/10.1371/journal.pone.0258561. This supplementary material is referenced as it was referenced in the original publication: “See SX” with X being the number of the supplementary file.

2.1 Abstract

Objectives

To determine whether a new triage system safely diverts a proportion of emergency department (ED) patients to a general practitioner cooperative (GPC).

Methods

Unblinded randomised controlled trial with weekends serving as clusters (three intervention clusters for each control). The intervention was triage by a nurse using a new extension to the Manchester Triage System assigning low-risk patients to the GPC. During intervention weekends, patients were encouraged to follow this assignment; it was not communicated during control weekends (all patients remained at the ED). The primary outcome was the proportion of patients assigned to and handled by the GPC during intervention weekends. The trial was randomised for the secondary outcome: the proportion of patients assigned to the GPC. Additional outcomes were association of these outcomes with possible confounders (study tool parameters, nurse, and patient characteristics), proportion of patients referred back to the ED by the GPC, hospitalisations, and performance of the study tool to detect primary care patients (the opinion of the treating physician was the gold standard).

Results

In the intervention group, 838/6294 patients (13.3%, 95% CI 12.5 to 14.2) were assigned to the GPC, in the control group this was 431/1744 (24.7%, 95% CI 22.7 to 26.8). In total, 599/6294 patients (9.5%, 95% CI 8.8 to 10.3) experienced the primary outcome which was influenced by the reason for encounter, age, and the nurse. 24/599 patients (4.0%, 95% CI 2.7 to 5.9) were referred back to the ED, three were hospitalised. Positive and negative predictive values of the studied tool during intervention weekends were 0.96 (95%CI 0.94 to 0.97) and 0.60 (95% CI 0.58 to 0.62). Out of the patients assigned to the GPC, 2.4% (95% CI 1.7 to 3.4) were hospitalised.

Conclusions

ED nurses using a new tool safely diverted 9.5% of the included patients to primary care.

ClinicalTrials.gov Identifier: NCT03793972

2.2 Introduction

In many countries, Out-of-hours (OOH) primary care is increasingly organised in General Practitioner Cooperatives (GPCs), and simultaneously, emergency care is provided by emergency departments (EDs) in hospitals. Although there is no clear definition of 'appropriate' or 'inappropriate' use of the ED, several authors reported that many medical problems presented at the ED could be managed in a primary care setting.[72-75] In the United States, primary care office visits for acute care dropped sharply in 2002-15, while ED visits increased modestly.[76] In Belgium, an ED has the legal obligation to assess and to treat all patients with an emergency medical condition regardless of an individual's ability to pay, which is very similar to the Emergency Medical Treatment & Labor Act in the United States.[77] Patients choose a service based on previous experiences, ease of access, explanation by the doctor about the illness and treatment, the anticipated waiting time, their relationship with their general practitioner (GP), and the perceived nature of the complaint.[19] Diverting patients in emergency departments to primary care services helps patients to make this choice, but little is known about its safety and effectivity.[18, 20, 48] Both patients and physicians in Belgium are in favour of co-locating these services.[35] Improved access to OOH primary care was associated with increased primary care utilisation but did not necessarily lead to a decrease of workload at the ED.[20] At the time of the current study, Belgian GPCs were only open during weekends and bank holidays.

Triage is defined as the sorting out and classification of patients or casualties to determine priority of need (urgency classification) and proper place of treatment (in the current study assignment to ED or GPC).[25] Before this trial, almost all EDs in Belgium used nurse triage to determine priority and place of treatment within the hospital but diverging patients to a GPC was only done in experimental settings.[78] The Manchester Triage System (MTS) is one of the few triage systems with a moderate to good validity, it is used worldwide.[79] Three, non-randomised trials about the MTS and diversion to primary care revealed promising results but did not allow for definitive conclusions about safety and effectiveness because of their small sample size and focus on specific groups of patients such as children.[43-45] An awareness-raising campaign was conducted as a pilot for the current study in order to collect baseline data, to assess the feasibility of local cooperation and to estimate the needed sample size.[80]

The objective of the current study was to determine whether a new triage system safely diverts a proportion of emergency department (ED) patients to a general practitioner cooperative (GPC). The trial design is a clustered randomised trial with weekends and bank holidays (from here out we refer to weekends and bank holidays as weekends) serving as units of randomisation and patients as units of analysis. Individual randomisation was not desirable because the triage process is by nature applied to a longer period of at least one working shift. A process and economic analysis of the present trial will be published separately.

2.3 Materials and methods

2.3.1 Study design, setting and participants

Single centre randomised controlled trial from 01/03/2019 to 30/12/2019. Weekends (7.00 PM Friday to 6.00 AM Monday) served as units of randomisation (approximately 200 participants each) and patients as units of analysis. A preparation period of two months for adapting the software, testing procedures, and training the staff was followed by the actual study (01/03/2019 to 30/12/2019).

This study was performed in the ED of a general hospital staffed by approximately 25 nurses and 10 physicians handling 36 743 contacts in 2018. The adjacent GPC, which is open during OOH care, covers a population of 145 000 inhabitants and handled 10 586 consultations in 2018. All 110 GPs working in the area covered by this GPC are obliged to work there approximately one shift per month. The surrounding area is ethnically diverse with a mix of middle-income and socially deprived neighbourhoods. The Belgian healthcare system is organised into primary, secondary, and tertiary care, with open access for patients to all levels. It is mainly organised as a fee-for-service system.

All patients with a national insurance number triaged by a nurse at the ED were included. Patients arriving at the ED by an ambulance staffed with a doctor or nurse, patients already admitted to the hospital, and patients referred to the ED by a doctor were excluded because they already underwent triage. See S12 Research Protocol**.** for the entire study protocol and S13 Minor changes to the study protocol.

2.3.2 Materials

The MTS (version 3.6) is a tool for prioritisation in the ED. When using the MTS, the nurse chooses one out of 53 presentational flowcharts each concerning a reason for encounter (e.g., abdominal pain in children). A flowchart consists of a list of discriminators (e.g., mild pain), the presence of which has to be checked in a top-down order. Each discriminator is linked to an urgency category ranging from one (immediate care necessary) to five (non-urgent).

For the current study, an extended version of the MTS (eMTS) was created. First, a questionnaire was distributed to a working group consisting of three GPs, two ED-nurses, and two ED physicians. Next, the working group drafted the eMTS during five consensus meetings. The aim of this tool is to identify low-urgency patient eligible for primary care. Due to legal concerns, only patients in urgency categories four and five were allowed to be assigned to the GPC but not all of them are eligible for primary care as some might need hospital care (radiology, complex interventions, hospitalisation. For example, a patient with a deformed joint with mild pain probably needs hospital care (radiology) but has a low

urgency category. The working group chose to allow assignment to the GPC when an expected 90% of the GPs would be able to safely help the patient. Wounds requiring sutures for example were assigned to the ED. Babies less than three months old were always assigned to the ED, as some of the GPs might not have enough paediatric experience.

The MTS flowcharts for self-harm, collapse, abused or neglected child, apparently drunk, major incident, behaving strangely, and unwell newborn were not extended. In 20 flowcharts, additional discriminators were created which had to be assessed whenever the urgency category was four or five. Presence of one of these additional discriminators means an assignment to the ED (see Figure 4 for an example). In 26 flowcharts, the only added discriminator was “GP Risk”, defined as an unspecified risk to assign the patient to the GPC according to the opinion of the triaging nurse, or because of age less than three months. The eMTS was integrated into a computer decision support system (E.care ED 4.1) that showed “assign to GPC” when appropriate. The nurses were allowed to overrule the result of this automated eMTS assignment. The eMTS is available upon request.

Figure 4. Example of an MTS presentational flowchart with the studied extension.

PV: Per Vaginam
Image based on Emergency Triage: Mackway-Jones K, Marsden J, Windle J, Manchester Triage Group. Emergency triage. Third edition. Ed, 2014, ISBN 9781118299067 p. 66 with kind permission

2.3.3 Intervention

All patients presenting at the ED were triaged by an experienced nurse using the eMTS, resulting in an urgency level (one to five) and an assignment (to GPC or to ED). The study was only conducted during OOH care as there were no centralised primary care services available during working hours. In a Belgian observational study, only 1.7% of the GPC patients were in need of urgent hospital care so patients presenting at the GPC were not triaged in the current study.[37] During control weekends the assignment was not communicated to the patients, they all remained at the ED. During intervention weekends patients were encouraged to comply to the assignment but were allowed to refuse it. Patients were informed in the ED about the study using flyers, posters, and a presentation broadcasted on a screen. During intervention weekends, this presentation contained additional information in five languages about the possibility of being assigned to the GPC. All nurses followed a twelve-hour training on using the eMTS, patient communication skills, and the study protocol. In one-hour sessions, the researchers informed emergency physicians (participation 80%) and GPs (participation 33%) about the study.

2.3.4 Outcomes

The primary outcome was the proportion of patients assigned to the GPC and handled by the GPC during intervention weekends. The secondary outcome was the proportion of patients assigned to the GPC during intervention and control weekends. Additional outcomes were the proportion of patients who did not comply to the assignment; the association between the primary and secondary outcomes and possible confounders (study tool parameters, nurse, patient characteristics, and timing of presentation); proportion of patients within the primary outcome referred back to the ED; admissions to the study hospital; and performance of the eMTS as an instrument to detect patients primary care patients (i.e., a low risk of hospital care). The exploration of the primary outcome after the trial ended was the only outcome not pre-specified, it was added to exclude a Hawthorne effect (the changes in behaviour found are caused by the impact of being studied, not by the intervention).[81]

2.3.5 Sample Size

The impact size of the determinants of the primary and secondary outcomes were unknown prior to this study but were expected to be in the order of 10-20%. Therefore, based on known volumes of inflow of patients, two weekends (one intervention and one control) would have been sufficient to provide empirical evidence of a statistically significant shift of patients from the ED to the GPC. However, multivariate analyses of the primary and secondary outcome, the additional outcomes (safety), monitoring of serious adverse events and assessment of a possible learning curve required data collection over a longer period of time. Consequently, a convenience sample of 48 weekends months was selected.

2.3.6 Randomisation

Because the primary outcome did not apply to the control group (the study needed randomisation for the secondary outcome and for future financial and process analysis), and because more data on the intervention weekends were needed to assess the additional outcomes, a ratio of three intervention weekends for each control was chosen. The trial intentionally started with two intervention weekends. The authors used an algorithm in Microsoft Excel 2016 to generate random allocation stratified for bank and school holidays, while no more than five consecutive intervention weekends were allowed. The head nurse and one assistant were aware of the randomisation. The ED staff were informed a few hours before their shift. The GPC staff were not informed but could find out during their shift. Patients were not blinded.

2.3.7 Data collection

The following patient characteristics were collected: sex; birth year; postal code; socioeconomic status (reimbursement status of the Belgian health insurance: increased reimbursement or not); type of admission to the ED (walk-in, arrived by ambulance, or already admitted to hospital); origin (self-referral, referral by GP, referral by specialist); ED physician's post hoc opinion on assignment (to GP or to ED); GP referral back to the ED; admission to the study hospital, and triaging nurse (anonymous identifier ranging from one to 22). After triage, the following study tool parameters were collected: MTS flowchart (52 flowcharts reported in 15 categories[1]); eMTS discriminator; MTS urgency level (one to five), and assignment (ED or GPC). The timing of presentation was registered both at the ED and, when applicable, at the GPC. It had three characteristics: weekend identifier, time period (day, evening, or night), and subjective crowding at the ED (quiet, normal, and busy). Except the subjective crowding, all variables were part of the routine medical records.

In order to calculate the complete number of exclusions, the number of patients without a national insurance number was extracted from the ED's software. All other data were collected using iCAREdata, a database for OOH care.[1, 2] iCAREdata links data from the ED and the GPC to each other using the pseudonymised national insurance number.

[1] These 15 categories were constructed by the authors. MTS flow charts of special interest (e.g. chest pain) were treated as a separate category while others were categorised based on organ system or clinical speciality. MTS flow charts designed for the paediatric population were categorised together as "children".

The studied intervention continued after the trial upon request of the participating sites, but a decline in the quality of the ED registrations made some registrations unreliable. To explore the primary outcome after the trial ended, the number of patients originating from the ED as noted by the GPC receptionist was extracted from the GPC's software (Mediris 2.4) both for the study period and one year afterwards. Because the COVID-19 pandemic disrupted the Belgian healthcare system mainly during two waves, the months April, November, and December 2020 were excluded.[82]

2.3.8 Monitoring

One and six months after the start of the trial, the research team presented interim results to the working group that prepared the study. All staff members and the hospital's ombudsperson were asked to report all serious adverse events possibly related to the study.

2.3.9 Patient and public involvement

A lay person volunteering at the ED of a hospital not participating in this study was involved in the study design, she gave advice about the study protocol and tool. An advisory board with stakeholders from EDs, GPCs and universities gave advice about the study design, discussed the interim analysis, and gave feedback on the results.

2.3.10 Analysis

The primary outcome expressed as a percentage will be reported with a 95% CI (which implicitly corresponds to testing the null hypothesis that this percentage is equal to zero). Bivariate logistic regression was used to calculate odds ratios (OR) of the dichotomous outcomes across multilevel categorical independent variables. Those variables found significant (alpha = 0.05) in the bivariate analysis were incorporated in the multivariate analysis. This multivariate analysis was started by creating three chi-square automatic interaction detection (CHAID) decision trees.[83, 84] Decision tree methodology is a data mining method used for developing prediction algorithms of a dichotomous target variable taking into account the interactions of the independent variables. The algorithm is non-parametric, can efficiently deal with large, complicated datasets, and can accept missing values. Decision trees based on Bonferroni-Holms corrected chi-square tests were constructed separately for the study tool parameters, patient characteristics and timing of presentation (weekend, time period, subjective crowding). K-fold cross validation was used to protect against overfitting. A final decision tree was fitted using the significant variables as they turned out in the three separate analyses. The significant variables in the decision trees were entered in a generalised mixed model considering that observations are nested in nurses, that is, with the nurse as a random intercept. To compare the primary outcome during the study period to the year 2020, an unpaired samples student's t-test was used.

Details about the statistical analysis and data cleaning can be found in S14 Statistical Analysis Plan.

IBM SPSS version 26 was used for the CHAID analysis. The generalised linear model was created in Jamovi version 1.6 using the GAMLj module.[85] The epiR package in R version 4.0 was used to calculate predictive values with a 95% CI.[86] For all other analysis, JMP pro version 15 was used.

2.4 Results

2.4.1 Study population

In this study, 9964 patients were assessed for eligibility, of which 1806 patients were excluded mostly because of the lack of a national insurance number[2] or because they were already triaged (see Figure 5). The intervention group consisted of 6374 patients (78.1%) clustered in 37 weekends. The control group consisted of 1784 (21.9%) patients clustered in 10 weekends. On one bank holiday allocated to the intervention group, the study was unintentionally not conducted. The baseline characteristics of the patients in the intervention and in the control group were similar except for the subjective crowding at the ED (see Table 4).

[2] There were not data available concerning these patients as they were not included in iCAREdata, the study database used. It would not have been ethical to collect their data using other resources.

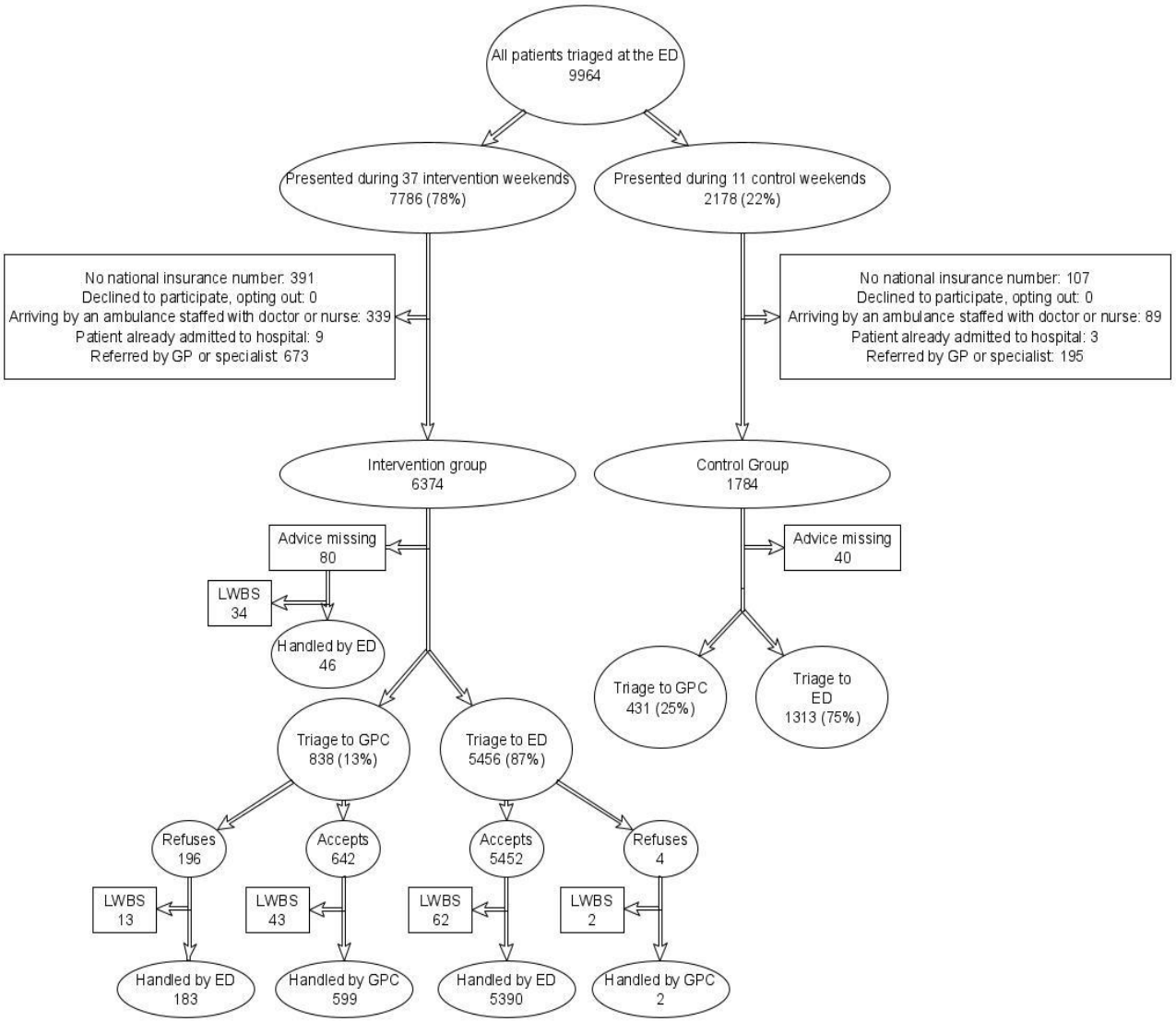

Figure 5. Patient flow through the study (CONSORT flowchart).

LWBS: Left Without Being Seen

Table 4. Baseline characteristics of participants in the TRIAGE trial. Values are numbers (percentages).

Characteristics	Intervention group (%) (n=6374)	Control group (%) (n=1784)	P-value
Mean age in years (standard deviation)	38 (25)	39 (24)	0.11*
Sex			0,95**
Women	3149 (49)	880 (49)	
Men	3225 (51)	904 (51)	
Residence			0.14**
Nearby***	4481 (70)	1217 (68)	
Others	1873 (29)	558 (31)	
Missing	20 (0)	9 (0)	
Socioeconomic Status			0.18**
Low	1642 (26)	494 (28)	
Not low	3716 (58)	1027 (58)	
Missing	1016 (16)	263 (15)	
Manchester Triage System urgency category			0.06**
One or two (max. waiting time ten minutes)	413 (6)	104 (6)	
Three (max. waiting time one hour)	2146 (34)	552 (31)	
Four (max. waiting time two hours)	3726 (58)	1097 (61)	
Five (max. waiting time four hours)	89 (1)	31 (2)	
Subjective crowding at the ED			<0.01**
Quiet	272 (4)	58 (3)	
Normal	2127 (33)	383 (21)	
Busy	344 (5)	92 (5)	
Missing	3631 (57)	1251 (70)	
Admission to the study hospital	1018 (16)	293 (16)	0.65**
Mean number of included patients per weekend (standard deviation)	172 (39)	178 (34)	0.63*

**P-value based on an unpaired samples student's t-test*
***P-value based on the Pearson's Chi-square test*
****Within the four communities covered by the GPC*

Out of the 22 nurses, five nurses worked significantly less during control weekends (lowest OR, 0.12 95%CI 0.04 to 0.38, p<0.01) and seven worked significantly more (highest OR, 3.63 95%CI 2.91 to 4.68).

2.4.2 Primary outcome

For 80 out of the 6374 participants in the intervention group the assignment was unknown; almost half of them (n=34) left without being seen, the others were seen at the ED. These 80 patients were excluded from the following analysis. Out of the remaining patients, 838/6294 (13.3%, 95% CI 12.5 to 14.2) were assigned to the GPC, 196/838 (23.4 %, 95%CI 20.6 to 26.4) refused this assignment, 43/642 (6.7% 95%CI 5.0 to 8.9) accepted the assignment but left without being seen. The primary outcome was 599/6294 (9.5%, 95% CI 8.8 to 10.3). This primary outcome was 578/3098 (15.7% 95%CI 14.6-16.9) for patients within urgency category four and 21/59 (35.6% 95% CI 24.6-48.3) for patients within urgency category five. See Table 5 for the bivariate analysis of the primary outcome.

Table 5. Logistic regression bivariate analysis of the primary outcome (all participants in the intervention weekends, excluding those with a missing assignment). For categorical variables with more than four categories, the categories with the highest and lowest primary outcome are reported.

Determinant	N	Mean prim. outcome	DF	Category	Est.	Wald Chi^2	P-value	Odds ratio of the prim. outcome (95%CI)
Study tool parameters								
MTS urgency category*	3735	16.0%	1	4: Standard				1
				5: Non-urgent	1.1	15.5	<0.01	2.96 (1.73 to 5.08)
MTS flowchart category	6238	9.4%	14	Unwell adult				1
				ORL Complaints	1.4	51.9	<0.01	3.91 (2.70 to 5.68)
				Chest pain	-3.0	8.5	<0.01	0.05 (0.01 to 0.38)
Patient characteristics								
Age	6294	9.5%	5	0-7 years	0.3	4.0	<0.01	1.34 (1.00 to 1.79)
				8-24 years	0.3	3.7	0.05	1.29 (1.00 to 1.68)
				25-39 years	0.1	0.96	0.33	1.14 (0.88 to 1.48)
				40-54				1
				55-74	-0.5	10.1	<0.01	0.58 (0.41 to 0.81)
				>74	-1.1	22.6	<0.01	0.33 (0.21 to 0.52)
Admission type	6291	9.5%	1	Walk-in				1
				Arrived by ambulance	-2.32	62.6	<0.01	0.10 (0.06 to 0.17)
Sex	6294	9.5%	1	Female				1
				Male	-0.16	3.54	0.06	0.85 (0.72 to 1.01)
Residence	6275	9.5%	1	Nearby				1
				Not living nearby	-0.47	20.4	<0.01	0.63 (0.51 to 0.77)

DF: Degrees of freedom
Est.: Estimate
ORL: Otorhinolaryngology
prim.: Primary
**: Only for urgency categories four and five because the primary outcome was zero in the other categories*

The most important determinants of the primary outcome were MTS urgency category (non-urgent versus standard, OR 2.96), MTS flowchart category (ORL (otorhinolaryngology) complaints versus unwell adult OR 3.91), patient's age (above 74 years versus 40-54 years, OR 0.33), admission type (arrived by ambulance versus walk-in OR 0.05), subjective crowding at the ED (quiet versus normal OR 2.16), and nurse (nurse four versus nurse nine OR 3.56).

CHAID analysis of the study tool parameters (see Figure 6) showed that the urgency category was primordial: none of the patients in the three highest urgency categories was seen at the GPC, patients within urgency category five were more likely to be diverted to the GPC as compared to urgency category four. Within urgency category four, the flowchart category became a determining factor. Abdominal complaints, ORL complaints, neurological complaints, respiratory complaints, children, unwell adult, and back neck pain led to the GPC in more than 30% of the cases, while limb problems, wounds, chest pain, eye problems, and mental complaints led to the GPC in 5.2% of the low urgency cases.

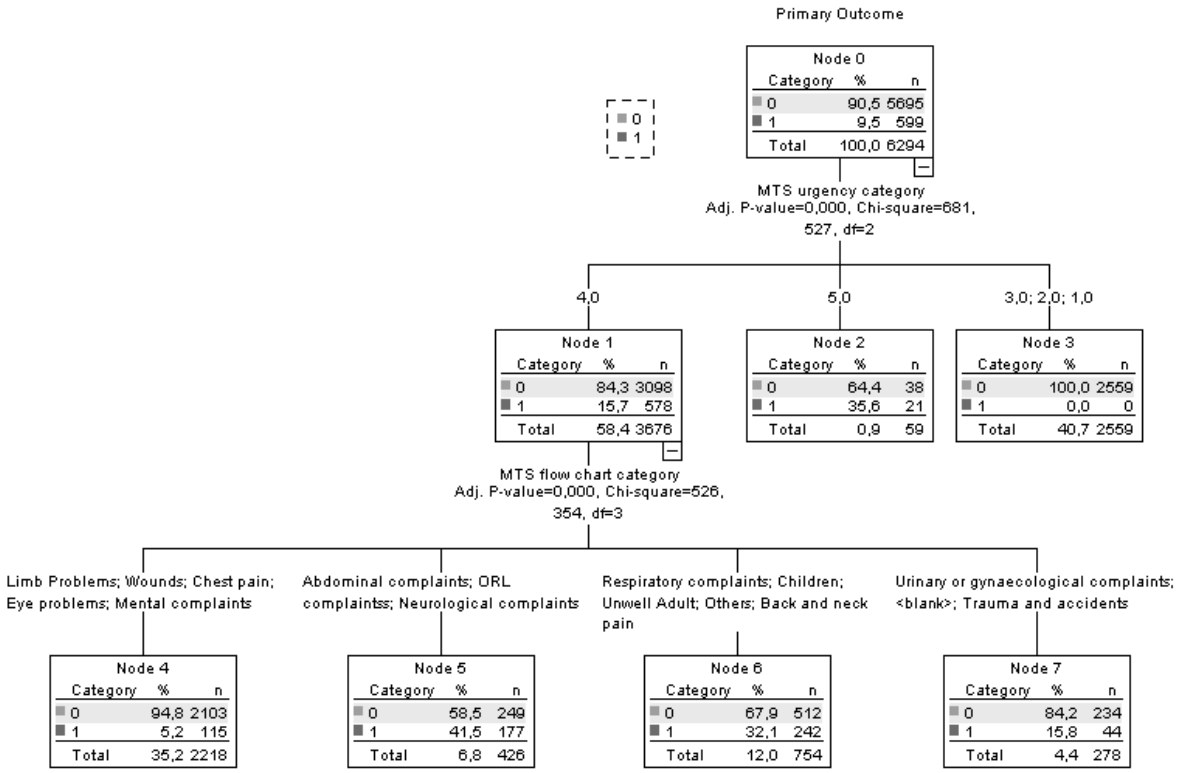

Figure 6. Primary Outcome - Chi-square automatic interaction detection (CHAID) decision tree of the study tool parameters.

ORL: Otorhinolaryngology

CHAID analysis of the patient characteristics (see Figure 7) revealed admission type as the crucial factor, followed by socioeconomic status, residence, and age as the least determining variable. Finally, CHAID analysis of the timing of presentation (see Figure 8) showed that during the day, the proportion of the primary outcome was lower when the subjective crowding was normal (7.5%) compared to quiet and busy ED (10.7%). A combined CHAID tree (see Figure 9) demonstrates the pivotal role of the study tool components. Only in a selection of flowcharts the admission type and the time period played a significant role.

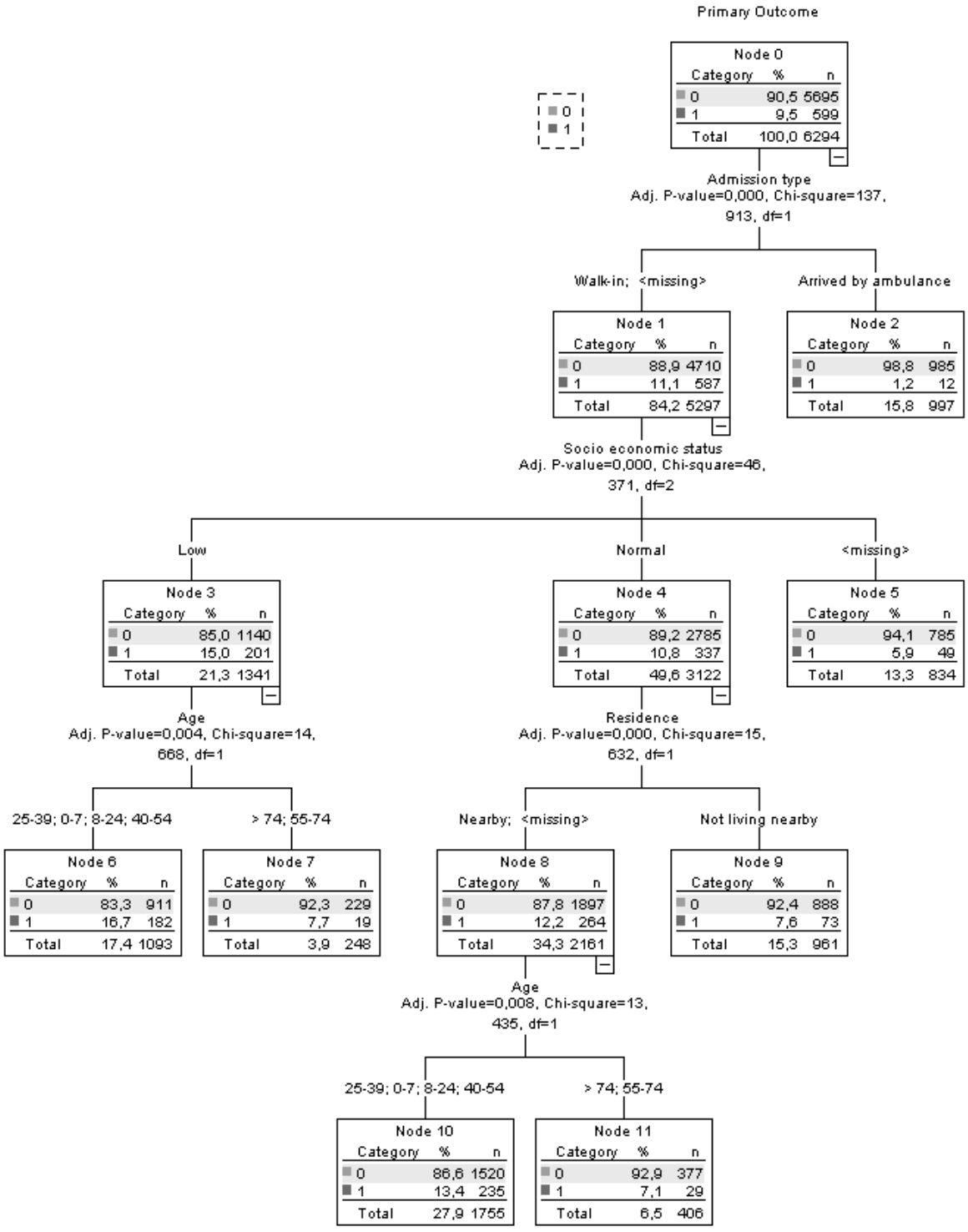

Figure 7. Primary Outcome - Chi-square automatic interaction detection (CHAID) decision tree of the patient characteristics

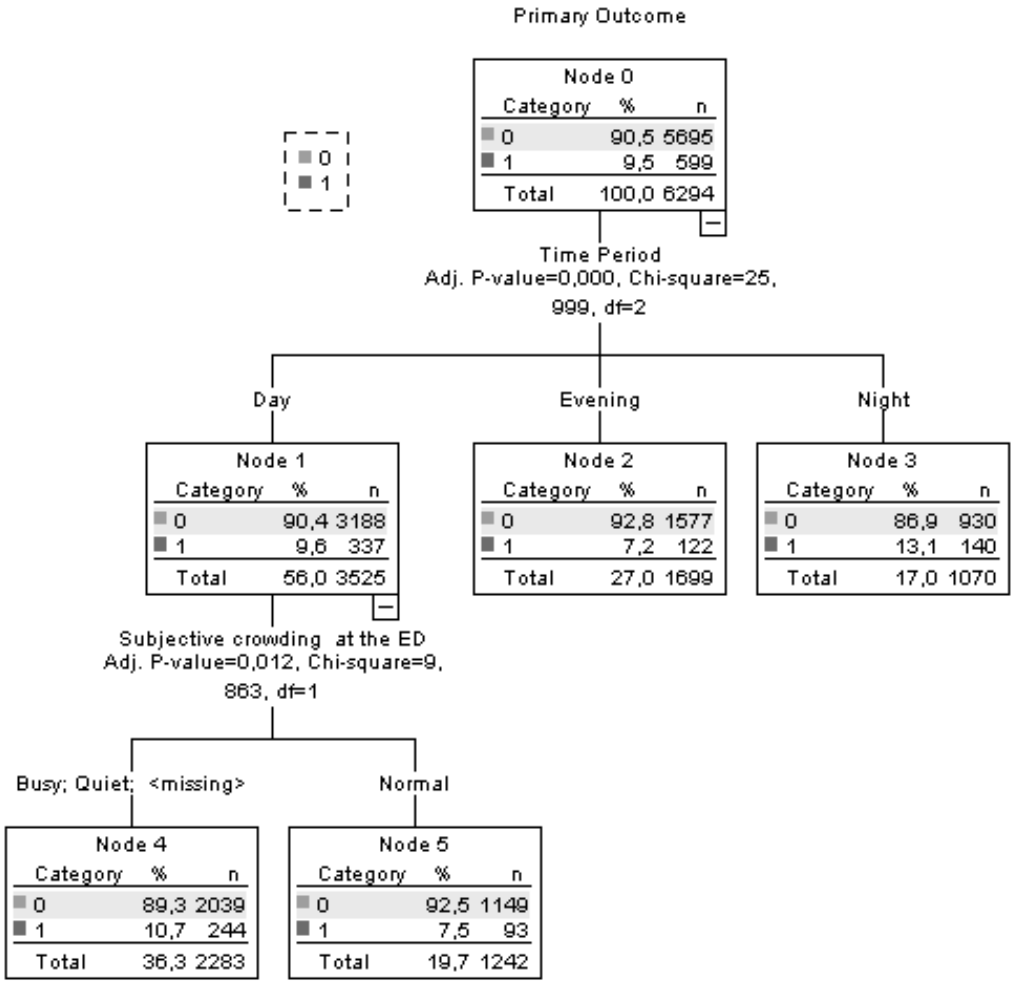

Figure 8. Primary Outcome - Chi-square automatic interaction detection (CHAID) decision tree of the timing of presentation

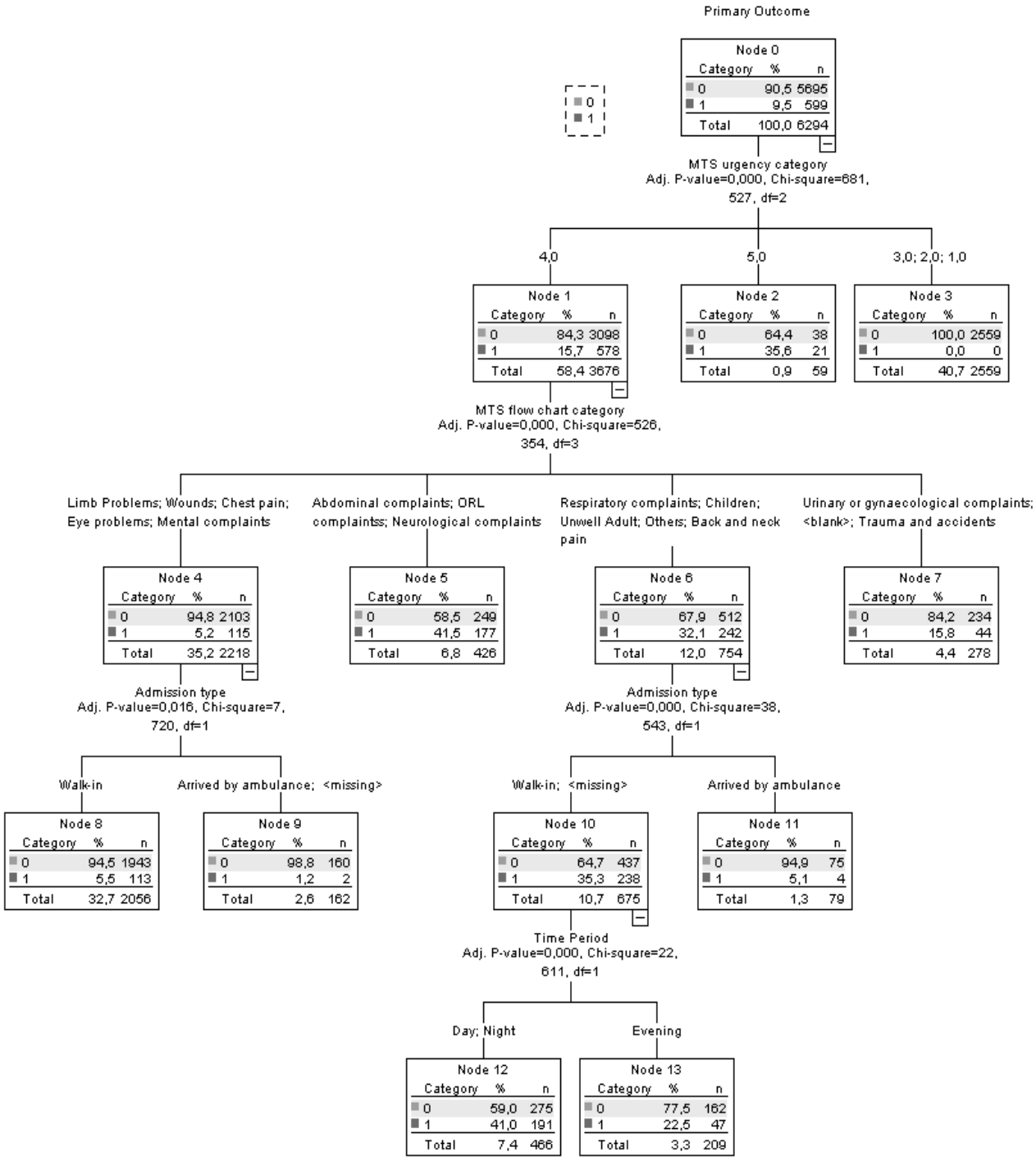

Figure 9. Combined Chi Square Aided Interaction Detection (CHAID) tree for the primary outcome

ORL: Otorhinolaryngology
<blank>: no MTS flowchart was registered

A comparison of the fixed effects generalised linear model (deviance 2200.6, df 53, AIC 2306.8, BIC 2636.7) with the generalised mixed model (deviance 2523.6, df 27, AIC 2577.6, BIC 2745.7) led to rejection of the nurse's random effect in favour of the fixed effects model. In the generalised linear model (for patients within the urgency categories four and five only, N= 3735, mean primary outcome 16%), all variables had a significant effect on the primary outcome (pseudo R-squared .22), with the largest contribution by the MTS flowchart category (S10 Supplementary table 3).

2.4.3 Secondary outcome

During the intervention weekends, assignment to the GPC was recorded for 838 out of 6294 patients (13.3%, 95% CI 12.5 to 14.2); during control weekends this proportion was almost twice as high: 431/1744 (24.7%, 95% CI 22.7 to 26.8). Bivariate analysis (S8 Supplementary table 1) and CHAID analysis (S4-S6 Supplementary figure 4-6) of the secondary outcome gave results similar to the primary outcome, but the intervention became the most important determinant after the study tool components. The nurses overruled the automated eMTS assignment in 4.2% (95% CI 3.6-4.7) of the cases within urgency category four and five.

2.4.4 Other outcomes

Patients within the primary outcome referred back to the ED

Out of the 599 patients within the primary outcome, the GPs referred 24 patients (4.0%, 95% CI 2.7 to 5.9) back to the ED (see Table 6). The proportion of these referrals was not significantly influenced by the triaging nurse, the patient's characteristics, or the weekend. Four out of the 19 patients with a presentational flowchart category 'neurological complaints' were referred back to the ED, which was significantly higher compared to the reference category 'unwell adult' (OR 7.2 95% CI 1.2 to 43.2).

Table 6. Characteristics of patients referred back to the ED after triage to the GPC.

Age	Sex	eMTS presentational flow chart	GP diagnosis	Hospital care	Admission
17	M	Falls	Concussion	Imaging	No
18	F	Back pain	Sciatica	None	No
33	F	Abdominal pain (adult)	Localised abdominal pain	None	No
13	M	Limb problems	Musculoskeletal injury	None	No
18	F	Unwell adult	Unwell	Imaging	No
9	M	Headache	Headache	Imaging	No
18	F	Abdominal pain (adult)	In labour	Monitor	No
87	M	Wounds	Cut/laceration	Imaging	No
47	F	Unwell adult	Headache	Monitor	Yes
76	M	Abdominal pain (adult)	Kidney stones	Monitor	No
35	F	Abdominal pain (adult)	Unspecified illness	Monitor	No
11	M	Headache	Symptoms of the nervous system	None	Yes
18	F	Abdominal pain (adult)	Kidney stones	None	No
22	F	Limb problems	Musculoskeletal injury	None	No
44	F	Limb problems	Unspecified fracture	None	No
21	F	Headache	Headache	None	No
27	F	Limb problems	Musculoskeletal injury	None	No
27	F	Abdominal pain (adult)	Generalised abdominal pain	None	No
1	M	Unwell baby	Fever	None	No
9	M	Abdominal pain (child)	Unspecified illness	None	Yes
53	F	Headache	Unspecified illness	None	No
32	M	Abdominal pain (adult)	Unspecified illness	None	No
1	F	Unwell child	Fever	Monitor	No
26	F	Back pain	Symptoms/complaints regarding back pain	None	No

One potential serious adverse event was reported, a middle-aged male complaining of mild back pain presented at the ED at 2.00 PM. He was diverted to the GP who prescribed an analgesic and reassured him. Thirty minutes later a taxi brought the patient, who was having a cardiac arrest, back to the ED. During unsuccessful resuscitation a ruptured abdominal aneurysm was diagnosed. After assessing the records of this patient and an interview with the involved staff, the working group judged that the management of this patient would not have been different if he had been assigned to the ED.

Admissions to the study hospital

The overall proportion of hospitalised patients was 1309/8038 (16.3% 95% CI 15.5 to 17.1). This proportion was 31/1236 (2.4% 95% CI 1.7 to 3.4) among patients with an assignment to the GPC. It was not influenced by the intervention (P= 0.56). Among the 599 patients in the primary outcome, three (0.5% 95% CI 0.2 to 1.5) were admitted to the hospital.

Performance of the study tool to detect primary care patients

Patients without a known assignment to GPC or ED (n=120) were excluded from this analysis. During intervention weekends, patients who refused the assignment (n=196) were also excluded. For patients within the primary outcome (n=599), the gold standard was referral by the GP. Patients referred back to the ED were considered “false positive” (n=24), the others true positives (n=575) leading to a positive predictive value of 0.96 (95% CI 0.94 to 0.97). For patients who accepted assignment to the ED (n=5452), the gold standard was the opinion of the ED physician: false negative when these patients were eligible for primary care (n=797) or true negative when these patients were not (n=1196). The negative predictive value was 0.60 (95% CI0.58 to 0.62).

During control weekends the gold standard was the opinion of the ED physician. The positive and negative predictive values were 0.84 (95% CI 0.78 to 0.90) and 0.56 (95% CI 0.51 to 0.60) respectively. The opinion of the ED physician was not registered at the ED in 4549/7196 (63%) of the patients. Eight out of the 24 physicians provided 94% of the values.

Exploration of the primary outcome after the trial ended

The primary outcome during the intervention weekends calculated on the GPC data was 645, on average 16 patients (standard deviation 8.8) per weekend. In 2020, it remained 16 (standard deviation 6.4, p=0.43).

2.5 Discussion

In this trial, 838 (13%) out of the 6374 included patients in the intervention group were assigned to the GPC, of which 599 (71%) were seen at the GPC which rejects the null hypothesis of no diverted patients. Four percent of these patients were referred back to the ED. The primary outcome was mostly influenced by the study tool parameters: urgency category and chosen presentational flowchart. The remaining variability can be explained by factors related to the patient (mostly arriving by ambulance), the triaging nurse, and the timing of presentation. The secondary outcome was roughly influenced by the same determinants. During control weekends, this secondary outcome doubled. The positive and negative predictive values of the studied tool for detecting primary care patients were 0.96 and 0.60 during intervention weekends. The effectiveness remained unchanged after the trial, suggesting that the study induced longer-lasting structural changes in the triage and referral processes.

This study was the first cluster-randomised trial about diverting ED patients to primary care. Its strengths lie in the large number of included patients, its real live setting, and its long study period. This study has the universal limitations of a cluster-randomised trial, such as the possibility of undetected imbalance among the study groups, interactions between individuals triaged after each other, and clustering of population characteristics on certain weekends. It was conducted in a single centre adapted to some local habits. The working group was not an independent data monitoring committee as they all worked in the studied services. The opinion of the ED physician about the assignment was well registered, but by a minority of the physicians, making the calculated predictive values prone to observer bias. There was an imbalance between intervention and control groups for the subjective crowding at the ED. This was probably due to a difference in motivation to register this parameter rather than due to an actual difference. An important difference between the studied tool and the original MTS is the discriminator GP Risk which allows a subjective judgment of the triaging nurse, this might reduce generalisability although it resembles everyday practice where nurses use their gut feelings.[87] The studied nurses were trained in the use of the MTS but whether or not the MTS was used correctly during the study period was not assessed. Finally, this study was only conducted during weekends and therefore the performance of the intervention during office hours or weeknights remains unknown.

A large study found a 22% increase of the proportion of patients attending the GP with a close collaboration with the ED as compared to the usual care setting, while another study found a decline in the number of patients treated at the ED by 20% after the introduction of a nearby GPC.[21, 66] These results are similar to the secondary, but not the primary, outcome of the current study, so the effectiveness of the studied tool was rather low. Whether or not it is desirable to increase this primary outcome depends on whether the perspective is from the third-party payer, the patient, the service, or the healthcare

professionals. This question will be answered in the upcoming process and financial analysis of the current study. Diverting 10% of the included patients to primary care reduced the workload at the ED, but the current study does not allow quantification of this impact. It might influence patient and staff satisfaction; a qualitative study about this aspect will be reported in the near future. The intervention might influence the long-term health seeking behaviour of patients as it is known that patients who were given the opportunity to be treated at a primary care clinic instead of an ED have increased future primary care follow-up compared with standard ED referral practices.[88] The higher primary outcome when the subjective crowding at the ED is quiet indicates that the ability of the studied tool to reduce crowding at the ED might be lower when it is needed the most.[3]

The referral rate of patients in the primary outcome to the ED (4%) was similar to the referral rate of the studied GPC for untriaged patients (6%) and in general practice OOH services in the United Kingdom (8.1%).[89] A retrospective study in which all self-referred, low-urgency patients were diverted to the GPC, found a referral rate back to the ED of 20%.[90] The lower referral rate in the current study is probably due to the design of the studied tool. The power of the analysis of the patients referred back to the ED was limited due to their small number. The participating GPs might have increased their threshold for referring study patients back to the ED as these patients already came from the ED. The very low admission rate, both for patients within the primary outcome as for patients with an assignment to the GPC is an indicator of safety. The positive predictive value for an assignment to the GPC of 0.96 in the intervention and 0.84 in the control group is another indicator of safety. Because the studied tool seems safe for patients refusing an assignment to the GPC, it might be interesting to study the possibility to oblige patients to follow an assignment to the GPC. Long-term multicentre studies are necessary to confirm these safety findings in larger populations. These studies should also focus on commonly missed diagnoses such as myocardial infarction and pulmonary embolism as these can be disguised by unspecific symptoms. The MTS has been found an acceptable tool for prioritising patients with symptoms of these diseases, but the current study does not allow extrapolation of these findings to the eMTS.[91, 92]

Unfortunately, one patient presenting with abdominal pain diverted to the GPC deceased due to a ruptured abdominal aneurysm. It is impossible to draw conclusions based on this sole case, but it is an important warning for further research and implementation: a robust follow-up system for incidents related to triage is necessary. Previous research proved that

[3] In the bivariate analysis, a significant difference was found between a quiet and a normal crowding but not between a busy and a normal crowding.

the MTS is safe and does not underestimate the severity of the patients presenting with abdominal pain but within this research patients were not diverted to the GPC.[93]

During intervention weekends, the number of patients left without being seen was higher in the group assigned to the GPC than in the group assigned to the ED. The authors received some anecdotal information about patients attending their own GP after the weekend but were not able to study what happened to all of these patients.

Most of the risk factors for the primary outcome (age, presentational flowchart, and timing of presentation) found in the multivariate analysis cannot be influenced by policy so the tool itself should be the focus for improvement. This seems feasible as the nurses followed the studied tool in 96% of the cases. The presentational flowchart 'limb problems' has the greatest potential as the nurses indicated a risk for referral to the GP in 1322/1803 (73%) low urgency cases mostly because they thought the patient needed radiology or sutures. In contrast to walk-in patients, those arriving with an ambulance had telephone triage before arriving at the ED. The low proportion of the primary and secondary outcome in these patients implies that is not useful to use studied tool afterwards. The differences in the primary outcome among nurses should be studied further and can be addressed by training. The higher primary outcome during the night demands further study: is it related to patient or nurse factors?

The secondary outcome was much higher in the control group than in the intervention group. It is probably easier for a nurse to write down a theoretical assignment to the GPC compared to discussing it with the patient. Qualitative and quantitative follow-up studies about this aspect will be reported soon. Training of the nurses might improve their ability to engage with patients to discuss the proper place of treatment.

2.6 Conclusion

In this randomised trial about triaging patients to primary care, ED nurses using a new tool safely diverted 9.5% of the included ED patients to the GPC. Young patients arriving without an ambulance with a typical primary care presentation were more often assigned to the GPC. These results remained stable after the end of the trial. These results prove it is useful to implement triage using the eMTS but further multicentre studies with a focus on increasing the proportion of diverted low-risk patients and safety are needed.

Chapter 3

TRIAGE trial: Process analysis

Submitted and revised as: Meysman J, Morreel S, Lefevere E, Verhoeven V, De Graeve D, Monsieurs K, and Philips H. Triaging and Referring In Adjacent General and Emergency departments (the TRIAGE trial): A process evaluation of medical staff experiences in a nurse-led triage system.

3.1 Abstract

Aims

This process evaluation aims at identifying the facilitators and inhibitors that influenced the successful uptake of a nurse-led triage system streaming low-risk patients from an emergency department (ED) to the general practitioner (GP).

Design & Methods

Semi-structured interviews with ED nurses (n=12), ED doctors (n=6) from the ED of a Belgian general hospital and GPs (n=5) affiliated with the adjacent GP cooperative (GPC). The process evaluation ran in parallel with the TRIAGE trial that started in March 2019 and ended 31st of December 2019. The first set of interviews was conducted in June 2019 and the second set in January 2020. Data were analysed based on grounded theory.

Results

Through a deductive framework, facilitators and inhibitors could be identified on three levels: the organisational, group and individual level. Main inhibitors are the degree of risk aversion of individual nurses, possible language barriers during delivery of the triage advice and the non-adapted ED infrastructure. Training on both the use of the triage protocol and effective delivery of the triage advice, in combination with periodical feedback from the GPC were the most important facilitators.

Conclusion

Based on the process evaluation we can conclude that a consensus exists among stakeholders that the ED Nurses are considered ideally positioned to perform the triage of walk-in patients, although a certain degree of experience is necessary. Although the extended triage protocol and GPC referral increases the complexity and duration of triage and entails a higher workload for the triage nurses, ED nurses found it did lead to a lower (perceived) workload for the ED in general.

3.2 Introduction

When patients have a medical problem after the GP's normal office hours they have to fall back on the system of out-of-hours (OOH) care.[94] In an increasing number of European countries, such as the Netherlands, Belgium, France and Denmark, OOH primary care is being organized through large-scale General Practitioners Cooperatives (GPCs).[94, 95] Hospital Emergency departments (EDs), where patients can receive urgent medical treatment without previous medical referral, work in parallel to these GPCs.[96] Despite the increasing number of GPCs, these EDs do not necessarily experience a reduction in patients. On the contrary, recent research has shown that EDs as well as GPs see an increasing number of patients.[7]

In Flanders, patients are free to consult any GP or a specialist for their health problems without specific referral. This freedom of choice is an important characteristic of the Belgian healthcare system and, in combination with the fact that EDs are designed to be convenient for those in need of medical attention,[97] makes that the threshold for patients to self-present at the ED after the GP's normal office hours, even with non-urgent complaints, is very low. This increased level of convenience is recognized as one of the contributing factors to the rising number of ED visits worldwide.[98]

3.2.1 Background

Previous studies have shown that, when it comes to OOH care, patients are often not aware of the different characteristics of the respective OOH services.[6, 96] They find it difficult to assess the urgency of their medical problem or illness and subsequently present themselves at the ED.[6, 96] Although a clear definition of what can be considered 'appropriate' or 'inappropriate' use of an ED is lacking,[97, 98] several international studies have reported that many of the presented medical problems at the ED could be managed in primary care.[10, 72, 73, 99] Observational studies have shown that 10 to 40% of self-presenting patients at the ED could be managed in primary care.[48, 68, 100, 101] The aim of the TRIAGE trial was to deliver the most appropriate care for self-presenters at the ED. In this trial, triage nurses assessed self-presenting ED patients aided by a triage protocol based on the Manchester Triage System but extended specifically for this research project. This assessment resulted in an advice concerning the most appropriate point of care for their medical problem: the GPC or ED. At the end of the TRIAGE trial, 13% of the included patients were assigned to the GPC.[102]

The evaluation of such a complex triage and streaming process is necessary in order to identify inhibitors and facilitators to its successful adoption.[103] An effective method is process evaluation, which provides insights into why an intervention is successful or not.[58, 104] It explores how the intervention is received by stakeholders, how it is implemented and in what context the trial is set.[104]

In this article, we report the findings of the process evaluation based on interviews with the ED nurses, ED doctors, and GPs on call at the GPC during the TRIAGE Trial. The TRIAGE trial was conducted in the ED of a general hospital and an adjacent GPC in a suburban area in Flanders, Belgium. The trial, in the form of a cluster randomised controlled trial, started March 1st, 2019 and ended December 31st, 2019. The ratio of intervention and control clusters was three to one. Overall, 8158 patients were included, 6374 during intervention clusters and 1784 during control clusters. During intervention clusters 838 patients (13.3%, 95% CI 12.5 to 14.2) received the advice to be seen in the GPC of which 196 (23.4 %, 95%CI 20.6 to 26.4) refused this advice. Young patients arriving without an ambulance with a typical primary care presentation were more often triaged to the GPC.[102]

The implementation of the triage intervention involved the development of Computer Decision Support Software (CDSS) to help the ED nurses in performing the triage. The training of the triage nurses both in the use of the CDSS and in persuasive patient communication with respect to managing the patient's expectations took 12 hours.

The triage was conducted in a separate examination room at the ED with the aim of seeing patients within 15 minutes after their arrival. Only nurses with at least one year of experience in the ED were allowed to triage. The ED nurse performed the triage aided by the CDSS resulting in allocation of the patient to either ED or GPC. During control clusters, the patient was not informed about this advice. During intervention clusters, the patient was allowed to accept or refuse this advice. When accepting the advice to attend the GPC, the patient received a short referral note and instructions to go to the GPC. In case the patient preferred to stay at the ED, the patient was led to a waiting room. When the triage protocol outcome indicated that a patient could be referred to the GPC, the ED nurse was allowed to overrule the outcome of the triage protocol if deemed inappropriate.

3.2.2 Aims

The aim of the process evaluation presented in this article is to identify factors that influenced the medical staff during the triage trial, as well as obtaining insight into the facilitators and inhibitors that have surfaced during the trial. Change management research has shown that the adoption of innovation and resistance to change depends on different factors that can be aggregated into three major levels: organisational, group and individual level.[105, 106] On the organizational level, the focus lies mainly on factors such as structure, strategy, and resources and how they facilitate or hinder the planned intervention. The group level encompasses the social interaction between co-workers and other staff members and stakeholders who participate in the intervention.[106] This envelops both interactions within a group and between groups.[105] On the individual level, literature identifies three sublevels of factors influencing the willingness to adopt innovation and change: the individual's personality, their motivation and their cognitive capabilities.[106]

3.3 Methods

3.3.1 Design

Grounded theory techniques were chosen, due to their compatibility with the aim of this study. Data collection and analysis were done simultaneously so that questionnaires could be expanded or deepened based on prior gathered information. Constant comparison allows for the induction of theory from the raw data and purposive sampling can be used in order to aim toward theory construction instead of population representativeness.[107-109]

3.3.2 Sample/Participants

In total, 25 ED Nurses, 10 ED Doctors and 110 GPs were involved in the TRIAGE trial during its term. For each of the staff groups, a purposive sample was constructed. Ten nurses were purposively selected through maximum variation sampling based on age, gender and experience.[110] Two nurses outside the selection volunteered for the interviews. Five were interviewed in June 2019 and seven in January 2020. Six ED doctors were selected based on availability,[110] all of them were interviewed in January 2020. In the case of the GPs, we specifically selected GPs that had seen at least 10 or more referred patients to ensure they had relevant experience with the system. As GPs generally are on call approximately once a month, this resulted in a limited short list of 11 individuals. From this shortlist, five GPs were selected purposively (maximum variation sample),[110] to cover as much variables as possible, including gender, age, type of practice, geographical location of the practice, socio-economic status of patients, etc. … For all groups, information saturation was reached.

3.3.3 Data collection and analysis

The semi-structured interviews were conducted face-to-face at the ED or at the GP's respective private practices during normal office hours.[110] All interviews were conducted in Dutch and recorded audio visually with the interviewees' permission. Quotes in this article are translated reflecting the sentiment of the original as closely as possible. The recordings of the interviews were transcribed verbatim and subsequently analysed using QSR NVivo 12.[107] A deductive coding framework was developed based on the earlier presented principles of change management and in accordance with the research questions of the process evaluation. This framework was tested in an initial round of coding of the first wave of interviews and deemed appropriate.

Subsequently, all interviews were coded inductively within the deductive framework, making it possible to extrapolate patterns and identify recurring themes and categories from the interviews. [107] The inductive coding focused specifically on areas of agreement

or disagreement on the necessity and usefulness of different aspects of the triage protocol, followed by the concurrence or difference of opinions between and within staff groups.

For all staff groups, theoretical saturation was reached. Theoretical saturation is described by Glaser and Strauss (1967) as the point when no new or relevant data emerges in the category framework, categories have well developed properties and dimensions and inter-category relationships are well established and validated.[111]

3.4 Findings

The results are structured following the principles of change management, in accordance with the coding framework used in the analysis of the interviews. In the following paragraphs, results will be presented for the organisational, group and individual level. For each level, specific facilitators and inhibitors will be summarised.

3.4.1 Results on the organisational level

Overall, both ED nurses and doctors (ED staff) felt that the implementation of triage for all walk-in patients was a welcome addition to the existing procedures. Until two years before the start of the trial, no formal triage was performed, and priority of care was determined based on waiting time and the patient's appearance and demeanour. Sometime before the start of the intervention, the hospital had set up a taskforce with the goal of developing a triage system in the ED. This led to the implementation of a first generation limited triage protocol based on the Manchester Triage System (MTS). Although the staff considered this as progress, the protocol was not considered optimal.

> *"Because we also knew that we really needed a triage system urgently. Because the way it was, it just didn't work anymore. We all felt that, though. Real mistakes were going to happen at those moments."*
>
> **Triage Nurse, Female, 8 years of experience**

Among the interviewed ED staff, there was unanimity that the extended version of the MTS protocol as developed for the intervention was suitable for its purpose. All Triage nurses indicated that they could easily find their way through the flowchart system after using the new CDSS during a few triage shifts, and that most of the program was self-explanatory. The additional information that is integrated in the CDSS to help the triage nurse in case of doubt, was also considered very helpful in the beginning and for less experienced nurses.

"On itself, it is indeed an easy system. Also certainly because, if you are in doubt, you can also request additional information. In… even if it is only with a word or two words, sometimes that is a good explanation of what [discriminant] still fits in or not."

Triage Nurse, Male, 6 years of experience

Another point of consensus was the necessity of infrastructural adaptions in order to facilitate this new triage procedure. The extent and the exact interpretation of these adaptions, however, differ between interviewees. While some focus on the redesign of the waiting infrastructure, others go as far as a complete integration of the adjacent GPC into the hospital.

"What can be a stressor is: you're triaging and the people waiting in the waiting room start complaining to you: am I going to be here for a long time? It adds to all the other things. So… the infrastructure has to change too, right? Larger waiting rooms, so that chaos can go away…"

Triage Nurse, Female, 32 years of experience

"The 'Common Entrance' is becoming more and more of a topic. […] Yes, that's positive isn't it. That does raise some questions, doesn't it… You have to find financing. For example, now just a very stupid question: your receptionist… Whose paying that for? Those are the questions that are going to be discussed a lot."

Triage Nurse, Male, 17 years of experience

"I think that integration [of the GPC] in the [hospital] building itself would be very useful. Triaging everyone? Yes everyone who comes in for one thing or another (slightly in doubt). I think that should also be explored, how interesting that is."

ED Doctor, Female, 7 years of experience

Facilitators

Before the start of the intervention, the ED nurses received trial-specific training by a specialised training company: a five-hour training on the use of MTS, a five-hour communication training focusing on assertive patient communication and a two-hour session on the trial itself. Additionally, all ED nurses received two months January and February 2019) of on-the-job training which was followed up by a research nurse to get used to the new triage procedure and to the CDSS. During these months, the ED nurses

would triage patients during the OOH care window according to the eMTS, without effectively referring the patient to the GP if this was the triage outcome. This allowed the staff to acquaint themselves with the procedures, the software and the outcomes of the triage protocol resulting in greater self-confidence during the future implementation of the intervention.

> *"In my opinion, they gave a training on … the interaction and communication and stuff… They did give some good tips. Yes, I thought so. Because that sentence of: 'I'm going to see which doctor is the best to help', they have taught you how to refer someone without giving them the feeling they are forced, but actually you do. So… you give them one choice, but not really. How you could do that. And I thought that was an added value, it helped a bit to be able to do that more confidently."*
>
> **Triage Nurse, Female, 12 years of experience**

What also facilitated the implementation of the intervention, was the fact that only 4% of the referred patients was sent back to the ED by the GP on duty at the GPC. This enhanced the confidence of the triage nurses on duty, and the trust in the triage protocols.

Inhibitors

Although the GPC is adjacent to the hospital, it has a separate entrance as depicted in Figure 10. Triage nurses have indicated that the fact that patients physically need to leave the ED to go to the adjacent building often causes delays. Patients are often not aware of the existence of the GPC and are confused when they are redirected to it. This often coincides with a language barrier.

> *"And what I always did, and I noticed that this helped people to take that step, is that I said: I'm going to go with you. Then I'll go down the corridor through the door: and then you must go next doors."*
>
> **Triage Nurse, Female, 12 years of experience**

> *"I think most [patients] don't know yet. Because if you tell them, then they dare to go to the GPC. But we are here in a hospital with a lot of multicultural… so a lot… either they don't understand that they have to go there or yes… they still think they have to pay, even if you explain it. Because they don't understand the language well..."*
>
> **Triage Nurse, Female, 1,5 years of experience**

Figure 10. Current situation of the Hospital ED (building on the left) and GPC (Building on the right) with separate entrances. (AZ Monica, 2016)

Multiple Triage nurses have indicated that they frequently accompany the patients outside the ED entrance to physically point out the GPC. This takes up valuable time, especially during busy moments. A possible solution could be to adapt the existing infrastructure so that patients have a direct passage to the GPC from the ED.

A second inhibitor is the existence of insufficiently defined discriminants. In the eMTS, a numeric pain scale is used. Pain is inherently subjective and previous research has already shown that ED nurses tend to rate a patient's pain level lower than reported by the patient .[112] During the interviews, experienced triage nurses indicated that they frequently adjusted the pain discriminator downward based on the patient's appearance or demeanour. This results in very different outcomes for patients with similar pain experiences, depending on the patient's tolerance level for pain and the adjustment made by the triage nurse. And although nurses are allowed to adjust this discriminator based on the MTS pain behaviour scale, this variance results in a distorted triage result. A possible solution suggested by an experienced ED Nurse is to determine pain based on predefined, discrete categories that indicate how the pain impacts the everyday life of the patient.

> *"But personally, I find a pain scale very difficult. […] We learned that pain is [the number] the patient says it is. But you can't use that number to… prioritise patients. A colleague once made her thesis on… It's a scale that is used to assess pain for people with mental disabilities. They*

assess facial expressions and body posture… And I think… you actually put the decision-making right, if I may say it like that, with the nurse who also studied for those things. […] When a patient can still do daily activities, then you can downscale. I think the pain scale is not working properly… "

Triage Nurse, Male, 35 years of experience

"The only thing I really keep bumping into is that pain. I think that's… a patient who… if you're really very short on staff and you have people who are inexperienced, who can't handle it well. Who obediently follow the triage protocol, then you will have very few people who get referred to the GPC. And that's a shame, sometimes... […] If someone is on their mobile all the time and you ask: is the pain bearable and that 'no, no, no… certainly not' and you ask: 'how much do you score the pain?' 'certainly eight'. Then he scores Orange…"

Triage Nurse, Male, 17 years of experience

A second discriminant that raised an issue during the interviews, was fever, specifically in the case of small children. All nurses indicated that the cut-off point of 38.5 degrees Celsius for the discriminant fever for small children (37.5 degrees Celsius for children younger than 6 months) was very strict. As small children produce high fever easily, and still can be very lively while doing so, the relatively low cut-off point seemed undue. The eMTS protocol also didn't discriminate between children who made a fever and did or did not receive an antipyretic earlier. This would result in relatively lively children with minor symptoms being triaged in the second most urgent category, due to a high, previously untreated, fever.

"Well… Sometimes [the doctors] ask: why are you keeping those children here? But yes, that is… in principle… I think you should perhaps be able to put in the criteria: have they already given something, yes, or no. Or if it is a persistent fever despite the fact that [the parents] have given medication. Or a persistent fever simply because they haven't given medication all day long. That's also a bit depending on the nature of the… patients… well, the mothers of the patients."

Triage Nurse, Female, 8 years of experience

The effect of these problematic discriminants resonates in the experience of the ED doctors with the system. As can be read in the excerpt above, triage nurses mentioned that ED doctors would ask why certain patients with relatively mild problems were retained, instead of being referred to the GP. In the interviews with the ED doctors, all of them indicated that they found the existing discriminators for referral correct or to lax, with a

majority specifying that, according to their professional opinion, even more patients would be eligible for referral to the GP.

In the current intervention, eligible patients were also referred to the GPC at night. The GPC has one GP on duty during the night and it is common practice that this GP sleeps during his shift and is only awakened in case of emergency. This is because GPs do their on-call services in addition to their work in practice, in contrast to ED doctors who work in 8 to 12 hour shifts. During the intervention, however, the GP on duty had significantly more consultations during the nightly hours. This led to some resentment with the GPs because this was often during periods when it was quiet in the emergency room. One GP stated:

> *"It is either a medical emergency for which you go to the ED, or it can wait [until the next morning]. Because what is urgent GP pathology? I have questions about that. I have serious questions about that. What is urgent as a general practitioner?"*
>
> **GP, Female, 30 years of experience**

It is, however, remarkable that the younger GPs were more understanding of the nightly consults than the older ones. It was frequently stated that, when one imposes an intervention, one should be consistent about it, even if that resulted in more night-time work.

3.4.2 Results on the group level

Findings regarding relations and interaction within groups

An important finding from the interview data, is that the workload of the triage nurse has increased significantly due to the intervention: because of the referral procedure, triage nurses have indicated that the administration and therefore the duration of triage has increased, resulting in a higher perceived intensity of the job. A shift as triage nurse takes between 7 and 10 hours, depending on the type of shift. The combination of high intensity and long shifts make this a very demanding task.

As the interviewed triage nurses reported that the job of triage nurse has become more intense, they also indicated that the intervention has an observable effect on the ED operations. All interviewed nurses indicate that, due to triage, the workload for the other ED nurses has reduced, and that they notice that, according to their subjective observations, the quality of care for the remaining patients generally has improved. Many nurses therefore indicate that they consider the increased intensity of triage as an example of 'taking one for the team'.

Within the group of ED doctors, especially the older generation, some concern existed about a loss of income due to the patients referred to the GPC. Most of those patients do not take up a lot of effort or time and could thus be considered as easy income. If the intervention would be continued and expanded, this could presumably amount to a considerable loss of income. The younger generation of ED doctors, however, all agreed that the patient demand would keep increasing due to demographic evolutions, and that chances were small that they would lose income on the long run. A popular view amongst the ED doctors was to use the referral protocol mostly during busy periods, creating an overflow to the GPC, whilst keeping patients at the ED during the off-peak hours would allow for the productivity of the doctors to keep up to standard.

The group of GPs associated with the GPC is rather large, with 110 members in 2019. Because of this, the number of shifts a GP has to be on duty at the GPC for OOH care is limited. Although the GPC administration organises frequent meetings and briefings and sends out regular newsletters, it proved to be difficult to involve everyone in the day-to-day business of the GPC. One GP admitted he does not pay much attention to the communication of the GPC administration in general, because the shifts at the GPC are his least favourite pastime.

> *"To speak for myself again: It is not what I am looking forward to, and then I am not the one who will anticipate in advance… what do I need to know in detail here?"*
>
> **GP, Male, 13 years of experience**

The fact that not all GPs are as diligent when it comes to the communication of the GPC administration, resulted in frustration with less informed GPs, as they were not correctly informed about the existing intervention, its procedures, and its aims.

Findings regarding relations and interaction between groups

Both the ED doctors and GPs were asked if they considered the triage nurse to be the right person to conduct the triage at the ED. As the aim of triage is to determine the urgency of the patient's medical issue, most of the doctors agreed that the triage nurse, given he or she has enough experience, is the right fit for the job. Multiple interviewees agreed that letting a doctor perform the triage would be cost-ineffective and would lead to opposite results. One GP formulated this as follows:

> *"We immediately think diagnostically, and that is precisely what you're not allowed to do during triage. During triage you have to see: what is*

the problem? Is it for now or is it for later? That is something we cannot do because it is not in our nature."

GP, Male, 4,5 years of experience

Triage nurses indicate that communication with patients is key for successful referrals. Quick triage after arrival at the ED serves as an opportunity to communicate with the patient about the urgency of the patient's problem and the projected waiting times. Triage nurses have indicated that, when they inform the patient about the most appropriate point of care for their medical problem, they also inform them about the probable waiting time for their problem at the ED. This often convinces the eligible patients to choose for the GP and informs patients who stay at the ED that their stay could be a lengthy one. Generally, the triage nurses agreed that this information made ED patient less impatient during busy periods. Not all patients, however, understood the consequences:

"If I send them there … if they… if I can send them on [to the GPC] and they choose to stay anyway, I will tell them that serious cases may come in and that they may have to wait a little longer. I'll pass that on, but that's just how it is. If it is a busy moment, it is, and they do not belong here. So then I tell that honestly: Look, it may be that it will take longer. But that's it ..."

Triage Nurse, Female, 3 years of experience

"Look, when it is busy, they ask ... why they have to wait a long time, but then you explain it. They don't always understand that someone else's problem is more urgent than theirs. But you will always have that."

Triage Nurse, Female, 1 year of experience

There were even ED nurses who stated that, to their subjective perception, the number of aggression cases diminished due to the intervention.

"Yes, those are so often the people of "yes: I am sitting here ... with my sick child who has been sick for two weeks and has to be checked again. And I have been here for two hours, and I have been here for three hours ... and then other people may go first! I don't know!"… it doesn't matter. And yes, those annoyances pile up, and eventually they become aggressive and they stand at your nurses' station all the time and yes ... So I think that is ... also happening less. It is never gone, but… So that is also a positive experience."

Triage Nurse, Female, 8 years of experience

"I thought it had a positive impact. Because the waiting times became shorter on some days. As a result, people also… Yes, we come across a lot of aggression, so yes… Some people can suddenly become aggressive when they have to wait a long time, so… that was a little less during that period. But you always have people who continue, so… but all in all I thought it was positive."

Triage Nurse, Female, 1 year of experience

During the intervention, the cooperation with the GPs on duty at the GPC was not always optimal, according to the triage nurses. When patients were sent back to the ED by the GP on duty, very limited feedback to the ED was given as to why. Triage nurses indicated that this feedback would help them in the future, to prevent them from making the same mistake again. If possible, the triage nurses would ask the ED doctor for a second opinion on the back referral afterwards.

Facilitators

The fact that the ED doctors are very approachable for the ED nurses to ask second opinions concerning triage, is very much appreciated. Also, within the ED nurses group there is a lot of willingness to support colleagues who are in need of advice.

"I am open to that. Ultimately, […] you see more together than you see alone. And if, anyway, the nurse here, who does the triage, ... Well, that's still individual, but ... When they say: "I don't have a good feeling about this triage result". Even though the parameters are good, and I should be allowed to refer them, I trust their assessment. And then indeed, when we see the patient… well, yes, the gut feeling prevails at that moment."

ED Doctor, Female, 10 years of experience

With regard to patient communication, the communication training the nurses received was perceived as a successful facilitator. During this training, the nurses learned several communication strategies and standard phrases to use as a starting point for their conversation with the patient. This was considered useful, as the practice of referral is not currently embedded in the Belgian habits, causing a reticence with almost all triage nurses. Generally, the older (and thus more experienced) ED nurses also indicated that patients tended to accept the referral advice more easily from them as opposed to from younger colleagues. Younger colleagues, however, stated that, during the trial, their confidence grew, resulting in a higher acceptance rate of the referral advice by patients.

Inhibitors

Because of the necessary efforts that are related to the triage protocol (e.g., Extra time to inform, persuade and direct the patient to the GPC), a certain risk exists that triage nurses might be less willing to invest time in referring patients during peak hours. During the interviews one triage nurse admitted being less diligent during peak hours, as she could not justify to herself the extra time spent on informing the patient about the referral:

> *"If it is really busy, and it is going over your head, then you have to. Then you'd better just carry on, instead of facing the hassle for those 10 minutes that they will sit inside."*
>
> **Triage Nurse, Female, 20 years of experience**

However, most triage nurses answered they understood that the benefit of the intervention was the overall reduction of workload at the ED, not that of the triage nurse. Specifically, during peak hours, referral could make a serious difference in (perceived) workload.

When a triage nurse asks an ED doctor for a second opinion, this often results in the patient staying at the ED. This could be attributed to the fact that the gut feeling of the nurse was correct and that the patient was not eligible for referral. However, one ED doctor admitted that, as the patient was already seen by her, she preferred the patient to stay:

> *"I don't think it's a problem. If the nurse feels insecure about something, or would like advice, she is allowed to. But of course, you've already seen the patient. So it is easier to say yes now that I have already seen him: to keep him here. Because yes…. Otherwise, you will have already done a little bit of your patient history and a little bit of your clinical examination. To refer him to the GPC is also a bit… Yes, so, it was often automatic…. That the patient then stayed here, even if it is something for the GP ..."*
>
> **ED Doctor, Female, 7 years of experience**

The fact that the number of GPs associated with the GPC is high, complicates the communication process. However, it has to be noted that the GPC administration uses different channels to reach its GPs, and that a certain level of due diligence should be expected from the GPs when it comes to communication and information. It was however striking that many of the triage nurses indicated that some GPs on duty sent almost every referred patient back to the ED with very little feedback.

"That was just the doctor who called for something else and I thought: now is the time. […] And then I asked kindly "hey, doctor, I now have had four of the six [patients] sent back by you, and really all by you. Did I do something wrong?" "Yes well, I have examined them better… "

Triage Nurse, Male, 6 years of experience

3.4.3 Results on the individual level

Cognitive Aspects

Both the operational and communication training provided at the start of the initial period before the official start of the intervention was considered very helpful. It was also reported that, the longer the intervention was in place, the easier it became to follow the triage protocols and to communicate the referral advice successfully. However, nurses reported that sometimes the triage outcome would not correspond with the patient's demeanour or appearance, and that their gut feeling would steer them towards another triage decision.

"Because sometimes it is difficult to tick a box on the clinical presentation of a person. Anyway, if someone is sitting in front of you, sweaty, clammy, but otherwise parameter-wise everything is ok: the system indicates everything is ok."

ED nurse, Female, 12 years of experience

These observations often result in the triage nurse manipulating the triage protocol to make the result fit with his or her gut feeling and experience. Often this was done through adjusting the pain score or choosing for the discriminator "GP Risk", which automatically leads to an ED advice. Consequently, many ED nurses have advocated for the addition of a discriminator "abnormal clinical presentation" as an option to overrule the triage protocol's outcome.

Motivational aspects

A topic that was very apparent in the interview results was that the intervention added to the improvement of professional pride and honour of being an ED nurse. The fact that the task of triaging delegated a part of the responsibility of care to the ED nurse, was considered an added value and a source of satisfaction for all interviewed nurses. Older nurses felt that they were able to contribute more to the task of triaging because of their extensive experience and saw the job as triage nurse as a good solution for when the more demanding manual labour of nursing becomes too difficult later on in their careers.

The fact that the ED nurses also perceived an improvement in the quality of care for the remaining ED patients due to the intervention, helped towards a more successful implementation, as the results of the intervention became apparent and improved motivation. The positive effects of the intervention also positively affect the acceptance of the heightened workload for the triage nurse due to the increased triage complexity.

Personality

One personality trait that has an important effect on the outcome of the intervention, is the degree of uncertainty avoidance of the ED Nurse. From the interviews, it has become clear that this trait is proportional to the trust the triage nurse has in the triage protocol of the intervention. Triage nurses with a high level of uncertainty avoidance, reported that they found it very difficult in the beginning to refer patients to the GPC. It was only after the reassurance that low-risk patients they referred were not send back, that they would gain trust in the system. This uncertainty avoidance also resulted in a discrepancy between the relative share of referred patients in the initial training period compared to the relative share of referred patients during the intervention period. One triage nurse summarises it as follows:

> *"It is true, in the beginning we had that trial period. […] That's the same as playing poker for chips. And when the real period arrives, it's poker for money. And then you start to think differently. Because no matter how you turn it: a nurse also has a sense of honour, I think… and she actually wants you to not see every patient who you send to the doctor come back."*
>
> **ED nurse, Male, 35 years of experience**

When it comes with dealing with negative patient reactions, and the effect it has on referral behaviour, another important factor is 'Locus of Control'. The construct of locus of control was defined by Rotter [113] in 1966 as a person's predisposition of the perception of internal or external causes of reinforcement.[114] Kormanik et al. (2009) specifically studied the link between planned organizational change and the locus of control of employees within that organization. In their article they found that employees with an internal locus of control respond better to change, when feedback programs are provided.[114, 115] During the interviews, it became clear that triage nurses with a stronger internal locus of control (i.e. those who saw the reason for a patient's negative reaction to their referral advice as their personal failure), were also the ones that would prefer more feedback, both on a personal and general level.

Facilitators

A few months after the start of the intervention, a research nurse involved in the development of the triage protocol spent several days at the ED as a triage mentor. This mentoring came on top of that of the already present research nurse who acted as a change champion to facilitate the intervention.[116] Both the continuous presence of the champion as the extra mentoring were perceived as positive and helpful as many of the triage nurses were reinforced in their triage practices. This decreased the level of uncertainty and doubt that still existed. From the quantitative data, it became clear that this effect persisted afterwards.

Inhibitors

During the intervention period, the feedback from the research team to the triage nurses was limited. A limited number of results was communicated after an interim analysis but no individual feedback was given to triage nurses. This was a deliberate choice, in order not to increase the pressure on the triage nurses by avoiding benchmarking themselves with their colleagues and to ensure complete privacy. However, through the (subjective) observation of a decreasing workload and the limited back referrals of patients by the GPC, the triage nurses did receive implicit feedback on their work. As mentioned earlier, a planned feedback strategy during the intervention, both in general and individually, could have contributed to faster adoption by ED nurses with a more internally focused locus of control.

A second inhibitor in this category, is the missing possibility of overruling the triage outcome based on a patient's deviating clinical presentation. This forces the triage nurses to adjust parameters in the triage protocol to influence the triage outcome. This has influenced the overall outcome of the intervention. However, all interviewed nurses indicated that this happened very rarely.

3.5 Discussion

The successful adoption of change depends heavily on the personal antecedents of the person undergoing the change.[116] Next to some general characteristics identified for all employees, two specific hurdles for starting triage nurses could be identified: the degree to which the triage nurse trusts the outcome of the triage protocol and the efficient delivery of the referral advice to the patient. The height of these hurdles is very individual to each triage nurse. However, specific training, planned feedback and mentoring can be considered as best practices to overcome said hurdles. Previous studies came to similar conclusions.[117, 118]

Several triage nurses indicated that triage with referral is a very time-consuming and complex process, and could take up to 15 minutes. This extra time is mostly taken up by informing and instructing the patient about the referral. However, literature shows that patients base their choice for OOH care mainly on the alternatives they are familiar with and the previous experiences they had with these alternatives concerning quality of care and waiting times.[119] A patient survey included in the triage intervention showed that only 40% of the triaged patients knew the GPC existed prior to visiting the ED. Therefore, this intervention also educates eligible patients about the GPC, hoping that in the future, when they have a medical problem with a similar degree of urgency, they will prefer the GPC over the ED. This is a position that is supported by Philips et al. and Carret et al. and has been shown to be successful in [88, 99, 120] However, for the extra time necessary for the intervention to be justifiable it may not exceed the projected care time of the patient. This trade-off became especially apparent during crowding at the ED, and triage nurses opted to ignore the outcome of the triage protocol in favour of triage speed.

In this intervention, the degree of the crowding of the ED was not taken into consideration. This resulted in situations where ED triage nurses had to send patients to the GPC next door, when there was excess capacity at the ED. This rose concerns about the long-term financial impact on the ED's funding and the increased (nightly) workload at the GPC. However, due to the current remuneration scheme in Belgian healthcare, a night consultation of a GP is more costly than an ED Doctor consultation due to extra fees, thus increasing the cost for the Belgian health insurance. Therefore, the discontinuation of night referral is, on the short term, not only advisable from an economic point of view, but will also facilitate an easier implementation of the intervention with the different stakeholders. On the long term, it is advisable to review the remunerations schemes of nightly OOH care on a national level, in order to level the financial playing field, that is currently putting ED doctors at a financial disadvantage.

From the ED Nurses' feedback during the process evaluation, it became clear that the clinical presentation of a patient sometimes doesn't correspond to the triage result of the extended protocol. Previous research shows that the experience of the ED nurse is a valuable tool during triage, as triage protocols cannot foresee all possible symptoms for a certain medical condition.[121] In this trial, however, it resulted in a limited number of cases where triage nurses were slightly manipulating discriminators in order to change the outcome of the protocol to a higher (or on occasion even a lower) urgency category. However, the research protocol foresaw such discrepancies, and as a rule, triage nurses were allowed to overrule the advice of referral to the GPC when deemed necessary. Nonetheless, they were not allowed to manipulate the discriminators in order to change the urgency category as this would lead to system validity issues. By manipulating the system protocol to over- or undertriage certain patients based on the ED nurse's gut feeling, the system protocol is no longer a validated instrument, potentially resulting in unexpected and unwanted effects. A consideration supported by Patel, Gutnik et al., who

reported that, as the experience of the triage nurses increases, triage decisions become more and more often intuition-based instead of analytical.[122] This leads to triage guidelines being used differently by ED nurses during the triage process, partly because explicit guideline information is internalised as nurses gain experience.[122] Although this manipulating of urgency category outcomes should have never taken place, the potential risks and effects of such adjustments would be interesting for further research.

Nurses also indicated that fever as an urgency discriminant for small children often lead to very lively children being scored in very high urgency categories. It is known that the MTS leads to much more over-triage than under-triage in children.[123] However, in some of these cases it is possible the child is actually very ill (e.g. Sepsis). By lowering the threshold for this discriminant, the risk of missing these cases will become too high.[124] A possible solution could be that in these cases an assessment by the ED doctors subsequent to the triage should be integrated in the protocol leading to a reclassification in a lower urgency category. A study by van Ierland, Seiger et al. shows that, with minor adaptions, discriminators in the MTS could serve as signal functions for the identification of febrile children at risk of severe illness.[124]

Triaging and referring to a GPC closely relates to the topic of postponement of health care. As indicated by some of the interviewed GPs, some patients that were referred to the GPC could have waited until after the weekend or bank holiday to seek treatment for their ailments. Although this might be the case for some pathologies, the Belgian law stipulates that patients asking for medical care at the ED cannot be sent away before they have seen a doctor. An extension of the triage protocol with the referral of patients to their own GP after the weekend is therefore legally impossible. However, the study shows that 22% of the patients that were actually seen at the GPC of the trial would be eligible for such a referral. Therefore, this could also be considered as an avenue for further research.

Limitations

An important limitation of this study is the fact that it was only performed in one ED. It is highly recommended that this intervention with triage and referral is repeated in several other hospital EDs located in different geographical areas in order to identify general and location specific hurdles, inhibitors and facilitators. For the same reason, it is important to note that this process evaluation still only covers a limited number of stakeholders in one location. Although saturation was reached for all groups in this specific setting, there is a limited risk that the findings are not generalizable and of anecdotal nature.

Another limitation of the study pertains to the CDSS that was used to assist the ED nurses during Triage which allowed for the extended triage protocol to be included within the existing user interface. However, the possibilities, both in functionality and registration, were a limiting factor throughout the trial.

Finally, the patient as stakeholder is not included in this part of the process evaluation. The experience of the patient during such a triage process can be very valuable information to improve the streaming process. Therefore, further research on this topic is to be advised.

3.6 Conclusion

The aim of this process evaluation was to map different facilitators and inhibitors that impact the successful implementation of a nurse-led triage system at an ED with patient streaming to an adjacent GPC. Overall, all medical staff stakeholder groups experienced the intervention of triage with referral to the most appropriate point of care as positive. The triage protocol, together with the CDSS was considered helpful and correct. Many interviewees, however, stressed the importance of overcoming some infrastructural issues that currently burden the process. A consensus exists that the ED nurse is best positioned to perform the triage: they are considered to have the correct level of education and the delegated responsibility adds to the professional pride of the job. It is also economically justifiable, as doctor's fees would make triage by a doctor much more expensive as no specific fees for triage by ED doctors are stipulated by the government. The experience of the ED nurse, together with their propensity for uncertainty avoidance and locus of control, has a large impact on the trust they have in the outcome of the system. The implementation of feedback programs and mentoring could lower these thresholds. Communication training is also important as it gives ED nurses the self-confidence to refer patients to the GPC. With the lack of formal feedback, motivation comes mainly from indirect results, such as a perceived lower workload and the low number of patients that are referred back from the GPC.

Chapter 4

TRIAGE trial: Cost analysis

Submitted and revised as: Morreel S, Homburg I, Philips H, De Graeve D, Monsieurs K, Meysman J, Lefevere E, and Verhoeven V. Cost effects of diverting patients from an emergency department to the adjacent general practice cooperative

Because this article has not been published at the time of writing, the supplementary material can be found in the appendix of this dissertation. This supplementary material is referenced as it was referenced in the revised publication: “See Appendix …”.

4.1 Abstract

Background

During the TRIAGE trial, emergency nurses diverted 13.3% of patients with low-risk complaints from a Belgian emergency department (ED) to the adjacent general practitioner cooperative (GPC). We examined the effects of this diversion on the total cost, insurance costs and patient costs, as charged on the invoice. Changes in the cost composition and the direct impact on revenues of both locations were examined as a secondary objective.

Methods

The differences in costs between intervention and control weekends were tested with two-sample t-tests and Kolmogorov-Smirnov (KS) tests. For the main outcomes an additional generalised linear model was created. Proportions of patients charged with certain costs were examined using Pearson's chi-square tests. Average revenues per weekend were compared using pooled t-tests.

Results

During intervention weekends, total costs increased by 3% (€3.3). The costs decreased by 8% (€2.2) for patients and increased by 6% (€5.5) for insurance, mainly driven by differences in physician fees. More patients were charged a consultation fee only (25% vs. 19%, p-value<0.01). The GPC's revenues increased by 13% (p-value=0.06); no change was found for the ED's revenues.

Conclusion

The intervention reduced costs slightly for patients, while total costs and insurance costs slightly increased. When implementing triage systems with primary care involvement, the effects on the costs and revenues of the stakeholders should be monitored.

4.2 Introduction

The steady increase in crowding at Emergency Departments (EDs) worldwide raises concerns about inappropriate use of EDs. Particularly during out-of-office hours (OOH), a substantial number of patients present at the ED on their own initiative for non-urgent health problems.[75, 99, 125] In Belgium, 70% of ED patients are self-referred and 40-56% are not in direct need of hospital care.[11] This raises the question whether some of these patients could be managed more appropriately in other settings.[48] To improve access to OOH primary care, many European countries are increasingly providing care in General Practitioners Cooperatives (GPCs). Despite the associated increase in primary care utilisation, many patients continue to make unnecessary ED visits.[23] Evaluations have indicated that the rise of GPCs has not necessarily led to a reduction in workload at the ED, but better access to after-hours primary care may reduce non-urgent ED utilisation.[18, 19] Unnecessary ED visits result in a high workload for health professionals, decreased patient satisfaction, and reduced quality of care. Some authors argue that inappropriate ED use could lead to unnecessary healthcare spending.[126, 127] Therefore, measures should be taken to assist patients in choosing the most appropriate care setting.

One solution is extended triage, the combination of a validated triage system at the ED with an extension to allow diversion of appropriate patients to the GPC. Classic triage systems, such as the Manchester Triage System (MTS), set treatment priorities, but are as such not suitable for a diversion to primary care.[42] An extended triage tool adds assignment to the most appropriate treatment site (ED for patients in need of urgent or advanced care and GPC for low-risk patients) to the triage system. Previous non-randomised studies have shown promising results but have seldom included a financial evaluation.[31, 43-45]

The Belgian healthcare system is organised into primary (such as GPs), secondary (general hospitals), and tertiary care (specialised hospitals), with open access for patients to all levels. It is mainly organised as a fee-for-service system. The fees for healthcare services are the result of historical negotiations between doctors' unions, semi-private health insurance funds, and the Belgian government. These fees do not necessarily reflect the actual costs to deliver the services. During OOH care, the health insurance's share is charged directly to the health insurance providers.[11] At the GPC, patients pay their share immediately on-site, while at the ED, the invoice is sent a few months later. At the time of the current study, Belgian GPCs were only open during weekends. During weeknights, GPs performed their on-call services at their own practices.

Different mechanisms may generate cost effects of extended triage. First, there are differences between consultation fees of ED physicians and general practitioners (GPs). In Belgium, the magnitude and the direction of these differences depend on the medical specialty of the physician and on the arrival time of the patient.[11] For instance, consultations during the night are more expensive at the GPC than at the ED, while the opposite occurs during daytime. Fees for technical procedures (e.g., sutures for a

laceration, or resuscitation in case of cardiac arrest) also differ between physicians and even among ED physicians with different professional degrees. Second, different physicians treat similar patients differently in terms of diagnostic procedures, treatments, and hospitalisations which might have an impact on costs. Low-risk ED patients diverted to the GPC might receive a different treatment than they would receive at the ED. This variation has been described between GPs working in a private practice versus an ED.[128] Variation in practice style between GPs and ED physicians has been reported as well.[129] Further, when some patients are referred to the GPC, ED physicians might treat their remaining patients differently leading to changes in costs.[130]

To guide Belgian policymakers and further implementation of extended triage, we designed a large, randomised trial to assess whether cost differences arise in practice. Previous studies were insufficient, as few assessed the economic impacts of a reduction in inappropriate ED use and had important methodological limitations.[19] For instance, no studies used a randomised design. Some studies found that the presence of a GP inside the ED led to an improvement in the effectiveness and quality of care and was less expensive than the usual care method, as they used fewer resources than usual ED staff.[131-134] Other studies focused on cost changes when a GPC and ED collaborate. Most of these studies simply compared costs of patients treated at a GPC or in the ED, without considering that patient characteristics might differ between the two settings. Several studies found small cost savings [67, 135], while others found an increased cost per patient in the integrated model.[136, 137] One study examined the cost savings when diverting self-referred, non-urgent children who present at the ED to the GPC.[135] This prospective observational before-after study found that overall cost benefits of the triage were minimal. The evidence supporting that care models aimed at reducing inappropriate use are financially beneficial remains weak. If savings are realised, this is likely to be overshadowed by the overall cost of introducing an alternative service.[69, 138] Finally, although diverting low-severity patients might reduce costs, compared with strategies aimed at reducing admissions, and to a lesser extent improving the efficiency of ED care for intermediate or complex conditions, the potential is small.[139]

This article is the first to use a cluster randomised design to investigate the cost effects of diverting ED patients with primary care problems from a Belgian urban general hospital to the adjacent GPC. The clinical results of this trial have been published elsewhere.[102] In this article, we examined whether diverting patients to primary care has an impact on total costs and on the costs for the social insurance and the patients, as charged on the invoice. In addition, we investigated which type of medical treatment drives the changes in costs and how the cost composition of the invoice changes. As a secondary objective, the direct impact of the intervention on the revenues of the ED and GPC was examined.

4.3 Materials and methods

4.3.1 The TRIAGE trial

The TRIAGE trial was designed to determine the effects of an extended nurse-led triage system that diverts low-risk patients from a Belgian ED to a GPC. This single-centre, clustered randomised trial ran from 01/03/2019 to 30/12/2019. Patients were the units of analysis and weekends (Friday 7 p.m. until Monday 7 a.m.) or bank holidays, hereinafter referred to as weekends, were the units of randomisation. During the trial, a trained nurse performed an extended triage at the ED and assigned patients to the ED or GPC. During intervention weekends, patients with a low risk for hospital care were advised to visit the GPC. Patients had the right to refuse the advice. During control weekends, patients were not informed about the GPC as the advice was recorded in the patient's file but not communicated to the patient. The study was carried out at the ED of an urban general hospital and at the adjacent GPC. The surroundings consist of ethnically diverse middle income and socially deprived neighbourhoods. The ED is staffed by approximately 10 physicians and 25 nurses, who managed 33 027 contacts in 2018. Compared to other Belgian EDs, the workload of 90 patients a day is on the 75th percentile. The GPC covers a neighbourhood of 145 000 inhabitants and all 110 GPs working in the area are required to work at least one shift per month in the GPC. In 2018, the cooperative handled 10 586 consultations. The GPC moved from a location nearby to a building adjacent to the ED two years prior to this study.

The population of the study site is comparable to other Belgian cities and suburban areas in Europe. Although important national differences exist, the GPC is increasingly the dominant model for organisation of OOH primary care in Europe.[140] More than half of the Organisation for Economic Co-operation and Development member states have established gatekeeping systems (GP referral is required to access secondary care) while in Belgium, ED and GPC are freely accessible.[34, 141]

For this study, all patients presenting at the ED during the trial were assessed for eligibility (N=9964). Patients arriving in a physician- or nurse-staffed ambulance, patients already admitted to the hospital, and patients referred to the ED by a GP or specialist were excluded because they already underwent a triage. Patients without a social insurance number were excluded as it was not possible to link their data from the ED to the data from the GPC. The final study population consisted of 8158 self-referred patients.

The extended triage was performed using a newly developed extension to the MTS.[142] It consists of 53 flowchart diagrams, each specific to a reason for encounter (e.g., abdominal pain). Every flowchart consists of discriminators (e.g., mild pain), eventually leading to an urgency category ranging from level one (immediate care necessary) to level five (non-urgent).[143] In the extended version, additional discriminators in the two lowest urgency categories were added to 44 flowcharts to determine the most appropriate caregiver (ED physician or GP).

The TRIAGE trial demonstrated that a sustainable, safe diversion of low-risk ED patients to primary care is possible using the extended MTS. During intervention weekends, 838/6294 patients (13.3%, 95% CI 12.5 to 14.2) were assigned to visit the GPC, of which 599/6294 (9.5%, 95%CI 8.8 to 10.3) followed the advice and were treated by a GP. Of these, 24 were referred back to the ED and three were admitted. More detailed results on the trial and its methodology are reported elsewhere.[102]

4.3.2 Outcome measures

The primary outcomes of this study are the total cost of all medical services delivered to the patient, the share of these costs for the patient, and the share of these costs reimbursed by the social health insurance. For this study, costs are defined as the prices that appear on the invoice of the patient for the supplied medical services. These costs do not necessarily reflect the opportunity costs of the delivered service. Additional outcomes are the different cost categories (physician fees, medical imaging, technical procedures, medication, and non-refundable items) and whether certain cost categories were charged. The secondary outcomes are the total revenues for the delivered medical services of the GPC and the ED during the trial. Some of the revenues described as 'ED revenues' do not go directly to the ED or ED staff but to other services of the study hospital, such as the radiology department.

4.3.3 Data collection

The following data were collected using iCAREdata, a database of OOH care medical records [144, 145]: patient's age, sex, residence (living within the communities covered by the GPC or not), and socio-economic status (receiving increased reimbursement or not); MTS flowchart (53 flowcharts combined into 15 categories); time period (day, evening, or night); subjective crowding at the ED (quiet, normal, busy). The data from the ED and GPC were linked through their pseudonymised national insurance number.

Patient-level data on the costs of treatment at the ED and GPC were received from the billing department of the hospital and the GPC, respectively. The data consisted of the nomenclature (billing) codes of all provided medical services and their costs. The cost for 87 study patients were not reimbursed by the social health insurance but by a private insurance company or another government institution. Because the paying party does not influence the total costs, these costs have been added to those of the social health insurance (further referenced to as insurance). The nomenclature codes were grouped to construct different cost categories: consultation fees, medical imaging, technical procedures, medication, non-refundable items, and the total billing cost of all medical services. Supplementary fees linked to other costs, such as a night time consultation supplement, have been added to the cost category they are linked to. The category non-refundable items consists of various articles at the request of the patient (e.g., a

toothbrush) or necessary for their medical care (e.g., crutches). Costs for medication only include the medication given to the patient during a consultation. The invoices were matched with the medical records based on sex, birth year, postal code, and time. Laboratory tests are in general billed by a separate department and were not routinely available for the study.

Only costs directly related to the care of individual patients and thus appearing on the patient's invoice were studied. The GPC and the ED have additional revenues, such as government funding for staff and infrastructure, which were not analysed. Patient-level data on medical imaging ordered by the GP were unavailable. However, GPs seldom order medical imaging. During the second semester of 2019, medical imaging was ordered for only 77 out 5747 GPC patients (1.3%, 95%CI 1.1-1.7).

4.3.4 Study population

For our primary objective (the impact of the intervention on costs), we included all study patients in the TRIAGE trial. For our secondary objective (the impact of the intervention on the revenues for the study sites) we included all patients who received an invoice from the ED or the GPC during the trial period. This included patients who visited the GPC without a prior ED visit. Patients with a missing invoice were excluded.

For our primary objective, we excluded patients who were hospitalised. Their ambulatory invoice was not representative of their costs at the ED and thus not comparable to ambulatory patients. Further due to the complex reimbursement system in Belgium, some ED costs appear on the invoice for the hospitalisation while others are not reimbursed in case of a hospitalisation.

For the secondary objective (impact of the intervention on the revenues of the ED and GPC), hospitalised patients were not excluded as these analyses did not require comparisons between patient groups. Weekends that include bank holidays and bank holidays in the week were excluded for the secondary outcome as the length of these was more than a standard weekend, naturally leading to different total revenues.

4.3.5 Statistical analysis

To test whether the randomisation was successful, patients' socio-demographic and medical characteristics were compared between control and intervention weekends using Pearson chi-square tests.

For the primary objective, mean costs were compared using a pooled t-test or a t-test for unequal variances, depending on which was most appropriate according to an F-test. Although the TRIAGE trial was randomised, a regression analysis could increase statistical

power, and thus a generalised linear model (GLM) with a log-gamma link was created for the total costs, the total share for patients, and the total share for the insurance. This model allowed us to estimate mean costs as a function of a set of covariates and is robust to outliers or asymmetries in the data distribution. As the invoice data were highly skewed with a long tail to the right (medcouple = 0.02). It was not suitable to study the composition of the invoices, as these categories contained many zero values.[146] A sensitivity analysis excluding four outliers with very high costs (above €1000) was executed in order to check whether these few records influenced the overall results.

Combined Kolmogorov-Smirnov (KS) two-sample tests were used to examine whether the samples from the intervention and control weekends were from populations with the same distribution. The KS test is an appropriate nonparametric test, as the invoice data were skewed and the direction of the effect was unknown prior to the analysis. Compared to a t-test, the KS test is sensitive for all types of differences that may exist between the two distribution functions, including differences in mean, median, or variance..[147] In case of a significant difference in the distributions, a one-sided KS test was used to assess the directions of this(ese) difference(s).

The cumulative density functions of the total cost per patient and the costs for different cost categories were analysed. Such an analysis allows to understand the changes caused by the intervention more precisely. The proportion of patients to whom a certain cost category or a combination of certain categories was billed was compared between intervention and control weekends using Pearson's chi-square tests.

For the secondary objective, the average number of treated patients and average revenues per weekend were compared between intervention and control weekends using a one-sided pooled t-test. An increase was expected for the GPC, while a reduction was assumed to occur at the ED.

Data were analysed using JMP Pro® version 15.0 (SAS institute) and Stata 17.0 (StataCorp LLC, College Station, TX USA). The significance level for all tests was set at 0.05.

4.4 Results

4.4.1 Study population

During the TRIAGE trial, 8158 patients were assessed for eligibility. The intervention group consisted of 6374 (78.1%) patients and the control group of 1784 (21.9%) patients.[102] Because of subsequent hospitalisation, 1339 (16.4%) patients were excluded for the analysis of our primary objective. Another 338 (4.1%) patients were excluded, as their ED invoice data was missing (N=299) or because no match could be made between invoice and medical data (N=39). Missing invoices were uniformly distributed over time. The mean

number of patients with a missing invoice and the mean number of hospitalised patients, as well as their characteristics, did not significantly differ between intervention and control weekends (see Appendix S1 and S2). The resulting sample consisted of 6481 patients, 5069 (78.2%) presented during intervention weekends and 1412 (21.8%) during control weekends. Of these patients, 543 received an invoice from the GPC and 5888 from the ED. Due to a mistake from the billing department (N=34) or due to being referred back to the ED (N=16) by the GPC, 50 patients received an invoice from both care settings.

The sample to analyse the revenues (secondary objective) consisted of 5898 patients with invoices from the ED and 8011 patients with invoices from the GPC, spread over 30 intervention weekends and 9 control weekends.

4.4.2 Sample characteristics

Appendix S3 compares patient characteristics between intervention and control weekends. The differences in socio-demographic characteristics (age, sex, socio-economic status, and residence) as well as the presenting medical complaint were not significant.

During intervention weekends there was a limited shift from the urgency categories four and five towards more urgent categories (p-value=0.049) (see Appendix S4). The selection of a certain urgency category is thus not independent from the intervention. As a result, comparing costs between control and intervention weekends within urgency categories was not appropriate.

4.4.3 Comparison of summary statistics

Table 7 provides a comparison of summary statistics for the total cost of care and various cost categories between intervention and control weekends. During control weekends, the mean total cost per patient was €119 (median €90). Costs during intervention weekends were on average 3% more expensive, with an average total cost of €122 (median €90). This difference in mean was not significant according to the to the t-test, but in the log-gamma GLM it was significant (see Appendix S5). The KS test indicated that the two samples did not have equal distributions. When examining the various cost categories separately, the KS test was only significant for the physician fees. However, the median (€49) and the mean (€46) were similar during control and intervention weekends. A small difference was also visible in the costs for medical imaging. The average cost for this type of service was higher during intervention weekends (€28 compared to €24).

The second part of Table 7 shows the share of the cost borne by the patient and by the insurance. On average, patients had an invoice of €26 and €28 during intervention and control weekends, respectively. This cost reduction of about 8% was significant both according to the t-test and the GLM model (see Appendix S5). The KS test indicated that the distributions differed between both groups. This difference was driven by the physician

fees. The mean consultation fee was significantly higher during control weekends. The opposite was found when examining the costs for the insurance. The mean total insurance cost during intervention weekends was around 6% higher than during control weekends, namely €97 compared to €91. This increase was significant at the 0.10 level according to the t-test and at the 0.05 level in the GLM (see Appendix S5). The KS test indicated that the two samples had significantly distinct distributions. Again, this was driven by higher consultation fees. In addition, the average cost for medical imaging borne by the insurance was higher during intervention weekends.

Table 7. Comparison of summary statistics for the total cost of care and various cost categories between intervention and control weekends. All costs are expressed in euro 2019.

		Intervention (n=5069)	Control (n=1412)	Total (n=6481)	p-value combined KS two-samples test	p-value t-test for unequal variances
Total invoice						
Total cost	Mean (SD)	122 (116)	119 (117)	122 (116)	<0.01	0.34*
	Median (IQR)	90 (49-137)	88 (49-135)	90 (49-137)		
Physician fees	Mean	46 (13)	46 (11)	46 (13)	<0.01	0.65
	Median	49 (39-49)	49 (39-49)	49 (39-49)		
Medical imaging	Mean	28 (58)	24 (51)	27 (56)	0.05	0.05
	Median	0 (0-28)	0 (0-28)	0 (0-28)		
Technical procedures	Mean	42 (68)	42 (79)	42 (71)	0.28	0.97
	Median	23 (0-53)	21 (0-48)	23 (0-48)		
Non-refundable items	Mean	3 (7)	3 (6)	3 (7)	0.49	0.70
	Median	0 (0-2)	0 (0-2)	0 (0-2)		
Delivered medication	Mean	3 (14)	2 (6)	3 (13)	0.49	0.28
	Median	0 (0-2)	0 (0-2)	0 (0-2)		

** Pooled t-test, most appropriate according to F-test for unequal variances*
SD: Standard Deviation
IQR: Interquartile Range

Table 7 continued. Comparison of summary statistics for the total cost of care and various cost categories between intervention and control weekends. All costs are expressed in euro 2019

		Intervention (n=5069)	Control (n=1412)	Total (n=6481)	p-value combined KS two-samples test	p-value t-test for unequal variances
Share for the patient						
Total cost	Mean (SD)	26 (28)	28 (36)	26 (30)	<0.01	0.014
	Median (IQR)	23 (12-31)	23 (15-31)	23 (13-31)		
Physician fees	Mean	16 (10)	18 (9)	17 (10)	<0.01	<0.01
	Median	21 (12-21)	21 (12-21)	21 (12-21)		
Medical imaging	Mean	2 (9)	2 (12)	2 (9)	0.61	0.29
	Median	0 (0-2)	0 (0-2)	0 (0-2)		
Technical procedures	Mean	3 (11)	3 (17)	3 (12)	1.00	0.41
	Median	0 (0-2)	0 (0-2)	0 (0-2)		
Non-refundable items	Mean	3 (7)	3 (6)	3 (7)	0.51	0.68
	Median	0 (0-2)	0 (0-2)	0 (0-2)		
Delivered medication	Mean	1 (4)	1 (4)	1 (4)	0.51	0.72*
	Median	0 (0-1)	0 (0-1)	0 (0-1)		
Share for the insurance						
Total cost	Mean (SD)	97 (108)	91 (109)	95 (109)	<0.01	0.092*
	Median (IQR)	62 (33-107)	57 (28-104)	61 (33-107)		
Physician fees	Mean	30 (14)	28 (11)	30 (13)	<0.01	<0.01
	Median	28 (25-37)	28 (27-37)	28 (25-37)		
Medical imaging	Mean	26 (55)	22 (48)	25 (54)	0.54	0.02
	Median	0 (0-27)	0 (0-27)	0 (0-27)		
Technical procedures	Mean	39 (65)	39 (74)	39 (68)	0.37	0.91
	Median	20 (0-48)	16 (0-46)	20 (0-46)		
Non-refundable items	Mean	0 (1)	0 (1)	0 (1)	1.00	0.86*
	Median	0 (0-0)	0 (0-0)	0 (0-0)		
Delivered medication	Mean	1 (12)	1 (3)	1 (11)	0.96	0.28
	Median	0 (0-0)	0 (0-0)	0 (0-0)		

A sensitivity analysis excluding four outliers with extremely high costs (above €1000) revealed similar results even though the significance of the difference in patient's share decreased and insurance's share increased (see Appendix S6).

4.4.4 Cumulative density functions

Figure 11 plots the cumulative density function of the total cost per patient for both intervention and control weekends. A remarkable difference between weekends can be observed at the lowest percentiles (one-sided KS p-value<0.01). During intervention weekends, a relatively large fraction of patients had a total cost of around €39, indicative of the most common OOH-consultation fee of a GP.[148] Compared to control weekends, a smaller fraction of patients had a cost of approximately €49, which corresponds with the consultation fee of an ED physician.

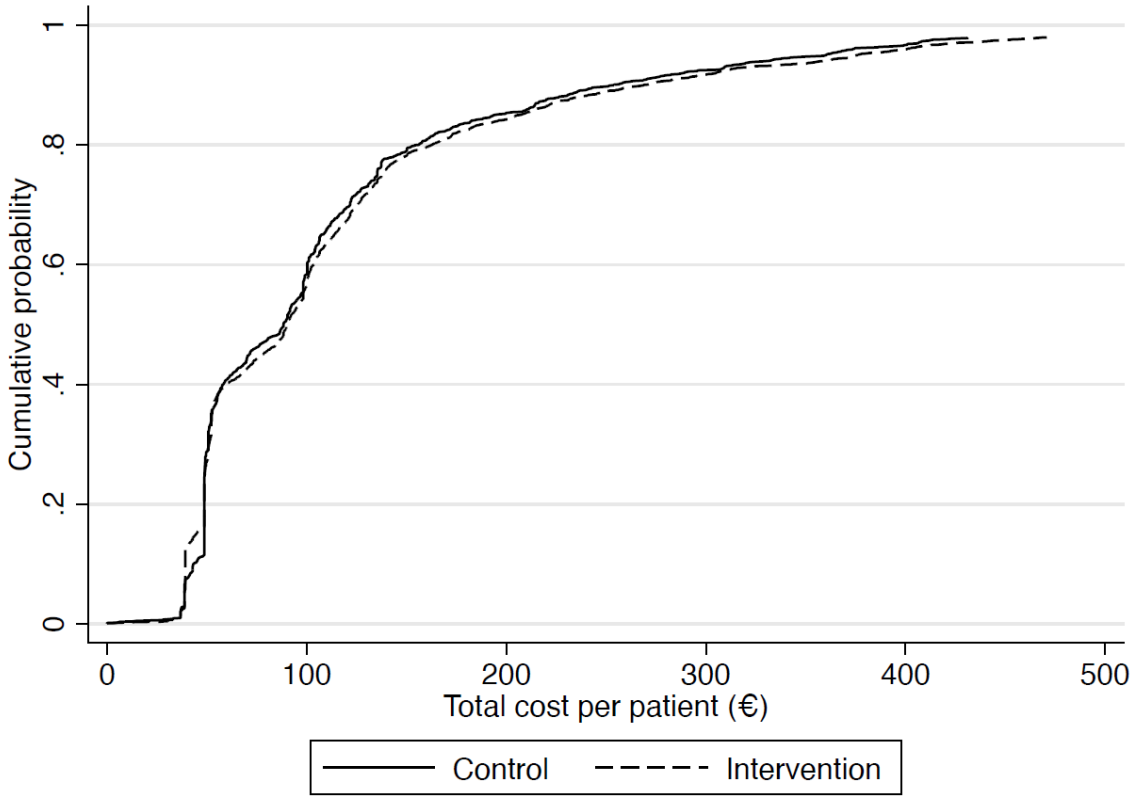

Figure 11. Cumulative density function of the total cost (in euro 2019) per patient for intervention and control weekends.

The x-axis has been restricted to the 98th percentile, otherwise the limited number of patients with a very high cost reduce the readability of the graph.

The cumulative distributions of the physician fees (see Figure 12) show that during intervention weekends, two shifts occurred. First, an additional fraction of patients paid a typical €39 consultation fee of a GP. Therefore, the distribution of costs during intervention weekends contains significantly smaller values than the distribution during control weekends (one-sided KS p-value<0.01). At the higher percentiles, the opposite is observed. During intervention weekends, a small group of patients was charged €52, the typical consultation fee for a GP at night.[148] The intervention group then contains larger values than the control group (one-sided KS p-value<0.01). Thus, the null hypothesis that the distribution of consultation fees is equal in intervention and control weekends is rejected (KS p-value<0.01). The cumulative density functions of the costs for medical imaging, technical procedures, medication, and non-refundable items are similar between intervention and control weekends (see Appendix S7).

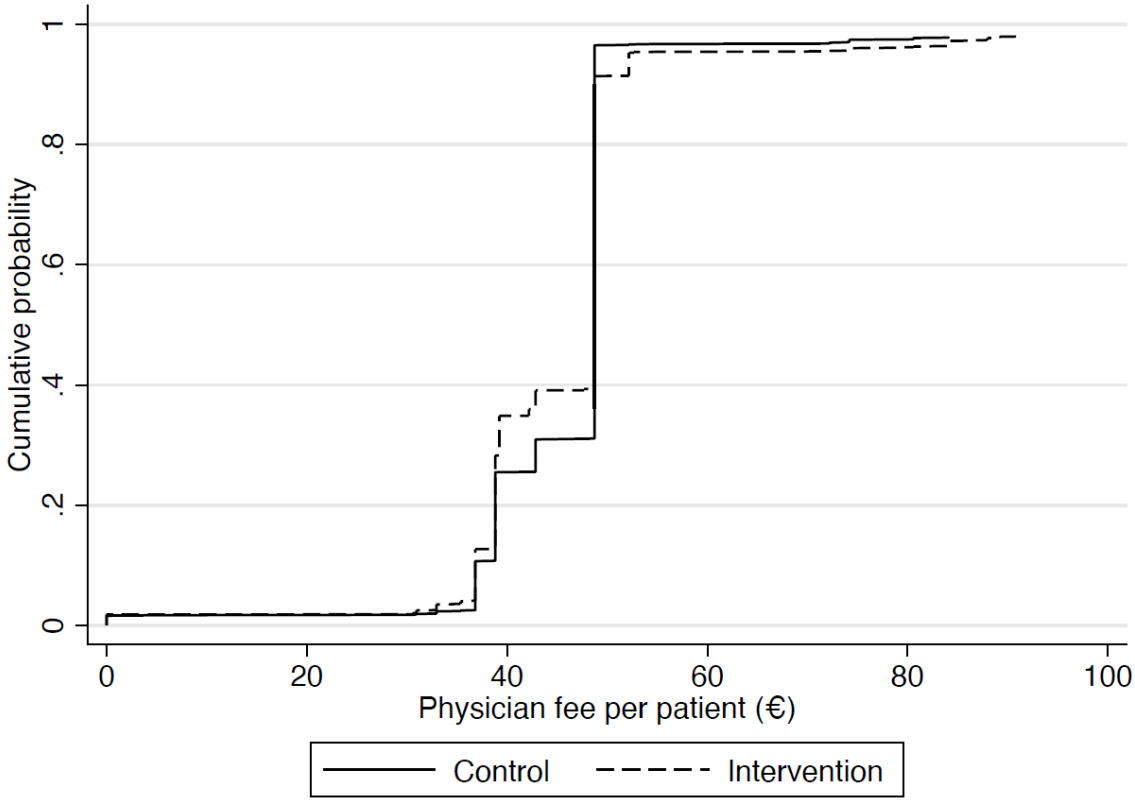

Figure 12. Cumulative density functions of the physician fee cost (in euro 2019) per patient for intervention and control weekends.

The x-axis has been restricted to the 98th percentile, otherwise the limited number of patients with a very high cost reduce the readability of the graph.

4.4.5 Cost composition of the invoice

Table 8 shows the composition of the invoices. During both intervention and control weekends, 98% of patients were charged a consultation fee. For the remainder, the hospital probably made an administrative mistake.

Table 8. Composition of the invoice per patient for intervention and control weekends.

	Intervention (%) (n=5069)	Control (%) (n=1412)	p-value chi-square test
Consultation fee	4977 (98%)	1389 (98%)	0.64
Medication	2216 (44%)	652 (46%)	0.10
Medical imaging	1983 (39%)	545 (39%)	0.72
Technical procedures	2773 (55%)	760 (54%)	0.56
Non- refundable medication/items/procedures	2295 (45%)	674 (48%)	0.10
Only consultation fee charged	1239 (24%)	271 (19%)	<0.01
Only consultation fee and medication charged	393 (8%)	147 (10%)	<0.01
Only consultation fee and non-refundable items charged	167 (3%)	64 (5%)	0.03
Only consultation fee, medication, and non-refundable items charged	283 (6%)	110 (8%)	<0.01

Regarding the extent to which this consultation fee was combined with other costs, two groups of patients can be described. First, there is a considerable group of patients to whom, apart from the consultation fee, very little or no other costs were charged. During control weekends, almost one fifth of the patients (19%, 95%CI: 17 to 21) paid for a consultation only. For another 10% (95%CI: 9 to 12), a consultation fee was combined with medication. The average cost of medication for these patients was €3. For 5% of the patients (95%CI: 4 to 6), the consultation was combined with non-refundable items. For these, the average cost of items was €3. Finally, 8% (95%CI: 6 to 9) had a consultation combined with medication and non-refundable items. The sum of medication and non-refundable items was on average €8 for these patients. A second group of patients had an invoice consisting of more substantial costs. Technical procedures were carried out for 54% (95%CI: 51 to 56) of patients seen during control weekends, with an average cost of €79 for them. Medical imaging was charged for 39% (95%CI: 36 to 41), costing on average €63 per patient.

A similar trend was observed during intervention weekends. However, significantly more patients were only charged a consultation fee, namely 24% (95%CI: 23 to 26, p<0.01). This was paired with a smaller fraction of patients for whom the consultation fee was combined

with either medication or non-refundable items. No differences were observed in the number of patients charged for technical procedures and medical imaging.

4.4.6 GPC's and ED's perspective

During intervention weekends, the GPC's revenues were on average 9885€ (13%) higher than during control weekends (€8608 vs. €7619, p-value=0.03). The mean number of patients seen per weekend increased as well, although not significantly (210 vs. 190, p-value=0.06). For the ED, no significant effect was found in the average revenues (€19228 vs €18869, p-value = 0.65). The number of patients seen per weekend decreased by 6% (149 vs. 159, p-value=0.05). See Appendix S8 for an analysis of the revenues and number of patients per weekend.

4.5 Discussion

The invoices of 6481 patients, 5069 (78.2%) from intervention weekends and 1412 (21.8%) from control weekends, were analysed. There was a small increase of 3% (€3.3) in the mean total costs per patient. The GPC's revenues increased by 13% during intervention weekends while no reduction was found for the ED's revenues. Average costs decreased 8% (€2.2) for the patient and increased 6% (€5.5) for the insurance during intervention weekends.

An increase in the average cost for medical imaging (€28 vs. €24, p=0.05) during intervention weekends was found. A possible explanation for this increase is that need for medical imaging (which was always linked to an ED assignment) was an important item (discriminator) in the extended MTS triage. Diverting a fraction of patients towards the GPC reduced the number of patients with small additional charges, such as medication or non-refundable items. This suggests that apart from cost for medical imaging, cost shifts due to the intervention occurred within the group of patients who would have received a moderate invoice anyway (consisting of a consultation and medication/refundable items).

Our findings are similar to previous findings that the potential cost savings of diverting low acuity patients from ED to GPC are limited.[139] The minor cost differences might be related to the small proportion of diverted patients (10%) as compared to similar studies that reported a diversion of around 20%.[21, 66] The total cost increase we found was mainly due to an increase in the cost of medical imaging and has to be monitored closely. We could not detect an increase for the other categories, but the study was not designed to study them, so an effect on these costs in any direction cannot be excluded. Policy makers should be aware of a possible (small) cost increase when implementing extended triage.

The small increase in total costs does not necessarily mean the intervention was not useful from a clinical perspective. For example, the ED staff considered the triage helpful and

found it a positive experience. Given the shortage of specialised ED nurses, a rewarding working environment is important.[149] Additionally, ED crowding is associated with worse quality of care and worse perception of care, the studied intervention might mitigate this effect.[150] There may also be a long-term effect, as patients who were previously introduced to the GPC will visit a GP more readily in the future.[88]

On average, the intervention was associated with a lower invoice paid for by the patient (€26 vs. €28) and a higher invoice for the insurance (€97 vs. €91). The share of the invoice borne by the patients decreased, driven by the physician fees. GPC consultations offer higher reimbursements from the insurance, such that only about a quarter is paid by the patient. In the ED, the patient pays almost half of the cost. Extended triage can be used to make emergency healthcare more accessible, especially because more patients with a low socio-economic status were diverted to the GPC.[102]

The GPC had a revenue increase of almost 13% (€8608 vs. €7619), while no reduction of the revenues at the ED was found. However, we cannot definitely exclude any loss at the ED, as the standard deviation on its mean revenues per weekend was large, the expected loss was small, and this outcome was a secondary objective only. It is possible that the ED treated the remaining patients during intervention weekends more intensively. The increase in the costs of medical imaging points in this direction. To mitigate shifts in income from ED to GPC, implementation of extended triage should be accompanied by a reform of the funding structure of the entire OOH system. One aim of the TRIAGE trial was to reduce health insurance costs, not to increase the revenues of the GPC so this reform should focus on a financing system that rewards efficient patient care and not the delivery of technical procedures and consultations. Under the intervention, the ED invested in personnel (receptionists and triage nurses) for triage that generated revenues for the GPC. At least partially, GPC and ED should be financed together so they have an incentive to collaborate efficiently. Synergies can be found in the sharing of infrastructure and staff.

In this study, one out of every four patients assigned to the GPC refused the extended triage and remained at the ED.[102] If the proportion of refusers is minimised, which can be achieved by making the advice compulsory or by improving patient-nurse communication, then cost changes may be larger.[135] Policy makers should consider an obligation to follow a GPC assignment while taking into account the patient's perspective.

Our study has some limitations. First, comparing costs between control and intervention weekends by urgency category was not possible since the categories were not independent from the intervention. Such an analysis would capture not only the impact of the intervention, but also the influence of a different and more selective allocation to low urgency categories by the nurses on duty. Doing so would overestimate the savings during intervention weekends giving the higher costs for higher urgency categories. However, when comparing the total cost and various cost categories for only urgency categories four

and five, the results were similar (see Appendix S9). Second, there was no full insight into the costs and revenues. Patient level data on medical imaging ordered by the GP and clinical laboratory tests from both settings were not available. We are confident that both imaging and laboratory test are rarely used at the GPC, but do not know the impact on laboratory testing at the ED. We did not study short- and long-term follow-up costs after the ED or GPC consultation. This article analysed only the invoice costs, which do not include all resources used and revenues generated. The GPC and ED have other costs and incomes, such as government funding for staff and infrastructure. Some of these are influenced by the number of patients. Fixed costs (e.g., infrastructure), costs related to the nursing staff or the ED's equipment, additional costs for implementing and executing the triage, and spillover effects, such as a decreased waiting time or patients refusing advice and leaving without care, were also not considered. Finally, caution is recommended when generalising our results. The study population is representative for other Belgian cities and to a certain extent to other European suburban districts. However, the findings may not be replicable in other settings because they were mainly driven by pricing differences in physician fees, which is country specific. These fees can change after new fee negotiations. Especially the large difference in night-time and day-time fees for the GP as compared to the ED physician is typical for the local healthcare system. Despite this limitation, our results do implicate a clear warning that implementing extend triage does not necessarily lead to a cost reduction, on the contrary, it might lead to an overall cost increase. Our findings support the need for thorough financial evaluation within a specific healthcare system before the implementation of extended triage in that system can be considered.

4.6 Conclusion

Using a cluster randomised controlled trial on extended triage, we analysed the cost effects of diverting ED patients to the adjacent GPC. Costs decreased significantly for a fraction of patients, mainly due to pricing differences in consultation fees between ED physicians and GPs. The limited cost effects occurred within the group of patients who would have received a moderate invoice anyway. The intervention reduced the patients' share of the total invoice by 5% due to lower co-payment at the GPC, but also increased cost of the social health insurance by 7%, mainly because GPC visits are reimbursed at a higher percentage than ED visits. The GPC's revenues increased with 13% due to the intervention, while no significant decrease was found at the ED. When implementing extended triage systems, the effects on the costs for patients and the government and the effects on the revenues of the involved healthcare services should be closely monitored. Further implementation of extended triage should be embedded in a reform of the funding for the OOH care system.

Chapter 5

TRIAGE trial: Refusing an assignment to the GPC

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5.1 Abstract

Background

During the cluster randomised TRIAGE trial, a nurse advised 13% of low-risk patients presenting at an emergency department in Belgium to visit the adjacent general practitioner cooperative. Patients had the right to refuse this advice. This study examines the characteristics of refusers by uncovering the determinants of non-compliance and its impact on costs, as charged on the patient's invoice.

Methods

Bivariate analyses with logistic regressions and T-tests were used to test the differences in patient characteristics, patient status, timing characteristics, and costs between refusers and non-refusers. A chi-square automatic interaction detection analysis was used to find the predictors of non-compliance.

Results

23.50% of the patients refused the advice to visit the general practitioner cooperative. This proportion was mainly influenced by the nurse on duty (non-compliance rates per nurse ranging from 2.9% to 52.8%) and the patients' socio-economic status (receiving increased reimbursement versus not OR 1.37, 95%CI: 0.96 to 1.95). Additionally, non-compliance was associated with being male, not living nearby and certain reasons for encounter. Fewer patients refused when the nurse perceived crowding level as quiet relative to normal, and more patients refused during the evening. The mean cost was significantly higher for patients who refused, which was a result of more extensive examination and higher out-of-pocket expenses at the ED.

Conclusion

The nurse providing the advice to visit the general practitioner cooperative has a central role in the likelihood of patients' refusal. Interventions to reduce non-compliance should aim at improving nurse-patient communication. Special attention may be required when managing patients with a lower socio-economic status. The overall mean cost was higher for refusers, illustrating the importance of compliance.

5.2 Background

Crowding of emergency departments (EDs) in hospitals is a commonly reported problem, particularly out-of-hours (OOH). Although there is no consensus on the definition of 'appropriate' or 'inappropriate' use of the ED, several studies found that many medical problems presented at the ED could be managed in a primary care setting, as they do not always require emergency care.[72-75] In many European countries, OOH primary care is organised in General Practitioners Cooperatives (GPCs). These GPCs operate as walk-in centres for unplanned OOH care, thus offering an alternative for ED visits, and are staffed by the regional GPs. In Belgium, approximately 80 cooperatives have been introduced from 2003 onwards, covering about 70% of the population.[11, 151] The organisation of these cooperatives improved access to OOH primary care and was associated with an increased use of primary care. However, GPCs did not necessarily lead to a decrease in the workload of EDs.[19] Patients with low-risk complaints, easily treatable by a GP, continue to make emergency visits because choosing the appropriate service is not easy. Most patients base their decision on previous experience, ease of access, the anticipated waiting time, the relationship with their general practitioner (GP), or the perceived nature of the complaints.[6, 152] 'Inappropriate' use of the ED is a problem because it may compromise efficient use of healthcare personnel, infrastructure, and financial resources. Therefore, measures should be taken to assist the patients in choosing the recommended place of care.[11] Triaging patients is one possible solution. Triaging is defined as sorting out and classifying patients to determine treatment priority and proper place of treatment.[153] After triage in the ED, some patients would be assigned to primary care services. However, little is known about the effectiveness and safety of this system.[48]

The TRIAGE trial determined the impact of a nurse-led triage system that assigned low-risk patients from the ED to the adjacent GPC. At the time of the current study, Belgian GPCs were only open during weekends and bank holidays. A newly developed extension to the Manchester Triage System (eMTS) was used to identify patients with low urgency complaints and advise them during intervention weekends to visit the GPC. During control weekends, the advice was recorded but not communicated to patients, who therefore all remained at the ED. The study showed that during intervention weekends 838/6294 (13.3%, 95%CI: 12.5 to 14.2) of patients received the advice to visit the GPC of which 196/838 (23.4%, 95%CI: 20.6 to 26.4) refused. During control weekends, the fraction of patients assigned to the GPC was twice as high, indicating nurses may find it easier to give theoretical advice rather than discuss it with the patient. Overall, the trial showed that a sustainable safe relocation of non-urgent ED patients to primary care is possible using the eMTS.[102]

The conclusion that such relocation is feasible is confirmed by smaller, non-randomised, studies as well.[43-45, 154] However, the role of patients who refuse the advice to visit the GPC is often omitted. Such non-compliance undermines the effectiveness of the system,

yet not much is known on this subject. The determinants of non-compliance to general medical treatment have been researched, but no theoretical framework exists that adequately predicts the behaviour. For instance, authors find contradictory results on the role of patient's sex and age.[155] Most studies find that socio-economic characteristics, such as unemployment or low-income contribute to non-compliance,[156, 157] although educational level does not seem to be a predictor.[158] Overall, high rates of non-compliance have been reported in multiple settings and across many socio-demographic groups. Estimates of its overall rate range from 30% to 50% and above.[159]

The TRIAGE trial offers a unique opportunity to examine non-compliance further. This article examines the patients who were assigned to the GPC during the nurse-led triage but refused the advice and were treated at the ED. This article investigates how large the proportion of refusers was, what the determinants were, and compares the costs of the provided medical services between compliers and non-compliers, as captured on the invoice that patients received from the ED or GPC. The aim is to formulate research suggestions for interventions to reduce the refusal rate.

5.3 Methodology

5.3.1 The TRIAGE trial

The TRIAGE trial was set up to determine the effectiveness and safety of a nurse-led triage system that assigns low-risk patients from an ED to the GP. A single-centre cluster randomised trial was performed with weekends and bank holidays (hereinafter called weekends) serving as units of randomisation and patients as units of analysis. The trial ran from 01/03/2019 to 30/12/2019. During intervention weekends, patients were assigned to the most appropriate service (ED or GPC) but had the possibility to refuse. Control weekends are not of interest in this study, as the advice was not communicated to patients and they all remained at the ED. The trial was executed in the ED of the Belgian general hospital 'AZ Monica' and the adjacent GPC 'Antwerpen Oost'. The surrounding area has citizens from a variety of ethnicities and consists of both middle income and socially deprived neighbourhoods. The Belgian healthcare system is mainly organised as a fee-for-service system and is characterised by free choice and open access for patients to all medical services.

The triaging of patients was done using a locally developed extension to the MTS (eMTS). The eMTS contains the entire MTS version 3.6, one of the main triage systems used worldwide.[142] The system is a tool for prioritisation in the ED, but previous studies have also used it to relocate patients. They have illustrated that the system presents an acceptable validity.[43-45] The MTS is a five-level triage system and consists of 53 presentational flowcharts. Each flowchart consists of discriminators, eventually leading to an urgency category ranging from level one (immediate care necessary) to level five (non-

urgent). In the adapted version, 44 flowcharts were extended with GP risk discriminators whenever the urgency category was four or five. If such discriminator was present, patients were assigned to the ED.[102]

5.3.2 Outcome measures

This study is a secondary analysis of the TRIAGE trial. The predefined primary outcome is the proportion of patients that were assigned to the GPC but refused. They were treated at the ED, despite the advice to go to the GPC. The secondary outcomes of this article (not predefined) are the determinants of non-compliance and the impact on the costs.

5.3.3 Data collection

The following patient characteristics were collected and used in this study: age; sex; patient lives nearby (within the four communities covered by the GPC); and socio-economic status (whether patients receive an increased reimbursement or not). The eMTS flowchart (53 flowcharts combined into 15 categories[4]), urgency level, type of admission to the ED (walk-in or ambulance), time period (day, evening, or night), subjective crowding at the ED (quiet, normal, or busy), and anonymous ID of the triaging nurse were also registered. All 22 nurses who performed a triage were numbered. The data from the ED and GPC were linked through their pseudonymised national insurance number using iCAREdata, which is a database for medical records during OOH care.[1, 2]

After the trial, the patient-level costs of treatment at the ED and GPC were received from the billing department of AZ Monica and the GPC respectively. Both settings make use of a fee-for-service system. The data consisted of the (pseudo)nomenclature codes of all medical services provided to the patients, as captured on the invoice. The codes were grouped to reflect different cost categories: consultation fees, medical imaging, clinical biology, technical procedures, medication, hospital lump sums, and non-refundable items. Data on medical imaging or clinical laboratory tests ordered by the GP were not available at the patient level. The category non-refundable items consists of various articles at the request of the patient (e.g., a toothbrush) or necessary for their medical care (e.g., crutches). Medication costs only include medicines given to the patient during a consultation and not the prescriptions given to them. The various cost categories (except consultation fees) give insight into the treatment people received, as prices for medical services are similar for both the GPC and the ED. Consultation fees are predetermined. In

[4] These 15 categories were constructed by the authors. MTS flow charts of special interest (e.g. chest pain) were treated as a separate category while others were categorised based on organ system or clinical speciality. MTS flow charts designed for the paediatric population were categorised together as “children”.”

Belgium, ED physicians and GPs receive different consultation fees, depending on the medical specialty of the physician and on the arrival time of the patient. For instance, under the current remuneration scheme, consultations during the night are more expensive at the GPC than at the ED, while the opposite occurs during daytime. The data also show the proportion of the invoice paid by the patient and by the national health insurance. The division is predetermined as well and depends on whether the consultation is with or without referral and on the socio-economic status of the patient. Consultations at the ED without referral require a higher share of co-payment from the patient.[160] Due to anonymity, data were matched with the medical records from above on the basis of sex, birth year, postal code, and time. For nine patients (1.2%) no invoice could be matched. Ten (1.3%) patients were hospitalized. They were excluded from the financial analysis, as only their ambulant costs were available.

5.3.4 Statistical methodology

The determinants of non-compliance were first considered using a bivariate analysis. The proportions of patient characteristics, patient status, eMTS components, and variables related to the time of admission were compared between refusers and non-refusers. Bivariate logistic regressions were used to calculate odds ratios. The data were analysed using JMP pro® version 14. Those variables found significant at an alpha of 0.10 were considered significant and incorporated in the multivariate analysis. A significance level of 0.10 was used since the smaller dataset and consequently larger standard errors were unlikely to produce more significant results.

A similar bivariate analysis was performed on the costs. The mean costs of compliers and non-compliers were compared using a T-test for unequal variances. A two-sided F-test for equal variance indicated this was most appropriate. A distinction was made between the fraction of the invoice paid by the national insurance and the fraction paid by the patient, as well as between the period of the day.

The multivariate analysis consisted of a chi-square automatic interaction detection (CHAID) decision tree.[84, 161] This methodology is commonly used for building prediction algorithms for a target variable and can deal with large, complicated datasets in an efficient manner, without imposing a complicated parametric structure. This method classifies the population into branch-like segments that construct an inverted tree with a root node, internal nodes, and leaf nodes.[162] For this article, a decision tree based on Bonferroni-Holm corrected chi-squared tests was constructed with as target variable the likelihood of refusing the advice to visit the GPC. The independent variables were all patient characteristics, subjective crowding, period of the day, flowchart category and nurse ID. A 10-fold cross validation was used to evaluate the model. The CHAID-analysis was performed using IBM SPSS® version 27.

5.4 Results

5.4.1 Study population

Of the 6374 patients that presented during intervention weekends, 838 (13.3%) patients were advised to visit the GP and 5456 (86.7%) were advised to be treated at the ED. For 80 patients the advice was unknown. Out of the 838 patients who received the advice to visit the GPC, 599 accepted and were seen by the GP while 183 refused and were treated at the ED.[102] The remaining 56 patients left without being seen i.e., were neither seen by a doctor at the ED nor at the GPC. A logistic regression showed that these patients were very similar to those seen by a doctor, in terms of sociodemographic characteristics. The only difference was that those who left, lived nearby significantly more often (OR 2.63, 95%CI: 1.02 to 6.78). In the analysis that follows, these patients are excluded. The 599 (76.5%) patients who accepted the advice were compared with the 183 (23.5%) patients who refused it. For 594 and 169 of these patients, respectively, the invoices were examined.

5.4.2 Bivariate analysis

The bivariate analysis of the characteristics of non-compliance is presented in Table 9. The results of the patient characteristics show that, while there was no significant age difference, the patient's sex, socio-economic status, and residence were significantly different between those who refused and those who accepted the advice. Male patients (OR 1.36, 95%CI: 0.98 to 1.90, p=0.07) and patients not living nearby (OR 1.43, 95%CI: 0.98 to 2.08, p=0.07) refused more often. Receiving an increased reimbursement was associated with more refusals (OR 1.37, 95%CI: 0.96 to 1.95, p=0.09). The patient's flowchart category seemed to have an impact as well (ORL complaints versus unwell adult OR 0.44, 95%CI: 0.22 to 0.89; children versus unwell adult OR 0.51, 95%CI: 0.26 to 1.02, p=0.06). Most patients were assigned urgency category four, while only few were given category five. The urgency categories did not significantly differ between refusers and non-refusers. Almost all patients arrived as a walk-in. Those who arrived by ambulance refused significantly more often (OR 2.84, 95%CI: 1.21 to 6.68). Finally, the timing of the triage also seems associated with the likelihood of refusal. Both subjective crowding at the ED (quiet versus normal OR 0.41, 95%CI: 0.16 to 1.01, p=0.05) and the period of the day (day versus evening OR 0.58, 95%CI: 0.39 to 0.85; night versus evening OR 0.39, 95%CI: 0.39 to 0.66) were significant.

Table 9. Bivariate analysis of determinants associated with non-compliance.

Determinant		Accept advice (%) (n=599)	Refuse advice (%) (n=183)	p-value	Odds ratio (95% CI)
Patient characteristics					
Age	Mean (in years)	30.02	32.78		
	Min – Max	0 – 90	0 – 93		
Age category	0-7	105 (78.36%)	29 (21.64%)	0.88	0.96 (0.54 to 1.71)
	8-24	156 (80.00%)	39 (20.00%)	0.60	0.87 (0.51 to 1.48)
	25-39	156 (74.64%)	53 (25.36%)	0.53	1.18 (0.71 to 1.97)
	40-54	104 (77.61%)	30 (22.39%)		1
	55-74	55 (71.43%)	22 (28.57%)	0.32	1.39 (0.73 to 2.63)
	>74	23 (69.70%)	10 (30.30%)	0.34	1.51 (0.65 to 3.51)
Sex	Female	318 (79.30%)	83 (20.70%)		1
	Male	281 (73.75%)	100 (26.25%)	0.07	1.36 (0.98 to 1.90)
Increased reimbursement	Yes	207 (74.19%)	72 (25.81%)	0.09	1.37 (0.96 to 1.95)
	No	342 (79.72%)	87 (20.28%)		1
Living nearby	Yes	469 (78.17%)	131 (21.83%)	0.07	1
	No	128 (71.51%)	51 (28.49%)		1.43 (0.98 to 2.08)
Patient status					
Flowchart category	ORL complaints	86 (83.50%)	17 (16.50%)	0.02	0.44 (0.22 to 0.89)
	Children	83 (81.37%)	29 (18.63%)	0.06	0.51 (0.26 to 1.02)
	Others*	122 (80.79%)	10 (19.21%)	0.05	0.53 (0.29 to 0.99)
	Abdominal complaints	76 (78.35%)	21 (21.65%)	0.16	0.62 (0.32 to 1.22)
	Wounds	34 (75.56%)	11 (24.44%)	0.45	0.72 (0.32 to 1.66)
	Limb Problems	75 (70.75%)	31 (29.25%)	0.81	0.93 (0.49 to 1.74)
	Unwell Adult	56 (69.14%)	25 (30.86%)		1
	Back and neck pain	57 (68.67%)	26 (31.33%)	0.95	1.02 (0.53 to 1.98)
Urgency category**	4	578 (77.17%)	171 (22.83%)		1
	5	21 (75.00%)	7 (25.00%)	0.79	1,13 (0.47 to 2.70)
Admission type	Ambulance with or without 112	12 (54.55%)	10 (45.45%)	0.02	2.84 (1.21 to 6.68)
	Walk-in	586 (77.31%)	172 (22.69%)		1
Timing of the triage					
Perceived crowdedness	Quiet	41 (87.23%)	6 (12.77%)	0.05	0.41 (0.16 to 1.01)
	Normal	161 (73.52%)	58 (26.48%)		1
	Busy	33 (84.62%)	6 (15.38%)	0.15	0.50 (0.20 to 1.27)
Part of the day	Day	337 (77.83%)	96 (22.17%)	0.005	0.58 (0.39 to 0.85)
	Evening	122 (67.03%)	60 (32.97%)		1
	Night	140 (83.83%)	27 (16.17%)	0.001	0.39 (0.23 to 0.66)

ORL: Otorhinolaryngology
**: This category contains chest pain, eye problems, mental complaints, neurological complaints, respiratory complaints, trauma and accidents, urinary or gynaecological complaints, and others. These categories had insufficient observations to be separately included and tested reliably.*
***: Only urgency categories four and five are reported as only five patients in category three and none in categories one and two received the advice to visit the GPC.*

The bivariate analysis of the patients' costs is presented in Table 10. First, a distinction was made between the period of the day. Only the total cost during the night and the amount paid by the insurance for patients presenting during the evening or night was not significantly different between those who accepted and those who refused the advice to visit the GPC. For other categories, the cost for the treatment of refusers was significantly higher than that of those who complied. For instance, the average total cost was 76.90 (95%CI: 68.07 to 85.72) euros for refusers, while only 49.86 (95%CI: 47.29 to 52.42) euros for accepters. This is a difference of 27.04 (95%CI:17.86 to 36.23) euros. The overall amount paid for by the patient was on average 20.43 (95%CI: 18.69 to 22.17) euros for refusers, compared to 5.61 (95%CI: 5.12 to 6.10) euros for non-refusers. Furthermore, making the distinction between cost categories indicates that, compared to the GPC, consultation fees at the ED were higher during the day and lower during the evening or night. Other cost components (technical procedures, medication, and non-refundable items) were significantly higher for patients who refused the advice and were treated at the ED ($p<0.001$). Data on medical imaging ordered by the GPC is unavailable. However, GPs seldom make use of this. During the second semester of 2019, imaging was ordered for only 1.3% (95%CI: 1.1% to 1.7%) of the patients who visited the GPC. In contrast, during the trial's intervention weekends, 45.19% (95%CI: 43.69% to 46.70%) of patients assigned to the ED were charged for medical imaging. It is therefore reasonable to assume that these costs were on average higher for non-compliers.

Table 10. Costs as captured on the patients' invoice; association with non-compliance.

Category	Timing	Mean in € for those who accept advice (N)	Mean in € for those who refuse advice (N)	p-value two-sided T-test
Total billing	Overall	49.86 (594)	76.90 (169)	<.001
	Day	44.39 (334)	77.49 (90)	<.001
	Evening	51.54 (122)	72.47 (56)	<.001
	Night	61.59 (138)	85.36 (23)	0.154
Billing for patient	Overall	5.61	20.43	<.001
	Day	5.38	21.05	<.001
	Evening	5.21	19.06	<.001
	Night	6.52	21.33	<.001
Billing for insurance	Overall	44.25	56.47	0.006
	Day	39.01	56.44	0.008
	Evening	46.33	53.41	0.180
	Night	55.07	64.03	0.580
Billing by cost category*				
Consultation fees	Overall	47.11	46.59	0.625
	Day	42.05	46.93	<.001
	Evening	51.13	47.13	0.096
	Night	55.78	43.94	<.001
Technical procedures	Overall	1.16	12.74	<.001
Medication	Overall	0.12	2.56	<.001
Non-refundable items	Overall	0.05	1.24	<.001
Medical imaging**	Overall		13.76	
Billing for patient, by cost category*				
Consultation fees	Overall	5.42	16.53	<.001
	Day	5.23	17.34	<.001
	Evening	5.21	15.09	<.001
	Night	6.06	16.89	<.001
Technical procedures	Overall	0.03	0.87	<.001
Medication	Overall	0.05	1.22	<.001
Non-refundable items	Overall	0.05	1.24	<.001
Medical imaging**	Overall		0.56	

Table 10 continued. Costs as captured on the patients' invoice; association with non-compliance.

Category	Timing	Mean in € for those who accept advice (N)	Mean in € for those who refuse advice (N)	p-value two-sided T-test
Billing for insurance, by cost category*				
Consultation fees	Overall	41.69	30.06	<.001
	Day	36.82	29.59	<.001
	Evening	45.92	32.04	<.001
	Night	49.72	27.05	<.001
Technical procedures	Overall	1.12	11.86	<.001
Medication	Overall	0.06	1.34	<.001
Medical imaging**	Overall		13.19	
Billing excluding medical imaging and clinical biology				
Total billing	Overall	48.43	63.13	<.001
Billing for patient	Overall	5.55	19.87	<.001
Billing for insurance	Overall	42.88	43.26	0.872

**The remaining categories were clinical biology and hospital lump sums. These were not included out as only one and zero patients, respectively, had an invoice belonging to these categories.*
***Data on medical imaging ordered by the GP were not available at the patient level.*

5.4.3 CHAID-analysis for accepting vs. refusing advice

The CHAID-analysis is presented in Figure 13 and Table 11. It has seven nodes and a depth of two. The nurse on duty is selected as a first splitting variable ($p<0.001$). The probability of refusing the advice to visit the GPC was only 2.9% for patients managed by nurses 4 and 19. For nurses 13, 5, 2, 1, 16, 8, 6, 7, and 15 this was 15%. Nurses 10, 11 and 20 had significantly more refusers, namely 52.8%. For patients managed by one of the remaining nurses, the probability of refusing was almost 30%. For this set of patients, economic status was selected as next splitting variable ($p=0.02$). Patients who received an increased reimbursement had a higher fraction of refusal, namely 38% compared to 23% for those not receiving it. The misclassification risk of the model is 25.5% with a standard error of 1.5%.

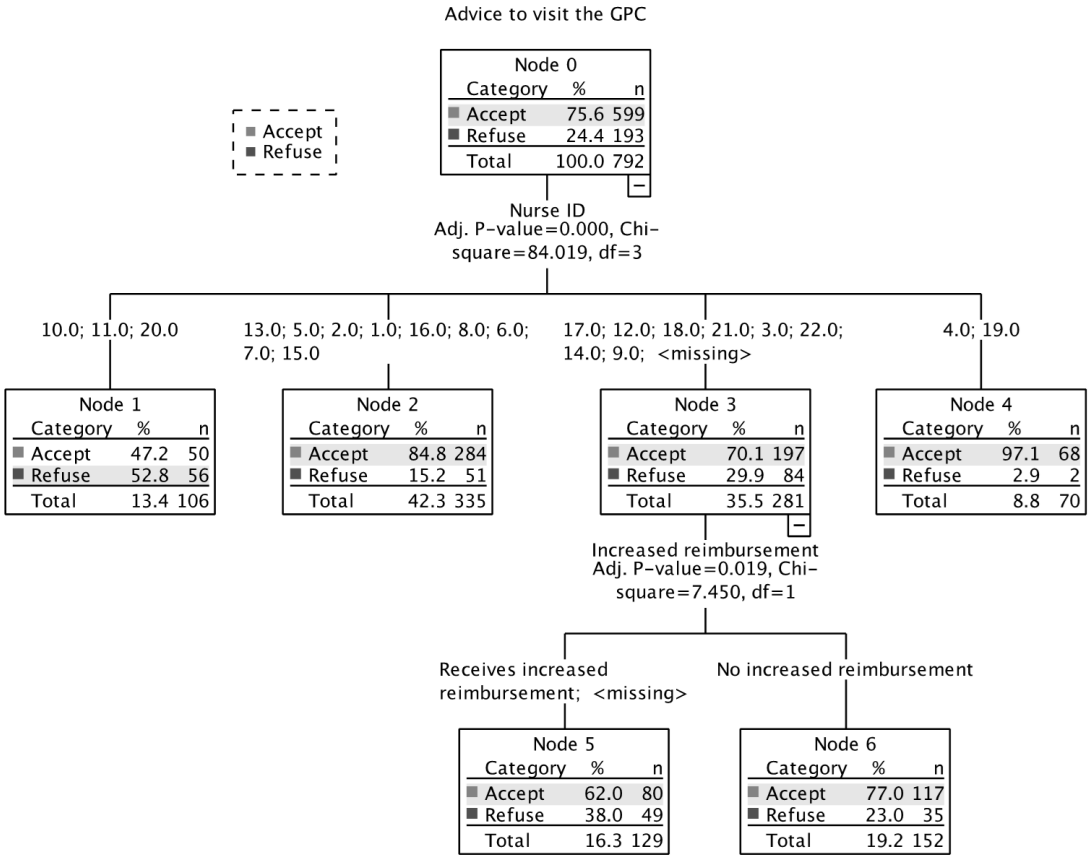

Figure 13. CHAID-analysis for refusing vs. accepting advice to visit the GPC.
ID: Identificator

Table 11. Statistics of the CHAID-analysis for refusing vs. accepting advice to visit the GPC.

Risk			
Method	Estimate	Standard Error	
Resubstitution	.236	.015	
Cross-Validation	.255	.015	
Classification			
	Predicted		Percent Correct
Observed	No	Yes	
No	56	137	29.0%
Yes	50	549	91.7%
Overall Percentage	13.4%	86.6%	76.4%

To illustrate that the importance of the nurse is unrelated to how often nurses advise patients to visit the GPC, the nurses' assignment and compliance rates are presented in Figure 14. Two nurses with an outlying low compliance rate (22.2% for nurse 20 and 40% for nurse 10) only triaged 70 and 90 study patients, respectively.

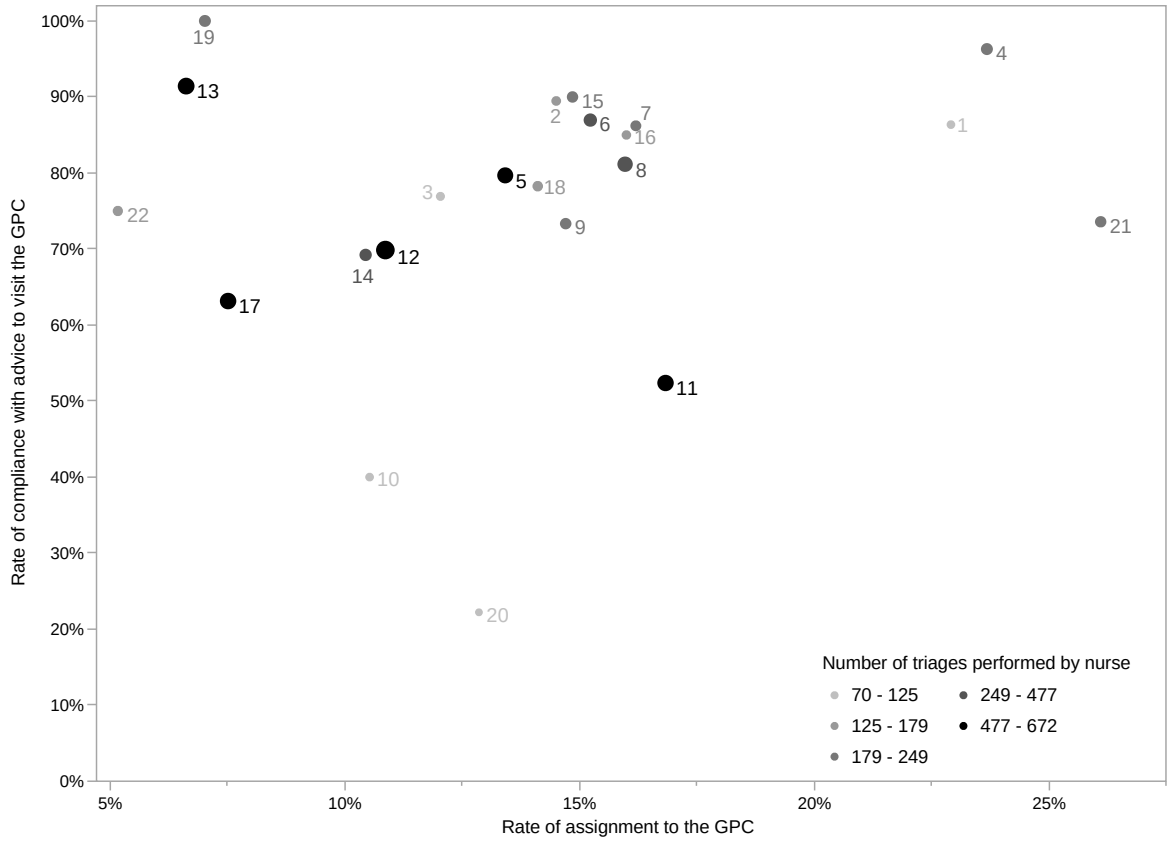

Figure 14. Rate of assignment to the GPC and patients' rate of compliance, per nurse.

5.5 Discussion

During this trial, 838/6374 (13.1%) patients from the intervention group received the advice to visit the GPC.[102] Of these patients, 56 left without being seen. When excluding those patients, 599 (76.5%) patients accepted and were seen by the GP, compared to 183 (23.5%) patients who refused and were treated at the ED. This proportion was mainly influenced by the nurse on duty. This indicates that the nurse delivering the advice to the patient plays a central role in the likelihood of acceptance. This effect is not driven by different assignment rates of nurses. It is not the case that certain nurses have a higher compliance because they advise a smaller share of patients to visit the GPC. One possible explanation for the observed variation in compliance is differences in communication style. During interviews, nurses on duty indicated that communication with patients was key for successful referrals. The practice of referral is not currently embedded in the Belgian habits, hence nurses still had to learn how to best approach patients. The remaining variability in

refusal was explained by the socio-economic status of the patients. Those receiving increased reimbursement were more prone to refuse the advice to visit the GPC, which was an expected result.[156, 157]

Additional significant differences were found. Patients living nearby accepted the advice to visit the GPC more often. It is possible that these patients simply chose the closest available care setting, compared to patients arriving from further, who may have explicitly chosen the ED with the expectation to be treated at the facility. Next, men refused disproportionately often. It is known that men are more likely to visit the ED instead of the GP on call.[163] Research on non-compliance with treatment advice is however more ambiguous about the role of patient's sex.[155, 158, 164] The flowchart category proved important as well, indicating that patients may be more worried about certain types of health issues. The perceived nature of the complaint can impact the preference for either the ED or the GPC.[152] Moreover, the likelihood of refusing depends on the perceived crowdedness and the part of the day. Compared to a normal crowding level, patients refuse less often when it is quiet at the ED. When it is calmer, the nurse has more time to persuade the patients, resulting in better explanations and arguments. Patients are less likely to refuse advice during the day and during the night than during the evening. A possible explanation is that patients are less willing to get into an argument at night or that different types of patients visited during the evening. No previous research found similar results.

The importance of complying with the advice to visit the GPC is illustrated in the analysis of invoices. On average, the total cost of refusers was 27.04 euros higher than that of accepters. Aggregating this difference over the 196 refusers amounts to an additional 5299.84 euros of possible savings, if non-compliers would have been treated by the GP in the same way as compliers. This is mainly driven by cost differences during the day and the evening. At night, there was no significant difference in total costs. This raises the question whether relocating patients to the GPC is useful during that period, especially since crowding of EDs is less of an issue at night.

For patients, complying with the advice is always financially beneficial. The mean invoice borne by patients was significantly higher for patients who refused and were treated at ED. This is partly a result of the fact that GPC consultations receive high reimbursements by the insurance, such that only about a quarter is paid by the patient. For ED visits, on the other hand, patients bear almost half the cost. The reason is that the ED consultations of patients in the trial were all without referral by a GP, resulting in lower insurance coverage.[160] A second driver of the cost difference seems to be that the ED examined patients more extensively, possibly using more expensive resources that are not available at the GPC. It is not known whether these additional resources were necessary or not. A causal effect cannot be isolated as there exists no control group. It is possible that those with more serious and expensive complaints self-select into the group of refusers.

The analysis additionally shows that the cost for the insurance company was not significantly different between refusers and non-refusers during the evening and night. This is due to supplementary consultation fees. During the evening, an additional fee must be paid at the GPC. During the night, additional fees must be paid at both locations, but the amount is higher at the GPC. These fees are entirely born by the insurance and offset the higher ED costs from other cost categories.[160]

This secondary analysis of a cluster randomised trial has some shortcomings. First, since the fraction of patients refusing the advice to visit the GPC was not the primary outcome of the TRIAGE trial, the sample size is not optimal and certain variables were not collected. For instance, the reason why advice was refused and the satisfaction with the received treatment are unknown. Second, many differences are only significant at the 0.10 level, in part due to the small sample size. Conclusions are therefore explorative rather than definitive. Third, patient level data on medical imaging and clinical laboratory tests ordered by the GP were not available. Although such tests are seldomly ordered by GPCs, this may lead to an underestimation of the costs.

Despite these weaknesses, this study offers an important contribution to the existing literature. Previous research focused either on the determinants of low-risk patients visiting the ED [6, 74, 152, 163] or on the determinants of non-compliance to medical treatment.[155-159] This study, however, is the first to gain insights into the determinants of non-compliance with the advice to visit a primary care provider. The analysis was based on the first cluster randomised trial on patient assignment to primary care using the eMTS. It was executed over a long study period and in a real-life setting.

The results allow to propose some targeted intervention. The nurse providing the advice is the most important predictor for non-compliance, indicating the relevance of improving nurse-patient communication. The most appropriate way of conveying a message should be taught to the emergency staff. It is necessary for patients to understand the message. Nurses should make certain that the advice is substantiated and in a clear language, as understanding about treatment decisions is associated with higher compliance.[164] If the concept of GPCs is unknown, it should be explained with a focus on why this type of care is more appropriate. Special attention may be required when managing patients receiving increased reimbursement. It may be useful to highlight that the personal invoice is on average four times lower at the GPC. Further research is needed to clarify whether non-compliance is due to poor communication by the nurse or due to patient misinterpretation. This will allow to make more specific recommendations.

5.6 Conclusion

A cluster randomised trial on the assignment of patients from the ED to primary care using the eMTS offered the opportunity for a secondary analysis, studying the determinants of

non-compliance with advice to visit the GPC. A bivariate and CHAID-analysis show that the nurse on duty delivering the advice has a crucial role. Interventions to reduce the fraction of refusals should therefore aim to improve nurse-patient communication. The analysis found a considerably higher overall invoice for patients treated at the ED (27 euros more expensive on average), illustrating the importance of compliance.

Chapter 6

TRIAGE trial: Differences in triage between the intervention and the control group

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Because this article has not been published at the time of writing, the supplementary material can be found in the appendix of this dissertation. This supplementary material is referenced as it was referenced in the revised publication: “See Online supplemental appendix…” .

6.1 Abstract

Objectives

In the TRIAGE trial, a cluster randomised trial about diverting emergency department (ED) patients to a General Practice Cooperative (GPC) using a new extension to the Manchester Triage System, the difference in the proportion of patients assigned to the GPC was striking: 13.3% in the intervention group (patients were encouraged to comply to an ED or GPC assignment, real world setting) and 24.7% in the control group (the assignment was not communicated, all remained at the ED, simulated setting). In this secondary analysis, we assess the differences in the use of the triage tool between intervention and control group and differences in costs and hospitalisations for patients assigned to the GPC.

Setting and participants

ED of a general hospital and the adjacent GPC. 8038 patients (6294 intervention and 1744 control).

Primary and secondary outcome measures

Proportion of patients with triage parameters (reason for encounter, discriminator, and urgency category) leading to an assignment to the ED, proportion of patients for which the computer-generated GPC assignment was overruled, motivations for choosing certain parameters, costs (invoices), and hospitalisations.

Results

An additional 3.1% ($p<0.01$) of the patients in the intervention group were classified as urgent. Discriminators leading to the ED were registered for an additional 16.2% ($p<0.01$), mainly because of a perceived need for imaging. Nurses equally chose flowcharts leading to the ED ($p=0.41$) and equally overruled the protocol ($p=0.91$). In the intervention group, the mean cost for patients assigned to the GPC was €23 ($p<0.01$) lower and less patients with an assignment to the GPC were hospitalised (1.0% versus 1.6%, $p <0.01$).

Conclusion

Nurses used a triage tool more risk averse when it was used to divert patients to primary care as compared to a theoretical assignment to primary care. Outcomes from a simulated setting should not be extrapolated to real patients.

6.2 Introduction

Worldwide, initiatives for collaboration between Emergency Departments (EDs) and sites for primary out-of-hours care (called General Practitioners Cooperatives or GPCs) have been installed to improve patient care, staff satisfaction, and to reduce crowding at the ED. In these initiatives, both services are located on the same site or in proximity of each other. They implement triage, defined as the sorting out and classification of patients or casualties to determine priority of need (urgency classification) and proper place of treatment (assignment to ED or GPC).[25] The efficiency of such a triage has been studied in simulated settings (written case scenarios or live cases), retrospective case studies or in prospective interventional studies describing the situation before and after implementation of triage.[21, 23, 68, 165] A comparison of live cases versus paper case scenarios revealed a lower intraclass correlation for urgency classification in live triage assessments as compared to paper cases. Paper case scenarios generally receive lower triage scores (less urgent) than live cases.[166] One of the few well validated and widely implemented triage systems is the Manchester Triage System (MTS). A multi-centre prospective observational study revealed a sensitivity of 0.47-0.87 and a specificity of 0.84 to 0.94.[79] In a meta-analysis, the agreement regarding written scenario assessment was substantial while it was almost perfect for assessment of real live cases.[38]

In 2018 a Cochrane review concluded that the current evidence concerning primary care professionals providing non-urgent care in EDs was insufficient to draw conclusions for practice or policy.[18] It is unknown how well the efficiency of triage observed in simulated settings compares to everyday practice (the real world).[48] Some studies found that the presence of a general practitioner (GP) leads to an improvement in the effectiveness and quality of care at the ED and is less expensive than the usual care method, as GPs use fewer resources than do usual ED staff.[132, 167-169] Again, it is unknown whether a simulated experiment can predict such a cost reduction.

The TRIAGE trial studied the efficiency and safety of a newly developed extension (called eMTS) to the original MTS assigning low risk patients to ED or GPC. This trial was executed during weekends and bank holidays (from here on we refer to weekends and bank holidays as weekends). An eMTS triage results in three parameters: reason for encounter (presentational flow chart, e.g. “abdominal pain”), discriminator (property of the complaint, e.g. “mild pain”), and urgency category (ranging from one or to five). Each combination of parameters is linked to an ED or GPC assignment. Weekends were randomly allocated to the intervention group (patients were encouraged to follow their assignment to ED or GPC) or the control group (the assignment was not communicated, all remained at the ED, a simulated setting). This intervention led to the safe diversion of 9.5% of the included patients.[102] In the intervention group, 838/6374 patients (13.3%) were assigned to the GPC, in the control group this was almost twice as much: 431/1744 (24.7%). We

hypothesise that this remarkable difference was caused by a difference in use of the triage tool between intervention and control weekends.

The objective of this secondary analysis was to assess the differences in the use of the triage tool between the intervention and the control group of the TRIAGE trial. As a secondary objective, the difference in hospitalisations and costs between the intervention and control group for low urgency patients was studied.

6.2.1 Methods

We refer to the original article on the TRIAGE trial for details on the participants, the intervention and the study design.[102] Another paper explores the characteristics of patients non-compliant to a GPC advice.[170] Below we only describe those aspects important for the current article.

6.2.2 Study design

The current study is a post-hoc analysis of a cluster randomised trial (RCT) executed from 01/03/2019 to 30/12/2019. This trial was randomised into ten control and 27 intervention weekends. The intervention was triage by a nurse using a new extension to the MTS assigning low-risk patients to the GPC and all other patients to the ED. During intervention weekends, patients were encouraged to follow this assignment while it was not communicated during control weekends (all patients remained at the ED). In the intervention group, the triage had immediate consequences which is comparable to real world circumstances. The virtual triage in the control group had no consequences which is comparable to a simulated setting with live cases. The primary outcome was the proportion of patients assigned to and handled by the GPC during intervention weekends (9.5%, 95% CI 8.8 to 10.3). The trial was randomised for the financial analysis (under review) and the secondary outcome: the proportion of patients assigned to the GPC during intervention (13.3%, 95% CI 12.5 to 14.2) and control weekends (24.7%, 95% CI 22.7 to 26.8).

6.2.3 Study tool

The study tool for the TRIAGE trial was based on the MTS (version 3.6), a validated tool for prioritisation.[79, 142] When using the MTS, the nurse starts by choosing a presentational flowchart (e.g., chest pain). A flowchart consists of a list of terms called discriminators (e.g., mild pain), the presence of which has to be checked top-down.

The eMTS adds site of treatment (ED or GPC) to this system in 42/53 flowcharts, the remaining nine flowcharts always lead to the ED. In 18 flowcharts, additional

discriminators[5] led patients in urgency categories four or five to an assignment to the ED (when at least one supplementary discriminator is applicable) or GPC (when no supplementary discriminators are applicable). These additional discriminators were either already present in the original MTS (e.g., mild pain) or newly introduced for the eMTS (e.g., "right lower abdominal pain" in the presentational flowchart for abdominal pain). See Figure 4 p. 34 for an example. In 26 flowcharts, urgency category four and/or five were directly linked to an assignment to the GPC or ED. In all flowcharts with possible assignment to the General Practitioner (GP), the nurses had the option to choose for the discriminator "GP Risk" linked to an assignment to the ED. "GP Risk" was defined as an unspecified risk to assign the patient to the GPC according to the opinion of the triaging nurse, or because of age less than three months. Nurses were instructed to use this parameter when they thought there was a good reason to keep the patient at the ED, but this reason was not specified in the eMTS.

The eMTS was built into the ED's computer decision support system (E.care ED 4.1). After choosing a flowchart and a discriminator, this system showed the advice "Assign to GPC" when applicable. Afterwards, the nurse had to register the final assignment he/she had given (intervention weekends) or considered the most appropriate (control weekends). Nurses working at the study ED with a degree in emergency medicine and at least one year of experience at the study hospital were allowed to triage, they all participated in the study. These nurses followed a training on using the eMTS, patient communication skills focussing on refusal of the assignment, and the study protocol.

6.2.4 Participants

Patients with an available national insurance number triaged by a nurse at the ED were included. Patients already admitted to the study hospital, those arriving by an ambulance staffed with a doctor or nurse, and patients referred to the ED by a doctor or nurse were excluded from the TRIAGE trial. Patients with a missing final assignment were also excluded from the current study. For the cost analysis, patients who were hospitalised were excluded because their invoice does not reflect their true costs at the ED, as it was not possible to differentiate their outpatient costs at the ED and the cost of their subsequent hospitalisation.

6.2.5 Setting

ED of a general hospital (AZ Monica, Deurne) with an annual census of 37 000 patients, and the adjacent GPC with an annual census of 10 000 patients (open during weekends only).

[5] See Appendix 2 for a list of these discriminators (in Dutch)

Before 2019, ED triage in Belgium only involved urgency classification for prioritisation; patients were only assigned to primary care in experimental settings.[40, 78, 171]

6.2.6 Data collection

The following study tool parameters were collected: MTS flowchart (52 flowcharts); MTS urgency level (one to five), chosen MTS discriminator (200 terms), computer-generated assignment (ED or GPC), and nurse-selected assignment (ED or GPC). Due to limitations of the used software at the ED, the collection of the discriminators was incomplete. When the nurse chose an original MTS discriminator (e.g., "mild pain), it was registered correctly. But when the nurse wanted to choose a specific newly introduced eMTS discriminator (e.g., "right abdominal pain") or the nonspecific newly introduced discriminator "GP Risk", they had to click the option "Not assigned to the GPC because of a specific newly introduced eMTS discriminator or GP Risk". Afterward they were asked to write down a free-text motivation why they had chosen this term, but that field was not obligatory. In the results section, the specific newly invented eMTS discriminators and "GP Risk" are reported together as additional discriminators in the eMTS linked to the ED. For the cost analysis, the total invoice cost and costs per cost category (physician fees, medical imaging, technical procedures, non-refundable items, and medication) were studied. The number of hospitalisations was calculated using these invoices.

After reading all free-text motivations concerning overruling the protocol and the choice of additional discriminators in the eMTS linked to the ED, authors VV an SM independently divided them into categories. Afterwards, authors VV and SM reached consensus on the categories to use and the classification of all free texts.

Data were collected using iCAREdata, a Belgian database for out-of-hours care.[1, 2] The data for the costs were obtained directly from the financial department of the studied ED and GPC and were linked to the medical data based on admission time, sex, and ZIP-code.

6.2.7 Outcomes

The first outcome of this study was the proportion of patients with study tool parameters leading to an assignment to the ED in the intervention and control weekends. The following parameters were studied: reason for encounter registered in the MTS as a presentational flowchart (9 flowcharts always leading to ED versus 43 with possible assignment to the GPC), urgency category (one to three always lead to ED, four or five might lead to the GPC), and discriminator (1197 discriminator-flowchart pairs linked to the ED, 175 to the GPC). The motivations for choosing additional discriminators in the eMTS linked to the ED and for overruling were studied using free text fields. The second outcome is the proportion of patients for which the nurse overruled a computer-generated assignment to the GPC in favour of the ED. A sub analysis for the most frequently used presentational flowchart (limb problems) was made using the same outcomes.

As a proxy for the need of specialist/secondary care in the group of patients assigned to the GPC, the number of hospitalisations and costs were studied. The total costs were studied as well as the different cost categories. The invoices were divided into the share of the invoice paid for by the patient, and the share of the cost refunded by the national health insurance (government costs).

6.2.8 Analysis

A Chi² test was used to compare proportions between intervention and control weekends. A two-sample T-test for unequal variances and a two-sample Wilcoxon rank-sum (Mann-Whitney) test was used to assess the difference in the mean costs and distribution of costs for the intervention and control group. Density histograms were created to illustrate the skewness of the cost data. Data were analysed using JMP Pro® version 15.0 (SAS institute) and Stata 17.0 (StataCorp LLC). The significance level for all tests was set at 0.05.

6.2.9 Patient and Public Involvement statement

A lay person volunteering at the ED of a hospital not participating in this study was involved in the study design, she gave advice about the study protocol and tool. An advisory board with stakeholders from EDs, GPCs and universities gave advice about the study design and discussed the interim analysis and gave feedback on the results.

6.3 Results

6.3.1 Population

In the TRIAGE trial, 9964 patients were assessed for eligibility, of which 1806 patients were excluded mainly because they were already triaged by a healthcare professional prior to arrival in the ED.[102] For this paper, patients with a missing final assignment (N= 338/8158, 4%) were also excluded leading to a population of 8038 (6294 intervention and 1744 control). The baseline characteristics of the patients in the intervention and in the control group were similar (see Online supplemental appendix Table 1).

6.3.2 Influence of the intervention on the selection of study tool parameters

See Figure 15 for a summary. Nurses equally chose flowcharts always leading to the ED for the control and the intervention group (2,5% vs 2.1%, Chi² p-value= 0.41). However, an additional 3.2% of the patients in the intervention group were classified in a higher urgency category (mandatory assignment to the ED) as compared to the control group (Chi² p-value=0.02). For an additional 17.3% of the patients within urgency categories four and five, a discriminator leading to the ED was selected in the intervention group (Chi² p-value<0.01). Among those discriminators leading to the ED, newly introduced eMTS

discriminators were selected more frequently than those already available in the original MTS (85.0% versus 15.0%) regardless of the allocation to intervention or control weekends (Chi² p-value=0.78).

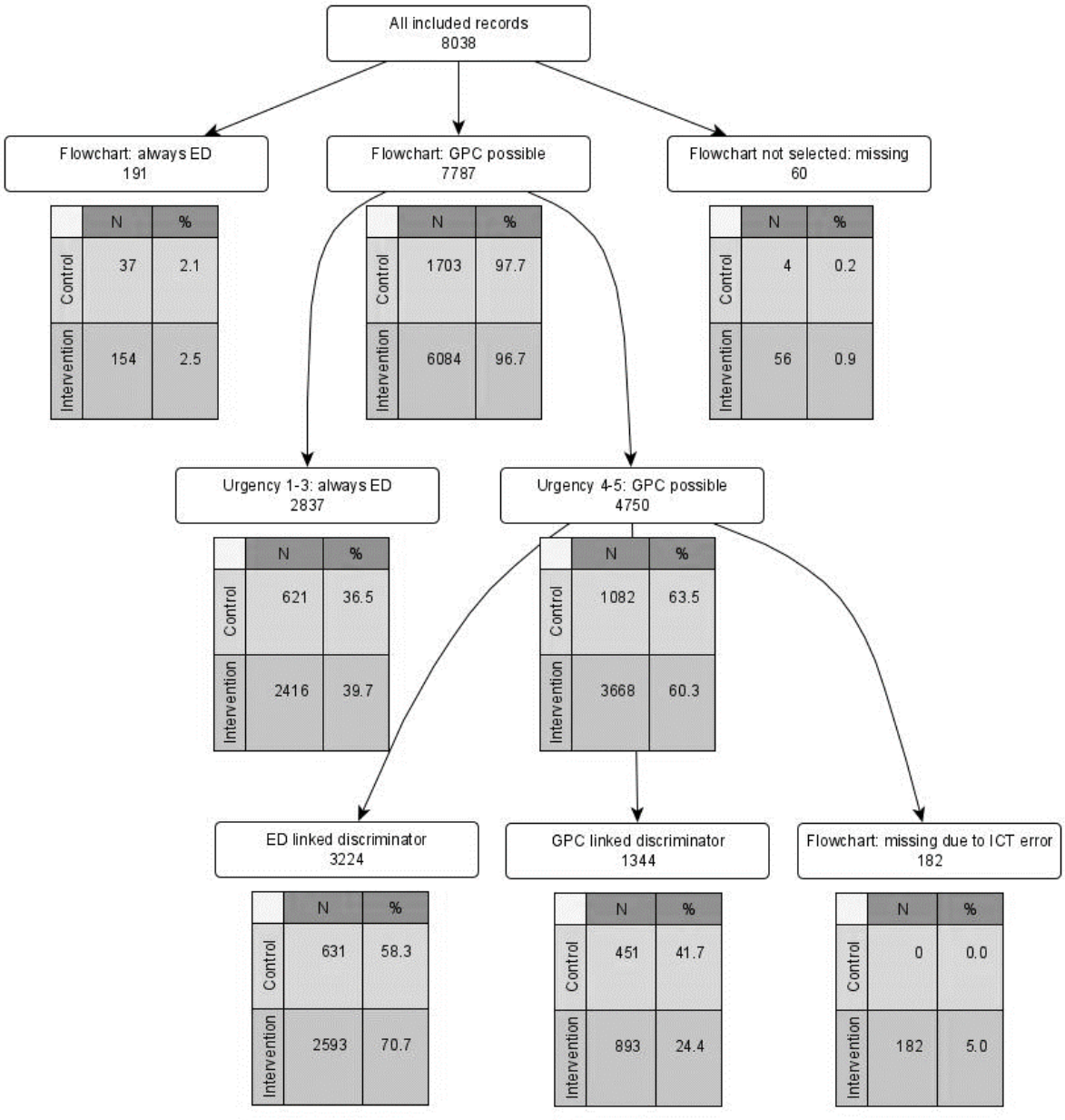

Figure 15. Influence of the intervention on the selection of study tool parameters.

The motivation for choosing an additional discriminator in the eMTS linked to the ED was registered for 347/2207 (15.7%, see Table 12) in the intervention and 39/534 (7.3%) in the control group. The most frequent motivation was the presence of a predefined eMTS discriminator, mainly the need for imaging according to the nurse. Out of the 202 patients with imaging as a motivation, 160 (79%) had a radiology cost on their invoice.

Table 12. Motivations for choosing an additional discriminator in het eMTS linked to the ED (N=347) in the intervention group.

Motivation	N	%
Presence of a predefined eMTS discriminator	243	63
Need for imaging according to the nurse	173	45
Need for a technical procedure according to the nurse	60	16
Physical observation by the nurse (e.g. right abdominal pain)	4	1
Age (<6 months or in some flowcharts >75 years)	5	1
History	1	
Medical reason not predefined in the eMTS	127	33
Need for imaging according to the nurse	29	8
Recent medical care for the same problem	27	7
Physical observation by the nurse (e.g. “patient looks bad”)	25	6
Patient’s history or current anamnesis contain worrisome elements	21	5
Need for a technical procedure according to the nurse	9	2
Other medical reasons	7	2
Mental illness such as anxiety disorder	5	1
Need for laboratory testing according to the nurse	4	1
Organisational	10	3
Other Motivations	6	2

6.3.3 Influence of the intervention on overruling the protocol

The nurses overruled the automated eMTS assignment of the software to the GPC in favour of the ED for 3.9% of the patients, there was no significant difference between intervention and control weekends (p=0.91). No motivations for overruling were given during control weekends while this information was available for 95/147 (64.6%) during intervention weekends. See Table 13 for these motivations. The vast majority of these motivations was either organisational or medical.

Table 13. Motivations for overruling the automated eMTS assignment (N=95).

Motivation	N	%
Organisational:	48	51
The emergency physician has already started helping the patient	9	9
The patient has a minor problem that can be resolved directly in the triage room	8	8
A companion needs ED care	8	8
Other organisational motivation	7	7
The GP refuses to see the patient	6	6
Patient arrived by ambulance	5	5
It is currently quiet at the ED	5	5
Medical reason	34	36
Communication problem	13	14

6.3.4 Influence of the intervention on the use of the flowchart for limb problems

There was no significant difference in the proportion of patients triaged with the flowchart limb problems (513/1740 or 29.5% versus 1691/6238 or 27.1%, p=0.05) or the selection of the three highest urgency categories (76/513 or 14.8% versus 252/1439 or 14.9%, p=0.96). There was, however, a marked difference in the selection of discriminators within urgency categories four and five. The additional discriminators in the eMTS linked to the ED (nurse perceived need for medical imaging, baby below three months or the unspecified GP Risk) were selected for an additional 15.2% of the patients (273/437 or 62.5% versus 1049/1351 or 77.7%, p<0.01) in the intervention group. The only original discriminator in the MTS linked to the ED for this presentational flowchart was “deformity” defined in the MTS as abnormal angulation or rotation. “Deformity” was selected equally in both groups (51/437 or 11.7% versus 180/1351 or 13.3%, p=0.37).

6.3.5 Influence of the intervention on hospitalisations in the study hospital for patients assigned to the GPC

During intervention weekends, 13 (1.0%) out of the 838 patients assigned to the GPC were hospitalised. During control weekends this proportion was significantly higher: 20/431 (1.6%, p<0.01).

6.3.6 Influence of the intervention on the costs for patients and government for patients assigned to the GPC

For this analysis, 1146 patients were included. Four patients were excluded because they had an unlikely low invoice, 33 were excluded because they were hospitalised, and the invoice was missing for 86 patients. Online supplemental appendix figures 1 and 2 illustrate the skewed distribution of the costs and indicates that the costs are more concentrated around zero during intervention weekends. The mean total cost during intervention weekends was €56 while this was €79 during control weekends (p<0.01). The Wilcoxon rank-sum test confirms that the distribution of costs among patients assigned to the GPC differs between intervention and control weekends. This difference was mainly driven by decreased use of medical imaging and technical procedures (p<0.01) during intervention weekends. See Table 14 for details.

Table 14. Costs for patients assigned to the GPC.

Cost		Intervention (n=760)	Control (n=386)	Total (n=1146)	p-value t-test for unequal variances	p-value Wilcoxon rank-sum test
Total cost (€)	Mean (SD)	55.58 (40.07)	78.74 (70.96)	63.38 (53.64)	<0.01	<0.01
	Median (IQR)	47.69 (39.22-52.17)	50.73 (48.73-92.00)	48.73 (39.22-52.53)		
Physician fees (€)	Mean	46.92 (12.86)	46.46 (8.74)	46.77 (11.64)	0.52	0.49
	Median	39.22 (39.22-52.17)	48.73 (42.85-48.73)	48.73 (39.22-48.73)		
Medical imaging (€)	Mean	4.17 (23.03)	12.55 (36.63)	6.99 (28.61)	<0.01	<0.01
	Median	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)		
Technical procedures (€)	Mean	3.53 (15.05)	15.64 (42.59)	7.61 (28.16)	<0.01	<0.01
	Median	0.00 (0.00-0.00)	0.00 (0.00-22.78)	0.00 (0.00-0.00)		
Non-refundable items (€)	Mean	0.30 (1.64)	1.75 (4.43)	0.79 (2.98)	<0.01	<0.01
	Median	0.00 (0.00-0.00)	0.00 (0.00-2.00)	0.00 (0.00-0.00)		
Medication (€)	Mean	0.65 (3.53)	1.97 (5.59)	1.09 (4.38)	<0.01	<0.01
	Median	0.00 (0.00-0.00)	0.00 (0.00-0.52)	0.00 (0.00-0.00)		

6.4 Discussion

In this secondary analysis of the TRIAGE trial, we analysed how emergency nurses used the triage tool differently for the intervention and the control group, which led to a remarkable difference in the proportion of patients assigned to primary care (13% in the intervention versus 25% in the control group). We found that nurses did not choose more flowcharts leading to the ED as compared to all other flowcharts, but they classified more patients as urgent (plus 3.1%) and they selected more discriminators linked to the ED (plus 16.2%). The motivation for choosing additional study tool discriminators leading to the ED were mostly the nurse-perceived need of medical imaging or medical reasons not specified in the protocol. The nurses did not overrule the protocol more often in the intervention group but when they did, they registered the reason for overruling more rigorously. These reasons mainly concerned organisational issues. The number of hospitalisations and the costs for patients assigned to the GPC were lower in the intervention weekends.

The strength of this study lies in the unique opportunity found in a cluster RCT making it possible to study the differences between an intervention and control group. The high number of included patients in a real-world setting is another strength. The study design has important limitations as well: the trial was not designed to study the outcomes of this paper. On the contrary, the marked difference in triage between the intervention and control group was an unexpected finding. Due to ICT limitations, it was not always possible to know which additional discriminators of the eMTS were chosen (either newly invented eMTS discriminators or the nonspecific GP risk). The collected free-text values were only available for a minority of the patients where an additional eMTS discriminator was chosen. Also, it was registered in 64.6% of the intervention patients where the protocol was overruled even though this was explicitly requested. This might cause an important bias. Finally, due to an ICT error during the first two intervention weekend, the chosen discriminator remains unknown for 5% of the patients within urgency category four and five.

A previous study revealed that paper case scenarios generally receive lower triage scores (lower urgency) than live cases.[166] As our intervention group is comparable to the real world, it seems logical that nurses triaged even more risk averse in the intervention group as compared to the control group (similar to live cases). Our study does not allow to definitely answer the question why the nurses classified more patients as urgent by selecting other discriminators during intervention weekends. It is likely that they did this either consciously or subconsciously because of a desired ED outcome and thus triaged more risk averse. Previous qualitative research concerning the same trial reveals some reasons why nurses are sometimes reluctant to assign a patient to the GPC (Meysman J, Morreel S, Lefevere E, *et al.* Triaging and Referring In Adjacent General and Emergency departments (the TRIAGE trial): A process evaluation of medical staff experiences in a nurse-led triage system. Submitted for publication). Some nurses reported that they found

it very difficult in the beginning to refer patients to the GPC. They gained trust in the system after reassurance that low-risk patients they diverted were not sent back. One nurse compared the control group to *"playing poker for chips"* and the intervention group to *"playing poker for money".* Nurses also indicated that it is time-consuming and complex to divert patients to the GPC even though the ED was only 50 meters away. Another possibility is the influence of the study hospital. When diverting patients to the GPC, the ED loses income. On the other hand, the intervention led to a relatively small but significant decrease in the workload which at times was very welcome. Another reason why nurses triaged differently in intervention weekends might be found in the theory of planned behaviour: whether or not a subjective norm (some patients should go to the GPC) leads to an intention (I want to divert these patients) and a behaviour (I have given the advice to go to the GPC) depends on the attitude of the nurse (how important is it to me to give this advice?) and the amount of perceived behavioural control (what are the consequences of this diversion?).[172] This attitude and the perceived behavioural control were probably different in the intervention group, because in the control group the nurse's decision had no influence on the patient's treatment.

The most frequently chosen eMTS discriminator was the perceived need for medical imaging. Even when not specified in the eMTS, nurses often used the non-specific discriminator GP risk with medical imaging as motivation. This need is subjective but, in most cases (79%), the physician did order medical imaging. The studied tool can be improved by providing more specific guidelines on the need for medical imaging especially for the presentational flow chart for limb problems, for example by implementing the Ottawa knee, midfoot and ankle rules which have been validated to rule out fractures at the ED [173, 174] and can be used by ED nurses.[175]

The admission rate of patients with an assignment to the GPC was low but significantly higher during control weekends. More medical imaging and technical procedures were used for patients with an assignment to the GPC during control weekends. The question whether or not this reflects a true medical need or a difference in clinical behaviour between ED and GPC physicians cannot be answered by the current study leaving the question open whether or not the more risk averse triage during intervention weekends leads to over triage. It also remains unknown whether this more risk averse triage during intervention weekends increased patients' safety.

The control group of the TRIAGE trial can be regarded as simulated circumstances comparable to triage research using paper-based scenarios or retrospective observational studies. The current study proves that the theoretical results of such research should be interpreted cautiously as the nurses are likely to triage more risk averse when it really comes down to diverting patients and not only writing down a theoretical assignment. This difference between simulated and real-world experiments is new for the research about triage but is well-known in other fields of research. For example, laboratory experiments

may both understate and exaggerate the importance of social preferences.[176] In lottery experiments, researchers found that research subjects in laboratory circumstances typically underestimate the extent to which they will avoid risk in the real world.[177]

6.5 Conclusion

Triage nurses classify more patients as urgent and select more discriminators linked to the ED when they actually have to divert patients to primary care as compared to a theoretical assignment to primary care. Researchers should be aware that outcomes from a simulated triage setting should not be extrapolated to the real world.

Chapter 7

Precursory studies on telephone triage

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7.1 Precursory study on telephone triage using simulated patients

7.1.1 Abstract

Background

Patients in Belgium needing out-of-hours care have two options: the emergency department (ED) or the general practitioner (GP) on call often organised in a general practitioner cooperative (GPC). Currently there is no triage system in Belgium, so patients do not know where to go.

Methods

Our primary objective was to examine the ability of a newly developed telephone guideline, called 1733, to adequately estimate the urgency of health problems presented by simulated patients. Ten clinical vignettes were presented to 12 operators in a simulated phone call. The operators had to assign a protocol, urgency level and resource to dispatch (ambulance, GP house visit, etc.) to each case.

Results

Hundred-twenty phone calls were analysed. The operators chose the right protocol in 69% and the correct urgency level in 35% of the cases. The proportion of under- and over-triage was 26% and 39% respectively. There was important variation in between the operators. The sensitivity for detecting highly urgent cases was 0.42, the specificity 0.92.

Conclusion

Using the new Belgian 1733 guideline for telephone triage, operators mostly chose the appropriate protocol but only chose the correct urgency in 1 out of 3 cases. In this phase of development, the studied telephone guideline is not ready for implementation.

7.1.2 Introduction

EDs in Belgium, as throughout Europe, are overcrowded.[65] Lower acuity problems presented at the ED can be managed in a primary care setting.[9, 72, 73] One of many solutions to the inefficient use at and overcrowding of the ED may be to redirect patients from secondary to primary care. From the 1990s, general practitioner cooperatives (GPC) have been established in many European countries, as a new alternative for the organisation of out-of-hours (OOH) medical care by general practitioners (GPs). The rise of GPCs in Belgium did not reduce overcrowding at the ED. On the contrary, there was a rise of contacts for both services.[23]

In Belgium, patients have a free choice to go to the ED or GPC. Previous research revealed that patients find it difficult to make this decision themselves and the Belgian healthcare system does not provide any services to assist them.[6] Internationally, a range of policy and organisational interventions have been tried to stream appropriate patients primary care: a GP working at the ED, information campaigns, financial barriers,…[18, 20]

Another possible solution is triage. Triage is the sorting out and classification of patients or casualties to determine priority of need and proper place of treatment. In physical triage, a healthcare professional at the ED or at the common gate of an ED and GPC makes a quick assessment of the patient and then allocates the patient to the most appropriate service. This can lead to efficient redirection of self-referrals.[21] In telephone triage, the patient calls a hotline and gets advice about the most appropriate service by a nurse, paramedic or doctor. When a patient's urgency is underestimated, the decision is considered under-triage. Research in real patients showed that on average about 10% of the telephone triage contacts were unsafe.[55] Overestimation of the urgency is called over-triage and leads to inefficiency because expensive resources are inappropriately dispatched. In other countries, research after implementation of telephone triage showed it is efficient but possibly not safe especially for highly urgent cases.[55] Consequently, research is necessary before implementing new triage tools.

Our primary objective was to examine the ability of a newly developed telephone guideline, called the 1733 guideline, to adequately estimate the urgency of health problems presented by simulated patients. An adequate telephone triage decision consists of three steps: choosing the correct protocol (e.g., headache), assigning the right urgency level (e.g., very urgent) and dispatching the according resource (e.g., ambulance). Estimating the interrater agreement when using the protocols was the secondary objective.

7.1.3 Methods

Used materials

We studied the 1733 guideline, named after the telephone number patients will have to call in the near future to have access to OOH care. It is based upon the historically used guideline for ambulance dispatch in Belgium, which has never been validated, but is being used for many years now. A working group consisting of four GPs, three emergency physicians and three staff members of the ambulance dispatch services adjusted this guideline and extended it with primary care options. The members of this working group were selected from the relevant stakeholder organisations and from every participating healthcare service. Two systems with an acceptable validity were used as a source of inspiration: the Manchester telephone triage system and the Netherlands Triage Standard. [79, 178]

Three new urgency levels were added to the old guideline: urgent GP, standard GP and standard non-urgent care. The development procedure of the 1733 guideline is described elsewhere.[179] It consists of 40 protocols, each for a specific patient presentation (see table 1 for an example). A protocol consists of a table with six urgency levels (U1-U6). Each urgency level contains a number of discriminators. The operator is supposed to check the presence of these discriminators in a top-down order. Each urgency level has a corresponding resource (see Table 15). Dispatchers are allowed to deploy another resource for reasons not described in the protocol (mostly psychosocial concerns or practical considerations). At the time of the research, there was no computer decision support system available.

Table 15. Example of a protocol form the 1733 guideline for the presentation "pregnancy/delivery".

Observations	Urgency Level	Recommended resource
Compromised vital signs Current seizures Third trimester (6-9 months of pregnancy) known high blood pressure and either persistent headache or abdominal pain with nausea Severe or continuous vaginal blood loss in the second or third trimester (3-9 months of pregnancy) In expulsion phase without professional help	U1	Ambulance with a doctor and nurse
>26 weeks of pregnancy and Malinas score[180] >5 with new onset or increased severe continuous abdominal pain	U2	Ambulance with nurse
>26 weeks of pregnancy and Malinas score[180] < 6 and no private transportation available or transport request from midwife, nurse or doctor.	U3	Ambulance with paramedics
New onset severe vomiting No more foetal movements	U4	Urgent GP (within one hour)
Abdominal pain in the first trimester Vaginal blood loss in the first trimester Other symptoms not directly related to the pregnancy (urinary infection, cough, diarrhoea, swollen ankles, …)	U5	Standard GP on call (within 12 hours)
Amenorrhea, request for blood analysis, suspicion of pregnancy, request for advice about medication, request for pregnancy certificate.	U6	Refer patient to standard non urgent care

Translation by the authors of this article. Operators using this guideline have more details and definitions available.

Pairs of a GP and an emergency physician wrote 28 clinical vignettes. Afterwards the head of the dispatch centre reviewed all vignettes and adjusted them in consensus with the writers. The entire working group unanimously decided on the correct outcome for each vignette (gold standard). For one presentation, several protocols may be used but all of them should eventually lead to the same urgency level. For each vignette the working group defined one 'most appropriate' protocol and none to three acceptable alternatives.

We piloted all of these vignettes. Those leading to unclear answers or ambiguous interpretations were left out, leading to 10 selected vignettes (see Table 16). Operators received a hard copy of the manual and a brief training on how to use it.

Table 16. Vignettes of the simulated cases used to study the 1733-guideline.

Caller	Complaint	Correct urgency class	Most appropriate protocol (%)	Correct urgency level (%)
1. Granddaughter of older female	My grandmother remains in bed and can no longer speak.	U4	100	58
2. Spouse of middle-aged male	Severe abdominal pain	U1	92	42
3. Mother of baby	Heat stroke with dehydration	U2	31	17
4. Mother of toddler	Intoxication with mushrooms and leaves	U4	69	58
5. Adult male	Chest pain, hyperventilation	U6	77	9
6. Middle aged male	Trauma with short term loss of consciousness	U5	54	50
7. Adult male	Chemical burn of forearms	U4	0	0
8. Middle aged female	Shortness of breath, long term psychosocial problems	U5	92	8
9. Adolescent female	Contusion of the head	U6	77	58
10. Adult female	Suicidal thoughts	U4	100	50

Study design

We performed a single centre prospective study using simulated patients, on April 20th, 2017. Three GPs (including author HP) simulated each three to four cases: they acted as real patients calling the operators. They extemporized when necessary but did not give any information not stated in the vignettes. All 13 operators working at the studied dispatch centre and available during the study period participated. They sat at their normal working station and were informed about the test situation. They noted the chosen protocol, urgency level, resource to dispatch on a spreadsheet with drop down menus (Microsoft Excel 2016). For each answer they added how confident they were in their answers on a scale from one to ten.

Analysis

Concordance with the golden standard, standard deviations and sensitivity/specificity were calculated using Microsoft Excel 2016.We calculated Interrater agreement in R with the Various Coefficients of Interrater Reliability and Agreement (IRR) package.

7.1.4 Results

We excluded one out of thirteen operators because of a lack of cooperation with the researchers: his/her supervisor reported to the researchers that he/she gave intentionally wrong answers to all questions. The simulated patients made 120 telephone calls. Table 17 shows the characteristics of the operators.

Table 17. Characteristics of the studied operators.

Average age	37 years (range 30-51)
Average experience as an operator	7 years (range 1-19)
Gender	7 (58%) female, 5 (42%) male
Educational level*	6 (55%) bachelor or master, 5 (45%) high school

**: one missing value*

Protocol

The operators chose in 83/120 (69%) cases the most appropriate protocol. In six out of 10 vignettes, at least three out of every four operators chose the most appropriate protocol. For the remaining four vignettes, the most appropriate percentage ranged from zero to 69. The operators chose an acceptable alternative in 33/120 (28%). For the case of a chemical burn to the forearm for example, the working group proposed the protocol “problems of the extremities” while all operators choose “exposure to chemical substances”. There were 4/120 (3%) entirely wrong answers all of them in case four (Intoxication with mushrooms and leaves).

Urgency level

The operators estimated the urgency correctly in 42/119 (35%) cases. Among the 77/119 (65%) wrong estimates, there was a difference of one urgency level in 49/119 cases (41%), two categories in 20/119 (17%) and three categories in 8/119 (7%). In total, they overestimated the urgency in 46/119 (39%) and underestimated it in 31/119 cases (26%). There was significant variation between the operators (see Table 18): one operator did not make any underestimation whereas two others made an underestimation of the urgency in four out of eight cases. The variation among the cases was similar: from zero to 58% of correct triage. The interrater agreement was moderate (Kendall’s W 0.57).

Table 18. Variation among the operators for urgency level (N cases: 119): Number of cases per operator triaged correctly, over- or under triaged.

Operator:	1	2	3	4	5	6	7	8	9	10	11	12	Total
Correct triage	1	3	7	3	5	2	2	4	3	5	4	3	42 (35%)
Possible over-triage	6	4	2	6	2	3	3	3	4	4	3	6	46 (39%)
Possible under-triage	3	3	0	1	3	5	5	3	3	1	3	1	31(26%)

The capacity to discriminate potentially life-threatening cases from less urgent cases was examined by creating a dichotomy between U1 and U2 and the other categories. In the two vignettes with a correct solution of U1 or U2, the operators chose U1 or U2 in ten out of twenty-four answers (sensitivity 0.42). In the other vignettes, the operators chose U1 or U2 in eight out of ninety-five cases (specificity 0.92).

Resource

Compared to the gold standard the operators deploy the correct resource in 45/120 (38%). Among the 75 wrong estimates, there was a difference of one category in 47/120 (39%), two categories in 22/120 (18%), three categories in 5/120 (4%) and four categories in 1/120 (1%). There was over-triage in 48/120 (40%) and under-triage in the remaining 27/120 (23%). The interrater agreement was moderate (Kendall's W 0.59).

In 101/119 (85%), the operators picked the resource corresponding to the chosen urgency level. In 13/119 (11%) this resource was higher (more urgent or upscaling) and in 6/119 (5%) it was lower (less urgent or downscaling).

The average certainty scores per operator were 8.5 (SD 0.93) for protocol, 7.5 (SD 0.77) for urgency level and 7.3 (SD 1.50) for resource. The scores per vignette showed similar averages and standard deviations.

7.1.5 Discussion

In this study, we examined whether the newly developed 1733 guideline used by operators adequately estimates the urgency of health problems presented by simulated patients. The operators mostly chose the appropriate protocol or an acceptable alternative. A low concordance with the gold standard was found for the urgency level. For the detection of the most urgent cases, this study reveals a low sensitivity and an acceptable specificity. This lower accuracy for high urgent cases is similar to current literature.[56]

In a systematic review the percentage of safe performance in highly urgent cases was 46% which was considered unsafe,[55] similar to the 42% in this study. A summary of this review and two more recent studies[181, 182] can be found in Table 19. The proportion of correct decisions in this study is the lowest among these comparable studies, mainly because of the high proportion of over-triage. In only one similar article, the authors made a positive conclusion about safety with better results than in the present study.[181] None of these comparable studies used the same methodology as we did: all either used mystery patients (simulated patients who call the operators unexpectedly during routine clinical work) or written case scenarios.

Table 19. Comparison of the findings of this study to the current literature.

First Author	Year of publication	Setting	Study design	Triagist's background	Number of scale levels	Total number of cases	% Correct triage	% Undertriage	% Overtriage	Author's conclusion
Morreel	2019	Out-of-hours call centre	10 simulated patients	Paramedics	6	120	35	26	39	Unsafe
Moriarty [183]	2003	Primary care telephone triage pilot service	4 mystery patients with need to refer (feasibility study)	Nurses	referral or not	85	51	49	N/A	None
Giesen [184]	2007	GPC (regional telephone number)	5 mystery patients, 20 cases	Nurses	4	352	69	19	12,5	Potentially unsafe
Derkx [185]	2008	GPC (regional telephone number)	7 mystery patients, no U1 or U5	Nurses	3	357	58	41	1	Unsafe
Hansen [181]	2011	OOH centre	20 written scenarios	Nurses	3	1620	70	12	18	Safe
Pasini [182]	2015	OOH call centre	4 mystery patients	GPs	2	40	93	N/A	8	None

A recent study on a Dutch guideline for daytime practice used by practice assistants tested written case scenarios. The authors found correct triage in 64%, under-triage in 17% and over-triage in 19%.[56] These figures are significantly better than the results of the present study (38%, 40% and 23% respectively). Most telephone triage systems use a four or five point scale whereas we have studied a six point scale. The more points, the more options an operator will have to make a mistake.

Although currently there is no agreement on the most appropriate statistics to assess interrater agreement in triage, the moderate interrater agreement presented here is not satisfactory.[186] We found high certainty scores indicating that the operators do not experience much doubt in their decisions. Possibly they feel acquainted to the new protocols as they appear similar to the ones they are used to work with, and they might not be aware of the importance of adding new resources like the general practitioner. Alternatively, the protocols might be clearly written but not correctly in terms of content.

We believe a combination of several factors causes our unsatisfactory results. Firstly, the operators might not have been prepared well enough for their complex task: they did not have any experience with the 1733 guideline and only received a brief training of half a day. Secondly, the protocols might be insufficient. They are written in an ambiguous way: not all discriminators clearly lead to a specific urgency level and the same presentation sometimes give different urgency categories depending on the chosen protocol. Protocols often contain discriminators that are difficult to interpret (e.g., structures with “and”, “or”, “not”). Finally, the way the vignettes were designed or played by the simulated patients might have confused the operators. The extent of the contribution of all these factors cannot be determined using the current study.

This study was the first in Belgium to try to validate a triage instrument and thus provides interesting insights. Unique in this study is that we did not only study the urgency level but also the dispatched resource and certainty scores. The results are very important for the organisation of OOH triage in Belgium but also in other countries using not yet validated telephone triage guidelines. When interpreting the results of this study it is important to consider that most researchers validate triage systems after implementation. This study proves that it is possible to study a new triage system in laboratory circumstances.

This study has some limitations. The operators, simulated patients and researchers were not blinded. We obtained a relatively small sample of operators, all but one from the same dispatch centre. The current sample was too small to assess the importance of training, experience and educational level. In further research, we need to assess these characteristics as they might explain the moderate interrater variability. The protocols were developed using a bottom-up approach and not using a validated methodology such as for example a Delphi procedure.[179] GPs took the role of simulated patients because

they have experience with the clinical presentation of the chosen vignettes. They might cause a bias by trying to direct the operator in the right direction.

This version of the 1733 guideline is not yet ready for clinical implementation. Ideally, it should be improved by using the current study and afterwards perform a new study on simulated patients. Keeping in mind its shortcomings, the Belgian government has chosen to start implementation with an improved but unvalidated guideline, as happened in most countries. Permanent evaluation of the 1733 guideline and performance of the operators is mandatory and will need to follow a transparent protocol.

7.1.6 Conclusion

It is feasible and useful to study telephone triage guidelines before implementation. Using the Belgian 1733 guideline for telephone triage, operators mostly chose the appropriate protocol but only dispatched the correct resource in 38% of the cases, which is lower than in similar studies. The studied telephone guidelines are not ready for implementation in this phase of the development.

7.2 Precursory study on telephone triage using real patients

7.2.1 Abstract

Objectives

Patients in Belgium needing out-of-hours medical care have two options: the emergency department (ED) or a general practitioner (GP) on call. Currently, there is no triage system in Belgium, so patients do not know where they should go. However, patients who could be managed by a GP frequently present themselves at an ED without referral. GPs often organise themselves in a General Practitioners Cooperative (GPC). This study assesses the accuracy of a newly developed telephone triage guideline.

Methods

Observational real-time simulation: all walk-in patients at two GPCs and three EDs were asked to call a triage telephone number with their current medical problem. The operator handling this call registered an urgency level and a resource (ED, GP, or ambulance) to deploy. The treating physician's opinion was used as the gold standard for correct triage. Patients were not informed about the outcome of the triage and continued the standard care path they had chosen.

Results

The overall sensitivity of the telephone triage for detecting patients who could be managed by a GP was 82% with a specificity of 53%. The correctness of the advice given by the operator according to the physicians was 69%, with 12% underestimation of urgency and 19% overestimation. At the GPC, the sensitivity for detecting patients requiring GP management/ care was 91% with a specificity of 36%. At the ED, the sensitivity for detecting GP patients was 67% with a specificity of 48%.

Conclusion

This study evaluates a new guideline for telephone triage, showing potential overtriage for patients wanting to attend the GPC, with possible inefficiency, and potential undertriage for patients wanting to attend the ED, with possible safety issues.

7.2.2 Introduction

Out-of-hours (OOH) medical care is provided after standard office hours, covering evenings, nights, weekends and bank holidays. In many European countries, OOH primary care is increasingly organised in large- scale General Practitioners Cooperatives (GPCs). Simultaneously, acute care is provided by emergency departments (EDs) in hospitals. Both services are under pressure because of increasing demands.

For patients, choosing the appropriate care at the right place and time is not always easy. They base their decisions on previous experience with a service, easy access, explanation by the doctor about the illness and treatment, the anticipated waiting time, their relationship with their general practitioner (GP) and the perceived nature of the complaint.[6, 7] In telephone triage, a patient with a perceived urgent medical problem calls a hotline. An operator questions the patient, directs to the most appropriate care and improves self-management.

The goal of telephone triage is to determine the urgency level of the patient's complaint and to refer to an appropriate location of treatment. An adequate telephone triage decision consists of three steps: choosing the correct presentation/protocol (e.g., chest pain), assigning the right urgency category (e.g. very urgent) and dispatching the according resource (e.g. ambulance).

Although we do not have a clear-cut definition of 'appropriate use' or, 'inappropriate use' of the ED, it has been documented that many medical problems presented at the ED could be managed in a primary care setting.[72-74] In other countries, telephone triage has proven to be efficient, but possibly with suboptimal safety for patients with highly urgent symptoms. Similar results were found in a review on triage scales used in EDs.[187] Underestimation of the patient's urgency may increase morbidity and mortality. Overestimation of the urgency level leads to inefficiency and higher costs.

The Belgian health-care system is organised in primary, secondary, and tertiary care, with open access for patients to all levels. There is a fee-for-service system: 82% of these fees are reimbursed by the mandatory public health insurance.[64] At the time, this study was conducted, patients could self-select to see the GP-on- call at the GPC or visit the ED during OOH without triage.

Our primary objective was to assess the accuracy of a newly developed telephone triage guide-line for unplanned acute primary and secondary care, called '1733' in a real-time setting. A previous study with simulated patients using this new guideline showed that operators mostly chose the appropriate protocol, but only chose the correct urgency in one out of three cases, with moderate interrater variability.[171]

7.2.3 Methods

Study setting

This observational real-time simulation study was conducted in two Belgian communities, over two separate weeks in 2016: from 21 October, until 28 October at the ED of the Hospital of Tienen and during the weekend at the GPC of Tienen, and from 7 November 2016 until 14 November 2016 in the EDs of the Regional Hospital in Leuven and the University Hospital of Leuven and during the weekend at the GPC of Leuven. These study sites cover both rural and urban areas.

A new guideline for telephone triage

We used the newly developed '1733' telephone triage guideline (version 1.7), which is based upon the existing guideline for ambulance dispatch in Belgium. 1733 is the phone number to call for patients needing non- urgent OOH healthcare (instead of 112). A working group consisting of general practitioners, emergency physicians and ambulance dispatch services staff adjusted this guideline for primary care. This guideline introduced two new levels of urgency: standard GP care and urgent GP care. The development of this guideline is described elsewhere.[179] The '1733' guideline consists of 40 protocols, each for a specific presentation. A protocol consists of a table with six urgency levels and corresponding resources (See Table 20). Each urgency level consists of several descriptors. The operator is asked to check the presence of each descriptor in a top-down order. Overtriage was defined as advice for ED by the telephone triage when the treating physician chose the GP as the most appropriate care and vice versa for undertriage.

Table 20. Description of the urgency levels used in the current study.

Level	Description	Recommended resource
U1	Immediate life-threatening	Ambulance (paramedics, nurse, and doctor)
U2	Possibly life-threatening, fast evolution expected	Ambulance (nurse)
U3	Not life-threatening, admission probably necessary	Ambulance (paramedics)
U4	Not life-threatening, admission probably not necessary	Urgent GP (within one hour)
U5	In need of less urgent care	Standard GP on call (within 12 hours)
U6	Does not need medical care at this moment	Refer patient to standard non urgent care

The lowest urgency level (U6) is the level for delay of care: the patient can see a doctor during office hours. Currently, there is no legal framework for this delay of care; therefore, we consider these patients (n = 101) as U5 in this paper. The protocols were tested in a pilot study using simulated patients.[171] Operators from the ambulance dispatch followed a brief training about the 1733 guideline, received a hard copy and the guideline was incorporated in their computer decision support system. The participating operators had various professional backgrounds but were not medical professionals.

Study design

Over the study period, all patients at the GPCs or walk- in patients (no referral from a GP and not arriving by ambulance) at the ED were invited to contact the dispatch centre while waiting for the doctor. Medical and paramedical students located at the GPCs and EDs identified possible participants, informed them about the study and obtained consent. They assisted participants in calling the dispatch centre and informed the operator about the upcoming study-related call. During this call, patients were triaged by the operator. The outcome of the triage (protocol used, urgency level and allocated resource) was registered by the operator. The triage advice was not given to the patient. If the patient could not participate himself, a companion was asked to join on his or her behalf.

The patient was then seen by the treating physician who filled in a questionnaire after the consultation. This questionnaire included the location where the patient should have sought care, based on the problem presentation (not the diagnosis): at the GPC or at the ED (not the urgency level). As there is no gold standard for the assessment of triage accuracy, this judgement is further used as a proxy for the true urgency level.

Most studies about telephone triage do not make a distinction between ED and GPC patients because they are required to call before choosing a service. Because this telephone service does not yet exist in many countries, including Belgium, there is a distinction between patients wanting to attend the ED or GPC, so it is useful to analyse them separately.

Data collection and analysis

Data from the operators were collected electronically from the dispatch centres. All other data were collected on paper and coded by the students. Reasons for encounter were coded using ICPC-2 (International Classification of Primary Care, 2nd edition) by the first author. We used a database for OOH care (iCAREdata)[1] and the clinical software of the hospitals to compare the study sample to the overall population of the participating sites in 2016 in terms of age and gender. The students noted the reason for exclusion for most excluded patients. Due to the organization of the ED, the students were not aware of all patients entering the ED. To assess the amount of missed exclusions, the number of

admitted patients was obtained using the software of the participating hospitals and GPCs. All data were analysed in IBM SPSS® version 24 except the 95% confidence intervals of likelihood ratios which was calculated in R version 3.5 with the BootLR package.[188]

7.2.4 Results

We analysed data from 1094 contacts assessed by 61 different operators. See Figure 16 for the included participants and Table 21 for their characteristics, epidemiology, and clinical conditions.

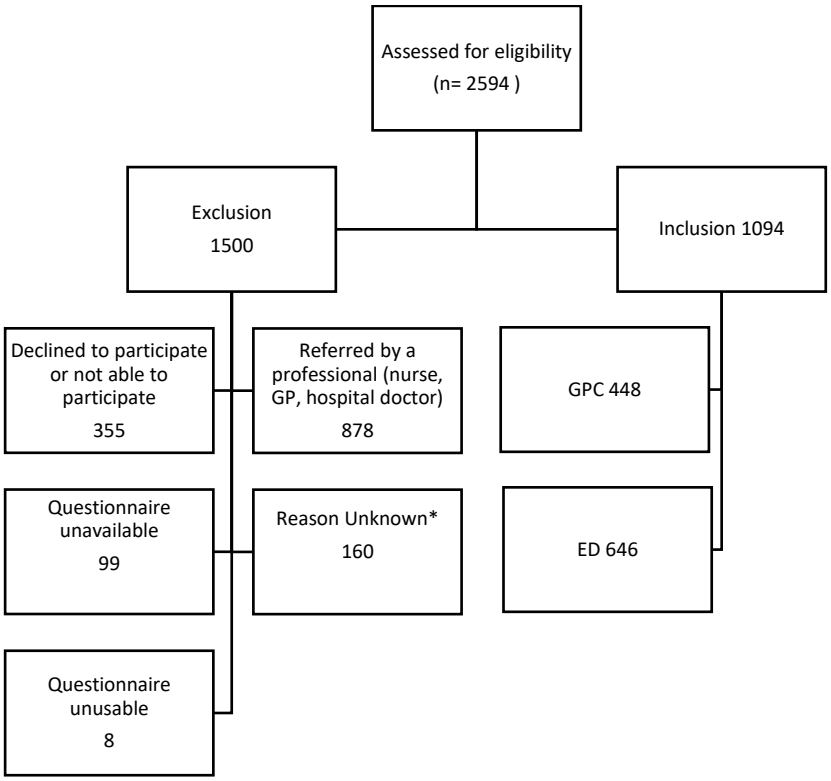

Figure 16. Flow-chart of the inclusions
**: using the software of the participating sites we have detected 160 patients not included in the study neither explicitly excluded by the students.*

Table 21. Characteristics, epidemiology, and clinical conditions of included patients (N=1094).

Characteristic		Cases	Percentage
Demographics	Male	512	47%
	Female	581	53%
	Age	Mean: 35,8 years (Standard deviation 25,7 years)	
Education	None	172	15.7
	Primary school	149	13.6
	High School	345	31.5
	Bachelor or Master	411	37.6
	Missing	17	1.6
Language most spoken at home	Dutch	953	87.2
	Other	140	12.8
Employment	Employed	395	36.1
	Student	238	21.8
	Retired	205	18.7
	Unemployed	63	7.3
	Missing	177	16.2
Reason for encounter: trauma?	Trauma	312	28.5%
	No trauma or missing	782	71.5%
Reason for encounter: ICPC-2* chapter	Musculoskeletal	288	26.3
	Digestive	180	16.5
	General	161	14.7
	Respiratory	138	12.6
	Skin	117	10.7
	Others	206	18.8
	Missing	4	0.4

**ICPC-2: International Catalogue for Primary Care second edition*

Patients were representative in terms of age and gender compared to the overall population during 2016 at the participating EDs and GPCs. See Table 22 for distribution of the sample across 46 protocols.

Table 22. Distribution of the study sample across the 1733 protocols (N = 1094).

1733 Protocol	Number of included patients (N)	Proportion of the total sample (%)
Respiratory Distress	72	7
Non-traumatic Abdominal Pain	131	12
Non-traumatic Back Pain	42	4
Bleeding/Blood loss	28	3
Headache	22	2
Unclear Problem	293	27
Trauma/Amputation	265	24
Febrile Child/Febrile Seizures	44	4
Cardiac Problem (not: chest pain)	21	2
Others	143	13
Missing	33	3
Total	1094	100

According to the treating physicians, 661 out of 1029 patients should have chosen the GP (65 missing values). Of these, the 1733 guideline would allocate 539[6] (82% sensitivity) to the GP. For 368 patients, the physician preferred the ED compared to the 1733 guideline that allocated 174[7] (47% specificity) to the ED. Overall, the correctness of the advice according to the physicians was 69%, with 12% overtriage and 19% undertriage. Because overtriage is considered inefficient but safe, the total safe performance is 82%. The positive likelihood ratio (LR+) of a correct GP advice by the 1733 operator was 1.55 (95% CI 1.40–1.72); the negative likelihood ratio (LR-) was 0,39 (0.32–0.47).

These results are different for both services (see Figure 17): At the GPC, the sensitivity for detecting GP patients is 91% with a specificity of 36%.[8] During the study period, this would have led to referring 46 patients to the ED, including 34 unnecessary referrals, while still misclassifying 21 patients who should have gone directly to the ED.

[6] 360 a the GPC and 179 at the ED
[7] 162 at the ED and 12 at the GPC leading to a specificity of 174/368 or 47%
[8] Sensitivity = (394-34)/394 = 91% and specificity = 12/33 =36%

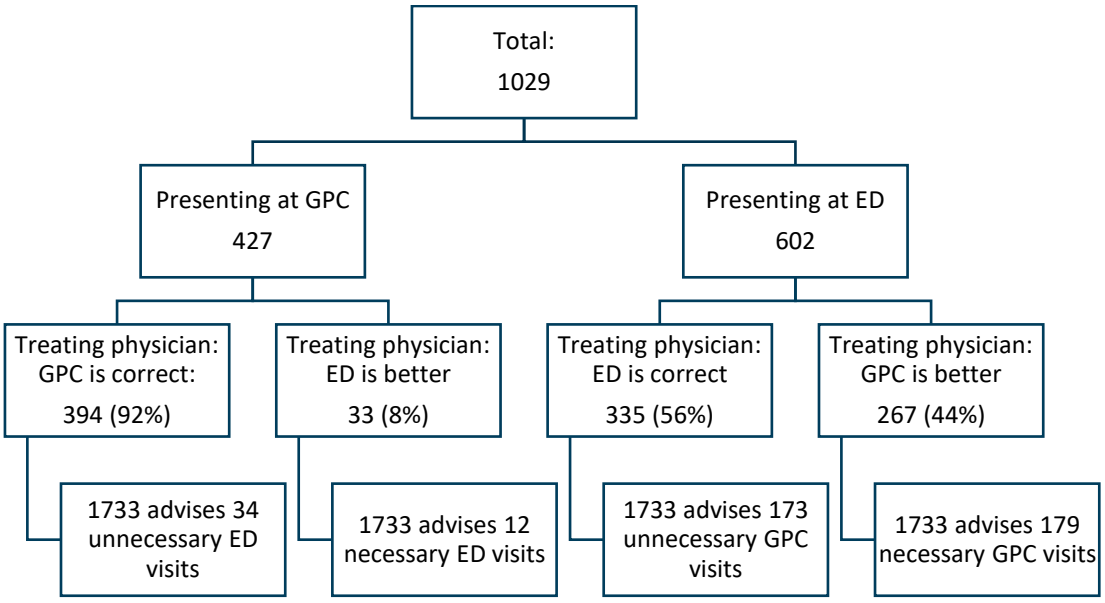

Figure 17. Opinion of the treating physician and 1733 guideline
The opinion of the treating physician was missing in 35 cases; the triage advice was missing in 33 cases.

At the ED, the sensitivity for detecting GP patients is 67% with a specificity of 48%[9]. During the study period, this would have led to referring 352 patients to the GPC including 173 possibly unsafe referrals, while misclassifying 88 patients suitable for the GPC.

7.2.5 Discussion

This study evaluates the accuracy of the implementation of a newly developed telephone triage guideline for OOH care. We found an acceptable sensitivity of 82%, but a low specificity of 47% for the telephone triage advice.

Using 1733 at the GPC would have led to detection of 12 (3%) patients who should have gone directly to the ED. On the other hand, 34 (8%) unnecessary referrals to the ED were detected. At the ED, 1733 would correctly refer 179 (30%) to the GPC, while 173 (29%) of patients possibly in need of ED care would be referred to the GPC.

Not all patients potentially in need of ED care will suffer a significant safety risk when going to the GPC. Many serious medical problems are suitable for both services (e.g., pneumonia, asthma exacerbation, mental illness). Further research should focus on these specific medical situations because the admittance rate and the use of hospital resources for these patients have not yet been studied. Although the current study does not allow

[9] Sensitivity = (394-360)/394 = 67% and specificity = (335-162)/335 = 0.48

quantification of the risks in this group, it is likely that at least a proportion of these patients are not suitable for the GPC.

There is no gold standard for correct triage.[189] We used the treating physicians' assessments as the best available proxy. Personal beliefs of the treating physicians about the professional roles and tasks of ED doctors and/or GPs in OOH care may have influenced their assessments. On the other hand, a large difference between the allocations of a triage system and the opinion of treating physicians will complicate implementation. Using another triage system (for example, The Manchester Triage System) as comparison or using a consensus procedure with a panel of experts could be an interesting topic for further research.

Implementing 1733 would lead to a higher workload at the GPC, and because of the low specificity, most likely also an increased referral rate to the ED. The ease of GP referrals to the ED in terms of distance, communication and financial consequences influences its acceptability. On the other hand, implementing 1733 would reduce the demand at the ED, but not necessarily have a large impact on the workload.[190]

Until now most studies on telephone triage have been either observational studies in contacts with real patients (mostly a combination of unselected and highly urgent contacts) or prospective observational studies using high-risk simulated patients before implementation.[55] The unique design of our study on telephone triage provides added value in exploring safety and effects on patient flow in real-time settings.

This multi-centre study was conducted in two large regions, with GPCs containing rural as well as urban areas. Two local hospitals as well as a university hospital participated. This led to a high inclusion rate of different types of patients resulting in a sufficient representativeness of the included patients.

The operators at the dispatch centre were not blinded for the location the patients from where the participants were calling. This could have influenced their triage decision. The operators received limited training, so based on this study, we recommend in- depth training before implementation. In addition, since patients already decided which service they would attend for their medical problems, this could have influenced their presentation towards the operator.

We had a large amount of exclusions because patients declined or were unable to participate due to serious illness or perceived inappropriateness by the students to enrol them. This could lead to a possible selection bias in two directions: patients who were at the correct site, for example a serious ill patient at the ED, or a patient with a minor symptom that declines to participate that should have been seen by a GP. Because of the

real-time setting, there was some missing data (missing patients, treating physician's opinion and triage advice).

7.2.6 Conclusion

The studied version of the 1733 guideline for telephone triage is potentially inefficient for 12% of the patients who could be handled at the GPC, but are sent to the ED, and it is potentially unsafe for 19% of the patients who preferably are seen at the ED but receive advice to attend the GPC. In 69% of the cases, the treating physician rated the advice from the telephone triage handler as correct. Further adaptation and study is necessary before implementation. It is feasible and necessary to study a triage guideline in real-time settings before implementation.

Chapter 8 Overall discussion

This dissertation covers several solutions for the difficulties patients face when choosing the right place of care in case of an unexpected illness outside of office hours. This final chapter explores the significance of the main findings of the chapters above, their implications on clinical practice, and their connections to each other.

8.1 Main findings and their meaning

Finding One: telephone triage is not sufficient

Chapter 7 contains two studies on telephone triage using the new 1733 guideline. The first pilot study using simulated patients, revealed that operators mostly chose the appropriate protocol (e.g., chest pain) but only chose the correct urgency in 1 out of 3 cases. The second pilot study included real patients, but these were triaged virtually as they all remained at the OOH service they had chosen themselves. The operators did not have a professional medical degree. In this paper we concluded that the 1733 guideline was potentially inefficient for 12% of the patients who could have been handled at the GPC, but were sent to the ED. In addition, the guideline was potentially unsafe for 19% of the patients at the ED who preferably should have been seen at the ED but received advice to attend the GPC instead. These findings, together with other unpublished data bundled into one report, were presented to the federal authorities and the involved stakeholders. Because of the rather negative findings compared to current literature,[55] these results were subject to criticism,[191-193] but they ultimately led to a revision of the 1733 manual.

At the time of writing, a new version of this manual was gradually implemented countrywide.[194] A new study showed major improvement in the reliability of the tool but it only focussed on one protocol out of the entire guideline.[62] Several master theses studied other aspects: costs related to ankle fractures (possible cost reductions), patient satisfaction (good), opinion of the GP (positive), undertriage of GP patients (<1%) and the use of GP specific protocols (correctly used in 50% of the cases).[195] No peer reviewed data concerning these aspects were available at the time of writing.

After we published our articles concerning 1733, another telephone guideline (called SALOMON) was published by our colleagues from Liège. In this retrospective study, nurses triaged 85.5% of the included patients appropriately but the research methodology, the competences of the operators and the gold standard were different from the 1733 studies.[40, 196] Further development of telephone triage in Belgium should seek to combine strengths from the 1733 and SALOMON guidelines and should be accompanied by a comprehensive research project as there is still no large prospective study that demonstrates safety nor efficiency. The legal framework for a delay of care remains unclear.[36, 197] Recently the authors of the 1733 guideline have stated that given the fact that the federal minister of health signed the 1733 guidelines, the federal governments accepts its liability. At the time of writing, patients are encouraged but not obliged to call 1733 prior to go to an ED or GPC. Patients are free to comply to the 1733 advice or to follow their own judgment. Because of this “patient freedom” and the lack of a fully validated telephone triage guideline in Belgium, telephone triage alone does not solve the central problem of this dissertation. Worldwide, its contributions might be larger but, in any system, some patients will always head directly to the ED or GPC.

Finding Two: a promotion campaign is a nice start but not sufficient

In the first chapter of this dissertation, we proved that a simple information campaign, which was easy to set up, safely encouraged 5.4% of the patients at the ED to triage themselves to the adjacent GPC. The costs of this campaign were very limited: three meetings, a few hours for preparing the material and printing costs were the only investments necessary. It was a meaningful step towards a more profound collaboration. The aim of this research was not merely scientific but also practical: was it possible to start a collaboration between the studied ED and GPC? Was it feasible to collect data without giving even more paperwork to the ED nurses? The answer to all these questions was clearly “Yes we can”. The involved stakeholders and the researchers were not satisfied with the results of this promotion campaign alone. They felt the need for a more profound collaboration, so we decided to go further by preparing the TRIAGE trial while simultaneously starting a quest for funding. The promotion campaign was ended because it was not compatible with the intervention of the TRIAGE trial (the patient received entirely different information). The methodology and the used material for this promotion campaign are available for other ED/GPC collaborations.[198]

Finding Three: extended triage as implemented during the TRIAGE trial had a rather low efficiency: a problem, an opportunity or is it just fine?

In the TRIAGE trial, 9.5% of the included patients were diverted from the ED to the GPC. The small 95% confidence interval around this main finding (8.8 to 10.3) proves that our sample was large enough to make conclusions regarding efficiency. Compared to the literature on which the design of the TRIAGE trial was based, this is rather low. A large Dutch study with a similar triage collaboration with the ED found a 22% increase of the proportion of patients attending the GP as compared to the usual care setting. Another study found a decline in the number of patients treated at the ED by 20% after the introduction of a nearby GPC with common physical triage.[21, 66] The proportion of patients who received a GPC assignment during the control weekends of the TRIAGE trial was similar to these studies indicating that the eMTS has got a higher potential. Again, our colleagues from Liège made their own guideline named PERSEE. In a prospective observational study they categorised 10% of the included patients as primary care treatable and thereby, as potentially eligible for redirection (similar to the secondary outcome of the TRIAGE trial).[31] This 9.5% does not necessarily include the 5% of voluntary swithers after a promotion campaign found in Chapter 1 because this campaign was conducted before the triage and thus at times even before registration at the ED. Probably, some patients (at least the 1.7% as measured before the information campaign) also switched voluntarily to the GPC before triage during the TRIAGE trial but we did not study this outcome. On the other hand, some patients might have thought about switching to the GPC but received an ED advice during triage.

Whether or not a diversion of 9.5% of the included patients was enough depends on the point of view:

- **The patient:** we did not examine this point so we do not know whether increasing the proportion of patients assigned to the GPC would also increase the fraction of patients refusing this assignment or what it would mean for patient satisfaction.
- **The ED staff:** when presenting the results to the ED staff of the study hospital and the advisory committee of the TRIAGE trial, we received mixed reactions. Some argue that ten percent is enough. The ED does not want to lose all the easy patients. Others argue that the steadily increase of patients at the ED year after year makes it important to increase this proportion. All agreed that 9.5% is an underestimation of the true proportion of patients suitable for primary care.
- **The GPs:** they underwent this project passively and accepted to see the diverted patients. Several GPs sent complaints to the board of the GPC about having to see patients with non-urgent problems during the night. Whether or not the GPC can handle more diverted patients depends on its own crowding which increased due to COVID-19.[82] GPs are probably not willing to do more OOH shifts in order to handle more diverted patients. When presenting some of the results to another GPC/ED collaboration, the GPs decided not to implement extended triage without a possibility to advice some patients a delay of care as they were not willing to welcome more patients. This lack of interest by GPs has been reported by other authors as well.[199] It is possible to increase the studied proportion by adjusting the eMTS. Some typical primary care interventions, such as stitching wounds and small incisions, were not sent to the GPC because a minority of the GPs refuses to do them and the ED was (and remains) not willing to adjust the eMTS to a specific GP on call.
- **The researchers:** the reason why this proportion is lower than expected raises new research questions: is it related to the studied tool? Or rather the local implementation? These questions can only be answered by a multicentre follow-up study.
- **The health insurance system:** on the one hand, this proportion is too low to justify supplementary investments to implement triage, especially because the costs of implementing physical triage have not been studied yet. The intervention even slightly increased government expenditures. On the other hand, the intervention can be seen as an improvement for access to the most appropriate care for vulnerable patients. More patients with a low socio-economic status were diverted to the GPC and the diverted patients needed to pay a lower share. The study site continued the project after the study without financial support so the process itself (after implementation) is not expensive for the health insurance system.

Altogether, I conclude that it was not a problem that we did not reach the expected proportion of patients diverted to the GPC. But we can conclude that the eMTS has got the potential to do so, should it be desired in the future. The following changes might increase this proportion and have been proposed to the staff of the study sites:

- The proportion of diverted patients varies among the nurses ➔ organise intervision during which low-triaging nurses can gain confidence in the eMTS.[200]
- Nurses assign many patients to the ED because they think medical imaging is necessary ➔ Revise the flowchart for limb problems. It could be interesting to include clinical rules for emergency nurses which have been validated to rule out fractures such as the Ottawa knee, ankle, and midfoot rules.[173, 175] However, more complex triage rules might lead to prolonged triage time and bottle necks.
- Patients in need of simple stitches are always assigned to the ED ➔ placing stitches is a core skill of a GP so these could be assigned to the GPC. Not all GPs will agree to do these stitches which could complicate the triage process.

At the time of writing, the representatives of the staff of the ED decided only to implement the first-mentioned recommendation as the latter were not implementable in a straightforward manner.

Finding Four: extended triage seems safe but do we know enough?

In Chapter 2 we concluded that the intervention of the TRIAGE trial was safe in terms of hospitalisations, referrals to the ED and monitoring of serious adverse events. This conclusion was based on the sample of 599 patients diverted to primary care, three were hospitalised, 24 were referred back to the ED. Because of the small sample size and the diversity of presentations at the ED, these conclusions about safety were exploratory, not definitive. In Chapter 6 we found that among those patients assigned to the GPC, slightly more patients were hospitalised, and more patients underwent technical examinations/procedures during control weekends as compared to intervention weekends. In Chapter 5 we described the characteristics of 193 patients that refused a GPC assignment, their risk of hospitalisation was 3.6% while this risk was 0.5% for those who complied to this advice. This 3.6% is low when compared to the overall ED population (16%). Whether or not these findings reflect a true medical need or a difference in clinical behaviour between ED and GPC physicians cannot be answered by this study. Differences in care can result from official guidelines and protocols that vary across medical disciplines, or they can result from variation in so-called physician practice style. This variation has been described between physicians from the same discipline [201-204] but is also present between practitioners from different disciplines or when the same practitioners work in different services.[205] It also remains unknown whether the more risk averse triage during intervention weekends (see Chapter 6) increased patient safety. Further research on this subject is necessary. Quantitative follow-up of indicators such as hospitalisations should be

accompanied by qualitative methods to understand how the triage process influences patient safety.[206] A recent realist review identified key factors for safe diversion of patients from the ED to a GPC. Some of these factors were present in the TRIAGE trial: adequately experienced staff, local guidelines and only streaming of patients with appropriate conditions. Other factors were not present: use of an early warning score, compatible computer systems and good communication between services about capacity and skillset of the GPs.[205]

At the study site, further monitoring was implemented using the internal ombudsman of the study hospital and regular meetings with the involved stakeholders. An error-free triage system is impossible, even in the situation where all patients remain at the ED, some patients will have to wait, which always exposes them to a certain risk. The waiting times at the studied GPC were shorter than the two-hour target of the MTS and the typical waiting time for low-risk patients at the study ED (the mean waiting time of diverted patients was 21 minutes, all but one were seen within 80 minutes). When implementing the eMTS elsewhere, safety should be monitored cautiously and compared to triage without diversion to primary care.

Finding Five: the patient pays less but the government slightly more

In Chapter 4 we described the impact of implementing the TRIAGE trial on the costs for patients and government and on the revenues of the studied healthcare services. During intervention weekends, a significant fraction of patients had lower total costs but the mean total costs slightly increased. The costs decreased with 5% for the patient and increased with 7% for the insurance, mainly driven by differences in physician fees. Our hope to reduce spending for government while improving the quality of care was thus not met. The GPC's revenues increased by 13% while no reduction was found for the ED's revenues. We could not definitely exclude any loss at the ED due to methodological and sample size limitations. To mitigate shifts in income from ED to GPC, a broader implementation of extended triage should be accompanied by a reform of the funding structure of the entire OOH system. Overall the impact of the intervention on costs and revenues was limited. This impact was clearer for the patients that refused a GPC assignment as their total costs were on average €27 more compared to those that accepted this assignment (see Chapter 5).

Finding Six: enthusiasm among the involved healthcare professionals was high, a promise for future projects?

Chapter 3 describes the results of in-depth interviews with nurses, ED physicians and GPs. We found a high degree of satisfaction with the research project. Nurses thought it was a recognition of their professional skills and knowledge but also noticed the increased length of the triage examination due to efforts needed to explain the role of the GPC and to guide the patient to the GP. These GPs accepted the task to help the diverted patients but had a

low affinity with the GPC and were reluctant to see patient with, in their eyes, very minor ailments, especially during the night. Some ED physicians suggested to only divert patients to the GPC when the ED is crowded. These positive results were an important reason to continue the project beyond the research period. We found a consensus among stakeholders that the ED nurses are considered ideally positioned to perform the triage which is in line with a recent study that proved that nurses performed better than GPs (in telephone triage).[50] We can conclude that the TRIAGE trial confirms our intuition and the literature described in the introduction: nurses can and like to take up the role of a triage practitioner.[54] As such, nurses work complimentary to physicians, each with different but equally important tasks.

Finding Seven: patients were happy with the triage examination but did not receive enough information

We conducted a small (n=121 at the ED and 19 at the GPC) structured questionnaire study concerning the patient's perspective on extended triage. Unfortunately, we were confronted with methodological difficulties, illness of a key researcher and a very small sample size at the GPC so were not able to answer most of the research questions and consequently did not deliver a report. However, this aspect is equally important as the professional perspective so we have summarised the relevant findings from this unpublished study that should be interpreted as exploratory only:

- In the GPC group (i.e. patients diverted after triage to the GPC or the primary outcome from the TRIAGE trial), more patients did not speak Dutch (53% vs 21%, $p<0.01$) and had a foreign nationality (63% vs 29%, $p<0.01$) as compared to the overall ED population. This finding generates an interesting hypothesis for further research: do ethnicity and language influence triage outcomes? And if so, is this because they influence the patient's presentation or the behaviour of the nurse? Research in the United States demonstrated a similar finding: ethnic minority patients receive lower priority triage.[207]
- Patients in the GPC group on average expected to pay €16 (standard deviation €15) which was less than those interviewed at the ED (€25, standard deviations €17) but they still overestimated their true share (at most €6).
- The vast majority of the patients (93%) felt that the nurse had taken them seriously and that they were triaged properly (71%). Less patients received enough information on the purpose of this triage (66%), the most appropriate caregiver (55%), and the probable waiting time (17%) while the urgency category was only known to 5% of the included patients. These results are in line with the current literature, a review studying nurse-led triage concluded that patients are generally satisfied with the service provided by nurses in EDs.[51]

Finding Eight: refusing an assignment to the GPC is linked to the triaging nurse and is expensive for the patient, should there be an obligation to follow this advice?

As nearly a quarter of the patients assigned to the GPC refused this advice, we decided to explore this aspect more profoundly in Chapter 5. The most important determinant of this refusal was the nurse on duty followed by determinants that are hard to influence such as the patients' socio-economic status, sex, and residence. Less patients refused when the nurse perceived crowding level was quiet relative to normal. The mean invoice price was significantly higher for patients who refused. In order to improve this compliance, we should focus on the triage nurse. The studies we performed do not allow for an explanation why some nurses had a much higher patient compliance as compared to others. We did have some characteristics of the nurses (age, sex, and experience) but were not able to link these characteristics to the proportion of patient compliance as splitting twenty nurses into different categories (e.g., 25-35 years of age) leaves only a few nurses into each category making conclusions impossible. Intervision as a peer coaching activity is the most logical step for quality improvement: nurses with a lower compliance might learn from others who succeed more often.[200] Individual feedback in the form of a personal report with triage indicators (proportion of patients in each urgency category, proportion of patients with a GPC assignment and compliance to this assignment) was offered to the ED but because of the possible stigmatisation this feedback might cause, this offer was not accepted. Finally, patient compliance might be improved by informing them about the financial consequences of refusing: the out-of-pocket payments will be higher at the ED and patients far overestimate their upcoming costs at the GPC. Nurses were instructed to give this information to patients during the TRIAGE trial but we do not know whether they actually did. Our study was too small to assess the impact of refusing a GPC assignment on the overall costs of urgent care, but a prospective observational before-after study concluded that high numbers of diverted patients and a high compliance are necessary to achieve cost savings.[135]

One way to increase compliance is to oblige patients to follow their assignment. In the Netherlands for example, patients who refuse a GPC assignment might have to pay all costs at the ED themselves.[208] The data from the TRIAGE trial suggests obligation might slightly decrease safety (see Chapter 6) but the sample was too small to draw definitive conclusions. The positive predictive value for a correct diversion to primary care according to the treating physicians was lower during control weekends (0.84 versus 0.96) which might also indicate a lower safety during control weekends when the proportion of primary care eligible patients was higher (see Chapter 2). We did not study the staff and patient perspective on this option. Currently, the evidence for such an obligation is too weak so it should only be implemented in a research setting which should include safety monitoring.

Finding Nine: nurses triage differently when it is money time, what is the ideal research design?

In Chapter 6, we explored the differences in triage between the intervention and control group of the TRIAGE trial. We concluded that nurses used the eMTS more cautiously when it is used to actually divert patients to primary care as compared to a theoretical assignment to primary care. The importance of this finding mainly lies in future research: when testing a triage instrument, one should never rely on simulated/laboratory studies alone. Simulated patients or paper scenarios do have scientific value as they can measure inter- and intra-rater variability and give a first impression on effectiveness and safety.[209] However, our findings clearly demonstrate that nurses will use the triage instrument differently when it is money time. This was already widely known in other settings. For example, in lottery experiments, researchers found that research subjects in laboratory circumstances typically underestimate the extent to which they will avoid risk in the real world.[177] In Chapter 6, we proved that our findings from Chapter 7 regarding telephone triage based on simulated experiments should be interpreted cautiously and do not necessarily reflect what happens when 1733 telephone triage is implemented in the real world. In Chapter 6, we found that the results from a simulated setting overestimated efficiency in physical triage. Overestimation of efficiency is not necessarily the case in telephone triage research. It is possible that operators use more common sense and background knowledge in the real world and thus perform more efficiently and safely. We simply do not know this, so we recommended to perform real-world studies while implementing 1733 country wide. An advice that was only carried out partially.[62]

8.2 Limitations

This subchapter describes the overall limitations of this dissertation only, each chapter contains a specific limitations section which discusses study specific bias and inevitable bias due to study design.

Selection of the interventions

This PhD trajectory got a flying start: the 1733 studies were being conducted and the study site of the TRIAGE trial was eager to start as well. Consequently, there was no time to make a systematic literature search before planning the interventions. These interventions were selected by healthcare workers based on intuition. Although this dissertation covers several interventions to help patients to make the choice between ED and GPC, promising interventions such as self-triage and public information campaigns have not been studied.[17]

Generalisability

Telephone triage was only studied at two sites close to each other, a promotion campaign and physical triage were studied in a single site only. All of these sites were located in Flanders. This limits generalisability to other settings including Wallonia. The Belgian healthcare system and especially its financing has some peculiarities (see Figure 1 p.8) which furthermore limit generalisability to other healthcare systems. Before wider implantation, these results should be confirmed in different settings and in other healthcare systems. Patients without a national insurance number were excluded from the TRIAGE trial, the results should not be extrapolated to this population. This might also have caused a selection bias which cannot be detected because no data were available concerning these patients. The eMTS was designed using a fast, informal consensus procedure. A more scientific approach by a Delphi procedure would have been better.[210] The eMTS contains some agreements typical for the study site (e.g., the availability of an ophthalmologist at the ED influenced the protocol for eye problems). It can only be used elsewhere after adaptation to local customs.

Unknown costs

We do not have enough data about implementation costs. The largest implementation cost is staff: working hours for meetings to prepare the intervention, training and the efforts during the interventions themselves. The data we do have concerning implementation costs cannot be separated from the research costs. At the study site of the TRIAGE trial for example, a supplementary nurse was deployed during the study period. This person's tasks included both implementation and research with no clear distinction between them. Previous research in triage revealed that a reduction in costs might not compensate the costs of additional staff.[211]

Other forms of bias

The patient's perspective largely remains unknown; the only study that was planned for this aspect failed. The patient's perspective can be different from the professional perspective. Views of primary care professionals, concerning what is important for health needs, are not closely matched by those of patients.[212] In all the studies included in this dissertation, patients were only studied during one acute contact. No data are available on the medium- or long term. This limits our conclusions regarding safety. More data on re-admissions and severe adverse events are necessary. The diagnostic accuracy of the eMTS and the 1733 guideline have been assessed using the post hoc opinion of the treating physician as the reference standard. This opinion, formed after the results of clinical and technical observations is not a gold standard. It is most likely influenced by the diagnosis after work-up. Finally, in the TRIAGE trial, weekends were randomised and not individual patients. This randomisation was stratified for seasonality and school holidays. The

intervention and control group were balanced for the available variables. Still, undetected imbalances between both groups or unknown confounders on the level of the weekend (e.g. a medical disaster) might have caused bias.[213]

As the first or second author of all included studies I had an important conflict of interests as I worked at the study site of the TRIAGE trial as a GP and was member of the board of the studied GPC. This might have led to a confirmation bias as I had some expectations regarding the outcomes which might have led to a confirmation bias (this applies to some of the co-authors as well).[214] On the other hand, this position made it possible to conduct the TRIAGE trial.

8.3 The future of extended triage

At the study site

When we presented the results of the TRIAGE trial to the local healthcare workers in September 2021, they decided to continue using the eMTS. Because the studied ED noticed a large increase in the number of consultations since the summer of 2021, they were eager to continue and broaden the collaboration. Two minor adjustments were made to adapt the process of extended triage to the COVID-19 era. Firstly, patients diverted to the primary care were given an appointment at the GPC and were no longer directly referred to the waiting room of the GPC. Secondly, in case the patient was a suspected COVID-19 case, an appointment was made in a separate COVID-19 primary care unit.

At the time of writing, 1733 telephone triage was not yet implemented at the study site of the TRIAGE trial, this could be the case in the near future. Beforehand, the local healthcare workers should seek a way to combine telephone triage using 1733 and physical triage using the eMTS. At times, these instruments will give contradictory results. One solution is to use the same instrument for both types of triage. In that case, more research is necessary either on the use of 1733 for physical triage or on the use of telephone triage with the MTS making this solution implausible on the short term. The MTS has a version for telephone triage, but this version has not been studied in Belgium.[41] Another solution is to keep using the eMTS at the ED but to keep all patients with a 1733 assignment to the ED at the ED. This means giving priority to 1733 over the eMTS. This solution will, at times, miss the opportunity to divert patients that have been overtriaged by telephone. Finally, it is possible to stick to the eMTS for all patients at the ED. In that case, some patients with a 1733 assignment to the ED will be diverted to the GPC. This might confuse staff and patients.

In case the study sites decide to continue the use of the eMTS, some improvements can be made. The ICT implementation can be improved by a adding a clearer button to overrule

the protocol based on the clinical judgement of the nurse. The discriminator "possible need for medical imaging" should be specified to limit its use. Several typical primary care protocols should be introduced to prevent overuse of the protocol "Unwell Adult". Small wounds and sutures should be defined better to allow more diversion to primary care. The nurses would appreciate changing the discriminators for fever and pain. Such a change might decrease safety so these changes should be studied before implementation. Finally, to increase safety, the protocols for abdominal pain should be revised cautiously.

In Belgium and beyond

This PhD dissertation started with the 2016 Belgian Healthcare Knowledge Centre proposal for a reform of the OOH care system (see Figure 2 p. 11).[32] Figure 18 contains a modified proposal based on the results of this dissertation. Although this scheme is country specific, most of its elements can be adapted worldwide as the central issue of this dissertation is a general problem, not specific to one country. Hotlines, common gates for EDs and primary care OOH services and general practitioners exist to some extent in every country.

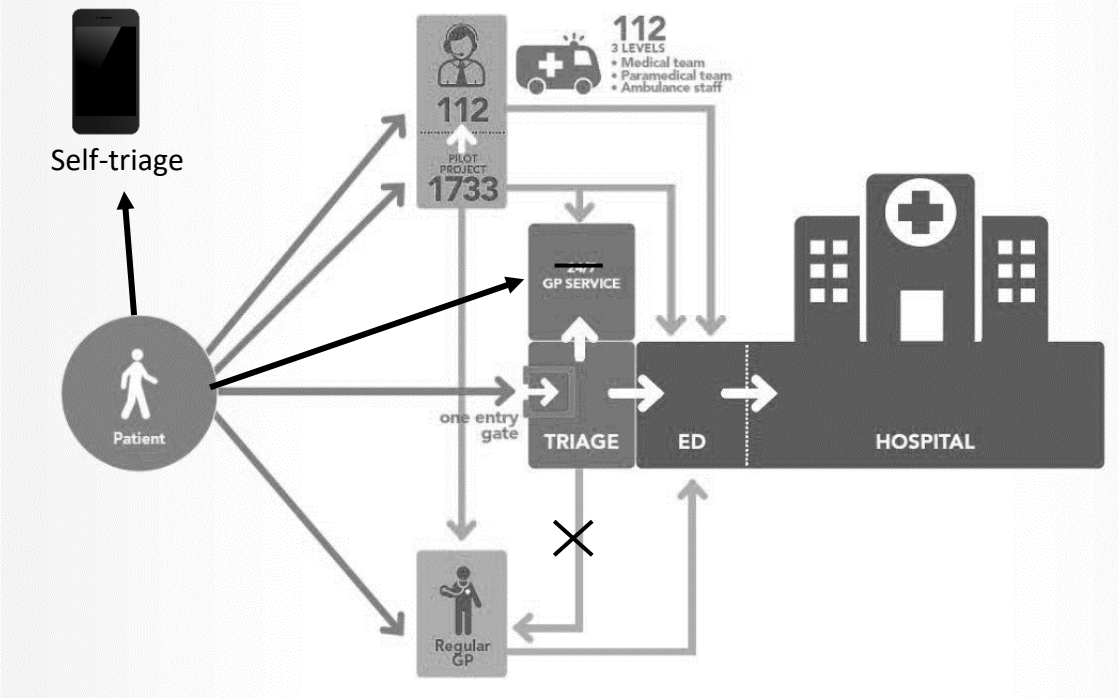

Figure 18. Proposal for the OOH care system in Belgium. Based on the 2016 Belgian Healthcare Knowledge Centre proposal.

This modified proposal is only applicable to OOH care as we did not study continuity of care during office hours. Patients are asked to call 112 in life-threatening situations. In all other situations, they contact their regular GP and when this GP is not available, they call the 1733 hotline. This hotline advises the patient to go to the ED, the GPC, or to wait for their

regular GP during office hours (delay of care, with a self-care advice when applicable). Patients can also go directly to a site with an ED and a GPC, in which case they choose themselves whether to consult the GPC or the ED. Those who choose to consult the GPC do not receive further triage. Those who choose to consult the ED receive physical extended triage, when appropriate they are diverted to the GPC on a voluntary basis. Finally, the patient can also use self-triage instruments. The GP, the GPC, self-triage instruments and the telephone/physical triagist can refer patients directly to the ED.

This proposal will lead to more workload for GPs. Hence, the weak point of this proposal is the availability of GPs. Belgium has got a relative shortage of GPs due to ageing of the GPs and a low attrition of young GPs.[215, 216]

In this proposal, the patient remains free to accept or refuse any triage advice. It does not seem ethical to oblige patients to follow a triage advice when its safety has not been established. It is recommended to study the perspective of healthcare professionals and patients before installing such a far-reaching obligation.

This proposal differs from the Belgian Healthcare Knowledge Centre proposal in the following aspects:

- **An important role for self-triage:** we proved that an information campaign works but it would probably be more efficient if combined it with a more personalised approach, for example by using an online questionnaire. An example of such a questionnaire ("moetiknaardedokter.nl") has been proved to be reliable and is CE-marked.[217] Use of this tool in Belgium is currently under investigation, amongst others on the study site of the TRIAGE trial. In several countries, self-triage has already been implemented, sometimes recently due to the COVID-19 disruption.[29, 218, 219]
- **Only applicable during OOH care:** Belgian GP practices are not ready to see patients triaged to their practice by 1733 or by physical triage. There are no formal systems for such a diversion and the supporting base has not been studied yet. In countries with a strong primary care system, it is feasible to organise a distinct flow for urgent patients within regular GP practices while those countries without universal access to primary care might prefer to install primary care services that are open 24/7 for urgent care.[220]

- **Direct access to the GPC:** In the ideal world, all patients receive physical triage, but it is pragmatic to leave direct access to the GPC open. Only a small proportion of the GPC patients is in need of ED care[37], triage in primary care takes more time, and there is no legal framework for a delay of care or self-care advice in Belgium.[36] At the moment, physical triage of all patients is not efficient. Physical triage for all patients would be expensive as it would double the need for triage as compared to ED triage only and thus require additional highly qualified nurses. It is also expected that few patients will agree with a self-care advise after physical triage. Finally, if the 1733 telephone triage is implemented well, the number of patients walking in at the GPC without prior telephone triage should be limited. In the Netherlands, such a delay of care is common practice while in the United States, regulations do not allow EDs to "refuse" patients.[77] The COVID-19 pandemic speeded up the implementation of a telephone first approach.[82] When the TRIAGE trial was designed, most GPC worked without appointment but after COVID-19, most switched to an appointment only system, similar to many other European countries.[220] This new organisation raises opportunities to manage patient flows.
- **Only telephone triage refers to the regular GP:** patients after triage considered as not in need of urgent care can be referred to their own GP during office hours by 1733. This is currently not allowed after physical triage and it is currently hard to implement as some GP's will not be willing to see these patients, and there is no formal structure for such a referral. In the United States, research demonstrated the efficiency of referring patients to a GP practice for a same day appointment: patients generally accepted this referral and 50% visited the GP practice again within the year.[88]

The background and training of those responsible for the triage is crucial for the successful implementation of this proposal. As argued in the introduction, an experienced emergency nurse is the best option for this task and is available at the ED for physical triage. When a patient is assigned to the ED, these nurses can directly switch from triage to diagnostic and therapeutic protocols, especially for highly urgent patients. When it comes to telephone triage, a nursing background with additional training is recommended as well but in the Belgian context unrealistic due to a shortage in nurses and increasing fall out among specialised nurses.[149, 221, 222] Paramedics are an acceptable alternative but they need extensive training and should be supervised by a specialist nurse. In the Netherlands, training for these paramedics ranges from four to seven months.[223] For the interventions studied in this dissertation, call takers and nurses only received a one- or two-day of training. The duration of these trainings should increase and they should be accompanied by regular intervision and refresher courses which should focus on rare but urgent cases.[200] As found in Chapter 3, GPs have a low affinity to the GPC because they only perform a limited number of shifts. Dedicated on-call GPs would probably improve collaboration with the ED and it would be possible to train them together with the ED team. There is currently insufficient evidence regarding the quality of care of primary care professionals providing non-urgent care in EDs.[18]

This dissertation cannot predict the costs of implementing this proposal. We only studied some aspects, were confronted with an unexpected finding (slight increase in total costs after implementing physical triage) and are unable to estimate the costs of implementation itself. Future research should focus on the financial consequences for patients, healthcare professionals and healthcare services. Currently, the Belgian healthcare system is mainly financed by a fee-for-service system. This obstructs reforms as it rewards EDs for seeing many (including low-risk) patients. A mixed financing model that combines the advantages of a fee-for-service system, lump sums and pay for quality might lead to more incentives for intensive collaboration and integrated care.[224]

Finally, reforming the OOH system can only be achieved when the government reaches a consensus between hospitals, healthcare workers and patients. All these groups should be involved in the design, implementation and follow-up of a reform.[199] The ultimate goal of such a reform might go further as the proposal presented above. In the end, a single centre for unscheduled care might be the ideal patient centred model.

8.4 Recommendations for implementing extended triage

In total, the intervention studied in the TRIAGE trial was regarded as positive considering some methodological limitations and the rather low efficiency. I would recommend implementing the intervention elsewhere with the following conditions:

- **Safety first:** triage with diversion to primary care can only be implemented when safety is monitored
- **Efficiency on demand:** the proportion of patients diverted to primary care can be adjusted to a desired outcome using intervision among triaging nurse and by adapting the eMTS.
- **Customise the eMTS:** the eMTS was developed locally, giving it a good support base but reducing its generalisability. When implemented elsewhere, some presentational flowcharts should be adapted to local circumstances.
- **Update the eMTS:** even in the short timespan between the TRIAGE trial and the writing of this dissertation, crowding at the ED increased even more and a new disease (COVID-19) appeared so continuously adapting the eMTS is crucial.
- **Make the eMTS more specific:** the eMTS contains a general discriminator "GP Risk" (unspecified risk to assign the patient to the GPC according to the opinion of the triaging nurse) and it assigns all patients with a possible need of medical imaging to the ED. Several presentational flowcharts should be adjusted to give the nurse more concise instructions.
- **Focus on the patient:** it was hard to involve patients in the design of the studies in this dissertation and even harder to study their perspective. Because the aim of healthcare is to improve the patient's health, their perspective should be studied further
- **(Don't) wake up the GP:** more patients were diverted to the GP during the night while GPs were reluctant to see low-urgency patients at that time. A consensus between ED and GPC staff should be sought in order not to lose the support base at the GPC.
- **Allow referral to the regular GP:** some patients do not need urgent care, referring them to their regular GP would improve the OOH care system. This is currently possible for 1733 telephone triage but not after physical triage. This change is currently hard to implement as some GPs will not be willing to see these patients and there is no formal structure for such a referral.
- **An integrated approach:** further implementation of the eMTS should fit in a wide reorganisation of OOH care including an important role for self-triage and telephone triage. This reorganisation should also incorporate a reform of the financing as the current system does not encourage ED's to divert patients to the GPC. The financial implications of such a reorganisation should be monitored closely.

8.5 What this dissertation adds

In this dissertation, the role of primary care in emergency triage was studied. While the precursory studies on telephone triage and the pilot study added knowledge to the field of triage, the TRIAGE trial was the core of the research. It was the first randomised trial concerning triage and primary care. The results of this dissertation might inspire ED/GPC collaborations worldwide to collaborate profoundly and will guide new initiatives locally.

8.6 Overall conclusion of the TRIAGE trial

When we combine the above-mentioned findings, an overall conclusion regarding the TRIAGE trial can be formulated: Using the eMTS, an emergency nurse can safely divert at least 9.5% of the patients presented at the ED. During control weekends, more patients were theoretically assigned to the GPC proving that the eMTS has a higher potential. The intervention improved the work satisfaction of the ED staff, was accepted by most GPs and the vast majority of patients. Patients who accepted an assignment to primary care saved some money but for the health insurance, the costs slightly increased. The future of extended triage lies in a renewed system of OOH care that uses self-triage and telephone triage to help patients to choose the most appropriate care: the ED or the GPC. Patients heading directly to the ED need physical triage to orient them towards ED, GPC or a delay of care with self-care advice when applicable. As long as such a delay of care is not allowed, direct access to the GPC should remain.

Ethics, financial disclosure, competing interests and data sharing statements

All published articles were attributed with an ethics statement, a conflict-of-interest statement and a financial disclosure. Those using the iCAREdata database also have a data sharing statement. Because these are very similar, they have been fused into three statements:

Ethics

For each study, ethical clearance was obtained from the ethics committee of Antwerp University Hospital and when applicable from the local study sites. For the precursory studies on 1733, the ethics committees of the University of Leuven also gave permission. More details are available in the original papers.

Financial disclosure statement

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Competing interests

Stefan Morreel is a general practitioner working in the surroundings of the study site for the TRIAGE trial, and as such, he performed on call shifts at the study site and treated some of the studied patients. Due to the anonymity of the studied data, the exact number of study patients seen by him cannot be determined, but it was definitely below ten. He is also a board member of the studied GPC receiving meeting fees. Hilde Philips is coordinator of the iCAREdata project (database used for several chapters). She had an appointment at the University of Antwerp for this project until September 2020.

Data sharing statement

Given the privacy policy of the iCAREdata database, the authors are not allowed to share the used databases. Sharing these databases would potentially harm the privacy of the included patients as one might get information about their identity by combining data from several columns (variables). We are however able to deliver a selection of columns upon reasonable request. A part of the iCAREdata database is disclosed to the public on a website (https://icare.uantwerpen.be). Research access to more detailed data can be requested at icaredata@uantwerpen.be. All data not collected through iCAREdata is available upon reasonable request.

English abstract of this dissertation

When confronted with an illness during out-of-hours care, patients can consult primary care (organised in General Practice Cooperatives, GPCs) or an Emergency Departments (EDs). Up to 40% of those who choose the ED have complaints suitable for primary care. One solution to this problem is to help patients to make this choice by triage, a quick examination to determine the priority of need and proper place of treatment.

In two precursory studies concerning 1733 telephone triage, we found that this system was not ready for implementation, telephone triage alone was not the solution. A pilot studying a campaign promoting the GPC at an ED, resulted in the save diversion of 5% of the patients from the ED to the GPC.

The TRIAGE trial was an unblinded randomised controlled trial with weekends serving as clusters. The intervention was triage by a nurse using a new tool assigning low-risk patients to the GPC. During intervention weekends, patients were encouraged to follow this assignment while it was not communicated during control weekends (all patients remained at the ED).

Out of the included patients, 9.5% were diverted to the GPC. This proportion was influenced by the reason for encounter, age of the patient, and the nurse on duty. Out of the diverted patients, 4% were referred back to the ED. The trial was randomised for the secondary outcome: the proportion of patients assigned to the GPC. In the intervention group, this proportion was 13%, in the control group 25%. This discrepancy was due to differences in the use of the studied tool.

Using semi-structured interviews with healthcare workers we found a high enthusiasm. Risk aversion of some nurses, possible language barriers and the non-adapted ED infrastructure were the main barriers to implementation. One quarter of the patients who received an assignment to the GPC refused to comply and stayed at the ED. This proportion was influenced by the nurse on duty and the patient's socio-economic status. The intervention reduces costs for patients but slightly increased cost for the government.

Overall, the intervention of the TRIAGE trial was evaluated positive, albeit some methodological limitations and a low efficiency. It helps patients to choose the most appropriate caregiver. An integrated approach which includes self- and telephone triage is required for further implementation.

Nederlandstalig abstract (Dutch abstract)

Wanneer men plots ziek wordt buiten de kantooruren kan men de eerste lijn raadplegen (georganiseerd in HuisArtsenwachtPosten of HAPs) of kiezen voor een dienst spoedgevallen (spoed). Tot 40% van de spoedpatiënten heeft klachten die ook kunnen behandeld worden in de HAP. Triage, een kort onderzoek om de prioriteit van de patiënt en meest geschikte zorgverlener te bepalen is een mogelijke oplossing voor dit probleem.

Na twee voorbereidende studies over 1733 telefonische triage concludeerden we dat dit systeem niet klaar was voor implementatie. Telefonische triage alleen was niet de oplossing. Een pilootstudie waarin we promotie voerden voor de HAP in een spoed resulteerde in het veilig verplaatsen van 5% van de patiënten van de spoed naar de HAP.

De TRIAGE trial was een ongeblindeerde gerandomiseerde studie met weekends als clusters. De interventie was verpleegkundige triage met behulp van een nieuw instrument dat patiënten met een laag risico toewijst aan de HAP. Tijdens interventieweekends werden patiënten aangemoedigd om deze toewijzing te volgen. Deze toewijzing werd niet gecommuniceerd tijdens controle weekends (alle patiënten bleven in de spoed).

Van alle geïncludeerde patiënten werden er 9.5% verplaatst naar de spoed (primaire uitkomstmaat). Dit aandeel werd beïnvloed door de aanmeldingsklacht, de leeftijd van de patiënt en de verpleegkundige van dienst. Van deze verplaatste patiënten werd 4% terug naar de spoed verwezen. Deze trial werd gerandomiseerd voor de secundaire uitkomstmaat: het aandeel van de patiënten met een toewijzing aan de huisarts. In de interventiegroep was dit 13%, in de controlegroep 25%. Die verschil werd veroorzaakt door een verschil in gebruik van het bestudeerde instrument.

Op basis van semigestructureerde interviews met gezondheidswerkers vonden we een groot enthousiasme voor dit project. De belangrijkste barrières waren risico aversie bij sommige verpleegkundigen, mogelijke taalbarrière en de onaangepaste infrastructuur van de spoed. Een kwart van de patiënten met een toewijzing naar de huisarts weigerden, zij bleven op de spoed. Dit aandeel werd beïnvloed door de verpleegkundige van dienst en de socio-economische achtergrond van de patiënt. De interventie verminderde de kosten voor de patiënt maar verhoogde beperkt deze voor de overheid.

Alles welbeschouwd werd de interventie van de TRIAGE trial als positief geëvalueerd ondanks een aantal methodologische beperkingen en de eerder lage efficiëntie. Ze helpt patiënten om de meest geschikte zorgverlener te kiezen. Een geïntegreerde aanpak inclusief zelf- en telefonische triage is nodig om deze verder te kunnen implementeren.

Dutch summary (Samenvatting)

Wanneer men plots ziek wordt buiten de kantooruren kan men de eerste lijn raadplegen (georganiseerd in HuisArtsenwachtPosten of HAPs) of kiezen voor een dienst spoedgevallen (spoed). Beide diensten zijn vrij toegankelijk en bevinden zich al dan niet op dezelfde locatie. Patiënten baseren zich voor deze keuze op eerdere ervaringen, toegankelijkheid, wachttijden, verwachte kosten, de relatie met hun huisarts en hoe ze hun klacht ervaren. Tot 40% van de patiënten die zich aanbieden op spoed heeft klachten die ook behandelbaar zijn in de HAP. Het oprichten van extra HAPs zorgt niet altijd voor een vermindering van het aantal spoedpatiënten. Deze doctoraatsthesis bevat de wetenschappelijke evaluatie van verschillende interventies met betrekking tot één probleem: Welke zorgverlener moet een patiënt kiezen buiten de kantooruren. Spoed of HAP?

Triage, gedefinieerd als het sorteren en classificeren van patiënten om de prioriteit van hun zorgnood (urgentiegraad) en hun meest geschikte dienst (spoed of HAP) te bepalen is een mogelijke oplossing voor dit probleem. In geval van telefonische triage dient de patiënt een advieslijn te bellen voordat deze zich verplaatst terwijl bij fysieke triage de beoordeling plaats vindt bij de zorgverlener of in een gemeenschappelijke toegangspoort. Voor 2017 bestond er in België geen formeel systeem van telefoontriage en werd fysieke triage alleen uitgevoerd in het kader van pilootprojecten.

Door middel van twee inleidende studies (zie Hoofdstuk 8) onderzochten we de 1733 richtlijn voor telefonische triage. We besloten dat deze richtlijn niet klaar was voor implementatie wegens veiligheidsproblemen en een ontgoochelende efficiëntie. Telefoontriage alleen was dan ook geen oplossing voor het probleem. In een pilootstudie (zie Hoofdstuk 1) onderzochten we het effect van een promotiecampagne voor de HAP in de wachtzaal van de spoed. Tijdens deze campagne resulteerde zelf-triage van de patiënten in een veilige verplaatsing van 5% van de patiënten van spoed naar HAP. Dit was een eerste kleine maar belangrijke stap naar een meer diepgaande samenwerking maar opnieuw onvoldoende om het probleem op te lossen.

Zo een diepgaande samenwerking werd uitgewerkt voor de TRIAGE trial, een niet geblindeerd gerandomiseerd onderzoek met weekends als clusters. De interventie was triage door een verpleegkundige op basis van een nieuwe uitbreiding van het Manchester Triage Systeem (genaamd eMTS). Deze uitbreiding wijst patiënten met een laag risico op ziekenhuiszorg toe aan de HAP. Triage gebaseerd op het eMTS resulteert in een stroomdiagram (aanmeldingsklacht, bv. keelpijn), urgentiegraad (van één tot vijf) en een discriminator (bv. milde pijn) welke automatisch worden gevolgd door een toewijzing (HAP of spoed). Tijdens interventieweekends werden patiënten aangemoedigd om deze

toewijzing op te volgen terwijl deze tijdens controleweekends niet werd medegedeeld aan de patiënt (iedereen bleef in de spoed).

De primaire uitkomstmaat van de TRIAGE trial was het aandeel van patiënten toegewezen aan en geholpen in de HAP gedurende de interventieweekends. In totaal werden er van de 6374 geïncludeerde patiënten 599 (9,5%) verplaatst naar de HAP. Dit aandeel werd beïnvloed door de reden van contact, leeftijd van de patiënt en de dienstdoende verpleegkundige. Vierentwintig (4%) van deze verplaatste patiënten werden door de huisarts terugverwezen naar de spoed. De positieve en negatieve predictieve waardes van het bestudeerde instrument waren 0.96 en 0.60. We besloten dat spoedverpleegkundigen die gebruik maken van het eMTS 9.5% van de geïncludeerde patiënten op een veilige manier konden verplaatsen naar de huisarts (zie hoofdstuk 2).

De TRIAGE trial werd gerandomiseerd voor de secundaire uitkomstmaat: het aandeel van de patiënten toegewezen aan de huisarts. In de interventiegroep was dit 13%, in de controlegroep 25%. We vergeleken het gebruik van het studie instrument (eMTS) tussen de interventie- en de controlegroep. Verpleegkundigen kozen even vaak stroomdiagrammen die steeds leiden tot een spoed toewijzing maar zij kozen tijdens interventieweekends voor een extra 3% van de patiënten een hoge urgentiegraad. Daarnaast werden er 16% extra discriminatoren die leiden tot een spoed toewijzing gekozen. De belangrijkste reden om deze discriminatoren te kiezen was de vermoedelijke nood aan beeldvorming. Tijdens interventieweekends was de gemiddelde totale kost voor patiënten toegewezen aan de HAP €23 lager en er werden in deze groep minder patiënten gehospitaliseerd (1.0% t.o.v. 1.6%).

We voerden een procesanalyse uit om mogelijke barrières en facilitatoren die de succesvolle implementatie van de TRIAGE trial konden beïnvloeden op te sporen (zie Hoofdstuk 3). Door middel van semigestructureerde interviews met verpleegkundigen, spoedartsen en huisartsen vonden we dat de ervaren spoedverpleegkundigen wordt gezien als de ideale persoon om patiënten te triëren. Het toepassen van het triage protocol was tijdrovend, arbeidsintensief en complex, toch vonden de verpleegkundigen dat het een positieve invloed had op de algemene werkdruk op hun afdeling. De belangrijkste barrières waren de mate waarin een verpleegkundige risico vermijdt, mogelijke taalbarrière bij het uitleggen van de toewijzing en de onaangepast infrastructuur/architectuur van de spoed. Als belangrijkste facilitatoren weerhouden we training van de verpleegkundige op het vlak van het triage protocol en de communicatie, in combinatie met regelmatige feedback van de HAP naar de spoed toe. Het perspectief van de patiënt werd ook onderzocht maar omwille van methodologische problemen, ziekte van een onderzoeker en een te kleine studiegroep konden we deze resultaten niet publiceren.

Bijna één op vier van de patiënten die tijdens de TRIAGE trial een toewijzing naar de huisarts kregen heeft dit geweigerd en bleef dus op de spoed (zie Hoofdstuk 6). Het aandeel

van deze weigeraars werd vooral beïnvloed door de verpleegkundige van dienst en de socio-economische achtergrond van de patiënt. Daarnaast waren deze weigeringen ook geassocieerd met het mannelijk geslacht, verder af wonen en bepaalde aanmeldingsklachten. Wanneer het rustig was weigerden minder patiënten dan wanneer de drukte normaal was. Ook tijdens de nacht werd er meer geweigerd. De rekening voor patiënten die weigerden (gemiddeld €77) was significant hoger dan voor zij die het advies HAP wel volgden (gemiddeld €45). Deze meerkosten werd veroorzaakt door extra onderzoeken en een hogere eigen bijdrage in de spoed.

Een financiële evaluatie van de TRIAGE trial toonden een beperkte toename van de totale kosten tijdens de interventieweekends. De kosten verminderden met 5% voor de patiënt maar namen met 7% toe voor de ziekteverzekering (veroorzaakt door het verschil in ereloon). Het aandeel van patiënten welke alleen een ereloon kreeg aangerekend lag hoger in de interventieweekends (25% versus 19%). De inkomsten van de HAP stegen met 13% terwijl er geen vermindering van de inkomsten op de spoed kon gevonden worden.

Alles welbeschouwd werd de interventie van de TRIAGE trial als positief geëvalueerd ondanks een aantal methodologische beperkingen en de eerder lage efficiëntie (zie hoofdstuk 9). De interventie helpt patiënten om de juiste zorgverlener te kiezen wanneer deze een onverwacht medisch probleem heeft tijdens het weekend. Ik kan dan ook aanraden om de bestudeerde interventie elders te implementeren en deze verder te zetten in Deurne. Met als belangrijkste kanttekeningen dat het eMTS regelmatig dient geüpdatet te worden en dat sommige aspecten verder onderzoek vereisen (veiligheid, patiëntenperspectief, efficiënte in andere omstandigheden en draagvlak bij de huisarts). Wanneer triagesystemen worden geïmplementeerd dienen de kosten en het effect op de inkomsten van de betrokken diensten van nabij gevolgd te worden.

English summary

When confronted with an unexpected illness during out-of-hours (OOH) care, patients can consult a general practitioner (mostly organised in General Practice Cooperatives, GPCs) or an Emergency Departments (ED). These freely accessible services are organised separately or together on the same site. Patients make their decision based on previous experiences, ease of access, the anticipated waiting time, anticipated costs, their relationship with their general practitioner (GP), and the perceived nature of the complaint. Up to 40% of the patients who consult the ED have complaints suitable for primary care. Installing supplementary primary care services does not necessarily lead to a reduction of ED visits. This dissertation reports the scientific evaluation of several interventions regarding the problem patients face when choosing an OOH service: ED or GPC?

One solution to this problem is to help the patient make this choice by triage, defined as the sorting out and classification of patients to determine priority of need (urgency classification) and proper place of treatment (assignment to ED or GPC). In telephone triage, a patient calls a hotline before choosing a service while in physical triage, the patient gets a triage examination at the chosen service or a common gate for ED and GPC. Before 2017, there was no formal telephone triage and only pilot projects for physical triage in Belgium.

In two precursory studies (Chapter 7) we examined a guideline for telephone triage called 1733. We concluded that this guideline was not ready for implementation because of safety problems and a rather disappointing efficiency. Telephone triage alone was not the solution to the problem. In a pilot study (see Chapter 1) we examined the effect of a campaign promoting the GPC at the waiting room of an ED. During this promotion campaign, self-triage resulted in the save diversion of 5% of the included patients from the ED to the GPC. A first meaningful step towards a more profound collaboration but still not enough to resolve our problem.

Such a profound collaboration was concretised in the TRIAGE trial, an unblinded randomised controlled trial with weekends serving as clusters. The intervention was triage by a nurse using a new extension to the Manchester Triage System (eMTS). The eMTS assigns patients with a low risk of hospital care to the GPC. A triage examination using the eMTS results in an urgency category (ranging from one to five), a presentational flow chart (reason for encounter, e.g., sore throat), and a discriminator (e.g., mild pain) followed by an automated assignment (either ED or GPC). During intervention weekends, patients were encouraged to follow their assignment while it was not communicated during control weekends (all patients remained at the ED).

The primary outcome of the TRIAGE trial was the proportion of patients assigned to and handled by the GPC during intervention weekends. In total, 599 (9.5%) of the included patients were diverted to the GPC. This proportion was influenced by the reason for encounter, age of the patient, and the nurse on duty. Out of the diverted patients, 24 (4%) were referred back to the ED of which three were hospitalised. Positive and negative predictive values of the studied tool during intervention weekends were 0.96 and 0.60. We concluded that ED nurses using the new eMTS tool safely diverted 9.5% of the included patients to primary care (see Chapter 2).

The TRIAGE trial was randomised for the secondary outcome: the proportion of patients assigned to the GPC. In the intervention group, this proportion was 13%, in the control group 25%. When comparing the use of the study tool in the intervention and control group (see Chapter 6), we found that nurse equally choose flowcharts leading to the ED and equally overruled the protocol in both groups. An additional 3% of the patients in the intervention group were classified to a higher urgency category. For an additional 16%, discriminators leading to the ED were registered. The main reason for choosing a discriminator leading to the ED was the perceived need for imaging. During intervention weekends, the mean cost for patients assigned to the GPC was €23 lower and less patients with an assignment to the GPC were hospitalised (1.0% versus 1.6%).

We conducted a process evaluation of the TRIAGE trial aimed at identifying the facilitators and inhibitors that influenced the uptake of the studied intervention (see Chapter 3). Using semi-structured interviews with nurses, ED physicians and GPs we found that ED Nurses were considered ideally positioned to perform the triage of walk-in patients, although a certain degree of experience is necessary. Although the extended triage protocol and GPC referral increased the complexity and duration of triage and entailed a higher workload for the triage nurses, ED nurses found it did lead to a lower perceived workload for the ED in general. The main inhibitors were the degree of risk aversion of individual nurses, possible language barriers during delivery of the triage advice and the non-adapted ED architectural infrastructure. Training on both the use of the triage protocol and effective delivery of the triage advice, in combination with periodical feedback from the GPC were the most important facilitators. A study concerning the patient perspective was executed but not published as we were confronted with methodological difficulties, illness of a key researcher and a very small sample size.

Nearly one quarter of the patients who received an assignment to the GPC in the TRIAGE refused it and decided to stay at the ED (see Chapter 5). This proportion was mainly influenced by the nurse on duty and the patient's socio-economic status. Additionally, non-compliance was associated with being male, not living nearby and certain reasons for encounter. Less patients refused when the nurse perceived crowding level as quiet relative to normal, and more patients refused during the evening. The mean invoice price was significantly higher for patients who refused (mean €77 versus €45 for those compliant to

a GPC advice), which was a result of more extensive examination and higher out-of-pocket expenses at the ED.

We carried out a financial evaluation of the TRIAGE trial which found that a small increase in total costs (see Chapter 4). The costs decreased with 5% for the patient and increased with 7% for the insurance, mainly driven by differences in physician fees. More patients were charged a consultation fee only (25% vs. 19%) during intervention weekends. The GPC's revenues increased by 13% while no reduction was found for the ED's revenues.

In total, the intervention studied in the TRIAGE trial was regarded as positive considering some methodological limitations and the rather low efficiency (see Chapter 8). It helps patients to choose the most appropriate place of care when confronted with an unexpected illness. I would recommend implementing the intervention elsewhere and continue its use at the study site. However, I also recommend keeping the eMTS up to date and to study some aspects further (safety, patient's perspective, efficiency in other circumstances and acceptability by GPs). When implementing triage systems, the effects on the costs and revenues of the stakeholders should be monitored closely.

French summary (Résumé)

Lorsqu'un patient se sent malade en dehors des heures de bureau, il a deux options : il contacte le médecin de garde (la plupart du temps organisé au Poste Médical de Garde – PMG) ou il va au service d'urgences. Ces deux services sont librement accessibles et peuvent se trouver à la même location. Pour cette décision les patients se basent sur leurs expériences passées, le mode d'accès, la durée d'attende, les coûts prévus, la relation avec leur médecin traitant en encore comment ils se sentent avec leurs plaintes. Jusqu'à 40% des patients qui vont aux urgences peuvent bien être aidés à la PMG. Installer des PMG extra ne résulte pas toujours dans une diminution du nombre de patients aux urgences. Dans cette thèse de doctorat je vais commenter des interventions différentes et leurs évaluations scientifiques par rapport à un problème : Quel aide-soignant un patient devrait-il choisir en dehors des heures du bureau : Urgences ou PMG?

Une solution possible est le triage : trier et classifier les patients selon leur besoin d'aide (le degré d'urgence) et déterminer le meilleur service (urgences ou GMP). Au cas d'un triage par téléphone, un patient contacte la ligne de conseil avant de se déplacer. Le triage physique se fait par l'aide-soignant ou à la porte d'entrée commune. En 2017 le triage par téléphone n'existait pas officiellement et le triage physique existait seulement dans des projets pilotes.

Dans deux chapitres d'introductions (voir chapitre 7) on a examiné la ligne directive 1733 pour le triage par téléphone. On a conclu que cette ligne directive n'était pas prête pour être implémentée à cause de problèmes de sécurité et une efficacité décevante. Uniquement un triage par téléphone n'était donc pas la solution pour le problème. Dans une étude pilote (voir chapitre 1) on a examiné l'effet d'une campagne de promotion pour le PMG dans la salle d'attende des urgences. Le long de cette campagne, le triage fait soi-même des patients a résulté dans un déplacement de 5% de ces patients des urgences vers le PMG. C'était un petit premier pas, mais important vers une collaboration plus profonde. Malheureusement de nouveau pas suffisant.

Une collaboration profonde fut élaborée pour le TRIAGE trial : une investigation randomisée mais pas blindée avec des weekends comme clusters. L'intervention était un triage effectué par un infirmier à base d'une nouvelle extension du Manchester Triage System (eMTS). A base de cette extension des patients avec un risque mineur sont affectés vers le PMG. Le triage basé sur le eMTS résulte dans un diagramme de flux (plaintes au moment d'arrivé, p.ex. mal à la gorge), le degré d'urgence (d'un à cinq) et un discriminateur (p.ex. douleur moyenne) et de cela une orientation automatique vers le PMG ou urgences. Pendant les weekends d'intervention les patients étaient encouragés de suivre le choix

proposé tandis que pendant les weekends de contrôle les patients ne recevaient pas des indications et ils restaient tous aux urgences.

Le résultat primaire du TRIAGE était la partie des patients orientés vers et aidés au PMG pendant les weekends d'intervention. Du nombre de patients au total, 599 (9,5%) étaient transférés vers le PMG. Ce nombre était influencé par la raison du contact, l'âge du patient et l'infirmier de service. De ces patients transférés, 24 (4%) étaient réorientés vers les urgences. Les valeurs prédictives positives et négatives de l'instrument étudié étaient 0.96 et 0.60. On a conclu que les infirmiers des urgences qui utilisaient le eMTS pouvaient orienter 9,5% des patients inclus vers le médecin traitant d'une manière sécurisée (voir chapitre 2).

Le TRIAGE trial était randomisé pour le résultat secondaire : la partie des patients orientés vers le médecin généraliste. Dans le groupe d'intervention c'était 13%, dans le groupe de contrôle 25%. On a comparé l'utilisation de l'instrument de l'étude eMTS entre le groupe d'intervention et celui du contrôle. Les infirmiers choisissaient autant de fois des organigrammes qui résultaient vers l'orientation aux urgences mais pendant les weekends d'intervention ils ont choisi 3% de patients de plus avec un de degré d'urgences haut. A côté de cela on a choisi 16% de discriminateurs extra qui menait vers l'orientation aux urgences. La raison la plus importante de choisir ces discriminateurs était le besoin supposé d'imagerie. Pendant les weekends d'interventions le coût total moyen pour les patients orientés vers le PMG était 23€ en moins et dans ce groupe moins de patients étaient hospitalisé (1.0% par rapport à 1.6%.

On a effectué une analyse de processus pour pouvoir tracer des barrières et facilitateurs éventuels qui pourraient influencer l'implémentation du TRIAGE trial. (Voire chapitre 3). Par moyen des interviews partiellement structurées avec des infirmiers, médecins d'urgences et médecins généralistes on a conclu que l'infirmier des urgences était la personne idéale pour trier les patients. Malgré le fait qu'appliquer le protocole du triage prenait du temps, était du travail intensif et complexe, les infirmiers trouvaient que cela exerçait une influence positive sur la charge de travail générale à leur département. Les barrières les plus importantes étaient la mesure dans laquelle un infirmier évite un risque, des barrières linguistiques possibles pendant l'explication de la décision et l'infrastructure/ architecture des urgences. On retient comme facilitateurs les plus importants l'entrainement de l'infirmier concernant le protocole du triage et la communication, combiné avec un feedback régulier du PMG vers les urgences.

La perspective du patient était examinée mais pas publiée à cause des problèmes méthodologiques, la maladie d'un chercheur et une taille des échantillons trop petite.

Des patients qui pendant le TRIAGE trial étaient orientés vers le médecin traitant, il y en avait presque un sur quatre qui refusait et qui restait donc aux urgences (voir chapitre 5). Ces refus étaient surtout influencés par l'infirmier de service et le contexte socio-économique du patient. Autres raisons de refus étaient associées avec le genre masculin, la distance de la maison et certaines plaintes d'admissions. Pendant les moments calmes moins de patients refusaient que pendant des moments plus occupés. Pendant la nuit il y avait aussi plus de refus. Le coût moyen pour les patients qui avaient refusés était signifiant plus haut que le coût pour les personnes orientées vers le PMG. Ce coût supplémentaire était pour des examens extra et une contribution personnelle plus haute aux urgences.

Une évaluation financière du TRIAGE trial montrait une légère augmentation des coûts totaux (voir chapitre 4). Le coût diminuait de 5% pour les patients mais augmentait de 7% pour les mutuelles (causé par la différence en salaire d'honneur). La partie des patients qui recevait seulement le salaire d'honneur était plus haut pendant les weekends d'interventions (25% par rapport à 19%). Les revenues du PMG augmentaient de 13% tandis qu'aux urgences il n'y avait pas une diminution.

Tout comptés ensemble l'intervention du TRIAGE trial était évalué comme positif malgré quelques restrictions méthodologiques et une efficacité plutôt basse (voir chapitre 8). Cette intervention aide les patients à choisir le service adéquat au moment d'un problème médical imprévu pendant le weekend. De cela je peux recommander d'implémenter l'intervention étudiée ailleurs et de le continuer à Deurne. Quelques conditions d'encadrement doivent être remplies : le eMTS doit être mis à jour régulièrement et certains aspects exigent une investigation continuée (sécurité, la perspective du patient, l'efficacité dans des circonstances divers et la base de soutien chez le médecin traitant). A l'implémentation des systèmes de triage il est nécessaire de suivre de près les coûts et l'effet sur les revenues des services utilisés.

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Because most of the people I want to thank speak Dutch, I wrote this chapter in their tongue. Most of my professional acknowledgements can also be found at the end of the original papers incorporated in this dissertation (in English).

Voilà, mijn doctoraat is eindelijk klaar. Bijna zes jaar werk samengevat in een handig boekje dat straks stof kan verzamelen in uw kast. Op voorhand dacht ik dat dit laatste stukje het eenvoudigste zou zijn (dat dacht ik ook over sommige andere onderdelen). Helaas, de lijst van mensen om te bedanken is lang en het risico om iemand te vergeten reëel. Hebben mijn zoons van zes en acht jaar meer geholpen dan mijn promotoren? Dat denk ik niet maar om eerlijk te zijn, ik zie ze wel liever. Om die reden heb ik besloten dit stukje niet te rangschikken volgens de internationale DBHAVEDS (Dankbaarheid Bij Het Afwerken Van Een Doctoraatsscriptie Schaal) maar gewoon in een aantal willekeurig geordende categorieën. Een dankwoord zal nooit volledig zijn dus moest je als lezer je naam niet in deze lijst tegenkomen dan wil dat niet zeggen dat ik je niet dankbaar ben. In tegendeel, ik ben elke lezer even dankbaar.

De patiënten, dankzij hen kon er iets worden onderzocht

Om privacy redenen (zie ongeveer elke inleiding uit de voorbijgaande hoofdstukken) ken ik alleen hun geëncrypteerde namen. Maar van de heer r8Cn0b/oPOZfP8jzbJiJOKdLnB/SQHVApPeYvmOEXLGqWYk7KSHD1bPZgCUvHaJy tot mevrouw sYgkvLUSaGGx1OD5EZb823gg69hF6U0c2mYLixOgTtk3+LmQWvlOifqoFdBNGLOJ, ik ben elk van jullie dankbaar dat jullie hebben deelgenomen aan onderzoek rond triage en de eerste lijn.

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Veronique Verhoeven kende ik al van uit mijn Master Na Master opleiding tot huisarts, toen zij mij hielp met mijn master na master proef.[225] Zij heeft van de huisarts Stefan mee een wetenschapper gemaakt door hulp, advies en constructieve kritiek te leveren op alle onderdelen van deze thesis.

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Het adviescomité van de TRIAGE trial

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SARS-CoV-2, het virus dat maximaal probeerde dit doctoraat te voorkomen

Dit beestje heeft hard geprobeerd om onze onderzoeken te dwarsbomen en ons gezondheidssysteem te overbelasten maar buiten een half jaar vertraging en een pak slapeloze nachten viel de schade voor deze thesis wel mee. Dit virus heeft zelfs geleid tot enkele wetenschappelijke zijsporen.[82, 226, 227]

Mijn gezin

Liesbeth Vervliet, mijn vrouw was er altijd: om te zorgen dat ik tijd kon vrij maken, om mij te steunen wanneer het even minder ging en om een flesje bubbels te openen wanneer het weer beter ging. Onze zonen Kobe en Bas begrepen niet echt waarom papa zo vaak achter de computer zat maar zijn wel trots dat hij nu dokter doctor is.

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List of tables

List of figures

Appendix 1: Newly introduced discriminators in the eMTS (in Dutch)

Publication of the entire eMTS would imply publishing the original MTS which is protected by copyright. We only have permission to publish one flowchart (see Figure 4 p. 34). To use the MTS, one needs to buy the official manual or use licensed software. More information regarding the design, use and contents of this tool can be found in this original manual.[41] The table below contains the newly introduced discriminators in the eMTS. Healthcare workers interested in the use of the eMTS can contact the FAMPOP research group for more information.

DISCRIMINATOR	UITLEG DISCRIMINATOR
<12 jaar	Elke patiënt jonger dan 12 jaar
>60 Jaar	Elke patiënt ouder dan 60 jaar
>75 jaar	Elke patiënt ouder dan 75 jaar
Abces met risico locatie	Abces met één van volgende lokalisaties: perianaal, geslachtsdelen, gelaat
Baby <3 maanden	Elke baby minder dan 3 maanden oud
Bijtwonde > 5 cm	De totale afmeting van de bijtwonde is meer dan 5cm
Bijtwonde risico lokalisatie	Bijtwonde met één van volgende lokalisaties: perianaal, geslachtsdelen, gelaat
Bloedverdunners	Elke chronische medicatie met een therapeutisch effect op de bloedstolling. Bv Vitamine K antagonisten (Mareven, Marcoumar, Sintrom), Nieuwe of Direct werkende Anticoagulantia (Pradaxa, Eliquis, Lixiana, Xarelto), Plaatjes remmers (Aspirine, Asaflow, Plavix, Clopidogrel, Efient, Ticlopidine, Brilique, Dipyridamole).
Drainage nodig	Een incisie kan zinvol zijn. Bijvoorbeeld palpabele fluctuerende massa.
Geen reden voor urgente behandeling --> Huisartsenpost zo open	Vrijdag 19:00-maandag 6:00. Tijdstip = start triage.
Geen reden voor urgente behandeling, nooit naar de huisarts	
Hechting nodig	Een hechting is nodig

Kattenbeet	Elke beet van een kat met penetratie van de huid
Kind <6 jaar	Elk kind minder dan 6 jaar oud
Nood aan beeldvorming	Volgens mening van de triagist is er dringende beeldvorming nodig welke niet kan wachten tot de gewone dagzorg. Deze discriminator is niet voldaan als alleen de patiënt denkt dat er beeldvorming nodig is.
Recent verwezen door specialist of huisarts	Patiënten recent verwezen voor de huidige aanmeldingsklacht worden nooit lager dan geel getrieerd.
Rechter fossa pijn	Patiënt of ouders geven pijn aan in de rechter fossa. Indien dit niet het geval is voelt de triagist zelf aan de rechter fossa. Indien ook dit niet pijnlijk is kan deze discriminator als negatief worden beschouwd.
Risico Behandeling huisarts	Baby <3 maanden / Een andere reden niet opgenomen in deze triagekaart.
Risico behandeling huisarts bij Aangezichtsklachten	Rode streep / Drainage nodig / Hechting nodig / Diplopie / Baby <3 maanden
Risico behandeling huisarts bij Abcessen en lokale infecties	Rode streep / Drainage nodig / Hechting nodig / Abces met risico locatie / Baby <3 maanden
Risico behandeling huisarts bij Astma	Verhoogde ademarbeid / Kind <6 jaar
Risico behandeling huisarts bij Bijtwonden en insectenbeten	Kattenbeet / Bijtwonde risico lokalisatie / Bijtwonde > 5 cm / Rode streep / Drainage nodig / Baby <3 maanden
Risico behandeling huisarts bij Blootstelling aan Braken, diarree	Voorgeschiedenis van bariatrische heelkunde / >75 jaar / Baby <3 maanden
Risico behandeling huisarts bij Buikpijn kind	Rechter fossa pijn / Baby <3 maanden
Risico behandeling huisarts bij Buikpijn volwassene	>75 jaar / Rechter fossa pijn
Risico behandeling huisarts bij Corpus alienum	Voorwerp met risico locatie / Baby <3 maanden
Risico behandeling huisarts bij Extremiteitenprobleem	Deformiteit / Nood aan beeldvorming / Baby <3 maanden
Risico behandeling huisarts bij Gebitsklachten	Zwelling aangezicht / Baby <3 maanden
Risico behandeling huisarts bij Gevallen	Deformiteit / Nood aan beeldvorming / Baby <3 maanden
Risico behandeling huisarts bij Hoofdpijn	Bloedverdunners / Braken / Baby <3 maanden
Risico behandeling huisarts bij Hoofdtrauma	Bloedverdunners / Braken / Hechting nodig / Schedelhematoom / >60 Jaar / Baby <3 maanden
Risico behandeling huisarts bij Kortademigheid kind	Kind <6 jaar / Thoraxletsel

Risico behandeling huisarts bij Kortademigheid volwassene	Thoraxletsel
Risico behandeling huisarts bij Oogklachten	Gevoel van vreemd voorwerp in oog / Diplopie / Hoofdpijn / Baby <3 maanden
Risico behandeling huisarts bij Oorklachten	Vertigo / Baby <3 maanden
Risico behandeling huisarts bij Rugklachten	Rode vlaggen
Risico behandeling huisarts bij Slagen en Verwondingen	<18 jaar / Deformiteit
Risico behandeling huisarts bij Wonden	Voorwerp met risico locatie / Hechting nodig / Nood aan beeldvorming / Baby <3 maanden
Rode streep	Longitudinale roodheid in de omgeving van het abces of de lokale roodheid over het verloop van een lymfebaan
Rode vlaggen	Rugpijn met één van volgende kenmerken: plasklachten, verlies of veranderingen van perianale of perineale sensibiliteit, verlies van darmcontrole, bilaterale uitstraling tot voorbij de knie
Voorgeschiedenis van bariatrische heelkunde	Elke ingreep met als doel gewichtsverlies in de voorgeschiedenis: gastric bypass, scopinaro ingreep, sleeve gastrectomie, intra-gastrische ballon, maagbandje, …
Voorwerp met risico locatie	elke anatomische locatie vormt een risico behalve vagina, navel, neus en oor

Appendix 2: Supplementary material for Chapter 4

Appendix S1: Patients with missing invoice - comparison of sample characteristics between intervention and control weekends

Characteristic	Category	Intervention (%) (n=370)	Control (%) (n=104)	p-value two-sided chi-square test
Age category	0-7	38 (10%)	10 (10%)	1.00
	8-24	82 (22%)	23 (22%)	
	25-39	82 (22%)	22 (21%)	
	40-54	48 (13%)	14 (13%)	
	55-74	60 (16%)	16 (15%)	
	>74	60 (16%)	19 (18%)	
Sex	Women	182 (49%)	42 (40%)	0.11
	Men	188 (51%)	62 (60%)	
Low socio-economic status	Yes	112 (35%)	31 (36%)	0.94
	No	206 (65%)	56 (64%)	
Living nearby	Yes	265 (72%)	64 (62%)	0.06
	No	104 (28%)	39 (38%)	
Presentational complaint category	Abdominal complaints	23 (7%)	7 (7%)	0.18
	Back and neck pain	3 (1%)	6 (6%)	
	Chest pain	11 (3%)	1 (1%)	
	Children	11 (3%)	3 (3%)	
	Eye problems	12 (3%)	1 (1%)	
	Limb Problems	126 (37%)	37 (38%)	
	Mental complaints	12 (3%)	5 (5%)	
	Neurological complaints	3 (1%)	3 (3%)	
	Otorhinolaryngology complaints	13 (4%)	4 (4%)	
	Others	11 (3%)	2 (2%)	
	Respiratory complaints	14 (4%)	3 (3%)	
	Trauma and accidents	19 (61%)	5 (5%)	
	Unwell Adult	46 (13%)	10 (10%)	

	Urinary or gynaecological complaints	13 (4%)	2 (2%)	
	Wounds	28 (8%)	9 (9%)	
Subjective crowding at the emergency department.	Quiet	14 (8%)	4 (11%)	0.36
	Normal	138 (78%)	25 (68%)	
	Busy	24 (14%)	8 (22%)	
Admission type	Ambulance	92 (25%)	24 (22%)	0.71
	Walk-in	278 (75%)	80 (77%)	
Manchester Triage System urgency category	1 (Red)	4 (1%)	3 (3%)	0.58
	2 (Orange)	45 (12%)	10 (10%)	
	3 (Yellow)	90 (24%)	22 (21%)	
	4 (Green)	198 (54%)	60 (58%)	
	5 (Blue)	33 (9%)	9 (9%)	
Mean number of missing invoices		370/6374 (6%)	104/1784 (6%)	0.97

Appendix S2: Hospitalised patients – comparison of sample characteristics between intervention and control weekends

Characteristic	Category	Intervention (%) (n=1040)	Control (%) (n=299)	p-value two-sided chi-square test
Age category	0-7	135 (13%)	36 (12%)	0.87
	8-24	78 (8%)	24 (8%)	
	25-39	115 (11%)	38 (13%)	
	40-54	142 (14%)	35 (12%)	
	55-74	232 (22%)	72 (24%)	
	>74	338 (33%)	94 (31%)	
Sex	Women	543 (52%)	150 (50%)	0.53
	Men	497 (48%)	149 (50%)	
Low socio-economic status	Yes	299 (35%)	90 (36%)	0.90
	No	548 (65%)	162 (64%)	
Living nearby	Yes	741 (71%)	207 (70%)	0.63
	No	297 (29%)	89 (30%)	
Presentational complaint	Abdominal complaints	138 (13%)	46 (15%)	0.38
	Back and neck pain	16 (2%)	4 (1%)	
	Chest pain	50 (5%)	11 (4%)	
	Children	1126 (2%)	32 (11%)	
	Eye problems	7 (1%)	2 (1%)	

	Limb Problems	94 (9%)	31 (10%)	
	Mental complaints	66 (6%)	15 (5%)	
	Neurological complaints	20 (2%)	7 (2%)	
	Otorhinolaryngology complaints	12 (1%)	5 (2%)	
	Others	18 (2%)	8 (3%)	
	Respiratory complaints	73 (7%)	10 (3%)	
	Trauma and accidents	81 (8%)	24 (8%)	
	Unwell Adult	260 (25%)	72 (24%)	
	Urinary or gynaecological complaints	43 (4%)	22 (7%)	
	Wounds	28 (3%)	9 (3%)	
Subjective crowding at the emergency department	Quiet	50 (11%)	14 (14%)	0.29
	Normal	351 (75%)	66 (67%)	
	Busy	67 (14%)	18 (18%)	
Admission type	Ambulance	437 (42%)	123 (41%)	0.79
	Walk-in	603 (58%)	176 (59%)	
Manchester Triage System urgency category	1 (Red)	6 (1%)	3 (1%)	0.35
	2 (Orange)	227 (22%)	59 (20%)	
	3 (Yellow)	630 (61%)	175 (59%)	
	4 (Green)	175 (17%)	60 (20%)	
	5 (Blue)	2 (0%)	2 (1%)	
Mean number of hospitalised patients		1040/6374 (16%)	299/1784 (17%)	0.65

Appendix S3: Comparison of sample characteristics between intervention and control weekends (all patients included in the sample)

Characteristic	Category	Intervention (%) (n=5069)	Control (%) (n=1412)	p-value two-sided chi-square test
Age category	0-7	683 (13%)	166 (12%)	0.15
	8-24	1158 (23%)	299 (21%)	
	25-39	1282 (25%)	388 (27%)	
	40-54	919 (18%)	273 (19%)	
	55-74	697 (14%)	204 (14%)	
	>74	330 (7%)	82 (6%)	
Sex	Women	2480 (49%)	704 (50%)	0.53
	Men	2589 (51%)	708 (50%)	
Low socio-economic status	Yes	1266 (30%)	384 (32%)	0.15
	No	3,013 (70%)	825 (68%)	
Living nearby	Yes	3553 (70%)	969 (69%)	0.29
	No	1498 (30%)	438 (31%)	
Presentational complaint	Abdominal complaints	360 (7%)	119 (8%)	0.41
	Back and neck pain	280 (6%)	69 (5%)	
	Chest pain	141 (3%)	41 (3%)	
	Children	428 (9%)	101 (7%)	
	Eye problems	195 (4%)	61 (4%)	
	Limb Problems	1493 (30%)	452 (32%)	
	Mental complaints	71 (1%)	19 (1%)	
	Neurological complaints	93 (2%)	23 (2%)	
	Otorhinolaryngology complaints	284 (6%)	72 (5%)	
	Others	181 (4%)	36 (3%)	
	Respiratory complaints	63 (1%)	16 (1%)	
	Trauma and accidents	254 (5%)	64 (5%)	
	Unwell Adult	337 (7%)	98 (7%)	
	Urinary or gynaecological complaints	200 (4%)	63 (4%)	
	Wounds	636 (13%)	173 (12%)	
Subjective crowding at the emergency department*	Quiet	216 (4%)	41 (3%)	<0.01
	Normal	1680 (33%)	300 (21%)	
	Busy	265 (5%)	71 (5%)	
	Missing	2908 (57%)	1000 (71%)	

Admission type	Ambulance	538 (11%)	157 (11%)	0.58
	Walk-in	4528 (89%)	1253 (89%)	

*: The level of subjective crowding was significantly different between type of weekend. This is mainly driven by a difference in registration, as this variable was missing more frequently during intervention weekends, and thus does not reflect a true difference in crowding

Appendix S4: Comparison of the classification into urgency categories between intervention and control weekends

		Intervention (%) (n=5069)	Control (%) (n=1412)	p-value two-sided Chi-square test
Manchester Triage System urgency category	2 (Orange)	176 (3%)	41 (3%)	0.049
	3 (Yellow)	1,475 (29%)	368 (26%)	
	4 (Green)	3,363 (66%)	982 (70%)	
	5 (Blue)	55 (1%)	21 (1%)	

Appendix S5: Log-gamma generalised linear model

Overview

Outcome variable	Variable	exp(b)	95% CI	Robust standard error	Robust p-value
Total cost	Intervention	0.0687***	0.0170; 0.120	0.0264	0.00919
Patient cost	Intervention	-0.0711***	-0.117; -0.0252	0.0234	0.00239
Insurance cost	Intervention	0.105***	0.0423; 0.169	0.0323	0.00108

*** p<0.01, ** p<0.05, * p<0.1
5422 observations.
Included control variables: presentational complaint, patients' socio-demographic characteristics, part of the day and admission by ambulance or walk-in.

Details

	(1) Total cost Adjusted cost ratio, exp(b) (robust Standard Error)	(2) Patient cost Relative cost ratio, exp(b) (robust Standard Error)	(3) Insurance cost Relative cost ratio, exp(b) (robust Standard Error)
Intervention	1.071*** (0.0283)	0.931*** (0.0218)	1.111*** (0.0359)
Presentational complaint			
Abdominal complaints	1.071 (0.0763)	1.143** (0.0667)	1.066 (0.0881)
Back and neck pain	1.080 (0.0796)	0.938 (0.0493)	1.115 (0.0931)
Chest pain	1.182*** (0.0745)	1.183** (0.0866)	1.194** (0.0881)
Children	0.685*** (0.0449)	0.981 (0.0522)	0.618*** (0.0487)
Eye problems	0.688*** (0.0498)	1.213*** (0.0674)	0.551*** (0.0507)
Limb Problems	1.455*** (0.0767)	1.318*** (0.0581)	1.506*** (0.0916)
Mental complaints	1.097 (0.195)	0.838 (0.110)	1.129 (0.220)
Neurological complaints	1.370*** (0.148)	1.045 (0.0729)	1.446*** (0.177)
Otorhinolaryngology complaints	0.843* (0.0806)	0.982 (0.0811)	0.824* (0.0957)
Others	0.686*** (0.0436)	0.896* (0.0536)	0.638*** (0.0483)
Respiratory complaints	0.978 (0.0842)	0.879* (0.0651)	0.998 (0.0957)
Trauma and accidents	1.482*** (0.105)	1.543*** (0.171)	1.496*** (0.121)
Unwell adult (baseline)			
Urinary or gynaecological complaints	0.952 (0.0803)	1.220*** (0.0878)	0.895 (0.0917)
Wounds	1.129** (0.0621)	1.971*** (0.0901)	0.932 (0.0609)
Age category			

0-7	0.801*** (0.0353)	0.863*** (0.0333)	0.773*** (0.0405)
8-24	0.875*** (0.0318)	0.903*** (0.0298)	0.867*** (0.0371)
25-39	0.948 (0.0377)	1.013 (0.0407)	0.931 (0.0440)
40-54 (baseline)			
55-74	1.109** (0.0457)	1.023 (0.0366)	1.131** (0.0546)
>74	1.343*** (0.0727)	1.138*** (0.0569)	1.386*** (0.0860)
Time period			
Night	0.974 (0.0330)	1.060 (0.0386)	0.965 (0.0391)
Evening	0.931*** (0.0234)	0.987 (0.0186)	0.915*** (0.0275)
Day (baseline)			
Female	0.920*** (0.0215)	0.929*** (0.0179)	0.914*** (0.0255)
Increased reimbursement	0.948** (0.0237)	0.523*** (0.0123)	1.095*** (0.0314)
Living nearby	0.932*** (0.0252)	0.935*** (0.0216)	0.931** (0.0301)
Admission by ambulance	1.440*** (0.0596)	0.735*** (0.0424)	1.622*** (0.0735)
Constant	111.6*** (7.194)	27.62*** (1.403)	83.15*** (6.328)
Observations	5422	5422	5422

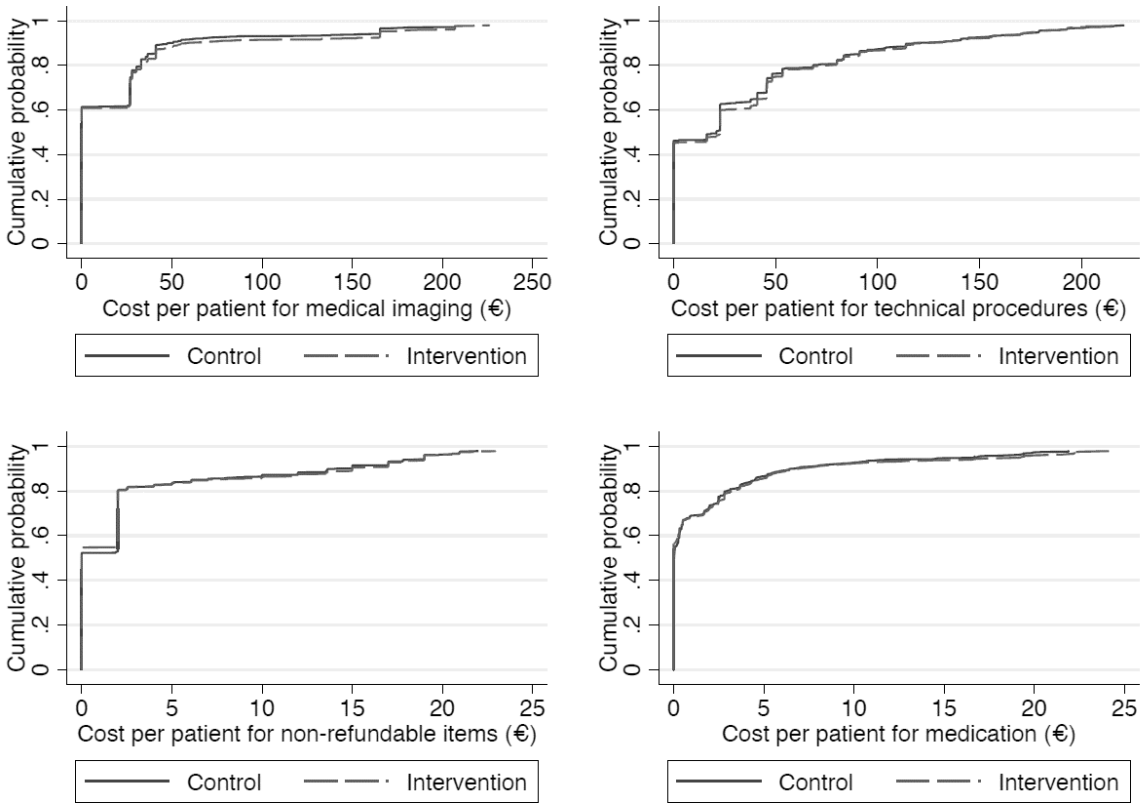
*** p<0.01, ** p<0.05, * p<0.1

Appendix S6: Comparison of summary statistics for the total cost of care and various cost categories between intervention and control weekends – excluding four extreme high outliers

		Intervention (n=5067)	Control (n=1410)	Total (n=6477)	p-value KS two-samples test	p-value t-test for unequal variances
Total invoice						
Total cost	Mean (SD)	122 (112)	117 (105)	121 (111)	<0.01	0.17
	Median (IQR)	90 (49-137)	88 (49-135)	90 (49-137)		
Physician fees	Mean	46 (13)	46 (11)	46 (13)	<0.01	0.62
	Median	49 (39-49)	49 (39-49)	49 (39-49)		
Medical imaging	Mean	28 (58)	24 (50)	27 (56)	0.57	0.031
	Median	0 (0-28)	0 (0-28)	0 (0-28)		
Technical procedures	Mean	42 (65)	41 (69)	42 (66)	0.26	0.65
	Median	23 (0-53)	21 (0-48)	23 (0-48)		
Non-refundable items	Mean	3 (7)	3 (6)	3 (7)	0.52	0.61
	Median	0 (0-2)	0 (0-2)	0 (0-2)		
Delivered medication	Mean	3 (6)	2 (6)	3 (6)	0.48	0.22
	Median	0 (0-2)	0 (0-2)	0 (0-2)		
Share for the patient						
Total cost	Mean (SD)	26 (28)	27 (24)	26 (27)	<0.01	0.078
	Median (IQR)	23 (12-31)	23 (15-31)	23 (13-31)		
Physician fees	Mean	16 (10)	18 (9)	17 (10)	<0.01	<0.001
	Median	21 (12-21)	21 (12-21)	21 (12-21)		
Medical imaging	Mean	2 (9)	2 (11)	2 (9)	0.55	0.63
	Median	0 (0-2)	0 (0-2)	0 (0-2)		
Technical procedures	Mean	3 (11)	3 (10)	3 (10)	1.00	0.72
	Median	0 (0-2)	0 (0-2)	0 (0-2)		
Non-refundable items	Mean	3 (7)	3 (6)	3 (7)	0.55	0.59
	Median	0 (0-2)	0 (0-2)	0 (0-2)		
Delivered medication	Mean	1 (4)	1 (4)	1 (4)	0.50	0.77*
	Median	0 (0-1)	0 (0-1)	0 (0-1)		
Share for the insurance						
Total cost	Mean (SD)	96 (105)	90 (101)	95 (104)	<0.01	0.05*

	Median (IQR)	62 (33-107)	57 (28-103)	61 (33-107)		
Physician fees	Mean	30 (14)	28 (11)	30 (13)	<0.01	<0.001
	Median	28 (25-37)	28 (27-37)	28 (25-37)		
Medical imaging	Mean	26 (55)	22 (48)	25 (53)	0.52	0.019
	Median	0 (0-27)	0 (0-27)	0 (0-27)		
Technical procedures	Mean	39 (63)	38 (67)	39 (64)	0.38	0.68
	Median	20 (0-48)	16 (0-46)	20 (0-46)		
Non-refundable items	Mean	0 (1)	0 (1)	0 (1)	1.00	0.86
	Median	0 (0-0)	0 (0-0)	0 (0-0)		
Delivered medication	Mean	1 (4)	1 (3)	1 (4)	0.97	0.082*
	Median	0 (0-0)	0 (0-0)	0 (0-0)		

Appendix S7: Cumulative density functions of different cost categories per patient in euros for intervention and control weekends - medical imaging, technical procedures, non-refundable items, and medication. Costs are expressed in euro 2019.



Appendix S8: GPC's and ED's mean revenues and mean number of patients seen per weekend for intervention and control weekends.

	Intervention (30 weekends)	Control (9 weekends)	p-value pooled t-test
GPC			
Mean revenue (€) per weekend (SD)	8608 (1395)	7619 (990)	0.03
Mean number of patients seen per weekend (SD)	210 (36)	190 (32)	0.06
ED			
Mean revenue (€) per weekend (SD)	19228 (2418)	18869 (2854)	0.65
Mean number of patients seen per weekend (SD)	149 (16)	159 (20)	0.05

Appendix S9: Comparison of summary statistics for the total cost of care and various cost categories between intervention and control weekends – urgency category four and five

		Intervention (n=3418)	Control (n=1003)	Total (n=4421)	p-value KS two-samples test	p-value t-test for unequal variances
Total invoice						
Total cost	Mean (SD)	112 (95)	113 (97)	112 (95)	<0.01	0.72
	Median (IQR)	90 (49-135)	90 (49-131)	90 (49-134)		
Physician fees	Mean	45 (12)	46 (10)	45 (12)	<0.01	0.02
	Median	49 (39-49)	49 (39-49)	49 (39-49)		
Medical imaging	Mean	21 (45)	21 (43)	21 (45)	1.00	0.73
	Median	0 (0-27)	0 (0-27)	0 (0-27)		
Technical procedures	Mean	39 (62)	40 (64)	39 (62)	1.00	0.81
	Median	23 (0-46)	23 (0-46)	23 (0-46)		
Non-refundable items	Mean	4 (7)	4 (7)	4 (7)	0.51	0.44
	Median	0 (0-2)	0 (0-2)	0 (0-2)		
Medication	Mean	2 (6)	2 (5)	2 (5)	0.09	0.88
	Median	0 (0-1)	0 (0-2)	0 (0-1)		
Share for the patient						
Total cost	Mean (SD)	26 (24)	29 (38)	26 (28)	<0.01	<0.001
	Median (IQR)	23 (12-32)	23 (16-32)	23 (12-32)		
Physician fees	Mean	16 (10)	18 (9)	16 (9)	<0.01	<0.001
	Median	21 (6-21)	21 (12-21)	21 (12-21)		
Medical imaging	Mean	1 (8)	2 (11)	2 (9)	1.00	0.16
	Median	0 (0-2)	0 (0-2)	0 (0-2)		
Technical procedures	Mean	3 (9)	4 (18)	3 (12)	1.00	0.30
	Median	0 (0-2)	0 (0-2)	0 (0-2)		
Non-refundable items	Mean	4 (7)	4 (7)	4 (7)	0.51	0.44
	Median	0 (0-2)	0 (0-2)	0 (0-2)		
Medication	Mean	1 (4)	1 (4)	1 (4)	0.07	0.69
	Median	0 (0-0)	0 (0-0)	0 (0-0)		
Share for the insurance						
Total cost	Mean (SD)	86 (87)	84 (88)	86 (88)	<0.01	0.50

	Median (IQR)	61 (33-98)	60 (28-94)	61 (33-97)		
Physician fees	Mean	29 (13)	28 (11)	29 (12)	<0.01	<0.001
	Median	28 (22-37)	28 (27-31)	28 (22-37)		
Medical imaging	Mean	20 (43)	19 (40)	20 (42)	1.00	0.52
	Median	0 (0-27)	0 (0-27)	0 (0-27)		
Technical procedures	Mean	36 (59)	36 (59)	36 (59)	0.98	0.96
	Median	20 (0-43)	20 (0-43)	20 (0-43)		
Non-refundable items	Mean	0 (0)	0 (0)	0 (0)	1.00	0.91
	Median	0 (0-0)	0 (0-0)	0 (0-0)		
Medication	Mean	1 (3)	1 (3)	1 (3)	0.18	0.83
	Median	0 (0-0)	0 (0-0)	0 (0-0)		

* Pooled t-test, most appropriate according to F-test for unequal variances
SD: Standard Deviation
IQR: Interquartile Range

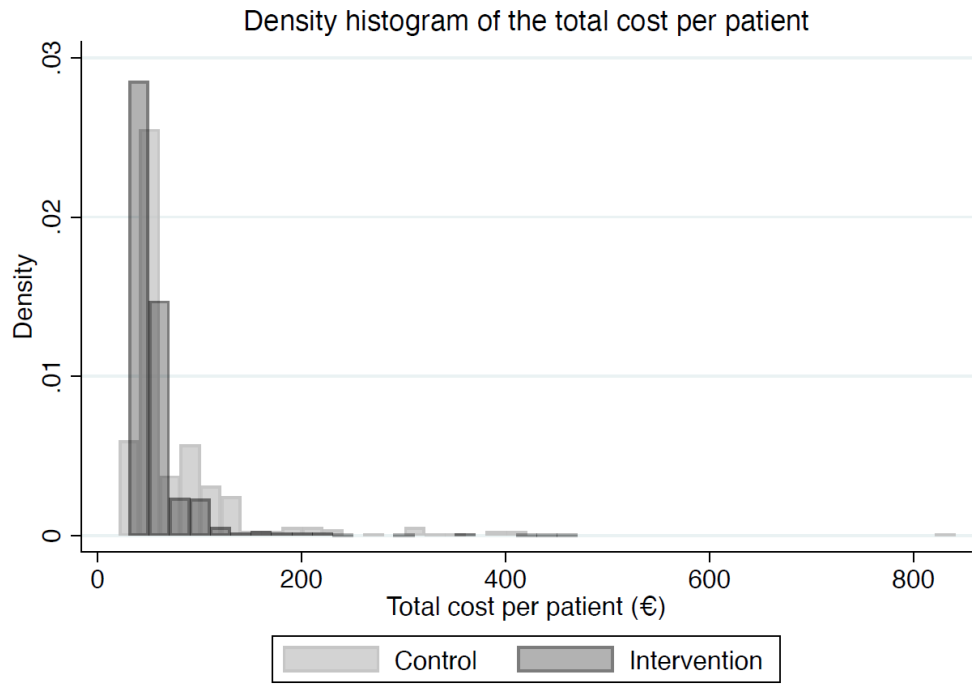
Appendix 3: Supplementary material for Chapter 6

Appendix Table 1. Baseline characteristics of participants. Values are numbers (percentages).

Characteristics	Intervention group (%) (n=6374)	Control group (%) (n=1784)	P-value
Mean age in years (standard deviation)	38 (25)	39 (24)	0.11*
Sex			0,99**
Women	3111 (49)	862 (49)	
Men	3183 (51)	882 (51)	
Residence			0.25**
Nearby***	4423 (70)	1191 (68)	
Others	1852 (29)	546 (31)	
Missing	19 (0)	7 (0)	
Socioeconomic Status			0.11**
Low	1624 (26)	485 (28)	
Not low	3669 (58)	1010 (58)	
Missing	1001 (16)	249 (14)	
Manchester Triage System urgency category			0.06**
One or two (max. waiting time ten minutes)	413 (6)	104 (6)	
Three (max. waiting time one hour)	2146 (34)	552 (32)	
Four (max. waiting time two hours)	3676 (58)	1064 (61)	
Five (max. waiting time four hours)	59 (1)	24 (1)	
Subjective crowding at the ED[$]			<0.01**
Quiet	272 (4)	58 (3)	
Normal	2127 (34)	383 (22)	
Busy	344 (5)	92 (5)	
Missing	3551 (56)	1211 (69)	
Admission to the study hospital	1016 (16)	292 (17)	0.55**
Mean number of included patients per weekend (standard deviation)	170 (39)	174 (34)	0.74*

**P-value based on an unpaired samples student's t-test*
***P-value based on the Pearson's Chi-square test*
****Within the four communities covered by the GPC*
$: There was an imbalance between intervention and control groups for the subjective crowding at the ED. This was probably due to a difference in motivation to register this parameter rather than due to an actual difference.

Appendix Figure 1



Appendix Figure 2