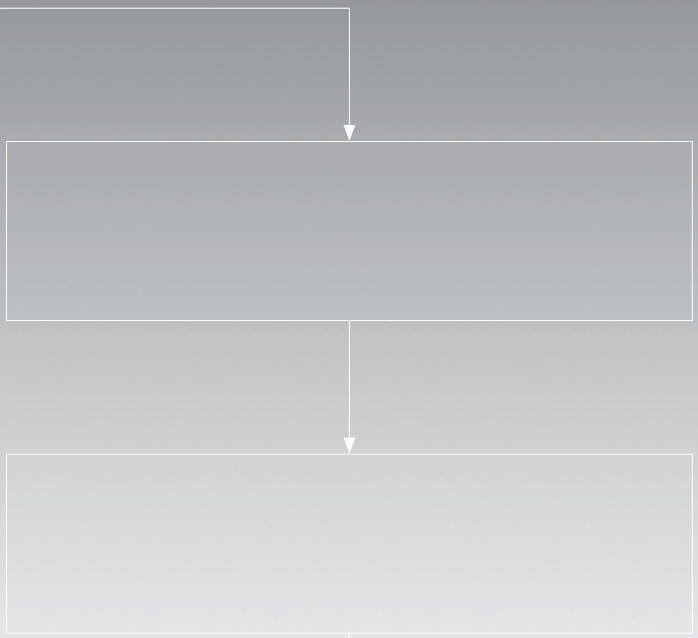
IN CASE OF EMERGENCY

Exploring guideline adherence in the chain of emergency care



Remco H.A. Ebben

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Funding
The studies described in chapters 2, 3, 4 and 5 were part of the KLPS-project (Ketenbrede Landelijke Protocollen Spoedzorg). The KLPS-project was funded by ZonMw – the Netherlands organization for health research and development (Project Number 8271.2001).

The study described in chapter 6 was funded by the HAN University of Applied Sciences.

HAN University of Applied Sciences
In accordance with the philosophy of the HAN University of Applied Science, the recommendations in this thesis were formulated for clinical practice, education and future (practice-based) research.

Thesis funding
- HAN University of Applied Sciences, Nijmegen, the Netherlands
- Radboud University Medical Centre, Nijmegen, the Netherlands

ISBN: 978-90-9028916-8
Print: Ipskamp Drukkers B.V.
Cover design and layout: Maarten Jeukens

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Proefschrift
ter verkrijging van de graad van doctor
aan de Radboud Universiteit Nijmegen
op gezag van de rector magnificus prof. dr. Th.L.M. Engelen,
volgens besluit van het college van decanen
in het openbaar te verdedigen op woensdag 17 juni 2015
om 12.30 uur precies

door
Remco Henricus Antonius Ebben
geboren op 16 februari 1984
te Doetinchem

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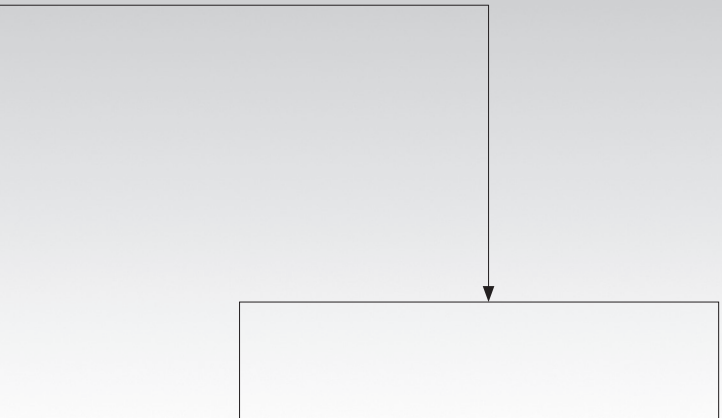
"What once seemed black and white
turns to so many shades of gray"
Blood Brothers (Bruce Springsteen, 1995), Columbia Records

TABLE OF CONTENTS

CHAPTER 1

General introduction



GENERAL INTRODUCTION

Evidence-based practice

Over the past 30 years, evidence-based medicine (EBM) has become increasingly important in healthcare. EBM is "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of EBM means integrating individual clinical expertise with the best available external clinical evidence from systematic research" [1]. The best available external clinical evidence is formed by patient centred research focussed on accuracy and precision of diagnostic tests, the power of prognostic markers, and the efficacy of therapeutic or preventive interventions [1]. As the quality of the research evidence can differ depending on type of design and control for bias [2], evidence-hierarchies have been developed to grade the level of evidence. Different evidence hierarchies exist which grade evidence differently, although all hierarchies grade the systematic review as highest level of evidence. A commonly used hierarchy is displayed in Figure 1.

Figure 1: The evidence hierarchy (http://completeconcussions.com/media-circus/)

The second component of EBM, individual clinical expertise, is defined as the proficiency and judgment that individual clinicians acquire through clinical experience and clinical practice [1]. As EBM evolved and became a paradigm for all healthcare professionals, a third component was 'added' to the concept of EBM: in consultation with the patient, the preferences, values and expectations of the patient can be integrated to help healthcare decision making for that individual patient, which led to the 'new' concept of evidence-based clinical practice (EBP): "Evidence-based clinical practice is

an approach to decision-making in which the clinician uses the best evidence available, in consultation with the patient, to decide upon the option which suits that patient best" [3]. The process of EBP takes place within the context of available resources, legal and ethical considerations [4]. By underpinning interventions, and screening/diagnostic tests, with evidence, and to integrate these with the expertise of the clinician and with patient preferences and values, the aim of EBP is to improve patient processes and outcomes. To support EBP by healthcare professionals, guidelines and protocols are developed.

Guidelines and protocols

Clinical practice guidelines and protocols are developed to reduce variation of practice, to improve quality of care, and to ensure that evidence is actually used when appropriate [5]. A distinction between a guideline and a protocol can be made. Initially, guidelines were based on consensus among experts, but there has been an evolution to development of evidence-based guidelines [2]. An evidence-based guideline consists of systematically developed recommendations to assist practitioners and patient decisions about appropriate health care for specific clinical circumstances [6]. These guidelines are developed by expert panels from (inter)national professional organizations from medical, nursing or allied health disciplines, or general quality institutes [7,8]. Evidence-based guidelines consist of several components: a systematic review of the literature on a specific research question, a synthesis of results from the systematic review resulting in conclusions with a level of evidence, consideration of the conclusion with regard to financial, ethical, contextual aspects and current practice, finally resulting in a recommendation [2]. As evidence for diagnostic tests or interventions can be of low quality or can be lacking, guideline recommendations can also be based on expert opinion.

A guideline recommendation is defined as any statement that promotes or advocates a particular course of action in clinical care [9]. These guideline recommendations to (not) administer an intervention, or to (not) apply a diagnostic test, are based on a weighing between benefits, risks, burden and costs [2]. As guidelines are sizeable documents with multiple recommendations, often guidelines are translated in more applicable protocols. A protocol is a specification of a guideline and exactly formulates how to act and which steps to follow [10]. A further distinction between a guideline and a protocol is that a guideline provides recommendations, and that a protocol provides instructions with formulations of what (not) to do.

Implementation

Systematic reviews show that the introduction and implementation of guidelines improves clinical practice and patient outcomes [9,11,12]. Despite these improvements, a systematic review on the quality of health care delivered to adults in the United States shows that 54.9% of recommended care was actually given to patients [13]. To ensure guideline adherence in practice and subsequently lead to improved patient outcomes, effective implementation is necessary [9]. Implementation is defined as "a planned process and systematic introduction of innovations or changes of proven value; the aim being that these are given a structural place in professional practice, in the functioning of organizations or in the health care structure" [14]. To guide the implementation process, several models and frameworks have been developed which differ in their applicability and complexity [15]. Grol and Wensing have developed the model for effective implementation, which provides a stepwise approach through rational and deliberate steps to accomplish practice improvement (Figure 2) [10,16].

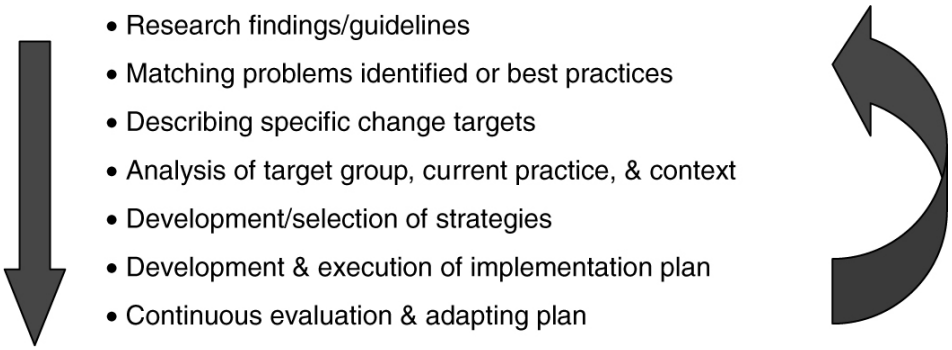


Figure 2: Model for effective implementation [15]

The first step in the model is the identification of guidelines, research findings or best practices that match the identified problems. This match is important as it justifies the start of an implementation process. The second step comprises the description of change targets: what has to be implemented, by whom, when, where, why and how? After change targets have been described, the third step includes an analysis of the target group, current practice and setting. The aim of this analysis is to identify barriers and facilitators for implementation. In general, factors influencing the implementation of guidelines were related to the characteristics of professionals, patients, environment, guidelines and implementation

strategies used [17]. On the basis of this analysis, implementation strategies can be selected or developed in step 4. It is reported that studies often fail to select tailored implementation strategies, which results in unsuccessful implementation [12]. The implementation strategies form the basis of an implementation plan, which should be developed and executed in step 5. Finally, step 6 comprises the continuous evaluation on process and outcome, and subsequently the adaptation of the plan.

Guidelines and protocols in the emergency care setting

Introduction of guidelines in the emergency care settings reduced ordering of blood tests and length of stay for the limping child in the emergency departement (ED) [18], reduced unnecessary urinary catheter placement in the ED [19], and improved drug prescription for community acquired pneumonia in the ED [20]. Despite the positive impact of implementing guidelines, implementation of guidelines is not obvious. For instance, it took emergency medical services (EMS) in the United States and the Netherlands around 1.5 years to implement guidelines for cardiopulmonary resuscitation and emergency cardiac care [21,22]. When implemented, it might also be challenging for guideline revisions to find their way to clinical practice. For example, the uptake of revisions of a field triage guideline by EMSs appeared to be slow and variable [23].

Despite the development and implementation of evidence-based guidelines and protocols, insight in the proportion of prehospital care that is consistent with available evidence is lacking [24]. Specifically for the ambulance and ED settings, adherence to guidelines and protocols regarding cardiopulmonary resuscitation, cervical spine immobilisation, initial ECG screening, pain management, hygiene precautions, triage, and domestic violence screening, shows a wide variation [25-32]. From the patient perspective this might indicate that professionals withhold evidence-based care from patients, which means that not the maximum possible number of patients receives the benefits of appropriate treatment, and that patients might be exposed to under- or overtreatment and risks. The proposed 'research agenda for advancing prehospital care' acknowledges this problem as recommends that study is needed regarding how well the delivery of evidence-based, guideline-directed care in the out-of-hospital setting actually adheres to those guidelines [24]. Guideline adherence is defined as "the conformity in fulfilling or following official, recognized, or institutional requirements, guidelines, recommendations, protocols, pathways or other standards" [33]. Adherence measurement to guidelines and protocols is becoming increasingly important

in the emergency care clinical practice and they provide a performance measurement on process level: measurements of process evaluate whether specific care was delivered [7,34].

Dutch chain of emergency care

The Dutch chain of emergency care is formed by the emergency medical dispatch center (EMD), the EMS, and the ED. Prehospital ambulance care is provided by 25 regional EMSs and 21 EMDs which provide 24/7 emergency care. The geographically spreading of the EMSs is based on the principle that in case of an emergency 95% of the Dutch population could be reached within 15 minutes [35]. A request for an ambulance can be made by a layperson calling the national emergency number, or by another healthcare professional (e.g. general practitioner). Ambulances can be dispatched with urgency level A1 (arrival <15 minutes), A2 (arrival <30 minutes) or B (planned). EMDs are staffed with EMD-dispatchers which are nurses who become qualified as an EMD-nurse after following a specific national training course. Ambulances are staffed with one driver and one ambulance nurse. To become qualified as an ambulance nurse, registered nurses must have followed extra training in the intensive care unit (ICU), coronary care unit (CCU), ED or anaesthesia, and several years of working experience in these areas, before entering the national ambulance training course. Ambulance nurses work autonomously, without direct supervision of a physician. Ambulance drivers are trained in basic life support, they medically support the ambulance nurse and act as an on-scene safety officer. EMSs are managed by EMS physicians, who have final responsibility for the medical care given within a specific EMS, for medical health policy and for the qualification and competency levels of the ambulance nurses. The EMS physician is not present on site, but can be consulted by the ambulance nurses.

On January 1st 2011, the Netherlands counted 98 EDs [36]. There are three types of EDs: 'full EDs' (level 1) in university medical centres, "profile EDs" (level 2) in hospitals with support facilities in the form of specialized care departments, and "basic EDs" (level 3) whose activities primarily involve resuscitation, stabilization, and the treatment of common, but not highly complex, acute problems [37]. EDs are staffed with emergency nurses, emergency physicians and medical residents. Registered nurses follow additional emergency training to become qualified as an emergency nurse. Recommended additional courses are a triage course, trauma nursing core course (TNCC), or emergency nursing pediatric course (ENPC) [37]. The

practice of emergency nurses is focused on the arrival and first care of the patient. Therefore emergency nurses must be able to triage patients, support or administrate interventions or diagnostic tests, and allocate additional care [37]. As not every ED has specialized emergency physicians yet, medical end-responsibility varies per emergency department as being allocated to the trauma surgeon or internist, although the medical end-responsibility is shifting towards the emergency physician. A physicians at the ED must have emergency medicine experience, must be able to directly recognize life threatening situations, resuscitate patients, estimate if required care is present at the ED or refer to another ED, and is responsible for the quality of care [37].

National protocols

To support clinical practice by ambulance nurses, the ambulance care national sector organization developed a National Protocol Ambulance Care (NPAC) [38]. The NPAC is implemented in the national training course for ambulance nurses and each ambulance nurse receives the NPAC during training. In line with the NPAC, a National Protocol Emergency Department (NPED) for emergency nurses was developed by the Dutch Emergency Nurses Association (DENA) [39]. After its publication, the NPED was disseminated to all emergency departments in the Netherlands. Emergency nurses can consult the NPED online if they are members of the DENA, or as a book if present in their emergency department. As ED training courses are not centrally organized, the NPED was not implemented in all courses. Both protocols are regularly updated and consist of symptom-orientated flowcharts which cover all aspects of prehospital and emergency care: general topics (e.g. hygiene, handover, starting/stopping treatment), cardiology, neurology, pulmonology, internal medicine, traumatology, paediatrics, gynaecology, psychiatry and intoxications. The flow-charts are based on a mixture of evidence, best practices and expert opinion. As both protocols were developed by national professional organizations they represent the professional nursing standard for ambulance and emergency care in the Netherlands.

KLPS-project

During the actual use of the NPAC in clinical practice, several problems arose. Firstly, professionals and the professional organizations experienced that for some topics the NPAC and NPED in the chain of emergency care were not consistent. The second problem was that some flowcharts were lacking evidence. Especially for prehospital care, this is a widely recognized problem [40]. Thirdly, barriers and facilitators for adherence to the NPAC

and NPED were unknown, with the result that no tailored implementations strategies were available for both protocols.

To overcome these problems, the research department acute care (lectoraat acute intensieve zorg, www.laiz.nl) together with AZN and DENA, started with KLPS-project in 2009. The KLPS-project had two main aims:

1. The development of three evidence-based guidelines for the chain of ambulance and emergency department;
2. The development of an evidence-based implementation strategy to implement the new guidelines and improve adherence to the existing NPAC and NPED.

The study was funded by a grant from the Netherlands organization for health research and development ZonMw (project number 8271.2001) in the research program 'Spoedzorg'.

At the start of the project, a national steering committee with formal representatives of national emergency care organizations was established. The steering committee provided input during the development and execution of the study. On the basis of consultation of professionals, the topics for the three guidelines were chosen by the steering committee:

1. Non ST-segment elevation coronary syndromes;
2. Sepsis/Septic shock;
3. Handover from ambulance to emergency department.

After development in 2012, the guidelines were transferred to AZN and the DENA with the aim to formalise and to implement the guidelines.

Aim of the thesis

As described earlier, guideline implementation in prehospital and ED settings is not obvious, which might lead to suboptimal guideline adherence. Potentially, this might lead to patients receiving inappropriate, unnecessary, or even harmful care. To improve adherence and to support development of implementation strategies, insight in factors influencing adherence is important. Therefore, the first aim of this thesis was to provide an overview of the degree emergency care professionals adhere to guidelines and protocols. The second aim is to gain insight in factors influencing adherence in the prehospital and ED settings. The third aim was test the effectiveness of a tailored educational intervention (e-learning) to improve adherence to a handover guideline. For clinical practice, research finding from this current thesis can be used by individual professionals, EMSs, EDs, and national

emergency care organisations when developing and implementing guidelines and protocols in the chain of emergency care.

In the chapters that follow, five studies are presented that each address specific research questions:

1. To what degree do professionals in the chain of emergency care adhere to guidelines and protocols?
2. Which factors influence adherence to guidelines and protocols in the chain of emergency care?
3. What is the effectiveness of a tailored e-learning program to the improve adherence to a handover guideline in de chain of emergency care?

These questions address steps two, three and four of the Model of Effective implementation (Figure 2) and therefore this model will serve as central model in this thesis.

Outline of the thesis

Chapter two reports the results of a systematic review which forms the basis and starting point of this thesis. The review addresses to what degree professionals in the chain of emergency care adhere to guidelines and protocols. Furthermore, this review also reports which factors influencing adherence are reported and explores the relationship between guideline adherence and patient outcomes.

Chapter three and four both describe the results of two studies which quantify factors influencing adherence. Chapter three addresses the ambulance setting, while chapter four addresses the emergency department setting.

Chapter five yields a qualitative study in which influencing factors for adherence are explored. Twenty nurses and physicians from the prehospital ambulance setting and emergency department throughout the Netherlands were interviewed. Together with chapters three and four, the three studies answer the question which factors influence adherence in the chain of emergency care.

Chapter six yields the results of a pre-test post-test study to assess the effectiveness of an educational intervention (e-learning) with a simulation component to implement a newly developed guideline for the handover from ambulance to emergency department.

Chapter seven includes the general discussion in which the findings on the three research questions above are critically discussed, conclusions are drawn, and recommendation are formulated. Chapters eight and nine yield summaries of the current thesis, in English and Dutch respectively.

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CHAPTER 2

Adherence to guidelines and protocols in the prehospital and emergency care setting: a systematic review

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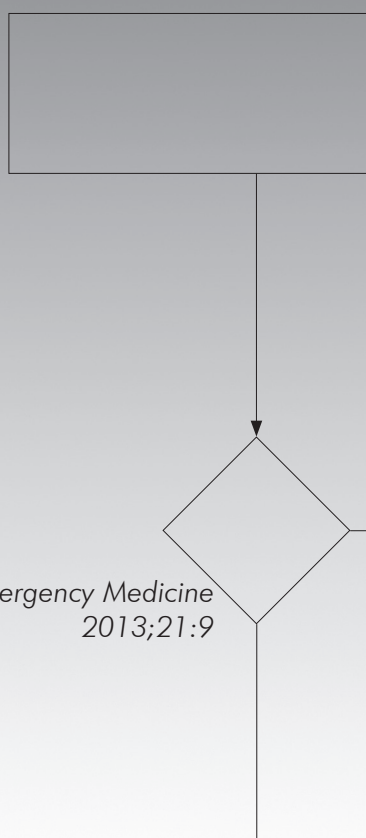


Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine 2013;21:9

ABSTRACT

A gap between guidelines or protocols and clinical practice often exists, which may result in patients not receiving appropriate care. Therefore, the objectives of this systematic review were (1) to give an overview of professionals' adherence to (inter)national guidelines and protocols in the emergency medical dispatch, prehospital and emergency department (ED) settings, and (2) to explore which factors influencing adherence were described in studies reporting on adherence. PubMed (including MEDLINE), CINAHL, EMBASE and the Cochrane database for systematic reviews were systematically searched. Reference lists of included studies were also searched for eligible studies. Identified articles were screened on title, abstract and year of publication (≥1990) and were included when reporting on adherence in the eligible settings. Following the initial selection, articles were screened full text and included if they concerned adherence to a (inter)national guideline or protocol, and if the time interval between data collection and publication date was <10 years. Finally, articles were assessed on reporting quality. Each step was undertaken by two independent researchers. Thirty-five articles met the criteria, none of these addressed the emergency medical dispatch setting or protocols. Median adherence ranged from 7.8-95% in the prehospital setting, and from 0-98% in the ED setting. In the prehospital setting, recommendations on monitoring came with higher median adherence percentages than treatment recommendations. For both settings, cardiology treatment recommendations came with relatively low median adherence percentages. Eight studies identified patient and organizational factors influencing adherence. The results showed that professionals' adherence to (inter)national prehospital and emergency department guidelines shows a wide variation, while adherence in the emergency medical dispatch setting is not reported. As insight in influencing factors for adherence in the emergency care settings is minimal, future research should identify such factors to allow the development of strategies to improve adherence and thus improve quality of care.

Keywords

Emergency medical technicians [MeSH]
Emergency medical services [MeSH]
Emergency medicine [MeSH]
Emergency nursing [MeSH]
Guideline adherence [MeSH]

INTRODUCTION

Clinical practice guidelines and protocols are developed to improve quality of care, to reduce variation of practice and to ensure that evidence is actually used when appropriate [1]. Often, these instruments are developed and disseminated by (inter)national professional organizations [2,3]. A guideline consists of systematically developed recommendations to assist practitioners and patient decisions about appropriate health care for specific clinical circumstances [4]. A guideline recommendation is defined as "any statement that promotes or advocates a particular course of action in clinical care" [5]. To assist implementation of guidelines, a protocol can be developed, which yields a specification of a guideline and exactly formulates how to act and which steps to follow [6]. Despite the existence of guidelines and protocols, a gap between recommended care and clinical practice often exists [7,8]. This is shown in a systematic review on the quality of health care delivered to adults in the United States [9]. Results showed that patients received 54.9% of recommended care, that the proportion of recommended care slightly differed for preventive, acute, and chronic care, and that differences were even larger for different medical functions (screening, diagnosis, treatment and follow-up).

It is suggested that effective implementation should ensure guideline adherence in practice and subsequently lead to improved patient outcomes [5]. Implementation is defined as "a planned process and systematic introduction of innovations or changes of proven value; the aim being that these are given a structural place in professional practice, in the functioning of organizations or in the health care structure" [6]. A systematic review on factors influencing implementation of clinical guidelines concluded that influencing factors were related to the used implementation strategies, and characteristics of the guidelines, professionals, patients and environment [10].

Similar to other settings, guidelines and protocols have become an important aspect of prehospital and emergency care clinical practice [11,12]. Yet, only few studies have investigated to what extent emergency care professionals actually adhere to these instruments [11]. When professionals do not adhere to guidelines and protocols, patients in the prehospital and emergency care settings may not receive appropriate care and quality of care can be threatened.

Objective

The first objective of this study was to present an overview of professionals' adherence to (inter)national guidelines and protocols in the emergency medical dispatch, prehospital and emergency department (ED) setting. The underlying rationale for choosing these settings is that they are often regarded as 'the chain of emergency care' and that all professionals, irrespective of setting, are expected to provide emergency care as described in guidelines and protocols. The second objective was to explore which factors influencing adherence were described in studies reporting on adherence. This insight can provide valuable input for the development of strategies to successfully implement guidelines and protocols in the emergency care settings.

METHODS

A systematic review of the literature was performed. The review is reported conform the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) [13].

Type of studies

All types of quantitative studies which described adherence to guidelines or protocols in the emergency medical dispatch, prehospital ambulance care and ED settings were included. Studies using self-report methods were excluded as they incorporate a risk of overestimation [14].

Type of guidelines

Studies describing adherence to (inter)national guidelines and protocols concerning all types of medical conditions in all types of emergency settings in all countries and regions within countries were included. Studies concerning local guidelines and protocols were excluded as it was unclear how they were developed and to what degree they were evidence-based.

Type of outcome measures

One of the outcome measures of the study had to include adherence quantified as percentage.

Electronic searches

PubMed (including MEDLINE), CINAHL, EMBASE and the Cochrane database for systematic reviews were searched in June 2010. Search strategies contained 'terms for professionals' AND 'terms for settings' AND 'terms for adherence' AND 'terms for guidelines/protocols'. Full search

strategies per database are given in Appendix 1. Searches were restricted by year of publication (≥1990). No other restrictions were used. In addition to the electronic search, we hand searched reference lists of included articles. We searched the Cochrane database for systematic reviews for both planned and completed reviews on adherence, but found none.

Selection of studies

All articles were screened on title and abstract by two independent reviewers (RE, LV) and included if the title or abstract described adherence in one of the emergency care settings. After initial selection, remaining articles were screened full text by researchers in two pairs (RE, LV, JM, TvA) and were included if (a) the adherence concerned specified guidelines or protocols, and (b) if the time interval between data collection and publication date of the guideline or protocol did not exceed ten years as non-adherence with outdated recommendations might be justified in these cases. Conference abstracts, editorials, personal communications, or unpublished studies were excluded.

Quality assessment

To provide a quality indicator, two pairs of independent researchers assessed reporting quality of all included studies (RE, LV, JM, TvA). For this assessment we developed a checklist, which was based on the STROBE statement to assess the reporting of cohort and cross sectional studies [15] and the TREND statement to assess the reporting of interventional studies [16]. The checklist consisted of ten items to assess quality: (1) objective, (2) key elements, (3) setting, locations and dates, (4) eligibility criteria, (5) outcomes, (6) data sources and methods, (7) data analysis and statistical methods, (8) number of participants, (9) characteristics of participants, and (10) main results. For each item an article could score a 'described' (1 point), 'partly described' (0.5 point), or 'not described' (0 points). All included articles were rated on a scale from 1 (poor study report) to maximum 10 (excellent study report).

Data extraction

From each article (a) the number of guideline or protocol recommendations described, and (b) adherence percentages for each recommendation were extracted. In case of multiple measurements regarding one recommendation, multiple adherence percentages were extracted. In case of a pre-test post-test design for the evaluation of quality improvement, only the pre-test percentages were extracted as we focused on actual care rather than effects of quality improvement strategies. From each study, the guideline

and protocol recommendations were categorized into medical condition (cardiology, pulmonology, neurology, infectious diseases, or other) and into type of medical function (diagnostic, treatment, monitoring, or organizational) (Table 1). Categorization was done as 'medical condition' and 'medical function' have been indicated as influencing factors for guideline adherence previously [10,17]. The median adherence for each recommendation was extracted or calculated. Additionally, factors influencing adherence were extracted when a statistically significant relationship between the factor and adherence was demonstrated in the article. Non-significant factors are not shown. The corresponding author of one study was contacted through e-mail to clarify and confirm results.

Table 1 Categories of guideline recommendations classified by medical function

Medical function	*Examples*
Diagnostic	1. Evaluate arterial blood gas for patients with acute exacerbations of COPD [19] 2. Obtain blood culture in case of a child with fever [42]
Treatment	1. Administer benzyl penicillin if a patient has a non-blanching purpuric rash [25] 2. Administer epinephrine 1 mg intravenous, intraosseous or endotracheal if a patient has cardiac arrest [27]
Monitoring	1. Monitor blood pressure and SaO_2 at least once for a patient with cardiac arrest [26] 2. Monitor $EtCO_2$ for a patient with cardiac arrest [26]
Organizational (referral, documentation)	1. Refer to an allergist in case of a severe allergic reaction [49] 2. Document asthma severity (mild, moderate, severe) [35]

All data were extracted by two independent researchers (RE, SM). To assess inter-rater reliability, the overall agreement percentages were calculated on number of guideline or protocol recommendations and adherence percentages. For articles concerning the prehospital care setting, these were 93% and 83% respectively, and for articles concerning the ED setting these were 90% and 85%. Since the heterogeneity of study designs, guideline recommendations, medical conditions, and medical functions was substantial, a meta-analysis was not feasible. Instead, we extensively analyzed the studies and conducted a qualitative synthesis.

RESULTS

Description of the studies

The electronic search identified 30 articles meeting the inclusion criteria. In addition, another five articles were included by searching the reference lists (Figure 1). Of the included articles (n=35), 24 used retrospective, 9 used prospective, and 2 used cross sectional methods. Eighteen studies were

multicentric and seventeen were monocentric, with 31 covering adults and 4 covering children. The studies were conducted in North America (n=19), Europe (n=13), Australia (n=2), and Asia (n=1). One study described adherence in the prehospital setting as well as in the ED setting [18] and results of this study are therefore presented in both the prehospital and ED result sections. All studies described adherence to (inter)national guidelines No studies on adherence to (inter)national protocols were identified. Seven studies assessed adherence to a guideline which was not developed in their own country [18-24]. The quality assessment revealed 34 articles of excellent or good reporting quality (excellent report - ten points, very good report - nine points, good report - eight points). Only one article was of moderate reporting quality with seven points [25]. As only the reporting quality was assessed, no articles were excluded on the basis of this quality assessment. Further details of the included studies are described in Table 2.

Emergency medical dispatch

Our electronic search strategy and reference search did not identify any eligible studies in the emergency medical dispatch setting.

Prehospital setting

Ten studies were identified describing adherence to (inter)national guidelines in the prehospital setting. These guidelines covered cardiology [18,26-28], pulmonology [29], neurology [30-33], and infectious diseases [25] (Table 3). Professionals included emergency physicians, anesthesiologists, ambulance nurses, nurse anesthesists, emergency medical technicians (EMT), and helicopter emergency medical service (HEMS) paramedics. Four studies were monocentric and six were multicentric. Seven studies were conducted in Europe and the remaining three in North America.

From the ten articles, a total of 40 recommendations were extracted. Four (10%) were monitoring recommendations and 36 (90%) were treatment recommendations. On these 40 recommendations, a total of 12 median adherence percentages were extracted or calculated, of which 2 (17%) were monitoring percentages, and 10 (83%) were treatment percentages. The distribution of the percentages across the different medical conditions and types of recommendations is displayed in Figure 2.

Figure 2 shows median adherence percentages in the prehospital setting varying from 7.8% to 95%. The three lowest median adherence percentages (7.8%, 22%, 27.5%) came with cardiology treatment recommendations

Figure 1 Inclusion of studies

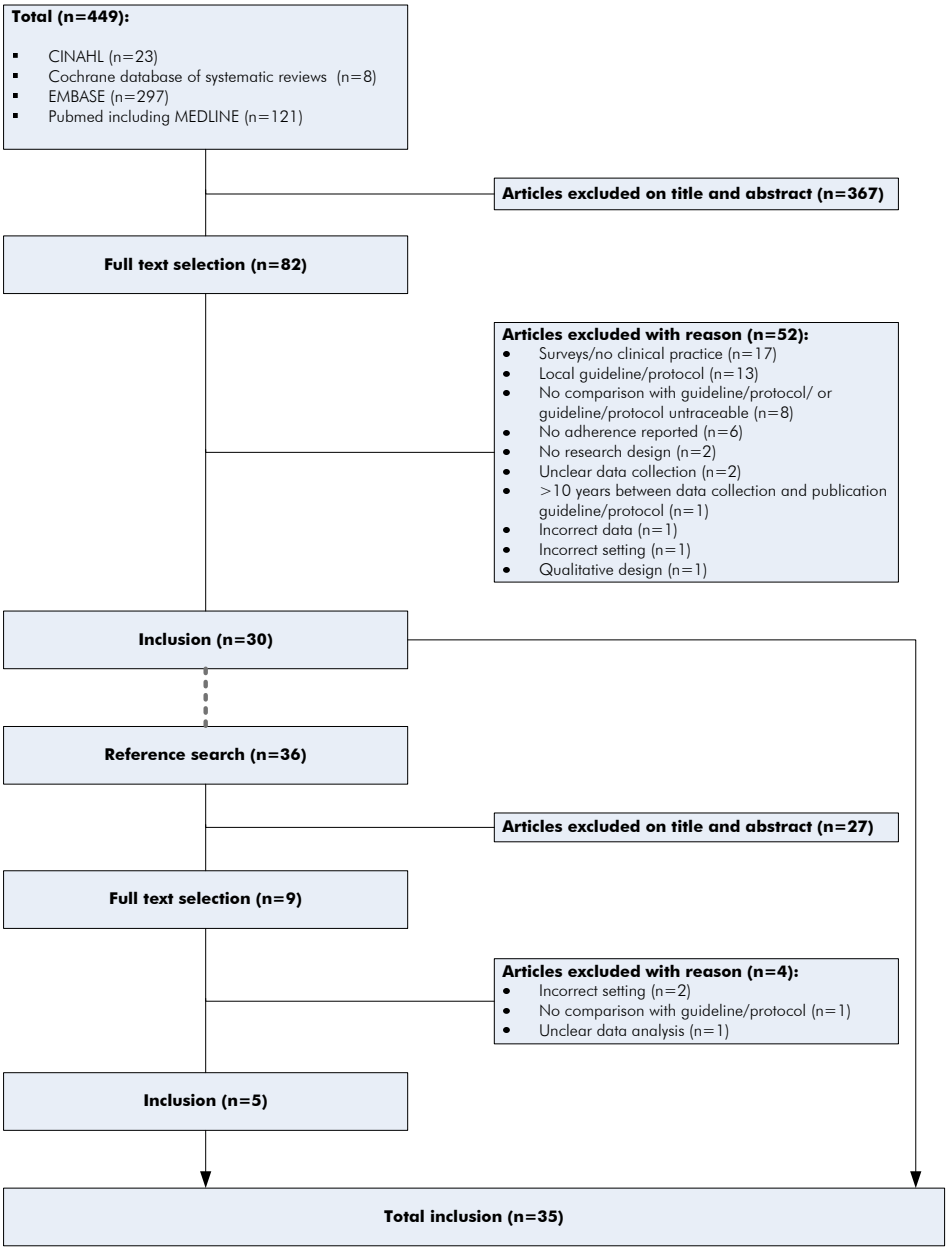


Table 2 Characteristics of included studies (n=35)

First author (Year) Country	*Design*	*Methods*	*Monocenter /multicenter*	*Professionals*	*Patients*	*Guideline (year of publication)*	*Quality*
Abbreviations: CICU: Cardiac Intensive Care Unit, ED: Emergency Department, EMS: Emergency Medical Service, HEMS: Helicopter Emergency Medical Service, MICU: Mobile Intensive Care Unit , UH: University Hospital Quality: assessed on a scale from 0 (poor quality) to 10 (excellent quality)							
Prehospital							
Caulfield (2009) USA	Retrospective, descriptive	Prehospital record review	Monocenter: 1 EMS	HEMS paramedics	100 patients with traumatic brain injury	Brain Trauma Foundation Guideline for prehospital management of patients with traumatic brain injury (2007)	9.5
Cooke (2005) UK	Retrospective, descriptive	Patient report forms	Multicenter: 19 EMSs	Paramedics	69 patients with suspected meningococcal septicemia	Joint Royal Colleges Ambulance Liaison Committee Clinical Guidelines for the administration of benzyl penicillin for suspected diagnosis of meningococcal septicemia (2003)	7
Franschman (2009) The Netherlands	Retrospective, descriptive	Medical record review	Monocenter: 1 EMS	Ambulance nurses EMS physicians	127 patients with traumatic brain injury	1. Brain Trauma Foundation Guideline for prehospital management of patients with traumatic brain injury (2007) 2. Dutch Ambulance Care National Protocol (2007)	9
Hale (2008) UK	Retrospective, descriptive	Prehospital record review	Monocenter: 1 EMS	Not specified	1022 patients who received O_2	Joint Royal Colleges Ambulance Liaison Committee Clinical Guidelines for the administration of oxygen (2007)	8.5
Jeremie (2006) France	Prospective, descriptive	Prehospital record review	Multicenter: 3 EMSs	Anesthesiologists Emergency physicians	143 patients who were sedated and intubated	SFAR Recommendations for sedation: analgesia in out-of-emergency medicine (2000)	10
Kirves (2007) Finland	Retrospective, cohort	Prehospital record review	Multicenter: >75 EMSs	Paramedics EMS physicians	157 patients with cardiac arrest	The Subdivision of Emergency Medicine of Finnish Society of Anaesthesiologists, Finnish Resuscitation Council and Red Cross of Finland. Resuscitation guidelines (2002)	9
Scliopou (2006) USA	Retrospective, descriptive	Database review	Multicenter: 35 EMSs	Paramedics	70 patients with cardiac arrest	American Heart Association Advanced cardiac Life Support Guidelines (2000)	10
Thomas (2002) USA	Prospective, descriptive	Data collection chart	Monocenter: 1 EMS	HEMS nurses HEMS paramedics	37 patients with traumatic brain injury	Brain Trauma Foundation guidelines for the Management of Severe Head Injury (1995)	10
Wik (2005) Norway /Sweden/UK	Prospective, case series	Data cards	Multicenter: 3 EMSs	Nurse anesthesists Paramedics	176 patients with cardiac arrest	1. Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care: International Consensus on Science (2000) 2. International guidelines for CPR and ECCL: a consensus on science (2000)	10

Table 2 Characteristics of included studies (n=35)

First author (Year) Country	*Design*	*Methods*	*Monocenter /multicenter*	*Professionals*	*Patients*	*Guideline (year of publication)*	*Quality*
Abbreviations: CICU: Cardiac Intensive Care Unit, ED: Emergency Department, EMS: Emergency Medical Service, HEMS: Helicopter Emergency Medical Service, MICU: Mobile Intensive Care Unit , UH: University Hospital Quality: assessed on a scale from 0 (poor quality) to 10 (excellent quality)							
Prehospital & ED							
Charpentier (2009) France	Prospective, cohort	Case report form	Multicenter: 1 UH, 8 EMSs, 26 MICUs, 37 EDs, 22 CICUs	Emergency physicians	1277 patients with ST-segment elevation myocardial infarction	American College of Cardiology/American Heart Association guidelines for the management of patients with acute myocardial infarction (1999)	10
ED							
Atreja (2005) USA	Retrospective, descriptive	Chart review	Monocenter: 1 ED	Emergency physicians	94 patients with an elevated international normalized ratio (INR)	American College of Chest Physicians recommendations for antithrombotic therapy for prevention and treatment of thrombosis (2001)	10
Clark (2004) USA & Canada	Retrospective, cohort	Medical record review	Multicenter: 21 EDs	Not specified	678 patients with allergic reaction to food	American academy of allergy, asthma, & immunology guideline for the management of food allergy (2003)	10
Cydulka (2003) USA/Canada	Prospective, cohort	Medical record review Telephone interviews	Multicenter: 29 EDs	Not specified	397 patients with exacerbation COPD	1. American thoracic society standards for the diagnosis and care of patients with chronic obstructive pulmonary disease (COPD) and asthma (1987) 2. British Thoracic Society guidelines for the management of chronic obstructive pulmonary disease (1997) 3. Global strategy for the diagnosis,management, and prevention of chronic obstructive pulmonary disease NHLBI/WHO Global Initiative for Chronic Obstructive Lung Disease (2001) 4. The European respiratory society task force guideline for assessment and management of chronic obstructive pulmonary disease (COPD) (1995) 5. American college of Chest Physicians and American College of Physicians-American Society of Internal Medicine management of acute exacerbations of chronic obstructive pulmonary disease (2001)	10
De Miguel-Yanes (2006) Spain	Retrospective, cohort	Medical record review	Monocenter: 1 ED	Not specified	53 patients with suspected sepsis	Surviving sepsis campaign guidelines for management of severe sepsis and septic shock (2004)	9.5
Doherty (2007) Australia	Retrospective, pre-test post-test	Database review	Multicenter: 2 EDs	Not specified	215 patients with asthma	NSW Department of Health guideline for the optimal treatment of chronic respiratory diseases (2003)	10
Elkharrat	Prospective,	Data collection	Monocenter: 1	Not specified	389 patients with open	World Health Organization guideline for antitetanus prophylaxis (1992)	10

Table 2 Characteristics of included studies (n=35)

First author (Year) Country	*Design*	*Methods*	*Monocenter /multicenter*	*Professionals*	*Patients*	*Guideline (year of publication)*	*Quality*
Abbreviations: CICU: Cardiac Intensive Care Unit, ED: Emergency Department, EMS: Emergency Medical Service, HEMS: Helicopter Emergency Medical Service, MICU: Mobile Intensive Care Unit , UH: University Hospital Quality: assessed on a scale from 0 (poor quality) to 10 (excellent quality)							
(1999) France	pre-test post test	chart	ED		wounds		
Ferguson (2010) USA	Retrospective, cohort	Medical record review	Monocenter: 1 ED	Pediatric emergency physicians	167 children with fever	Agency for Health Care Policy and Research guideline for the management of infants and children 0 to 36 months of age with fever without source (1993)	9.5
Grant (2006) UK	Retrospective, descriptive	Medical record review	Monocenter: 1 ED	Not specified	473 patients with acute pain	British Association of Accident and Emergency Medicine guideline for the management of pain in adults (2005)	10
Jain (2002) USA	Retrospective, descriptive	Medical record review	Monocenter: 1 ED	Pediatric residents Fellows Nurse practitioners	229 children with fever	Agency for Health Care Policy and Research guideline for the management of infants and children 0 to 36 months of age with fever without source (1993)	9.5
Kelly (2003) Australia	Prospective, descriptive	Data collection chart	Multicenter: 38 EDs	Not specified	1340 patients with acute asthma	National Asthma Campaign asthma management guideline (1998)	9.5
Lee (2001) Taiwan	Retrospective, cohort	Medical record review	Multicenter: 6 EDs	Emergency physicians	120 patients with acute asthma	1. British Thotacic Society guidelines I & II for the management of asthma in adults (1990&1993) 2. National Heart, Lung and Blood Institute guideline for the diagnosis and management of asthma (1991 & 1994 & 1997) 3. Asthma management guidelines and therapeutic Issues relating to the treatment of asthma. Chest (1999)	9
Mansbach (2007) USA	Prospective, cohort	Medical record review Interviews	Multicenter: 17 EDs	Not specified	624 children with bronchiolitis	American Academy of Pediatrics Committee on Infectious Diseases and Committee of Fetus and Newborn guidelines for prevention of respiratory syncytial virus infections: indications for the use of palivizumab and update on the use of RSV-IGIV (1998)	9
Milks (1999) USA	Retrospective, descriptive	Medical record review	Monocenter: 1 ED	Not specified	181 patients with asthma	National Heart, Lung and Blood Institute guideline for the diagnosis and management of asthma (1991)	8
Muayqil (2007) Canada	Retrospective, descriptive	Medical record review	Monocenter: 1 ED	Emergency physicians	45 patients with convulsive status epilepticus	Epilepsy Foundation of America guidelines for the management convulsive status epilepticus (1993)	10

Table 2 Characteristics of included studies (n=35)

First author (Year) Country	*Design*	*Methods*	*Monocenter /multicenter*	*Professionals*	*Patients*	*Guideline (year of publication)*	*Quality*
Abbreviations: CICU: Cardiac Intensive Care Unit, ED: Emergency Department, EMS: Emergency Medical Service, HEMS: Helicopter Emergency Medical Service, MICU: Mobile Intensive Care Unit , UH: University Hospital Quality: assessed on a scale from 0 (poor quality) to 10 (excellent quality)							
Musacchio (2009) USA	Retrospective, descriptive	Medical record review	Monocenter: 1 ED	Not specified	163 patients with urinary tract infections, urinary symptoms or sexually transmitted disease	Center for Disease Control and Prevention: guideline for treatment of sexually transmitted diseases (2006)	9
Pham (2007) USA	Cross sectional, descriptive	Database review	Multicenter: 544 EDs	Not specified	1492 patients with acute myocardial infarction 3955 patients with pneumonia	Center for Medicare and Medicaid Services. Specification manual for national hospital quality measures for acute myocardial infarction and asthma (2007)	10
Reid (2000) Canada	Retrospective, descriptive	Medical record review	Multicenter: 3 EDs	Emergency physicians Emergency nurses	130 patients with asthma	National guideline for the emergency management of asthma in adults (1996)	10
Roy (2006) France & Belgium	Prospective, cohort	Data collection chart	Multicenter: 117 EDs	Emergency physicians	1529 patients with suspected pulmonary embolism	1. American College of Emergency Physicians Clinical Policies Committee. Clinical policy: critical issues in the evaluation and management of adult patients presenting with suspected pulmonary embolism (2003) 2. British Thoracic Society guidelines for the management of suspected acute pulmonary embolism (2003) 3. European Society of Cardiology Guidelines on diagnosis and management of acute pulmonary embolism (2000)	9.5
Salmeron (2001) France	Prospective, cohort	Data collection chart	Multicenter: 37 EDs	Emergency physicians	4087 patients with acute asthma	1. National Asthma Education and Prevention Program guidelines for the diagnosis and the management of asthma (1997) 2. British guidelines on asthma management, 1995 review and position statement (1997)	10
Shaked (2009) USA	Retrospective, descriptive	Medical record review	Monocenter: 1 ED	Not specified	56 children with febrile seizure	American Academy of Pediatrics (AAP) Practice Parameter: the neurodiagnostic evaluation of the child with a first simple febrile seizure (1996)	10
Teismann (2009) USA	Retrospective, descriptive	Medical record review	Monocenter: 1 ED	Emergency residents Physician assistants	553 patients with suspected venous thromboembolism	American College of Emergency Physicians Clinical Policies Subcommittee on Suspected Pulmonary Embolism, evaluation and management of adult patients presenting with suspected pulmonary embolism (2003)	9
Thakore (1999) Scotland	Retrospective, descriptive	Medical record review	Monocenter: 1 ED	Not specified	100 patients with syncope	American college of physicians guideline for management of patients with syncope (1997)	9

Table 2 Characteristics of included studies (n=35)

First author (Year) Country	*Design*	*Methods*	*Monocenter /multicenter*	*Professionals*	*Patients*	*Guideline (year of publication)*	*Quality*
Abbreviations: CICU: Cardiac Intensive Care Unit, ED: Emergency Department, EMS: Emergency Medical Service, HEMS: Helicopter Emergency Medical Service, MICU: Mobile Intensive Care Unit , UH: University Hospital Quality: assessed on a scale from 0 (poor quality) to 10 (excellent quality)							
Trzeciak (2006) USA	Retrospective, cohort	Medical record review	Monocenter: 1 ED	Emergency physicians	22 patients with confirmed or suspected sepsis	Surviving sepsis campaign guidelines for management of severe sepsis and septic shock (2004)	10
Tsai (2009) USA	Retrospective, cohort	Medical record review Interview	Multicenter: 2 EDs	Emergency physicians	272 patients with COPD	1. Global Initiative for Chronic Obstructive Lung Disease guidelines for the diagnosis, management, and prevention of chronic obstructive pulmonary disease (2001) 2. American College of Physicians guidelines for Management of acute exacerbations of chronic obstructive pulmonary disease (2001) 3. American Thoracic Society and European Respiratory Society joint guidelines Standards for the diagnosis and treatment of patients with COPD (2004)	10
Wright (1998) USA	Retrospective, descriptive	Medical record review	Monocenter: 1 ED	Emergency physicians	244 patients who received vancomycin	Center for Disease Control and Prevention: Recommendations for preventing the spread of vancomycin resistance: Recommendations of the Hospital Infection Control Practices Advisory Committee (1995)	10

Table 3 Guideline topics

Medical condition	*Prehospital setting*	*Emergency department setting*
Cardiology	Cardiac arrest [26-28] Myocardial infarction [18]	Myocardial infarction [18, 34]
Neurology	Sedation[32] Traumatic brain injury [30, 31, 33]	Convulsive status epilepticus [21] Syncope [24]
Pulmonology	Oxygen administration [29]	Bronchiolitis [37] Asthma [20, 23, 35, 36, 38, 39] COPD [19, 40] Pneumonia [34]
Infectious diseases	Meningococcal septicaemia [25]	Antibiotic therapy [47] Antitetanus prophylaxis [43] Fever [42] Febrile seizures [44, 45] Sepsis [41, 46]
Other	-	Allergic reactions to food [49] Antithrombotic therapy [48] Pain [50] Pulmonary and venous embolisms [22, 52] Urinary complaints/sexually transmitted diseases [51]

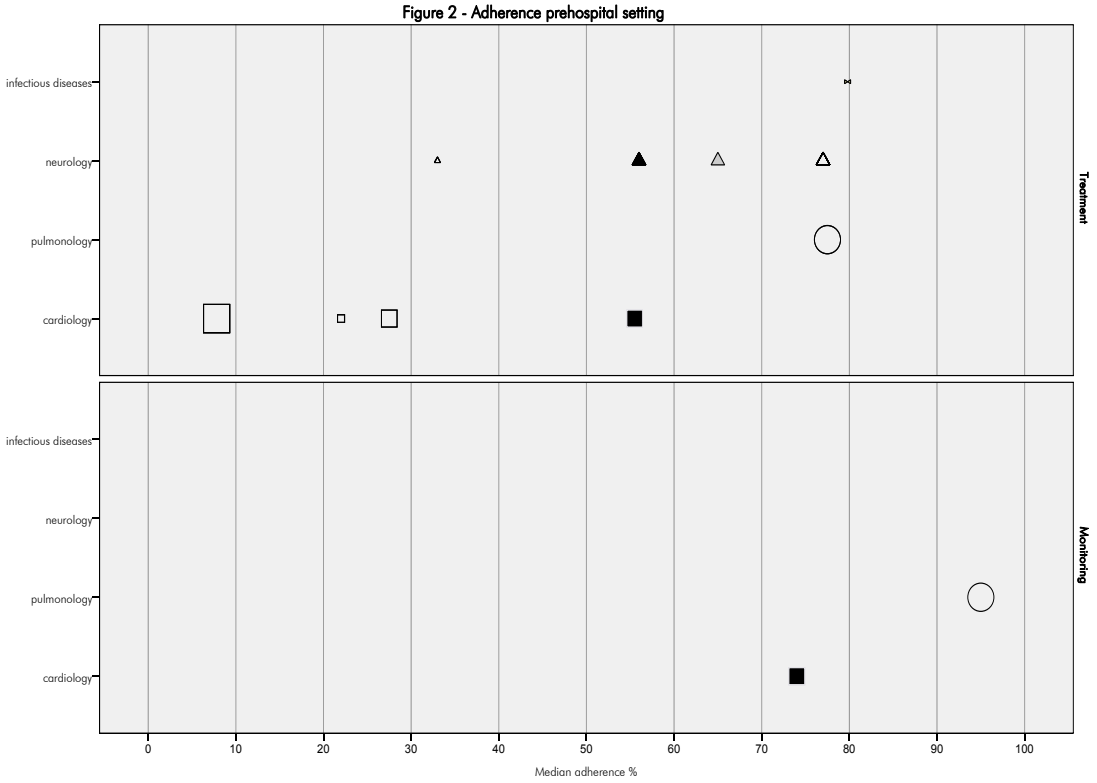
related to myocardial infarction [18] and cardiac arrest [27,28], whereas the three highest median adherence percentages (77.5%, 79.8%, 95%) came with treatment recommendations related to oxygen administration [29] and septicaemia [25], and to one monitoring recommendation related to oxygen administration [29]. Looking at medical functions, monitoring recommendations came with less variation in adherence when compared to the treatment recommendations, and monitoring recommendations came with higher median adherence percentages. Regarding the medical conditions, cardiology treatment recommendations are less often adhered to than treatment recommendations for other medical conditions.

Emergency department setting

Twenty-six studies describing adherence to (inter)national guidelines in the ED setting were identified. These guidelines covered cardiology [18,34], pulmonology [19,20,23,34-40], neurology [21,24], infectious diseases [41-47], and 'other' conditions [22,48-52] (Table 3). Professionals were (paediatric) emergency physicians, medical fellows, emergency nurses, and nurse practitioners. Fourteen studies were monocentric and twelve were multicentric. Sixteen studies were conducted in North America, seven in Europe, two in Australia, and one in Asia.

From the 26 studies, a total of 161 recommendations were extracted. Fifty-one (32%) were diagnostic recommendations, one (<1%) was a monitoring recommendation, 102 (63%) were treatment recommendations, and

Figure 2 - Adherence prehospital setting



Legend Figure 2 prehospital setting

Medical condition	*> 200 patients*	*100-200 patients*	*<100 patients*
Cardiology	[18]	[28] [26]	[27]
Pulmonology	[29]		
Neurology		[32] [31] [30]	[33]
Infectious diseases			[25]

Study [18] is displayed in Figure 3 also

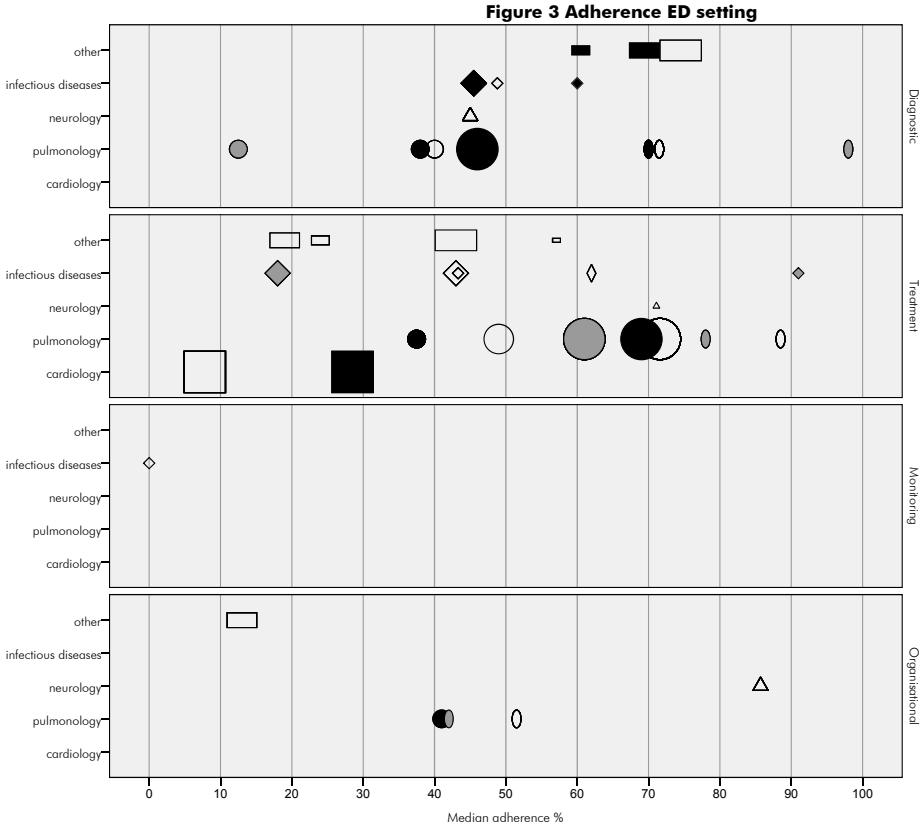
seven (4%) were organizational recommendations. On these 161 recommendations, a total of 40 median adherence percentages were extracted or calculated. Fourteen (35%) were percentages on the uptake of recommendations for diagnostics, one (2.5%) was a percentage for adherence to a recommendation on monitoring , 20 (50%) were percentages for the uptake of treatment recommendations, and five (12.5%) were adherence percentages for organizational recommendations. The distribution of the percentages across the different medical conditions and types of recommendations is displayed in Figure 3.

Figure 3 shows a wide variation in adherence percentages in the ED setting, varying from 0% to 98%. The three lowest median adherence percentages (0%, 7.8%, 12.5%) came with a monitoring recommendation related to sepsis [41], a treatment recommendation related to myocardial infarction [18], and a diagnostic recommendation related to asthma [20]. The highest median adherence percentages (88.5%, 91%, 98%) came with a diagnostic recommendation related to COPD [40], and treatment recommendations related to asthma [38] and sepsis [46]. Looking at medical functions, diagnostic and organizational recommendations came with higher median adherence percentages compared to the treatment recommendations. Among medical conditions, pulmonary treatment recommendations came with higher median adherence percentages, and cardiology treatment recommendations came with lower median adherence percentages compared to other conditions.

Influencing factors

Eight studies reported factors influencing adherence [18,20,22,26,34,37,42,51]. These factors were related to the patient (age, race, sex, weight, time of presentation, insurance status, current disease/condition and comorbidity) and to the organization (presence of an emergency physician, ownership (non-federal or governmental) hospital/ ED and location) (Table 4). When categorized along medical conditions, the patient related influencing factors had different directions and no clear patterns existed, although male sex, lower age and a disease specific condition (rhythm on the electrocardiogram) seemed to positively influence adherence to cardiology guidelines. As for organizational factors, there seemed to be a pattern that treatment in a governmental or non-federal ED negatively influences adherence to (inter)national guidelines.

Figure 3 Adherence ED setting



Legend Figure 3 ED setting

Medical condition	*> 1000 patients*	*500-1000 patients*	*100-499 patients*	*<100 patients*
Cardiology	[18] [34]			
Pulmonology	[36] [34] [23]	[37]	[19] [35] [20] [38] [39] [40]	
Neurology			[24]	[21]
Infectious diseases			[43] [42] [44] [47]	[41] [45] [46]
Other	[22]	[49] [52]	[50] [51]	[48]

Study [18] is displayed in Figure 2 also

Table 4 Influencing factors

Domain	*Influencing factor*	*Medical condition*
Patient characteristics	*Age*	Cardiology • Patients with ST-segment elevation myocardial infarction aged ≤75 years were more likely to receive care in accordance with the guideline [18] • Patients with acute myocardial infarction aged <55 years were more likely to receive aspirin [34] Pulmonology • Patients with pneumonia aged <18 years were more likely to receive recommended antibiotics [34] • Patients with pneumonia aged <18 years were less likely to be monitored with pulse oximetry [34] • Patients with suspected pulmonary embolism aged >75 years were less likely to be diagnosed in accordance with the guideline [22] • Children with bronchiolitis whose gestational age was 30 weeks were more likely to receive palivizumab compared to children whose gestational age was 32 weeks [37] Other • Patients with urinary complaints aged >19 years were more likely to be taken their sexual history [51] • Children with fever who were aged 28-59 days were more likely to receive complete blood cell count, blood culture, urine culture, cerebrospinal fluid culture and viral studies compared to children who were aged 60-90 days [42]
	Gender	Cardiology • Male patients with acute myocardial infarction were more likely to receive ß-blockers [34] • Male patients with cardiac arrest were more likely to receive treatment in accordance with the guidelines [26]
	Weight	Pulmonology • Children with bronchiolitis with birth-weight <3lbs were more likely to receive palivizumab [37]
	Current disease/condition	Cardiology • Patients with ST-segment elevation myocardial infarction with a symptom onset 08.00-20.00 were more likely to receive care in accordance with the guideline than patients with a symptom onset 20.00-08.00 [18] • Patients with ST-segment elevation myocardial infarction with a typical STEMI on the ECG were more likely to receive care in accordance with the guideline compared to patients without a typical STEMI on the ECG [18] • Patients with cardiac arrest of whom the arrest was witnessed or with an initial rhythm of VF/VT were more likely to receive care in accordance with the guideline than patients with an unwitnessed arrest of initial rhythm other than VF/VT [26] • Patients with cardiac arrest with a longer time interval between return of spontaneous circulation and hospital admission were more likely to receive care in accordance with the guideline compared to patients with a shorter time interval [26] Pulmonology • Patients with suspected pulmonary embolism currently receiving anticoagulation were less likely to be diagnosed in accordance with the guideline compared to patients with anticoagulation [22] • Children with bronchiolitis with a history of wheezing were more likely to receive palivizumab than patients without a history of wheezing [37] Other • Patients with urinary complaints with a history of fever were more likely to be taken their sexual history than patients without a history of fever [51] • Patients with urinary complaints with genital discharge were more likely to be taken their sexual history than patients without genital discharge [51]
	Race	Cardiology • Patients with acute myocardial infarction of Hispanic race were less likely to receive aspirin compared to patients of white or nonwhite race [34]

		Pulmonology • Patients with pneumonia of nonwhite race were less likely to be monitored with pulse oximetry compared to patients of white or hispanic race [34]
	Insurance	Cardiology • Patients with acute myocardial infarction with a private insurance were more likely to receive aspirin than patients with a medicare or Medicaid insurance [34]
		Pulmonology • Patients with pneumonia with a private insurance were more likely to receive antibiotics than patients with a medicare of Medicaid insurance [34]
	Comorbidity	Cardiology • Patients with cardiac arrest with a prior neurological disease were less likely to receive care in accordance with the guideline compared to patients without prior neurological disease [26]
		Pulmonology • Patients with suspected pulmonary embolism with known heart failure, known chronic lung disease or current/recent pregnancy were less likely to be diagnosed in accordance with the guideline than patients without known heart failure, chronic lung disease or current/recent pregnancy [22] • Patients with suspected pulmonary embolism with previous thromboembolism were more likely to be diagnosed in accordance with the guideline than patients without previous thromboembolism [22]
	Time of presentation	Other • Patients with urinary complaints who presented in the evening were more likely to be taken their sexual history compared to patients who presented in over daytime [51]
Organizational factors	*Location*	Cardiology • Patients with ST-segment elevation myocardial infarction treated in an urban ED were more likely to be treated in accordance with the guideline compared to patients treated in a rural ED [18] • Patients with acute myocardial infarction treated in a Midwest or Southern ED were less likely to receive ß-blockers compared to patients treated in a northeast or west ED [34]
		Pulmonology • Patients with pneumonia treated in a Southern ED are less likely to receive antibiotics compared to patient treated in a northeast, west or midwest ED [34] • Patients with pneumonia treated in a metropolitan ED are more likely to receive antibiotics and are more likely to be monitored with pulse oximetry compared to patients in a non-metropolitan ED [34] • Patients with asthma treated in medical centers were more likely to be diagnosed with oximetry or arterial blood gas compared to patients in regional and district EDs [20]
	Presence of a physician	Cardiology • Patients with cardiac arrest where a prehospital physician was present on scene were more likely to receive care in accordance with the guideline than patients without prehospital physician presence [26]
	Ownership of the ED	Cardiology • Patients with acute myocardial infarction treated in an ED with governmental or non-federal ownership are less likely to receive aspirin than patients treated in an nonprofit or proprietary ED [34]
		Pulmonology • Patients with pneumonia treated in an ED with governmental or non-federal ownership are less likely to receive antibiotics compared to patients treated in an nonprofit or proprietary ED [34]

DISCUSSION

This systematic review aimed to give an overview of professionals' adherence to (inter)national guidelines and protocols in the emergency medical dispatch, prehospital ambulance and ED settings. In addition, factors influencing adherence were explored. Thirty-five articles describing adherence to (inter)national prehospital and ED guidelines were identified. No studies describing adherence to protocols or studies in the emergency medical dispatch setting were identified. Despite the life-threatening and urgent conditions covered by the guidelines, results showed a wide variation in adherence. Extracted factors influencing adherence were related to the patient and to the organization.

For both the prehospital and ED setting adherence showed a wide variation. Suboptimal adherence has also been shown in other critical care fields, such as the intensive care unit [53,54] and the recovery room [55,56], but also on more general topics as hand hygiene [57] and medication safety [58]. It is possible that the wide variation in adherence is due to often poor evidence-based prehospital guidelines [59], to differences in guideline quality or due to justified deviations as guidelines have to be tailored to unique patients. Unjustified deviations may also contribute to this wide variation in adherence, as situations where guideline deviations are desired are unclear [60]. Specifically regarding the ED setting, another reason for suboptimal adherence may be that guidance for some ED presentations are derived from guidelines of specialties outside the ED as ED guidelines are lacking. As guideline development programmes increasingly become evidence based [61] and guidelines represent the standard of care, our results probably also imply that many patients in the prehospital and ED setting do not receive appropriate care.

Guideline recommendations were extracted to categorize the adherence percentages into recommendation categories in relation to medical function and medical condition. For medical function in the prehospital setting, monitoring recommendations came with higher adherence percentages compared to treatment recommendations. In the ED setting, diagnostic and organizational recommendations came with higher median adherence percentages compared to treatment recommendations. This may indicate that the type of medical function influences adherence to (inter)national guideline recommendations. This result is supported by a previous non-emergency care review, which showed that characteristics of the guideline recommendations (medical condition, type of procedure, complexity) influence guideline

adherence [17]. A possible explanation for the large variation in adherence rates for different types of guideline recommendations may be the existence of barriers specifically for individual recommendations rather than guidelines as a whole [5]. For instance, the strength of evidence and the impact on patient outcomes may vary across individual recommendations. Another explanation may be that guidelines contain too many recommendations to adhere to, or that EMSs and EDs are not able to implement all recommendations at the same time and make choices. If this is the case, guidelines could be translated into more efficient, practical and feasible protocols, algorithms, and decision trees.

In addition to differences for types of medical functions of guideline recommendations, variation in adherence percentages for medical conditions was observed. This variation has been reported previously [17]. Especially the cardiology and 'other' guidelines came with lower adherence percentages compared to other medical conditions. These cardiology guidelines cover cardiac arrest and ST-elevation myocardial infarction, two conditions known for their high mortality rates [62,63], while pain ('other' guideline) is reported to be the main complaint for patients to use emergency care [64].

Factors influencing adherence were reported in eight studies [18,20,22,26,34,37,42,51]. These factors can be clustered into factors related to the patient and to the organization. No professional related factors were studied, which is remarkable as previous studies showed that individual experience, professional autonomy, attitudes and believes also determine to what degree professionals adhere to a guideline and that additional, individual training for ambulance nurses improves adherence to national prehospital protocols [65-67]. Additional research is needed, focussing on the perspectives of professionals, patients, organizations, social environment and characteristics of guidelines and protocols [7]. This knowledge can be used to develop and revise guidelines and protocols [68] and to tailor strategies to improve adherence. It is even argued that these strategies should be tailored to individual guideline recommendations instead of the guideline as a whole [5]. A systematic review showed that strategies tailored to identified barriers are effective to improve professional practice [69]. For the emergency care setting, previous studies showed that strategies tailored to influencing factors improve adherence to guidelines and protocols for patients with asthma, acute coronary syndromes and ST-elevation myocardial infarction [35,70,71]. To monitor adherence and assess effectiveness of implementation strategies it is recommended that guidelines contain clinical

indicators [72]. These indicators have shown to be useful to assess and monitor guideline adherence [73]. Therefore, quality indicators should be part of the guideline development process or should be integrated in existing guidelines.

Besides implementations strategies, solid evidence based recommendations and a clear relationship between guideline adherence and patient outcomes may be the strongest motivators for emergency care professionals to adhere to guidelines. Generally, it is stated that especially prehospital care lacks strong evidence and clear indicators to measure effectiveness [74]. In this review, four studies assessed the relationship between adherence and patient outcomes. Three of these showed that adherence to guidelines improves patient outcomes by decreasing mortality and adverse events for patients with ST-segment elevation myocardial infarction, cardiac arrest and suspected pulmonary embolism [18,22,26]. However, the limited number of studies assessing the relationship prevents us from drawing firm conclusions. Therefore, future research should focus on the relationship between guideline adherence and patient outcomes.

We did not find studies in the emergency medical dispatch setting which met our inclusion criteria. Since the dispatch center is the first in the 'chain of emergency care', adherence to dispatch guidelines and protocols is important to correctly identify and prioritize the most urgent patients. Therefore, we recommend additional research on guideline and protocol adherence in this specific setting. One article assessed adherence in two consecutive emergency settings [18]. It is widely recognized that patients enter a 'chain of emergency care', and therefore assessment of adherence to guidelines and protocols in consecutive settings seems reasonable.

Limitations of included studies

The included studies predominantly had a retrospective design and used patient records or databases to retrieve their data. These methods incorporate a high risk of bias. The second problem we faced was the fact that the included studies incorporated a variability of guidelines, medical conditions, medical functions, designs, and methods, and that some studies assessed adherence to 'foreign' guidelines. Therefore, an overall comparison between the studies was difficult. Third, the included studies used several synonyms and definitions of adherence, including compliance, deviation, and 'guideline follow-up'. Literature shows no clear and widely used definition of adherence, while agreement on a useful definition would assist research.

Finally, none of the included studies addressed the seriousness of the deviations, which may have been useful as previous research indicated that 45% of guideline deviations can be categorized as serious or very serious [68].

Study limitations

A limitation regards the assessment of reporting quality of the included articles, for which we used a checklist based on the STROBE and TREND statements. We are aware that the intended goal of these statements is to provide guidance on reporting research rather than assessing study quality, but adequate quality assessment tools for observational studies are lacking [75]. Furthermore, the differences in settings, personnel, disease processes, and guidelines made interpretation of the results exceedingly challenging.

CONCLUSION

Despite the often life-threatening and vital topics of the guidelines, adherence to (inter)national prehospital and ED guidelines showed a wide variation and ranges from 7.8-95% and 0-98% respectively. Research on adherence in the emergency medical dispatch setting is lacking. In the prehospital setting monitoring recommendations came with higher adherence percentages than treatment recommendations. For both settings, the cardiology treatment recommendations were less adhered to than recommendations for other medical conditions. These results indicate that the medical function and medical condition into which a guideline recommendation can be categorized might influence adherence. Further factors influencing adherence were related to the patient and the organization. Factors related to professionals were not found. Further research should focus on identifying factors influencing adherence, taking into account the perspectives of the professional, patients, organization, and characteristics of the guidelines. On the basis of these influencing factors, strategies can be developed to improve adherence to prehospital and ED guidelines, with the ultimate goal to ensure that patients receive appropriate care.

Competing interests

The authors declare that they have no competing interests

Grant

The study was funded by a grant from the Netherlands organization for health research and development ZonMw (grant ID: 8271.2001). ZonMw had no involvement in the design of the study or analysis of the data.

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Appendix 1 Full Search strategies

PUBMED (incl MEDLINE)

"emergency medicine" [MeSH]
"emergency medicine [MeSH]" OR "emergency medicine" [tiab]
"emergency physician"
"emergency physician" OR "emergency physician" [tiab]
"emergency physicians"
"emergency physicians" OR "emergency physicians"[tiab]
"emergency medical technicians"[MeSH]
"emergency medical technicians"[MeSH] OR "emergency medical technicians"[tiab]
"ambulance nurs*"
"ambulance nurs*" OR "ambulance nurs*"[tiab]
"emergency nursing"[MeSH]
"emergency nursing"[MeSH] OR "emergency nursing"[tiab]
"emergency medical dispatchers"
"emergency medical dispatchers" OR "emergency medical dispatchers"[tiab]
#2 OR #4 OR #6 OR #8 OR #10 OR #12 OR #14
"emergency medical service"[MeSH]
"emergency medical service"[MeSH] OR "emergency medical service"[tiab]
"ambulances"[MeSH]
"ambulances"[MeSH] OR "ambulances"[tiab]
"emergency service, hospital"[MeSH]
"emergency service, hospital"[MeSH] OR "emergency service, hospital"[tiab]
#17 OR # 19 OR # 21
"guideline adherence"[MeSH]
"guideline adherence"[MeSH] OR "guideline adherence"[tiab]
"protocol compliance"
"protocol compliance" OR "protocol compliance"[tiab]
"protocol deviation"
"protocol deviation" OR "protocol deviation"[tiab]
"protocol omission"
"protocol omission" OR "protocol omission"[tiab]
"protocol errors"
"protocol errors" OR "protocol errors"[tiab]
#24 OR #26 OR #28 OR #30 OR #32
"clinical protocols"[MeSH]
"clinical protocols"[MeSH] OR "clinical protocols"[tiab]
"practice guidelines as topic"[MeSH]
"practice guidelines as topic"[MeSH] OR "practice guidelines as topic"[tiab]
#35 OR #37
#15 AND #22
#15 AND #33
#15 AND #35
#22 AND #33
#22 AND #35
#33 AND #35
#15 AND #22 AND #33
#15 AND #22 AND #33 AND #38

CINAHL

(MH "emergency medicine")
(MH "emergency Medicine") OR AB "emergency medicine"
(MH "physicians, emergency")
(MH "physicians, emergency") OR AB "physicians, emergency"
(MH "emergency medical technicians")
(MH "emergency medical technicians") OR AB "emergency medical technicians"
"ambulance nurs*"
"ambulance nurs*" OR AB "ambulance nurs*"
(MH "emergency nursing")
(MH "emergency nursing") OR AB "emergency nursing"
"emergency medical dispatchers"
"emergency medical dispatchers" OR AB "emergency medical dispatchers"
#2 OR #4 OR #6 OR #8 OR #10 OR #12
(MH "emergency medical services") OR AB "emergency medical services"
(MH "ambulances")
(MH "ambulances") OR AB "ambulances"
(MH "emergency service")
(MH "emergency service") OR AB "emergency service"
#15 OR #17 OR #19
(MH "guideline adherence")
(MH "guideline adherence") OR AB "guideline adherence"
"protocol compliance"
"protocol compliance" OR AB protocol compliance"
"protocol deviation"
"protocol deviation" OR AB "protocol deviation"
"protocol omission"
"protocol omission" OR AB "protocol omission"
"protocol errors"
"protocol errors" OR AB "protocol errors"
#22 OR #24 OR #26 OR #28 OR #30
(MH "nursing protocols")
(MH "nursing protocols") OR AB "nursing protocols"
(MH "practice guidelines")
(MH "practice guidelines") OR AB "practice guidelines"
#33 OR #35
#13 AND #20
#13 AND #31
#13 AND #36
#20 AND #31
#20 AND #36
#33 AND #36
#13 AND #20 AND #31
#13 AND #20 AND #31 AND #36

EMBASE

"emergency medicine" /
"emergency physician"
"paramedical personnel"/
"ambulance nurs*"
"emergency nursing"/
"emergency medical dispatcher"
"emergency medical dispatcher*"
#1 OR #2 OR #3 OR #4 OR #5 R #7
"emergency health service"/
"ambulances"/
"emergency ward"/
#9 OR # 10 OR # 11
"practice guideline"/
"protocol adherence"
"protocol compliance"
"protocol deviation"
"protocol omission"
"protocol errors"
#13 OR #14 OR #15 OR #316 OR #17 OR #18
"clinical protocols"/
"practice guideline"/
#20 OR #21
#8 AND #12
#8 AND #19
#8 AND #22
#12 AND #19
#12 AND #22
#19 AND #22
#8 AND #12 AND #19
#8 AND #12 AND #19 AND #22

COCHRANE

"emergency medicine" [MeSH]
"emergency medicine [MeSH]" OR "emergency medicine"
"emergency physician"
"emergency physicians"
"emergency medical technician"
"emergency medical technicians"

"ambulance nurs*"
"ambulance nurse"
"emergency nursing"[MeSH]
"emergency nursing"[MeSH] OR "emergency nursing"
"emergency medical dispatch*"
"emergency medical dispatchers"
"emergency medical dispatcher"
#2 OR #3 OR #4 OR #5 OR #6 OR #8 OR #10 OR #11 OR#12 OR#13
"emergency medical service"[MeSH]
"emergency medical service"[MeSH] OR "emergency medical service"
"ambulances"[MeSH]
"ambulances"[MeSH] OR "ambulances"
"emergency service, hospital"[MeSH]
"emergency service, hospital"[MeSH] OR "emergency service, hospital"
#16 OR # 18 OR # 20
"guideline adherence"[MeSH]
"guideline adherence"[MeSH] OR "guideline adherence"
"protocol compliance"
"protocol deviation"
"protocol omission"
"protocol errors"
#23 OR #24 OR #25 OR #26 OR #27
"clinical protocols"[MeSH]
"clinical protocols"[MeSH] OR "clinical protocols"
"practice guidelines as topic"[MeSH]
"practice guidelines as topic"[MeSH] OR "practice guidelines as topic"
#30 OR #32
#14 AND #21
#14 AND #28
#14 AND #33
#21 AND #28
#21 AND #33
#28 AND #33
#14 AND #21 AND #28
#14 AND #21 AND #28 AND #33

CHAPTER 3

Factors influencing ambulance nurses' adherence to a National Protocol Ambulance Care: an implementation study in the Netherlands

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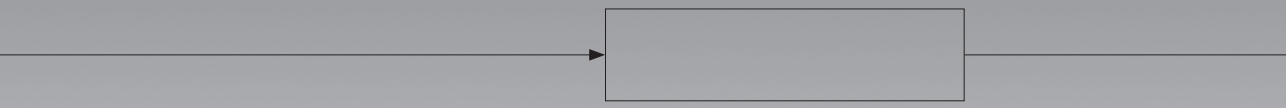

European Journal of Emergency Medicine 2014: March 1,
doi: 10.1097/MEJ.0000000000000133

ABSTRACT

Objectives
Adherence to prehospital guidelines and protocols is suboptimal. Insight in influencing factors is necessary to improve adherence. The aim of this study was to identify factors that influence ambulance nurses' adherence to a National Protocol Ambulance Care (NPAC).

Methods
A questionnaire was developed using the literature, a questionnaire and expert opinion. Ambulance nurses (n=452) from four geographically spread emergency medical services (EMSs) in the Netherlands were invited to fill out the questionnaire. The questionnaire included questions on influencing factors and self-reported adherence.

Results
Questionnaires were returned by 248 (55%) of the ambulance nurses. These ambulance nurses' adherence to the NPAC was 83% (95% confidence interval 81.9-85.0). Bivariate correlations showed 23 influencing factors that could be related to the individual professional, organization, protocol characteristics and social context. Multilevel regression analysis showed that 21% of the variation in adherence (R^2=.208) was explained by protocol characteristics and social influences.

Conclusion
Ambulance nurses' self-reported adherence to the NPAC seems high. To improve adherence, protocol characteristics (complexity, the degree of support for diagnosis and treatment, the relationship of the protocol with patient outcomes), and social influences (expectance of colleagues to work with the national protocol) should be addressed.

Keywords
Guideline adherence [MeSH]
Emergency medical services [MeSH]
Emergency medical technicians [MeSH]
Clinical protocols [MeSH]

INTRODUCTION

To support implementation of evidence in clinical practice, evidence-based guidelines and protocols have been developed [1]. Guidelines consist of systematically developed recommendations to aid practitioner and patient decisions about appropriate health care for specific clinical circumstances [2]. To aid implementation of guidelines, protocols can be developed that formulate exactly which steps to follow [3]. Despite the existence of these guidelines and protocols, a gap between available evidence and clinical practice often exists [1,4]. A systematic review showed that patients in acute care settings received 53.5% of recommended care [5]. Specifically in the prehospital setting, guideline adherence rates were low for patients with cardiac arrest, ST-elevation myocardial infarction, traumatic brain injury and in need of oxygen [6]. This review also indicated that guideline deviations showed higher rates of mortality and adverse events.

To stimulate adherence to guidelines and protocols, it is important to identify influencing factors [7]. In general, factors influencing the implementation of guidelines were related to the characteristics of professionals, patients, environment, guidelines, and implementation strategies used [8]. For the prehospital setting in particular, factors related to the patient (age, sex, presentation of disease, comorbidity), professional (knowledge, attitude, educational level, communication), organization (location of the emergency department, presence of a physician) and protocols (lacking or inadequate protocols) were identified [9-12]. As only one qualitative study focused on the professionals' perspective, insight into influencing factors from the perspective of prehospital professionals is needed. Therefore, the objective of this study was to identify factors that influence adherence to a National Protocol Ambulance Care (NPAC), from the perspective of ambulance nurses.

METHODS

Setting

In the Netherlands, ambulances are staffed with one driver and one ambulance nurse. Qualified ambulance nurses are registered nurses with additional intensive care unit (ICU), coronary care unit (CCU), emergency department (ED) or anaesthesia education and several years of working experience. Ambulance nurses work autonomously with their national protocol without direct supervision of a physician. Emergency medical services (EMSs) are managed by EMS physicians, who are responsible for the medical care. The EMS physician is not present on site, but can be consulted by the ambulance nurses when they judge that this is necessary.

To support clinical practice by ambulance nurses, the Dutch ambulance care national sector organization developed a NPAC as the professional standard for prehospital ambulance care [13]. The NPAC consists of flowcharts categorized into general topics (e.g. hygiene, handover, starting/ stopping treatment), cardiology, neurology, pulmonology, internal medicine, traumatology, paediatrics, gynaecology, psychiatry and intoxications. These flowcharts are based on a mixture of evidence, best practice and expert opinion. Since its publication, the NPAC has a central position in the national ambulance nurses' training course. The NPAC is updated every three years and all ambulance nurses receive a hardcopy (NPAC version 7.2 is online at: http://visio.ambulancezorg.nl/LPA7.2/). Ambulance nurses are allowed to deviate from the NPAC with valid arguments and are required to register the deviations including the justification [13].

Design and framework

We adopted a quantitative, correlational design and used Grol's model for effective implementation as a framework (Figure 1) [3,4]. The model provides a stepwise approach for improving clinical practice and starts with the identification of research findings or guidelines that have to be implemented (step 1). Steps 2 and 3 include a description of (change) targets and an analysis of the target group, current practice and setting. On the basis of the analysis, implementation strategies can be selected or developed (step 4), followed by the execution and evaluation of an implementation plan (steps 5 and 6).

As the NPAC has already been introduced into clinical practice, this study focuses on the third step of the model: an analysis of the target group, setting and current practice. The analysis focussed on individual, organizational, and social factors, and protocol characteristics [3].

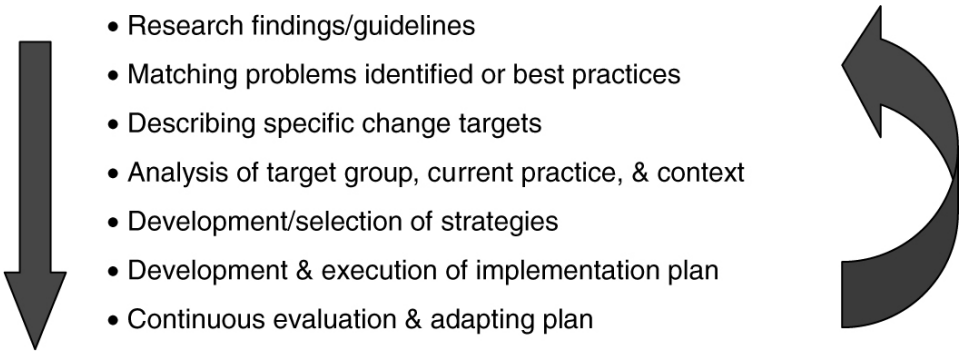

Figure 1: Model for effective implementation [4]

Questionnaire

A questionnaire on influencing factors from the perspective of ambulance nurses was developed, including sociodemographics, degree of self-reported adherence and influencing factors related to the individual, organization, social context and protocol characteristics (Table 2). The questions on the individual, organizational and social factors were based on implementation literature [3], previous qualitative studies [9,14] and expert opinion. The statements on protocol characteristics were developed by modifying the instrument 'Attitudes Regarding Practice Guidelines' [15,16]. This instrument showed a good test-retest reliability and internal consistency. From this instrument, the statements on hand hygiene were excluded as these were beyond our purpose, and the general statements were modified for the Dutch setting and the NPAC. These general statements were translated into Dutch by three independent researchers and backwards translated into English by a qualified translator. For answers to questions, a six-point Likert scale was used. Most questions were positively formulated and some were reversely phrased. Self-report adherence was measured as a continuous variable on a scale ranging from 0 to 100 per cent. Ambulance nurses could rate their own adherence by answering the question *"to what degree do you adhere to the NPAC?"*. The questionnaire was reviewed, adjusted and face validated by emergency care experts: ambulance nurses (two), emergency physicians (one), and researchers (one).

Sample

The study population included ambulance nurses as the primary target group for the NPAC. To select the ambulance nurses, we took a sample (n=4) from all EMSs (n=25) in the Netherlands. Geographical spreading ensured

coverage over the country. All ambulance nurses (n=452) employed at these four EMSs received an e-mail with a hyperlink to the digital questionnaire by a contact person at their EMS, being either an ambulance nurse or an EMS physician. The ambulance nurses filled in the questionnaires in April and May 2012. Completed questionnaires were digitally returned to the research team. All ambulance nurses received three digital reminders with the hyperlink to the questionnaire.

Data analysis

Demographic data were analyzed using descriptive statistics. To identify relationships between factors and ambulance nurses' self-reported adherence, two-tailed Pearson's (r) and Spearman's (r_s) correlation coefficients were computed. To assess the reliability of the scales, Cronbach's α was computed. Relationships between scales, demographics and ambulance nurses› adherence were determined using multiple regression analysis. Considering the data as hierarchical by clustering the respondents into four EMSs, we used multilevel regression analysis with EMSs as a random effect. Statistical significance was set at P-value less than 0.05. For all analyses, we used the Statistical Package for the Social Sciences (SPSS, IBM SPSS Statistics for Windows, version 20.0; IBM Corporation, Armonk, New York, USA).

Ethical considerations

The recommendations of the Dutch Central Committee on Research Involving Human Subjects were implemented, following the step-by-step review plan (www.ccmo-online.nl/main.asp?pid=1&taal=1). Ethical approval of a certified healthcare ethics committee was not needed.

RESULTS

The questionnaire was returned by 248/452 (55%) of the ambulance nurses. Table 1 shows respondents' characteristics. Two-thirds of the respondents were men, mean age 44.6 years. Most ambulance nurses completed the national ambulance care training course as specialist education. Average years active in ambulance care was 11.1 years. The ambulance nurses reported an average adherence rate to the NPAC of 83.4% (95% confidence interval 81.9-85.0), with a range of 35%-100%.

Table 1 Ambulance nurses' characteristics (n= 248)

Variables	
Sex n (%)	
Male	169 (68.1)
Female	79 (31.9)
Age in years (mean, SD)	44.6(14.7)
Basic education* n (%)	
Intermediate nursing education (MBO-V, level 4)	39 (15.7)
Bachelor of nursing (HBO-V, level 5)	58 (23.4)
In-service hospital	165 (66.5)
In-service psychiatric ward	17 (6.9)
Other**	11 (4.4)
Specialist education/training* n (%)	
National ambulance care training course (SOSA)	208 (83.9)
Emergency care course	72 (29)
Intensive care course	149 (60.1)
Coronary Care course	108 (43.5)
Anesthesia course	25 (10.1)
Master of advanced Nursing practice (MANP)/Physician Assistant	8 (3.2)
Other**	33 (13.3)
Years active in ambulance care (mean, SD)	11.3 (8.1)
Years active at current EMS (mean, SD)	9.5 (6.8)
Member of the professional ambulance care association n (%)	
yes	97 (39.1)
No	151 (60.9)

*Multiple answers possible
**Other basic education: lecturer and military nurse
**Other specialist education: laboratory employee, management, oncology course, pediatric course, chirurgical course

Table 2 shows bivariate associations between the scales and ambulance nurses' self-reported adherence, as well as reliability scores for internal consistency of the scales. The individual factors scale ($\alpha = 0.617$), the protocol characteristics scale ($\alpha = 0.684$) and the social factors scale ($\alpha = 0.729$) showed satisfactory reliability scores for internal consistency. The organizational factors scale showed a relatively low internal consistency score ($\alpha = 0.477$). All scales were correlated positively with self-reported adherence, with rs=0.273 for the individual factors scale (p=0.000), r_s=0.216 for the organizational factors scale (p=0.001), r_s=0.337 for the protocol characteristics scale (p=0.000), and r_s=0.276 for the social factors scale (p=0.000).

Table 2 Bivariate correlations between factors and adherence rate

Demographic	Question (factor)	Correlation coefficient	p-value	Cronbachs' Alpha
	Age	-0.003	0.968	
	Work experience	-0.166**	0.009	
Individual factors scale		**0.273****	**0.000**	**0.617**
	I have sufficient knowledge to work with the NPAC (knowledge)	0.121	0.059	
	I have sufficient skills to work with the NPAC (skills)	0.092	0.152	
	It is impossible for me to keep up with all the national changes of the NPAC (signaling national new insights)	-0.244**	0.000	
	It is impossible for me to keep up with all the regional changes of the NPAC (signaling regional new insights)	-0.195**	0.002	
	The NPAC constrains my freedom to use my own techniques (professional autonomy)	-0.216**	0.001	
	I agree with the content of the NPAC (agreement)	0.255**	0.000	
	Following the NPAC does not cost me extra time (time)	0.236**	0.000	
	I fear a patient complaint when I deviate from the NPAC (legal consequences)	0.038	0.552	
	The NPAC is part of my routines (own routines)	0.400**	0.000	
	I mainly adhere to the NPAC to avoid risk (risk avoiding behavior)	0.103	0.109	
Organisational factors scale		**0.216****	**0.001**	**0.477**
	In my EMS there is sufficient education/training to work with the NPAC (training/education)	0.190**	0.003	
	In my EMS new versions of the NPAC are adopted within 3 months (innovation capacity of the organisation)	0.161*	0.012	
	In my EMS there are consequences when I deviate from the NPAC (control)	0.002	0.973	
	Ambulance nurses have sufficient input in the development of the NPAC (input during development)	0.149*	0.020	
	In my EMS the NPAC is readily available (paper/digital) (availability)	0.460	0.480	
	In my EMS the equipment and medications described in the NPAC are present (availability)	0.004	0.949	
	My EMS-physician marks the NPAC as important (importance NPAC)	0.037	0.560	
	My colleague ambulance drivers mark the NPAC as important (importance NPAC)	0.141*	0.027	
	My colleague ambulance nurses mark the NPAC as important (importance NPAC)	0.205*	0.001	
	I feel safe to discuss NPAC deviations in my organisation (safe culture)	0.086	0.178	
ANP characteristics scale		**0.337****	**0.000**	**0.684**
	The NPAC supports me when I diagnose and treat a patient (support)	0.291**	0.000	
	The NPAC improves patient outcomes (relationship with patient outcomes)	0.278**	0.000	
	The NPAC is rigid to use (rigidity)	-0.188**	0.003	
	The NPAC is difficult to apply in my work (complexity)	-0.393**	0.000	
	The NPAC standardizes care and assures that patients are treated in a consistent way (standardization)	0.219**	0.001	
	The NPAC is sufficient evidence-based (evidence-based)	0.176**	0.006	
	New (scientific) developments are quickly integrated in the NPAC (innovation capacity)	0.223**	0.000	
	The sector organisation ambulance care is sufficient expert to develop the NPAC in collaboration with other professional organisations (trust in development)	0.151*	0.019	
Social factors scale		**0.276**	**0.000**	**0.729**
	My EMS-physician expect that I work with the NPAC (expectance colleagues)	0.147*	0.022	
	My colleague ambulance nurses expect that I work with the NPAC (expectance colleagues)	0.311**	0.000	
	My colleague ambulance drivers expect that I work with the NPAC (expectance colleagues)	0.312**	0.000	

*significant at □ 0.05 (2-tailed)
**significant at □ 0.01 (2-tailed)

At the individual item level, higher adherence was related to agreement with the NPAC (r_s=0.255, p=0.000), lower time investment (r_s=0.236, p=0.000) and the ambulance nurses considering the NPAC as part of their own routines (r_s=0.400, p=0.000). Lower adherence was related to more work experience (r=-0.166, p=0.009), higher professional autonomy (r_s= -0.216, p=0.001), and difficulties for ambulance nurses in keeping up with national (r_s=-0.244, p=0.000) and regional (r_s=-0.195, p=0.002) changes of the NPAC.

At the organizational level, higher adherence was related to ambulance nurses perceiving sufficient education and training to work with the NPAC (r_s=0.190, p=0.003), ambulance nurses indicating higher innovative capacity of the organization (r_s=0.161, p=0.012), more ambulance nurses' input during development of the NPAC (r_s=0.149, p=0.020), and to colleague ambulance nurses (r_s=0.205, p=0.001) and colleague ambulance drivers (r_s=0.141, p=0.027), marking the NPAC as important.

According to the NPAC characteristics scale, adherence was higher when ambulance nurses perceived the NPAC as supportive for diagnosis and treatment (r_s=0.291, p=0.000), perceived a positive relationship with patient outcomes (r_s=0.278, p=0.000), perceived the NPAC as a tool to standardize care (r_s=0.219, p=0.001), perceived the NPAC sufficient evidence-based (r_s=0.176, p=0.006), trusted the developers of the NPAC (r_s=0.151, p=0.019), and believed that scientific developments are quickly integrated into the NPAC (r_s=0.223, p=0.000). Lower adherence rates correlated with increasing rigidity (r_s=-0.188, p=0.003) and higher complexity of the NPAC (r_s=-0.393, p=0.000).

At the social level, higher adherence rates correlated with increasing degree of EMS-physicians' (r_s=0.147, p=0.022), ambulance nurses' (r_s=0.311, p=0.000), and ambulance drivers' (r_s=0.312, p=0.000) expectancy to work with the NPAC.

Together with the sociodemographic variables, all four scales were entered into a multiple regression analysis using the backward and forward stepwise methods. Because of the small number of nurses who had an MANP or PA specialist education (n=8) and the nonspecificity of the 'other education' category (n=11), these variables were not entered into the analyses. Both backward and forward methods showed comparable models; therefore, only the forward method models are presented in Table 3. The best-fitting forward

model ($R = 0.527$, $R^2 = 0.278$) included five predictors: NPAC scale, social factors scale, individual factors scale, sex and CCU additional education. These predictors were then entered in a multilevel model taking into account clustering of predictors in the EMSs. The final multilevel model did not include CCU additional education as a predictor, but for all other factors, the multilevel model did not differ from the best forward model.

DISCUSSION

This study identified factors that influence ambulance nurses' adherence to a NPAC. Ambulance nurses' self-reported adherence rate was 83.4% (95% confidence interval 81.9-85.0). Twenty-one per cent of variation in adherence could be explained by two factors: protocol characteristics and social influences ($R = 0.456$, $R^2 = 0.208$).

Compared with the total population of ambulance nurses in the Netherlands, our sample is representative in terms of the distribution of sex and age, but participants had somewhat more years of experience in ambulance care [17]. The protocol adherence rate is high in comparison with other researches [6]. An obvious explanation is the self-report method, which is known to cause response bias and overestimation [18]. Appropriate methods to overcome overestimation of adherence rates are checking patient records, using clinical vignettes, or video tape observations [12,19,20]. Although the self-reported adherence rate is relatively high, it still indicates room for improvement. Complete adherence to the NPAC, however, is not a priori best practice as

the NPAC is not entirely evidence-based and a clear relationship between the NPAC and patient outcomes has not been established. Also, contextual factors and patient preferences may require deviations. Furthermore, criteria and situations for protocol deviations are often unclear [21]. Therefore, ambulance nurses should use their professional judgment when applying the NPAC and can only deviate from the protocol with clear motivations. Nevertheless, other reasons such as standardization and uniformity of care also justify the focus on protocol adherence.

For transparency, we have reported all 5 models of the forward regression analysis (Table 3), but our results indicate that 21% of the adherence variation can be explained by protocol (NPAC) characteristics and social influences (model 2). Protocol related factors including complexity, support for diagnosis and treatment, and a relationship with patient outcomes seem to influence adherence. The complexity of guidelines and protocols was

Table 3 Forward regression analysis

	Factors	R (R^2)	β	Standardized β	p-value
Model 1		0.369 (0.136)			
	Constant		45.134		0.000
	NPAC_scale	0.369	8.863	0.369	0.000
Model 2		0.456 (0.208)			
	Constant		19.924		0.019
	NPAC_scale	0.369	7.017	0.292	0.000
	Social_scale	0.456	6.914	0.279	0.000
Model 3		0.494 (0.244)			
	Constant		5.786		0.537
	NPAC_scale		5.388	0.224	0.001
	Social_scale		6.136	0.248	0.000
	Individual_scale		5.425	0.206	0.002
Model 4		0.514 (0.264)			
	Constant		5.629		0.544
	NPAC_scale		5.556	0.231	0.000
	Social_scale		6.189	0.250	0.000
	Individual_scale		5.775	0.219	0.001
	Sex		-3.633	-0.145	0.014
Model 5		0.527 (0.278)			
	Constant		7.009		0.448
	NPAC_scale		5.233	0.218	0.001
	Social_scale		6.439	0.260	0.000
	Individual_scale		5.719	0.217	0.001
	Sex		-3.224	-0.128	0.030
	Coronary Care Unit Course		-2.787	-0.117	0.048

previously reported as a factor influencing adherence [8,22]. In combination with our results this stresses the need to make protocols less complex for ambulance nurses. To reduce complexity, the intended target group can be involved in protocol development, which has been indicated as an effective strategy [23]. Also, draft protocols can be tested for complexity in small scale practice settings. To reduce patient risks and limit the burden on daily practice, high-fidelity simulation settings to test protocol complexity and applicability seem promising. During simulations, participants are able to try and rehearse 'new' clinical practice, even if it concerns rare or complex situations [24].

The lack of expectation that adhering to specific recommendations will lead to improved patient outcomes is reported as a barrier for physicians' adherence [15]. Our study showed a positive correlation between adherence and a positive patient outcome expectancy of the ambulance nurses, indicating that adherence might improve when prehospital protocols are clearly related to positive patient outcomes.

At the social level, especially the expectancy of colleague ambulance nurses

and drivers to work with the NPAC correlate with adherence positively. The support of colleagues can be a motivator for professionals to change their behavior [3], and might even improve protocol adherence.

In the best fitting model, 72% of variation in adherence remains unexplained. This could possibly be explained by the study's focus on adherence to the NPAC as whole and not on individual protocols in the NPAC. This is in line with a systematic review that describes the reasons for non-adherence on the level of guideline recommendations instead of the whole guideline [25]. Another explanation for non-adherence can be the local protocols that compete with the NPAC: some EMSs make adjustments to the NPAC because of the local health policy. Competing local protocols influencing adherence to a national protocol have been reported previously [14]. Furthermore, patient characteristics such as age and sex may influence adherence [11].

Implications for practice, education and future research

Studies showed that non-adherence to guidelines leads to higher rates of mortality and adverse events [10,12]. Therefore, protocol adherence should be improved by strategies aimed at influencing factors [4]. Adherence to the NPAC in the Netherlands may benefit from organizational strategies that provide a role for ambulance nurses during protocol development. Furthermore, educational strategies should focus on positive outcome expectancy providing evidence-based rationale for interventions in the NPAC. This way, ambulance nurses can observe the relationship between the NPAC and patient outcomes.

Our results may stimulate ambulance nurses to become involved in protocol development. EMSs should involve the intended target group when developing or adjusting protocols. Our results may also contribute towards prehospital education and training for nurses by providing information on how to implement protocols. As our study is one of the first studies to quantify factors influencing adherence in the prehospital setting, future research should corroborate these findings and additionally take into account the perspective of the patient and situational factors. Thereby, it is important to identify general barriers as well as barriers related to specific medical conditions or topics, as barriers can be located at the level of the whole guideline or an isolated guideline recommendation [25].

Limitations

Besides self-report bias, selection bias of responding ambulance nurses who

are in favor of the NPAC is possible. Furthermore, ambulance nurses might deviate from the NPAC without being aware of the deviation, and therefore did not report these deviations as non-adherence. Another limitation is the 55% response rate. Also, as the Dutch ambulance care system is nurse based, with specific educational requirements, the results may not be fully transferrable to other countries. Finally, the internal consistency of the organizational factors scale was relatively low, which may indicate that the organizational factors scale did not have optimal operationalization.

CONCLUSION

Ambulance nurses' self-reported adherence to the NPAC seems high, with 83% adherence, although there may be some overestimation because of self-reporting. Twenty-one percent of the variance in adherence can be explained by factors related to the protocol itself and social influences. The main protocol characteristics were complexity, the degree of support for diagnosis and treatment and the relationship of the protocol with patient outcomes. Social influences include the degree to which colleagues expect nurses to work with the national protocol. To stimulate ambulance nurses' adherence, multifactorial tailored implementation strategies are needed.

ACKNOWLEDGEMENTS

The authors would like to thank Loes Josemanders and Femke van Uden for their support during data collection and analysis.

Conflicts of interest

None declared

Funding

The study was funded by a grant from the Netherlands organization for health research and development ZonMw (project number 8271.2001). The funding organization had no involvement in the study.

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CHAPTER 4

Factors influencing adherence to a national protocol emergency department

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European Journal of Emergency Medicine 2012, 19:53–56

ABSTRACT
The objective of this study was to identify factors that influence emergency nurses' adherence to an national protocol emergency department (NPED). Survey of emergency nurses (n=200) and physicians with medical end responsibility on an emergency department (n=103) was carried out. Emergency nurses' self-reported adherence to the NPED was 38%, 55% of the nurses and 44% of the physicians were aware of the protocol. Interference with professional autonomy, insufficient organizational support and the NPED's applicability were indicated as barriers for adherence. A main influencing factor seems awareness. Other factors related to the individual, the organization and to protocol characteristics. Solely disseminating the NPED is not enough to get the protocol used in clinical practice.

Keywords
Guideline adherence [MeSH]
Emergency nursing [MeSH]
Emergency medicine [MeSH]

INTRODUCTION

Guidelines and protocols are supposed to improve quality of care and reduce variation of practice [1]. Yet, a gap between recommended care and delivered care often exists [2]. This gap is also present in the emergency department (ED) setting with suboptimal adherence to guidelines and protocols [3-5]. It is important to identify factors that influence adherence to facilitate the development or selection of strategies to improve adherence [2]. The objective of this study was to identify factors that influence emergency nurses' adherence to a National Protocol Emergency Department (NPED).

METHODS

Setting

In the Netherlands, EDs are staffed with emergency nurses, emergency physicians and medical residents. To support clinical practice by emergency nurses the NPED was developed, which was intended as input for emergency nursing education and consists of consensus based treatment algorithms [6]. (Online demo at http://www.lpseh.nl/demo/index.htm). After its publication, the NPED was disseminated at all EDs. Emergency nurses can consult the NPED online when they are members of the Dutch Emergency Nurses Association (DENA), or as a book if present on their ED.

Design

We adopted a quantitative, descriptive design and analysed target group and setting [2]. The target group consisted of emergency nurses and the setting included physicians with medical end-responsibility at the ED as they have to support the NPED.

Questionnaire

We developed a questionnaire with questions and statements on adherence and factors influencing adherence by modifying an instrument that consisted of statements regarding general and hand hygiene guidelines [7]. The statements on hand hygiene were excluded. The general statements were modified to fit the Dutch setting. After translation into Dutch by three independent researchers, the instrument was reviewed, adjusted and face validated by experts in emergency care practice and science. Finally, the statements and questions were categorized into a framework of individual, organizational, and social perspectives, and protocol characteristics [1]. We used the original six-point Likert scale, ranging from strongly agree to strongly disagree. Adherence to the NPED was operationalised as a self-rating scale: emergency nurses rated their adherence between 0-100 percent.

Sample

We surveyed a random sample (n=200) of emergency nurses from the member database (n=628) of the DENA and all physicians with medical end-responsibility (n=103). Criteria for filling in the questionnaire included registration and employment as emergency nurse or physician. The need for ethical approval was waived by the regional ethical committee.

RESULTS

Seventy-eight (39%) emergency nurses and 50 (49%) physicians returned the questionnaire, a total response of 128 (42%). Table 1 shows respondents' characteristics. Forty-two emergency nurses (55%) and 22 emergency physicians (44%) were aware of the NPED. These respondents completed the questionnaire. Twenty-two of the 42 emergency nurses rated an average adherence of 38% (standard deviation: 32.4), the other 20 nurses did not provide a percentage.

From the emergency nurses' individual perspective, 33% stated that the NPED interfered with professional autonomy, and 41% stated that they preferred personal routines. As for organizational factors, 51% disagreed with the protocol being important in the organization, 79% stated they were not really expected to use the NPED, and 82% disagreed with sufficiency of support to implement the NPED. Twenty-seven percent of the emergency nurses thought the NPED was too 'cookbook-like', and 42% agreed that the NPED was difficult to apply in practice.

From the physicians' individual perspective, 41% stated that the NPED interfered with professional autonomy, and 55% preferred personal routines. Regarding organizational factors, 38% of the physicians agreed that the NPED was considered important by the organization, and 65% experienced insufficient support to implement the NPED. Furthermore, 52% disagreed with the physicians' responsibility to stimulate usage. Regarding protocol characteristics, 91% of the physicians agreed with the NPED standardizing care, and 50% agreed with the NPED improving patient outcomes. Finally, 62% found the NPED too 'cookbook-like' (Table 2).

DISCUSSION

We identified factors influencing emergency nurses' adherence to the NPED. With only half of the nurses and physicians aware of the existence of the NPED, awareness seems the main influencing factor. This resembles other

Table 1 Respondents' characteristics

	Emergency nurses	*Physicians*
	%	%
Sex		
Male	20	70
Age		
20-29 years	3	0
30-39 years	20	36
40-49 years	38	46
50-59 years	38	16
>60 years	1	2
ED work experience		
0-4 years	7	22
5-9 years	21	60
10-14 years	22	16
15-19 years	19	2
20-24 years	22	0
25-29 years	4	0
>30 years	5	0
Function*	-	
Trauma surgeon		42
Emergency physician		34
Surgeon		28
Internist		2
Other		4
Basic education*		-
In-service hospital	71	
In-service psychiatric ward	3	
In-service hospital + psychiatric ward	5	
Intermediate nursing education	4	
Bachelor of nursing	16	
Other	9	
Emergency Department Courses*		-
Initial ED training	95	
Triage course	64	
Nurse Practitioner	1	
Trauma Nursing Core Course	91	
Emergency Nursing Pediatric Course	49	
Other	22	

*multiple answers possible

studies [8,9]. Poor awareness exists despite the nurses' membership of the DENA that developed and disseminated the NPED. Three reasons could explain this poor awareness: (i) the protocol was disseminated to EDs without an implementation strategy, (ii) high percentages of nurses and physicians missed sufficient organizational support, and (iii) the NPED is not integrated in education and training of emergency nurses.

Table 2 Influencing factors

Emergency nurses					*Physicians*			
Strongly agree %	(somewhat) agree %	(somewhat) disagree %	strongly disagree %		Strongly agree %	(somewhat) agree %	(somewhat) disagree %	strongly disagree %
				Individual				
16	74	10	0	I am familiar with one of the algorithms from the NPED	13	73	14	0
11	63	26	0	It is impossible for me to keep up with all the algorithms of the NPED	18	55	27	0
0	33	67	0	The NPED interferes with my professional autonomy	0	41	55	4
5	36	56	3	I would prefer to work on the basis of my routines and habits rather than to work on the basis of the NPED	9	46	45	0
0	18	80	2	Generally, the NPED is cumbersome and inconvenient	5	18	77	0
0	0	44	56	I/nurses always register which algorithms from the NPED I/they have used	0	0	59	41
0	3	36	61	I/nurses always register from which algorithm from the NPED I/they have deviated	0	0	54	46
8	4	45	0	I prefer working with own hospital protocols instead of working with the NPED	-			
3	28	67	2	Following the NPED is time consuming	-			
0	8	81	11	I disagree with the content of the NPED	-			
				Organizational				
23	44	25	8	The NPED is readily available (paper/digital)	19	33	43	5
3	46	48	3	In this organization, the NPED is important	0	38	43	19
13	66	18	3	I am/nurses are not really expected to use the NPED in daily practice	14	32	50	4
0	18	69	13	In my organization there is sufficient support to implement the NPED	5	30	55	10
18	59	23	0	Not training the NPED increases the risk of malpractice	10	45	35	10
0	0	49	51	When I do not use the NPED there are consequences	-			
-				It is a task of the physician with medical end-responsibility to stimulate usage of the NPED	0	48	33	19

				Social				
0	8	56	36	Patients are aware that emergency nurses work with the NPED/protocols	0	9	50	41
0	11	60	29	My colleagues think it is important to work with the NPED	-			
				Protocol characteristics				
				The NPED…				
3	24	73	0	…is too "cookbook-like"	5	57	38	0
0	71	29	0	…is practical to use	0	46	50	4
0	42	50	8	…is difficult to apply	9	41	50	0
3	75	22	0	…improves patient outcomes	0	50	50	0
3	89	8	0	…standardizes care and assures that patients are treated in a consistent way	0	91	9	0

The self-reported adherence rate was low compared to other research [3-5]. Our percentage probably represents the best-case scenario as responders may have a higher adherence rate than non-responders. Valid contraindications could explain deviation from the NPED, but only few emergency nurses reported registering protocol deviations, therefore insight in contraindications is lacking. Furthermore, local hospital protocols can be used instead of the NPED. It is unknown to what extent these local protocols meet the NPED.

The struggle of nurses and physicians with their professional autonomy may relate to criticism to evidence-based practice, in which protocols are perceived as a threat to the professional autonomy [10]. This may also explain the relatively high percentages of nurses and physicians who preferred local protocols and personal routines to the NPED.

Finally, the applicability of the NPED is perceived as moderate by the emergency nurses and physicians. Reasons could be that the NPED as national protocol still needs to be tailored to local emergency departments. In addition, although these emergency nurses and physicians were aware of the NPED, they may not be sufficiently familiar with the content to apply the protocol.

Recommendations

These results confirm the importance of awareness [1]. Strategies should focus on enhancing awareness among the principal professionals. The NPED should be reintroduced in practice, with additional strategies focused on professional autonomy, organizational support, and the NPEDs applicability.

Limitations

The modest response rate and poor awareness limits the overall generalizability of the findings. Furthermore, the NPED was the research subject, which may limit the transferability to other settings and protocols.

CONCLUSION

Emergency nurses' adherence to the NPED is poor. A main influencing factor for adherence is awareness. This underlines that dissemination of protocols is not enough to get them used in clinical practice, and that an analysis of the target group and setting is essential to identify factors influencing adherence. After awareness has been improved, implementation strategies should focus on professional autonomy, organizational support, and applicability.

ACKNOWLEDGEMENTS
The authors thank Pieter Jochems (Dutch Emergency Nurses Association) and Judith Mulder (Dutch Emergency Physicians Association) for reviewing the manuscript.

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CHAPTER 5

An exploration of factors influencing ambulance and emergency nurses´ protocol adherence in the Netherlands

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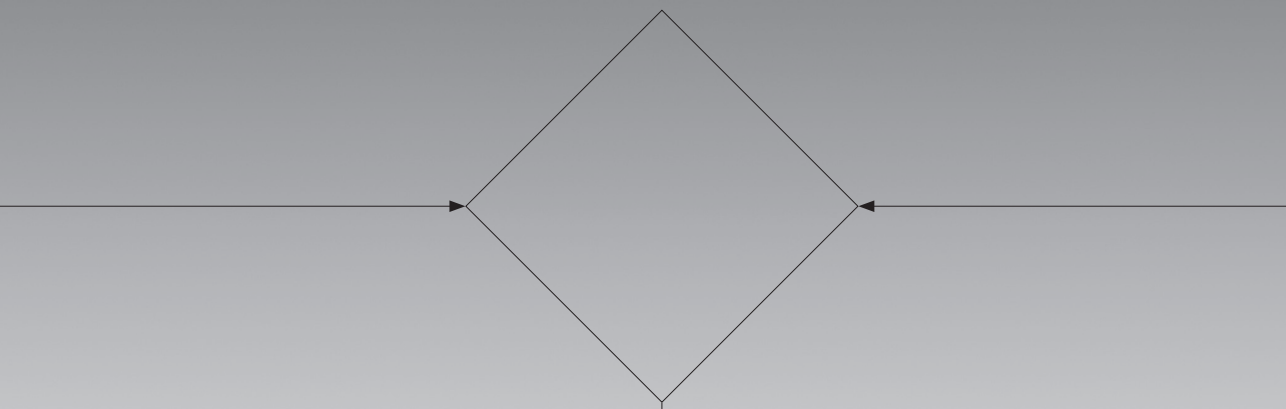

Journal of Emergency Nursing 2014:40(2):124-30.
doi: 10.1016/j.jen.2012.09.008.

ABSTRACT

Introduction

Adherence to ambulance and emergency department (ED) protocols is often suboptimal. Insight into factors influencing adherence is a requisite for improvement of adherence. This study aims to gain an in-depth understanding of factors which influence ambulance and emergency nurses' adherence to protocols.

Methods

Semi-structured interviews (n=20) were held with ambulance nurses, emergency nurses and physicians with medical end-responsibility in the Netherlands to explore influencing factors. Content analysis was used to identify influencing factors.

Results

The main influencing factors for adherence were individual factors, including individual (clinical) experience, awareness, and the preference of following local protocols instead of national protocols. Organizational or external factors were involvement in protocol development, training and education, control mechanisms for adherence, and physicians' interest. Also of influence were protocol characteristics including integration of the advanced trauma life support approach, being in accordance with daily practice, and the generality of the content. Influencing factors could be a barrier as well as a facilitator for adherence.

Discussion

Factors influencing ambulance and emergency nurses' protocol adherence could be assigned to individual, organizational, and external categories, and to protocol characteristics. To improve adherence, implementation strategies should be tailored to identified factors. Multifaceted implementation strategies will be needed to improve adherence.

Keywords

Emergency nursing [MeSH]
Emergency medical services [MeSH]
Guideline adherence [MeSH]

INTRODUCTION

Guidelines and protocols are developed and implemented to improve quality of care and to reduce variation of practice [1]. A guideline consists of systematically developed statements for decision making that are based on research results, clinical experience, patient preferences and available resources [2]. A protocol is a specification of a guideline that exactly formulates how to act and which steps to follow [2]. Despite the existence of guidelines and protocols, a gap between recommended care and delivered care often exists [1], which may suggest suboptimal adherence to these guidelines and protocols. For the ambulance and emergency department (ED) settings, adherence to guidelines and protocols regarding cardiopulmonary resuscitation, cervical spine immobilization, initial electrocardiographic screening, pain management, hygiene precautions, and domestic violence screening shows a wide variation [3-9]. It is important to gain in-depth understanding of reasons for non-adherence to guidelines and protocols in order to reduce the incidence of errors occurring through omission of treatment, as well as to ensure that a maximal number of patients receive the benefit of appropriate treatment [10]. Furthermore, implementation strategies to improve adherence can be tailored to these influencing factors. From an implementation perspective, influencing factors can be categorized into the individual professional, the organization, the external context (social/physical/regulations/policies), and the innovation (e.g. guidelines and protocols) [2].

Previous studies in the prehospital and emergency department settings associated patient-related factors (age, gender, weight, presentation of disease, comorbidity), professional-related factors (knowledge, attitude, communication), organizational factors (location and type of the emergency department [urban or rural], presence of a physician), and protocol-related factors (lacking or inadequate protocols) with adherence to guidelines and protocols [5,9,11-18].

Despite the existence of these studies, in-depth understanding of factors that influence nurses' adherence to ambulance and ED protocols is lacking. Therefore, the study objective was to gain an in-depth understanding of factors that influence ambulance nurses' and emergency nurses' adherence to ambulance and ED protocols.

METHODS

Setting

In the Netherlands, prehospital ambulance care is provided 24 hours per day by 25 emergency medical services (EMSs). Geographical dispersion of these EMSs is based on the starting point that 95% of the urgent patients can be reached within 15 minutes after the first call. Regular ambulances are staffed with one driver and one registered ambulance nurse. Registered nurses become qualified as an ambulance nurse following a specific national training course. Ambulance nurses work autonomously and are allowed to administer medical treatment based on their national protocol, without direct consultation of an EMS physician. Though not directly involved on site, the EMS physician has medical end-responsibility for the provided care. Dutch emergency departments provide 24 hours per day emergency care for all types of patients. At the time of the study there were 103 emergency departments in the Netherlands, which are staffed with emergency nurses, emergency physicians and medical residents. Registered nurses follow additional emergency training to become qualified as an emergency nurse. Medical end-responsibility varies per emergency department, although the medical end-responsibility is shifting towards the emergency physician.

To support clinical practice by ambulance nurses, the ambulance care national sector organization developed a national protocol ambulance care (NPAC) [19]. The NPAC is implemented in the national training course for ambulance nurses, and each ambulance nurse receives the NPAC during training. In line with the NPAC, an ED national protocol (NPED) for emergency nurses was developed by the Dutch Emergency Nurses Association (DENA) [20]. After its publication, the NPED was disseminated through all emergency departments in the Netherlands. Emergency nurses can consult the NPED online if they are members of the DENA, or as a book if present in their ED. Because ED training courses are decentrally organized, the NPED was not implemented in all courses. Both protocols are regularly updated and consist of symptom-orientated algorithms that cover all aspects of prehospital and emergency care. Because both protocols were developed by national professional organizations, they represent the professional nursing standard for ambulance and ED care in the Netherlands.

Framework

To construct the study, Grol's model for effective implementation (Figure 1) was selected as the main framework [1,2]. The model provides a stepwise approach for improving clinical practice and starts with the identification

of research findings, guidelines or best practices which are intended to be implemented (step 1). Steps 2 and 3 include a description of change targets and an analysis of the target group, current practice and setting. On the basis of this analysis, implementation strategies can be developed or selected (step 4), followed by the development, execution, evaluation and adaptation of an implementation plan (steps 5 and 6). Because the NPAC and NPED are already in use in clinical practice, this study focused on the third step to identify factors that influence adherence. Ambulance nurses and emergency nurses (referred to as nurse participants) were included in this study as they represent the intended target group for the NPAC and NPED, respectively. If ambulance nurses and emergency nurses use and adhere to the NPAC or NPED, organizational support is essential and therefore EMS and emergency physicians (referred to as physician participants) were included for context analysis.

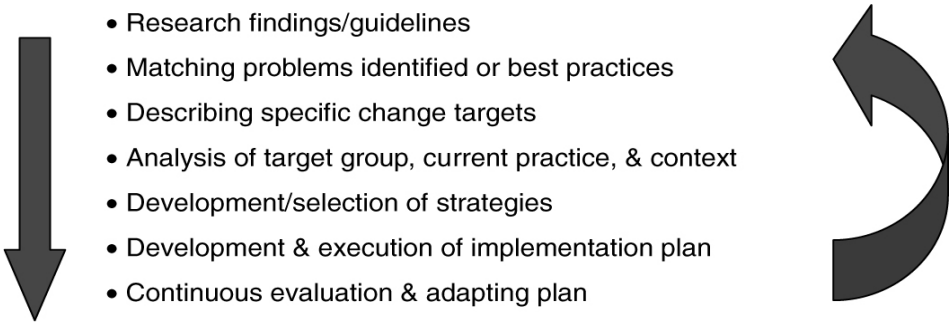

Figure 1: Model for effective implementation [1]

Interviews

We used a qualitative design and performed individual, semi-structured interviews that focused on influencing factors related to the individual, the organization, the external context, and the protocols. Interviews were held from the perspectives of nurses and physicians with medical end-responsibility in the prehospital and ED setting. Between September 2009 and January 2010, five ambulance nurses, five emergency nurses, five EMS physicians, and five emergency physicians were interviewed by the same researcher (R.H.A.E.). Five interviews per discipline were needed to achieve data saturation. Initially, participants were recruited by advertisements on acute care national websites. Seven participants were selected after their response to the advertisements. Inclusion criteria were that participants (i) were registered as nurses or physicians, (ii) could read, write and speak Dutch,

and (iii) had a current EMS or ED appointment. Snowball sampling [21] was used to complete the sample when included participants recommended nurses and physicians. Interviews were audiotaped and were held on a location chosen by the participants, including emergency departments (n=9), EMS offices (n=8), residences (n=2), and the office of the researcher (n=1). Of the 20 participants, seven were women. The ambulance participants worked in nine different EMSs, and the ED participants worked in ten different emergency departments from teaching and university hospitals. The topic list used to structure the interviews contained explorative opening questions ("What can you tell me about factors influencing adherence related to..") related to the individual, the organization, the external context and protocol characteristics [2]. The interviewer made sure that every topic was discussed, but no pre-structured questions besides the explorative opening questions were formulated.

Data analysis

Content analysis [21] was used to identify influencing factors. Therefore, audio taped interviews were transcribed verbatim and segmented in manageable pieces, which contained one or two related topics. The second step was coding the text in the segments using open and in-vivo codes. To assess inter-rater reliability, a random sample (20%) of the segments was drawn, which then were coded and discussed by two researchers (R.H.A.E., D.M.J.S.) until consensus was established. Finally, two researchers (R.H.A.E., D.M.J.S.) assigned the codes into categories of influencing factors until consensus was reached. Whenever possible, identified influencing factors were marked as barriers or facilitators and illustrative quotes were added to the results.

To increase dependability and credibility, data-triangulation, investigator-triangulation, peer reviews, and member checks were applied [21]. To ensure data-triangulation, data were collected from different individuals from different organizations. Investigator-triangulation was accomplished by involving two different researchers in the data-analysis phase. Re-analyses of raw data were made by a peer researcher (D.M.J.S.). Finally, identified categories of influencing factors were sent to the participants for a member-check and supplementary comments. We used the Kwalitan program (version 5.0; Malden, The Netherlands, 2000) for qualitative analysis. During and after data collection and analysis, data was stored at a 'stand alone' computer, (with periodic backups stored in a safe), to which only the researcher (R.H.A.E) and the supervisors (L.C.M.V. and J.A.J.M.) had access.

Ethical considerations

The recommendations of the Netherlands' Central Committee on Research Involving Human Subjects were executed, following the step-by-step plan research committee review (www.ccmo-online.nl/main.asp?pid=1&taal=1). For this study, ethical approval of a certified healthcare ethics committee was not needed, because - by Dutch law - this is not necessary when patients are not exposed to experimental care or treatment, when data collection does not occur at patient level, when participants are not asked for medical or highly personal information, and when data collection is not burdensome. Although no ethical approval was needed, written informed consent was obtained from every participant before the start of each interview.

RESULTS

Figure 2 gives an overview of identified influencing factors for the ambulance and ED settings. Results for influencing factors were categorized into individual, organizational, external factors, and protocol characteristics. Because nurse participants were the intended target group they could mention 'individual factors'. Opinions of the physician participants were considered as organizational factors.

Influencing factors - ambulance

Individual factors

All nurse participants reported how clinical experience facilitates their deviation from the NPAC and thereby using the protocol as a guideline: *"To me the protocol is a guideline"*. These nurse participants believed that a deviation based on (clinical) experience leads to justified, professional care. On the other hand, most nurses used the NPAC as an instrument to justify their treatment and feel protected from prosecution when they strictly adhere: *"Legally, you are protected when you adhere to the protocol"*. The NPAC is also used as argumentation when decisions were questioned by other professionals, like ED staff or general practitioners.

Organizational factors

Most physician participants reported that protocol deviations based on ambulance nurses' (clinical) experience are justified and that an ambulance nurse has to be capable of deciding when to deviate from the protocol: *"I expect from the ambulance nurses that, if necessary, they can decide to deviate from the protocol"*. To monitor protocol adherence, all physician participants pointed out that they check patient records. Nurse participants perceived this check by the physician as disciplinary action: *"If they check*

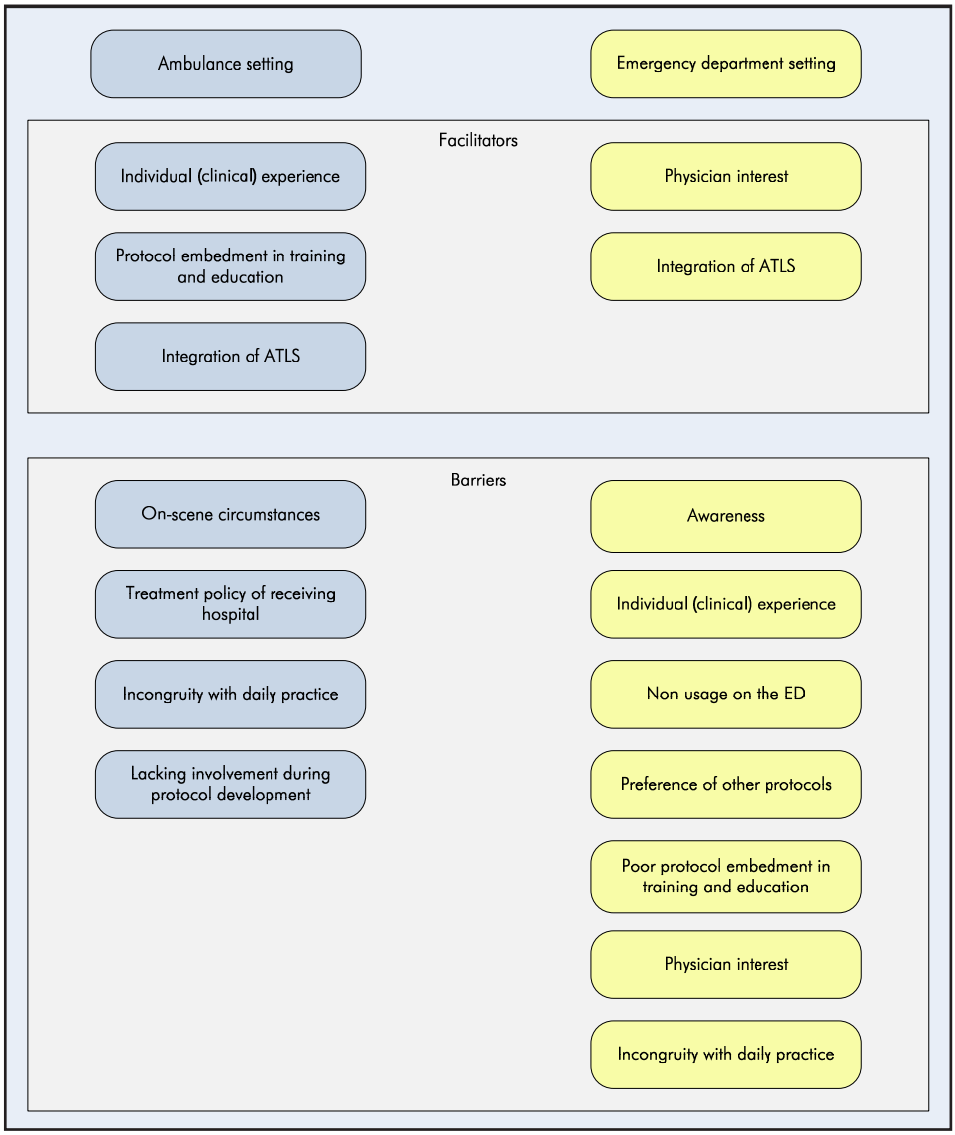

Figure 2: Overview of influencing factors

patient records, the NPAC is used against you because you used your common sense". A barrier mentioned by most of the nurse participants was the feeling that they have too little input during the development of the NPAC. Regarding this development, nurse participants felt medical dominance by the EMS physician and were afraid that this would lead to a

gap between the NPAC and daily practice, especially when local adjustments to the protocols are made by the EMS physicians: *"Physicians who don't have close contact with daily practice decide what I can and can't do"*. All nurse participants mentioned that the embedment of the NPAC in education and training is a facilitator for adherence: *"The national training and protocol belong together"*. However, some nurse participants felt a need for structural feedback in their organization to discuss protocol use.

External factors
On-scene circumstances (e.g., bystander expectations, aggression, and environmental factors) influenced protocol adherence, especially when the ambulance nurses' own safety was at stake. The treatment policy of the patients' receiving emergency department was also mentioned as barrier for ambulance nurses' adherence to the NPAC: *"In case of a high energetic trauma, you go to (named hospital) with the patient. It's a trauma center. Then I think, let's adhere completely to be sure"*.

Protocol characteristics
Most nurse and physician participants believed that the NPAC is sometimes incongruent with daily practice. They felt medical treatment according to the NPAC is not always appropriate and sufficient and that some medications are not present or do not correspond with other disciplines: *"Then you look and you start, but you keep thinking it isn't right, the dosage prescribed isn't present on the ambulance so I can't give it"* and *"So, apparently ambulance nurses have to little medication options in their protocol to cope with primary hyperventilation; they get blocked in their protocol"*. The integration of the advanced trauma life support (ATLS) approach in the NPAC was perceived as an essential component that offers assistance for systematic, clinical practice and perceived as a facilitator for adherence: *"Working with the ATLS is an essential condition for functioning as ambulance nurse"*.

Influencing factors - emergency department

Individual factors
A barrier for adherence felt by all nurse participants was that awareness that the NPED is lacking. Nurse participants who were aware of the NPED out of personal interest stated that most colleagues were not aware of the NPED. For example, the interviewer asked, *"If I understand correctly, your colleagues aren't aware of the existence of the NPED?"* The respondent answered, *"No, I'm practically sure; maybe a few are"*. Instead of working with the NPED, most nurse participants preferred locally developed hospital

protocols. Another barrier for protocol adherence in general was when most of the nurse participants stated they preferably work on the basis of (clinical) experience rather than on the basis of protocols: *"Most of my colleagues prefer working on the basis of their experiences and won't look at any protocol"*.

Organizational factors
In addition to the awareness factor mentioned by the nurse participants, most of the physician participants also identified the awareness factor as a barrier, relating that they did not know the NPED existed and had to review it before the interview: *"To be honest, I wasn't aware of the NPED before the interview"*. Another barrier mentioned was that none of the emergency departments where the nurse participants worked used the NPED as official ED protocol: *"I personally happened to have the NPED. But it isn't used in this emergency department"*. Most nurse participants also stated that the NPED is not embedded, used, or mentioned in training and education: *"School never mentioned that there was such thing as a national protocol"*. Some physician participants mentioned that in the emergency department, an emergency physician is present, and more time exists to administer treatment compared to prehospital care: *"Ambulance nurses work solo and have to make decisions on their own. At the emergency department, there is always a physician present who makes treatment policy, with or without protocol"*.

External factors
Some nurse participants felt that emergency physicians would be less interested in the NPED: *"When a book states 'nurse' on the cover, they won't look at it"*. However, all physician participants stated that they were interested in the NPED so they could integrate nursing and medical practice, which leads to uniformity and absence of equivocality: *"It's important to know the content of the protocols colleagues work with"* and *"It is important for nurses to have a national protocol"*.

Protocol characteristics
All nurse participants considered the content of the NPED as too general and not congruent with ED practice and therefore a barrier for adherence: *"Main disadvantage of the protocol is that it's too general. It isn't specific enough"*. The integration of ATLS approach was considered positive and as leading to a better connection between the NPED and NPAC and, thereby as facilitator for adherence.

DISCUSSION

This qualitative study provided in-depth understanding of factors influencing ambulance and emergency nurses' adherence to ambulance and ED protocols. We identified individual (clinical) experience, awareness, preference of other local protocols, physician interest, protocol embedment in training and education, involvement during protocol development, integration of ATLS, interest of emergency physicians, local circumstances, treatment policy of the receiving hospital, and being in accordance with daily practice as influencing factors. Understanding of these factors is important when developing and selecting strategies to improve adherence [18].

Individual clinical experience was found as an influencing factor for adherence to ambulance and ED protocols. Emergency nurses preferred experience over the NPED and locally developed hospital protocols, so this may be a barrier for emergency nurses to adhere to their professional standard. Emergency nurses preferring their own routines and habits were described earlier by Ebben et al. [22]. In contrast, ambulance nurses felt that their clinical experience was a facilitator for protocol adherence. Literature shows that during emergency situations, nurses use their experiences in the decision-making process by comparing previously experienced situations with the current situation [23,24]. In this process the similarity of the current patient compared to a group of patients in the past (representativeness) plays an important role. Because emergency nurses see more patients during a shift compared with ambulance nurses, it is possible that emergency nurses have a larger 'reference-group' to which to compare the current patient, which may lead to the preference of their own routines and habits. Furthermore, they also have the option to rely on other colleagues and can use locally developed hospital protocols instead of the NPED.

Another explanation for the difference between ambulance and emergency nurses may be differences in training and education. Ambulance nurses are trained with the NPAC and learn to manage it in the context of their individual experience. In contrast, emergency nurses are not trained in their protocol because the NPED is not always included in their training and education. Therefore it is possible that emergency nurses consider individual experience and protocols as two separate entities whereas ambulance nurses integrate the protocol and individual experience. The perception of protocols as authoritative rules of practice that threaten professional autonomy and judgment has been earlier described by Swinkels et al. [25]. Because evidence-based practice acknowledges the integration of individual

clinical expertise with external evidence [1], using individual experience can sometimes be justified. However, protocol-based care can also be viewed as a mechanism that expands and extends nursing roles and thereby increases professional autonomy [26].

From the individual as well as the organizational perspective, both emergency nurses and emergency physicians reported poor awareness of the NPED. In this study the lack of awareness may have led to nonuse of the NPED and poor embedment in training and education. In a previous study we already identified awareness as barrier for adherence [22], even though awareness seems to be a crucial first step to improve implementation and adherence. In both ambulance and ED settings, it appears that physicians support the protocols and, specific to the ED setting, the physicians are willing to integrate nursing and medical practice. This positive attitude reflects the opportunity to develop integrated guidelines and protocols for nurses and physicians.

Looking at protocol characteristics, for both protocols, the integration of the ATLS approach was described as being a facilitator or even as an essential condition for functioning as an ambulance or emergency nurse. This positive attitude towards ATLS is also shown in a study with physician ATLS trainees [27]. The incongruity of the NPAC with daily practice reported by the ambulance nurses seems consistent with their feeling of too little input during development, which may provide a considerable barrier for adherence. Mrayyan (2006) argues that nursing involvement during protocol development can enhance autonomous decision making by nurses [28], although nursing involvement during guideline and protocol development seems not to be the general rule [29]. Our results indicate that involvement of intended target users during development of protocols may positively influence adherence and implementation.

Limitations

This qualitative study possibly suffered from selection bias in the process of recruiting participants: seven participants selected themselves by responding to advertisements. These participants may be extremely negative or positive about protocols. However, because influencing factors were our focus rather than the level of adherence, this is not necessarily a problem. This selection bias may have seeped into sampling bias by using snowball sampling to recruit participants. Furthermore, no emergency nurses who were unaware of the NPED were included. Another limitation considering

the emergency nurses was their difficulty separating their experiences with the national protocol from the self-developed hospital protocols, although the self-developed protocols may have been based on the national protocol without their knowing it. Adherence to protocols is important to reduce the incidence of errors occurring through omission of treatment and to ensure that a maximal number of patients receive the benefit of appropriate treatment [10]. This implies that protocols need to be evidence-based and have a positive impact on patient outcomes. In reality, however, not every protocol is evidence-based or has a clear relationship with patient outcomes, and therefore deviations might be necessary. Therefore, professionals should always use their professional judgement when applying a protocol. Deviations from protocols should be accompanied by strong arguments. However, other reasons, such as standardization and integration of care, can also justify the efforts on improving adherence.

Implications for practice, education and future research

For ambulance and emergency nurses, our results can serve as a starting point to identify facilitators and barriers for adherence when implementing protocols. Our results may also contribute to emergency care education and training for nurses by providing information for nursing educators on how to use protocols. Specifically, the tension between professional autonomy and protocols should be addressed. For organizations, it is important to involve a delegation of the intended target group when developing protocols, to prevent nurses from having too little input and to make protocols more congruent with daily practice. Because our study is one of the first studies that identified factors influencing adherence, future research should continue with the identification of these factors. Thereby, it is important to gain in-depth understanding as well as to quantify which influencing factors contribute the most to non-adherence.

We identified influencing factors for adherence to guide the selection and development of implementation strategies. The implementation process can be divided in five phases: orientation, insight, acceptance, change, and maintenance [2]. When classifying the identified influencing factors in these phases, it is shown that the factors influencing adherence to the NPED are most related to the orientation and insight phases. For the NPAC, factors especially relate to the acceptance and maintenance phase. According to this classification, the ambulance protocol is ahead in implementation compared with the ED protocol. For clinical practice, this implies that dissemination and implementation strategies should be tailored at these phases.

CONCLUSION

This study shows that in the Netherlands, ambulance and emergency nurses' adherence to protocols is influenced by factors related to the individual, the organization, external (social/physical), and protocol characteristics. An influencing factor can be a barrier as well as a facilitator depending on the setting. Therefore implementation strategies should be targeted at these categories and tailored to the setting.

An online copy of the NPAC is available at http://lw2.easy-site.nl/Ambulanceplein_c01/root/AmbulancezorgHandboek/index2011.htm
An online copy of the NPED is available at http://www.lpseh.nl/demo/index.htm

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CHAPTER 6

A tailored e-learning program to improve handover in the chain of emergency care: a pre-test post-test study

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Demographics

Mechanism of injury

Injuries

Accepted for publication in Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine

Signs

ABSTRACT

Objective

To standardize patient handover in the chain of emergency care a handover guideline was developed. The main guideline recommendation is to use the DeMIST model (Demographics, Mechanism of Injury/illness, Injury/Illness, Signs, Treatment given) to structure pre-hospital notification and handover. To benefit from the new guideline, guideline adherence is necessary. As adherence to guidelines in emergency care settings is variable, there is a need to systematically implement the new guideline. For implementation of the guideline we developed a e-learning program tailored to influencing factors. The aim of the study was to evaluate the effectiveness of this e-learning program to improve emergency care professionals' adherence to the handover guideline during pre-hospital notification and handover in the chain of emergency medical service (EMS), emergency medical dispatch (EMD), and emergency department (ED).

Methods

A prospective pre-test post-test study was conducted. The intervention was a tailored e-learning program that was offered to ambulance crew and emergency medical dispatchers (n=88). Data on adherence included pre-hospital notifications and handovers and were collected through observations and audiotapes before and after the e-learning program. Data were analyzed using X^2-tests and t-tests.

Results

In total, 78/88 (88.6%) professionals followed the e-learning program. During pre- and post-test, 146 and 169 handovers were observed respectively. After the e-learning program, no significant difference in the number of handovers with the DeMIST model (77.9% vs. 73.1%, p=.319) and the number of handovers with the correct sequence of the DeMIST model (69.9% vs. 70.5%, p=.159) existed. During the handover, the number of questions by ED staff and interruptions significantly increased from 49.0% to 68.9% and from 15.2% to 52.7% respectively (both p=.000). Most handovers were performed after patient transfer, this did not change after the intervention (p=.167). The number of handovers where information was documented during handover slightly increased from 26.9% to 29.3% (p=.632).

Conclusion
The tailored e-learning program did not improve adherence to a handover guideline in the chain of emergency care. Results show a relatively high baseline adherence rate to usage and correct sequence of the DeMIST model. Improvements in the handover process can be made on the documentation of information during handover, the number of interruptions and questions, and the handover moment.

Keywords
Guideline adherence [MeSH]
Patient handoff [MeSH]
Emergency medical services [MeSH]

INTRODUCTION

Patient handover from one health care setting to another includes possible threats to quality and continuity of care [1]. A handover is characterized by the involvement of two or more professionals, the exchange of verbal and/or written information about the patient's diagnosis, treatment and care, and the transition of patient responsibility [1-5]. The handover from ambulance to emergency department (ED) involves 2-way communication between the ambulance crew and ED-staff [6]. Especially the handover from ambulance to ED seems error prone as there is a high patient turnover, patients present themselves with a wide diversity of clinical conditions, there are acute time constraints, and the ambulance crew has only one opportunity to transfer patient information [7]. Previous studies report a loss of information during handover from ambulance to ED [5,8,9]. Factors which might influence the quality of the handover from ambulance to ED are a lack of active listening skills or inattention of ED-staff, unnecessary repetitions or provision of unnecessary information by ambulance crew, interruptions, workload, working relationships between ambulance crew and ED-staff, uncertainty about the transfer of responsibility, and failure to reach shared understanding [5,6,10-12].

To overcome these problems and barriers, standardization of the handover from ambulance to ED is recommended [5,13]. To facilitate standardization, structured models for ambulance to ED handover have been developed: (De)MIST (Demographics, Mechanism of Injury/illness, Injury or Illness found or suspected, Signs, Treatment given), AMPLE (Allergies, Medications, Past illnesses, Last meal, Events), ASHICE (Age, Sex, History, Injuries, Condition, Expected time of arrival), IMIST-AMBO (Identification of the patient, Mechanism/medical complaint, Injuries, Signs, Treatment and treatment respons/trend, Allergies, Medications, Background and Other), SOAP (Subjective information, Objective information, Assessment, Plan) and BAUM ('Bestand' (inventory), 'Anamnese' (medical history), 'Klinische Untersuchungsergebnisse' (clinical findings), 'Massnahmen' (actions)) [5,13-15].

To standardize handover practice from ambulance to ED in the Netherlands, an evidence-based guideline has been developed. The key-recommendation of the guideline is to use the DeMIST-model to structure prehospital notification and handover in the chain of ambulance, emergency medical dispatch (EMD) and ED. Due to a lack of evidence about effectiveness and applicability of handovers models, the choice for the DeMIST model

was based on the fact that the MIST model was already in use. Other recommendations of the handover guideline are (a) that the pre-hospital professional who is responsible for the patient, provides a handover to the ED-professional who will be responsible for the patient, (b) that a handover takes place before patient transfer, and (c) that the ambulance crew verifies if the handover was clear.

To assist implementation of the newly developed guideline, a tailored e-learning program was developed to serve as educational intervention. The e-learning program was tailored to influencing factors that were identified beforehand in the local chain of emergency care. Previous studies show that e-learning can be effective to teach emergency physicians and nurses to recognize child abuse, to administer metoclopramide and to improve triage skills [16-18]. The effect of e-leaning on handover has not been studied.

Therefore, the aim of the study was to evaluate the effectiveness of an e-learning program to improve adherence to the handover guideline, hereby structuring pre-hospital notification and handover in the chain of ambulance-EMD-ED. We hypothesized that the e-learning was effective to improve handover on the two key-guideline recommendations (Table 1), being 1) to use the DeMIST model and 2) to use the DeMIST model in the correct sequence.

METHODS

Design

The study had a prospective pre-test post-test design.

Setting

The study setting was located in the chain of emergency care of Nijmegen, the Netherlands. The chain of emergency care consists of the regional ambulance service (EMS), the emergency medical dispatch centre (EMD), and the emergency department (ED) of the Radboud university medical centre. In 2013, the EMD in this region managed 66.316 ambulance calls. Ambulances are staffed with one driver and one registered ambulance nurse, specialized EMD-nurses staff the EMD. Registered nurses become qualified as an ambulance nurse or EMD-nurse after following a specific national training course. Ambulance nurses work autonomously and are allowed to administer medical treatment based on their national protocol, without direct consultation of an EMS physician. The ED of the Radboudumc is a level 1 traumacenter, meaning the ED is delivering 24/7 trauma care for all types of patients. The ED had 21.672 admissions in 2012 and is staffed with emergency nurses and emergency physicians. Additional medical teams (trauma surgeon, intensivist) can be activated.

Handover process

The transfer process of the patient and patient information in the chain of emergency care is displayed in Figure 1. A request for an ambulance can be made by a lay person calling the national emergency number, or by another healthcare professional (e.g. general practitioner). The request is handled by the EMD-intake nurse, who interrogates the caller and triages the problem. During the intake, information is stored into (1) the EMD-system and (2) the digital ambulance run sheet. On the basis of this information and guided by dispatch-protocols, the EMD-dispatch nurse decides about dispatching an ambulance. The ambulance can be dispatched with urgency level A1 (arrival <15 minutes), A2 (arrival <30 minutes) or B (planned). After on-scene diagnosis and treatment, the ambulance nurse may decide to transfer the patient to the ED. The ambulance crew provides a notification (N1) to the EMD-dispatch nurse by telephone, then the EMD-dispatch nurse calls the ED and notifies the ED (N2). Both calls are logged into the EMD-system. At the same time, the ambulance sends a digital notification (N3) to the ED. The digital notification is a short version of the ambulance run sheet with DeMIST data. When the ambulance arrives at the ED, the handover of the patient,

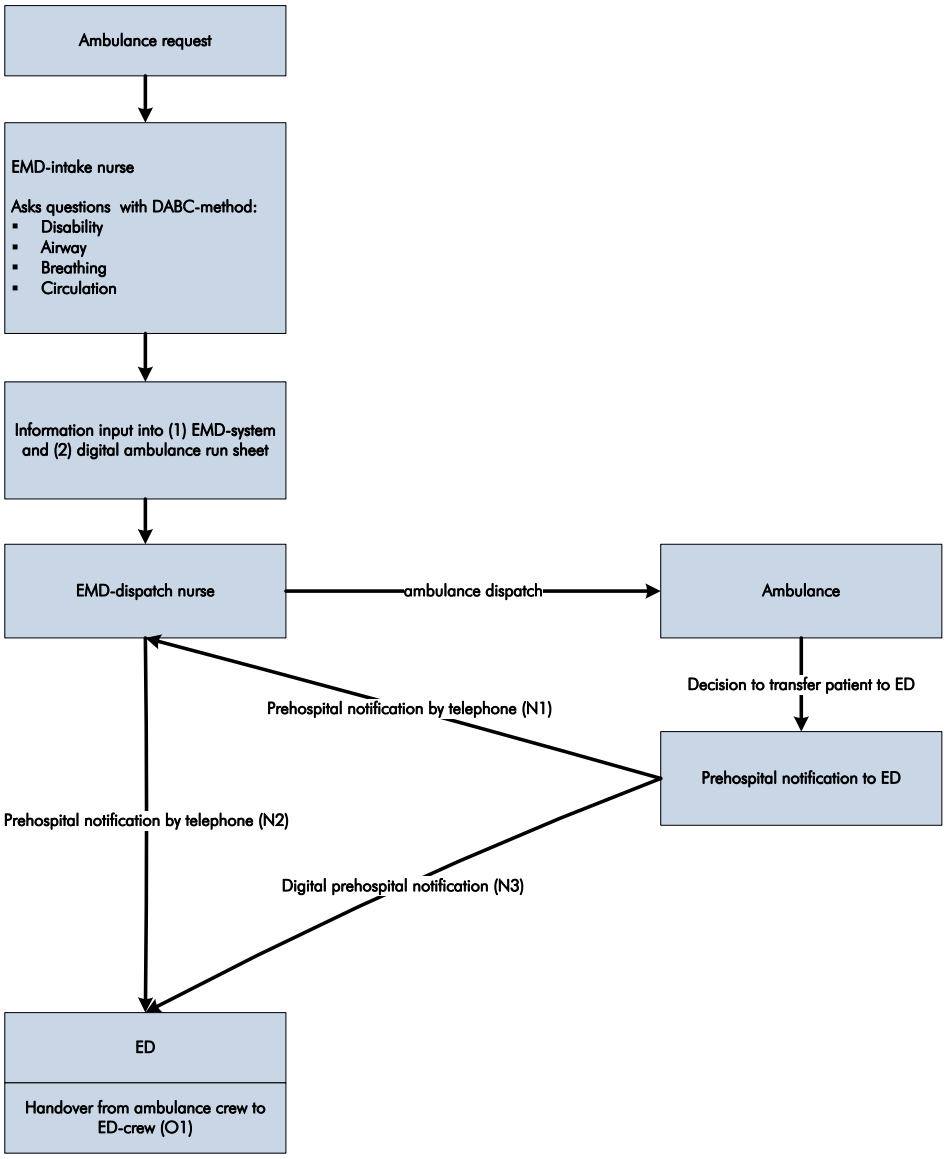

Figure 1: Handover process

the patient information, and the patients' personal belongings from ambulance to ED takes place (O1).

Outcomes

The degree of adherence to the key-recommendation to use the DeMIST-model in the correct sequence to structure pre-hospital notification and handover from ambulance to ED was the primary outcome of this study for N1, N2 and O1 (Table 1). For handover (O1), secondary outcomes based on guideline recommendations were the professional providing a handover (sender), the composition of the receiving team, recognizability of the receiver, handover moment, and verification if the handover was clear. The choice for 'composition of the receiving team' was also based on the idea that if the receiving team is complete at the start of a handover, this reduces the risk of loss of information due to multiple handovers ('Chinese whisper') [5]. Additional secondary outcomes based on literature were documentation of information from the handover, the number of repetitions, number of questions, and the number of interruptions other than repetitions and questions.

Table 1 Outcomes

Primary outcomes (N1 + N2 + O1)	Origin	Scoring options
Handover model used	Key-guideline recommendation	DeMIST/Other
Correct sequence of DeMIST model	Key-guideline recommendation	Yes/no/Specification of sequence if incorrect
Secondary outcomes (O1)		
Sender of the handover	Guideline recommendation	Ambulance nurse/ambulance driver
Composition of the receiving team	Guideline recommendation	ED-physician/ED-nurse/team
Recognizability of the receiver	Guideline recommendation	Optic/verbal/none
Handover moment	Guideline recommendation	Before/during/after patient transfer
Verification if handover was clear	Guideline recommendation	Yes/no
Documentation of handover	Literature	Whiteboard/DeMIST-form/patient file/different
No. of clarifying questions asked by receiver	Literature	Actual number
No. of repetitions from sender	Literature	Actual number
No. of interruptions other than questions or repetitions	Literature	Actual number

Pre-test

The pre-test phase consisted of two periods of 4 weeks between April 22nd and August 9th 2013. Handovers from ambulance to ED for all types of ambulance runs and all types of patients were included. Handovers of patients with a possible or confirmed MRSA-contamination were excluded, as these handovers took place in separate rooms with infection precautions.

Data were collected in two steps. First, all handovers from ambulance to ED were observed using a structured data collection form based on primary and secondary outcomes and scoring options (Table 1). Secondly, to collect data for the prehospital notification (N1+N2) from ambulance to ED we used audiotapes. Corresponding audiotapes for a handover were identified at the EMD using an unique ambulance run identifier. All data were collected by trained 4th year students from the bachelor of nursing or bachelor of health studies.

Intervention

We used Grol's model for effective implementation as study framework (Figure 2) [19,20].

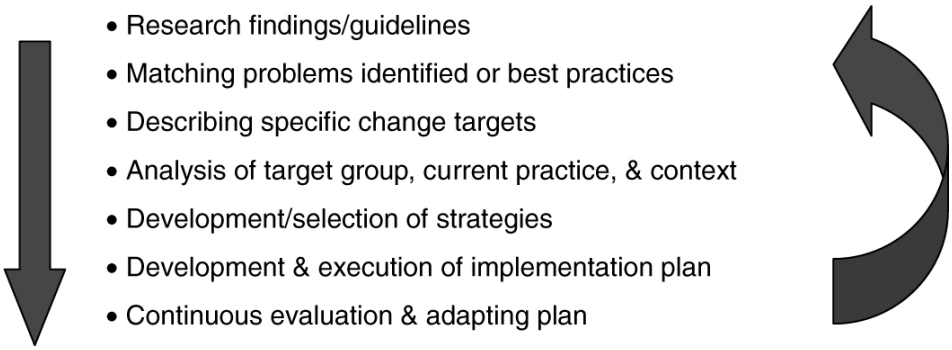

Figure 2: Model for effective implementation [19]

The model provides a stepwise approach for improving clinical practice and starts with the identification of research findings or guidelines that have to be implemented (step 1). Steps 2 and 3 include a description of (change) targets and an analysis of the target group, current practice and setting. On the basis of this analysis, implementation strategies can be selected or developed (step 4), followed by the execution and evaluation of an implementation plan (steps 5 and 6). For step 1 in this study, the aim was to implement the handover guideline. The analysis of the target group (step 2 and 3) was undertaken composing a multi-disciplinary steering group and conducting a focus group interview. The multi-disciplinary steering group included opinion leaders from the chain of emergency-care: 1 EMD nurse, 1 ambulance nurse, 1 ambulance care medical manager, 1 emergency physician and 1 emergency nurse. The role of the steering group was to provide input in the study design and to create support for the study in the local chain of emergency care. The aim of the focus group interview was to identify

handover problems in the local chain of emergency care. The focus group was organized in April 2013, participants were 2 emergency physicians, 2 emergency nurses, 2 ambulance nurses and 1 EMD-nurse. The focus group interview was audiotaped, and transcribed verbatim. Two researchers identified the problems on the basis of the transcription, and for each problem a key-determinant was added (Table 2). To enhance trustworthiness a member check was performed [21], therefore identified problems and determinants were sent to the participants of the focus group interview. Furthermore, problems which arose from the pre-test were also addressed.

Table 2 Handover problems identified in the chain of emergency care

Focus group interview	Determinants
• Non-usage of the DeMIST model • Incorrect sequence of the DeMIST model • Difficulties with applying the DeMIST model to trauma and non-trauma patients • Handover of subjective information/interpretation of information ("patient is stable) instead of objective parameters • Ambulance crew has the impression that the digital notification is only used for retrieval of patient information and not for monitoring the patient • Unclear for ambulance crew who is the receiver of the handover at the ED	Knowledge, skills and motivation on: • how to use the DeMIST for all types of patients (trauma and non-trauma) • the correct sequence of DeMIST • usage of objective information • the timing of the handover • the documentation of handover • the advantages of using the DeMIST model in the chain of emergency care
Pre-test • 77.9% of the handovers were structured with the DeMIST model • 69.9% of the DeMIST handovers had the correct sequence • 73.1% of the handovers took place after patient transfer • 49.0% of the handovers were interrupted by questions from ED-staff • 26.9% of the handovers were documented	

On the basis of identified problems and determinants the steering group chose to use a tailored online e-learning program as intervention. Literature suggests tailoring interventions to identified problems to increase effectiveness, although the effectiveness of tailoring has not been proven irrefutable yet [22]. Reasons to choose e-learning were (a) the fact that all determinants could be addressed, (b) the flexibility, availability and accessibility of using e-learning which suits the emergency care context [23], and (c) the fact the target group was familiar with e-learning in their training programs. The e-learning program was specifically designed for EMD-nurses, ambulance nurses and drivers, emergency nurses and physicians, on the basis of (1) the handover guideline, (2) literature, (3) expert opinion, and (4) identified problems. The e-learning program yielded five components aimed at (1) knowledge about the DeMIST model and handover process, (2) skills how to use the DeMIST model to provide a proper handover, and (3) motivation to use the DeMIST model in the total chain of emergency care (Table 3).

Table 3 Components and content of the e-learning program

Component	Aim	Content
Introduction	Explanation on the usage of the e-learning program and the learning goals to the participant	Learning goals • The professional knows the elements of a proper DeMIST handover • The professionals knows why it is important to use the DeMIST model for handover • The professional knows the role of the emergency medical dispatcher, ambulance driver, ambulance nurse, emergency nurse and emergency physician during handover • The professional performs a DeMIST handover for trauma and non-trauma patients
Theory	Provision of theory on DeMIST and its usage to the participant	Theory on DeMIST • De: full name, date of birth/age and sex of the patient • M: trauma or non-trauma • I: injuries found or suspected/complaints • S: Airway, Breathing (frequency, SpO_2), Circulation (heart rate, blood pressure), and Disability (EMV-score, pupil reaction, pain, blood glucose) • T: working diagnosis, treatment given, effect of the treatment When to use DeMIST How to use DeMIST Supply of objective information When to provide a handover Verification if handover was clear Who provides a handover to whom (professionals' role) Advantages of using the DeMIST in the total chain of emergency care
Knowledge test	Summative test whether the participant has sufficient knowledge, insight and basic skills about a DeMIST handover	8 random questions out of 22 on knowledge, insight and application of theory
Simulation test	Summative test whether the participant can integrate knowledge and skills to provide a DeMIST handover	2 high fidelity simulation scenarios, randomly picked from 7 possible scenarios: 1. Female (75 yrs), low energetic trauma (pedestrian-car) 2. Male (45 yrs), high energetic trauma (tree-car) 3. Female (28 yrs), hypovolemic shock (fluxus post partum) 4. Male (30 yrs), fever, hypotension altered consciousness (septicaemia) 5. Female (55 yrs), resuscitation 6. Male (68 yrs), resuscitation 7. Female (70 yrs), stroke
Evaluation	Feedback on knowledge and simulation test to the participant	Achievement on learning goals with feedback

During the knowledge test, 8 random questions were presented. The caesura for the knowledge test was 87.5% (1 wrong answer). The e-learning program included 7 simulation scenarios on trauma (2x), resuscitation (2x), septicaemia (1x), fluxus post-partum (1x), and stroke (1x). All scenarios were designed with regard to the 3 diagnoses with the highest national incidence in emergency care: cardiology, trauma and internal medicine. The scenarios could be simulated from EMD, EMS or ED perspective that the professional could choose. This choice was added to the e-learning program to emphasize the chain of emergency care. Professionals could exercise simulations before entering the simulation test. During the simulation test the professionals had to simulate two scenarios (caesura 90%). The construction of the simulation test included that the result of the first scenario cumulated to the result of the second scenario, so if the professional failed the first simulation, zero faults were allowed during the second simulation. The rationale was that professionals provided a good handover the first time, as in real practice the ambulance crew has only one opportunity to provide

a handover. Both the knowledge and simulation tests provided feedback to the professionals. The draft version of the e-learning program was tested on content and usability by representatives (n=6) from the targetgroup. There was no maximum time restriction for completion of the entire e-learning program.

Intervention phase

All possible professionals from the EMD (n=15) and EMS (n=73) who could be involved in a handover during the study period were invited to follow the e-learning program on October 3rd 2013. The e-learning program was accompanied by an email in which the purpose was explained, and in which the professionals were motivated by their managers and educational coordinators. Also, information on the EMD and EMS intranet was published and professionals were motivated to follow the e-learning program by members of the steering group. The professionals could start the e-learning program any time on any computer they wanted, until November 16th 2013. During this period, each professional received 2 digital reminders. To stimulate the professionals to follow the e-learning program, the program was accredited with official registration points for EMD and ambulance nurses, and ambulance drivers.

Post-test

The post-test phase lasted from November 11th until December 8th 2013. To collect data, the same methods were used as in the pre-test.

Data analysis

As this study is the first intervention study on handover, the number of observed handovers was based on feasibility and we did not perform a formal power analysis. To have an estimation, the minimum number of handovers required was determined by a power analysis using G*Power 3 [24]. Hereby, we set the α-level at .05 and the power level at .8. Based on these settings, we needed 143 handovers. Data were entered in SPSS and analysed using descriptive techniques. To compare the pre-test data with the post-test data, X^2-tests and t-tests were performed. For all tests, statistical significance was set at P-value less than 0.05. To enhance validity and reliability, all handovers and audiotapes were observed/listened by two independent observers who discussed differences until consensus was reached. Inter-rater reliability was computed for a random sample of 10% (n=17) of the observations in the post-test and was 91.9%.

Ethical considerations

On the basis of the study protocol, the Committee on Research Involving Human Subjects region Arnhem/Nijmegen waived the need for ethical approval (registration number 2013/046).

RESULTS

Intervention

In total, 78/88 (88.6%) professionals followed the e-learning program, of which 70/78 (89.7%) certified for the knowledge test, and 41/70 (52.6%) certified for the simulation test also. The professionals spent an average median time on the e-learning program of 75 minutes (Table 4).

Table 4 Characteristics of the e-learning program

Variable			
All professionals (n=88)			**n (%)**
Started the e-learning program			78 (88.6)
Certification status of starters (n=78)			**n (%)**
Knowledge test alone			29 (37.2)
Knowledge test + simulation test			41 (52.6)
Started but no certification			8 (10.3)
Average time spent of starters (n=78)	**25th percentile**	**Median**	**75th percentile**
Time spent on theory (in minutes)	5	11	18
Time spent on knowledge test (in minutes)	15	30	46
Time spent on simulation test (in minutes)	14	34	115
Total time spent (in minutes)	*47*	*75*	*181*

Handover from ambulance to ED

All observed handovers during the pre-test (n=145) were included. From the observed post-test handovers (n=169), two handovers were excluded as these were provided by EMS-students who did not work at the EMS during the intervention period, leaving a total of 167 handovers. There were no significant differences between both study periods regarding patient gender, medical specialty or urgency.

Regarding the primary outcome, no significant difference in the number of handovers that were structured with the DeMIST model between the pre-test (77.9%) and the post-test (73.1%) existed (Table 5). In the pre-test, 69.9% of the DeMIST handovers used a correct sequence, in the post-test this was 70.5%. When professionals deviated from the correct sequence during both the pre- and post-test, the most common deviation was to mix or switch the 'S' and 'T'. There was no association between medical specialty (trauma/non-trauma) and the correct sequence (X^2=.36, p=.872).

Table 5 Handover from ambulance to ED (O1)

Variable	*Pre-test (n=145)* *n (%)*	*Post-test (n=167)* *n (%)*	*p-value X^2-test*
Characteristics			
Patient gender			.797
Male	75 (51.7)	83 (49.7)	
Female	70 (48.3)	73 (43.7)	
Missing*		10 (6.0)	
Medical specialty			.106
Trauma	32 (22.1)	25 (15.0)	
Non-trauma	113 (77.9)	142 (85.0)	
Urgency			
A1 (within 15 minutes)	49 (33.8)	44 (26.3)	.152
A2 (within 30 minutes)	81 (55.9)	93 (55.7)	.975
B (low urgency/planned)	15 (10.3)	30 (18.0)	.056
Primary outcomes			
Handover model used			
DeMIST	113 (77.9)	122 (73.1)	.319
ABCD	0 (0.0)	2 (1.2)	-
AMPLE	0 (0.0)	1 (0.6)	-
No method/not recognizable	32 (22.1)	42 (25.1)	.523
Correct sequence of the DeMIST			
Yes	79 (69.9)	86 (70.5)	.159
No	34 (30.1)	24 (19.7)	
No sequence recognizable within DeMIST	-	12 (9.8)	
Secondary outcomes			
Receiving team composition at start handover			
Physician and nurse	62 (42.8)	68 (40.7)	.715
Physician later than start	64 (44.1)	90 (53.9)	.035**
Nurse later than start	18 (12.4)	9 (5.4)	.055
Physician and nurse too late	1 (0.7)	-	-
Receivers recognizability			
Optic	33 (22.8)	39 (23.4)	.901
Verbal	29 (20.0)	49 (29.3)	.057
Not recognizable	83 (57,2)	79 (47.3)	.080
Handover given by			
Ambulance nurse	143 (98.6)	157 (94.0)	.035**
Ambulance nurse + ambulance driver	2 (1.4)	10 (6.0)	

Receiver handover			
ED physician	19 (13.1)	26 (15.6)	.553
ED nurse	64 (44.1)	89 (53.3)	.120
ED team (minimum: ED nurse + ED physician)	61 (42.1)	52 (31.1)	.040**
Missing	1 (0.7)	-	-
Handover moment			
Before patient transfer	28 (19.3)	40 (24.0)	.322
During patient transfer	3 (2.1)	9 (5.4)	.128
After patient transfer	106 (73.1)	110 (65.9)	.167
Different (patient is to toilet or is in different room)	8 (5.5)	8 (4.8)	.772
Number of handovers with repetitions	17 (11.8)	21 (12.6)	.819
Number of handovers with questions	71 (49.0)	115 (68.9)	.000**
Number of handovers with interruptions	22 (15.2)	88 (52.7)	.000**
Number of handover were verification was asked	22 (15.2)	19 (11.4)	.322
Handover documented	39 (26.9)	49 (29.3)	.632
Whiteboard	0 (0.0)	2 (4.1)	-
DeMIST form	1 (2.6)	3 (6.1)	-
Patient file	0 (0.0)	1 (2.0)	-
Different***	38 (97.4)	43 (87.8)	.095

*The gender was not registered for 10 patients, this could not be retrieved
**significant difference
***glove, napkin, sheet, paper

The composition of the receiving team differed after the intervention as less handovers started with presence of an emergency physician. There was no difference in how the receivers made themselves recognizable. During the post-test, significantly more handovers in which the ambulance driver was involved took place. Between pre- and post-test, there were no significant differences between the moment of the handovers, although the highest number of handovers take place after patient transfer. After the intervention, the number of handover with questions (p=.000) and interruptions (p=.000) significantly increased, the number of handovers with repetitions did not differ. The percentage of handover with a verification did not significantly decrease.

Pre-hospital notification

During the pre-hospital notification from ambulance to EMD (N1), no

significant difference in the number of handovers that were structured with the DeMIST model between the pre-test (72.9%) and post-test (80.7%) existed (Table 6). In the pre-test, 66.7% of the DeMIST handovers used a correct sequence, in the post-test this was 56.5%. During the pre-hospital notification from EMD to ED (N2), no significant difference in how many handovers were structured with the DeMIST model between the pre-test (83.3%) and post-test (86.5%) existed. In the pre-test, 84.0% of the DeMIST handovers used a correct sequence, in the post-test this was 73.3%.

Table 6 Prehospital notification (N1+N2)

	Pre-test (n=145) *n (%)*	*Post-test (n=167)* *n (%)*	*p-value X^2-test*
EMS to EMD by telephone (N1)			
Notification given	70 (48.3)	57 (34.1)	
Handover model used			
DeMIST	51 (72.9)	46 (80.7)	.147
ABCD	1 (1.4)	-	-
AMPLE	1 (1.4)	-	-
No method/not recognizable	17 (24.3)	11 (19.3)	.500
Correct sequence of the DeMIST			
Yes	34 (66.7)	26 (56.5)	.304
No	17 (33.3)	20 (43.5)	
EMS to ED by telephone (N2)			
Notification given	60 (41.4)	52 (31.1)	
Handover model used			
DeMIST	50 (83.3)	45 (86.5)	.149
ABCD	1 (1.7)	-	-
AMPLE	-	-	-
No method/not recognizable	9 (15.0)	7 (13.5)	.817
Correct sequence of the DeMIST			
Yes	42 (84.0)	33 (73.3)	.203
No	8 (16.0)	12 (26.7)	

DISCUSSION

This study evaluated the effectiveness of a tailored e-learning program to improve adherence to a handover guideline in the chain of emergency care. A total of 314 handovers from ambulance to ED were observed and results show no significant differences regarding the usage and correct sequence of the DeMIST model between the pre-test and post-test.

Results from both the pre-test and post-test phase show adherence rates to the DeMIST model ranging from 77.9%-73.1%, and adherence rates for correct sequence ranging from 69.9%-70.5%. To our knowledge, no studies investigated adherence to an ambulance to ED handover model in real practice, only one study assessed adherence the ISBAR handover model in a simulated setting, reporting an improvement in correct sequence from 0%-

46% after a high-fidelity simulation intervention [25]. Compared to other guideline adherence rates in the prehospital and ED setting, adherence in our study is relatively high [26]. Nevertheless, the results also indicate room for improvement as in 22.1%-25.1% of the handovers no model was recognizable. This might incorporate the risk for loss or deformation of essential information. Possibly, this result indicates that professionals might perceive that the DeMIST model does not fit entirely for all patients handed over from ambulance to ED. For instance, one often heard counter argument for the (De)MIST is that it might be less applicable to non-trauma or non-critical patients [13], however our results show no association between trauma or non-trauma and the correct sequence of the DeMIST. On the other hand, one might argue that there are no valid reasons to deviate from a handover guideline, in contrast to diagnostic or therapeutic guidelines and protocols where deviations on the basis of patient conditions or preferences can be justified.

The e-learning program was not effective in improving and thereby implementing the new guideline, this can be explained by several reasons. The first reason might be the relatively high baseline adherence rates. These high rates can be caused by the (De)MIST integration in basic emergency care education in the Netherlands. Another reason might be the sole use of the e-learning program as the sole use of an educational intervention might not be effective [20]. However, emergency care research shows moderate to good effects of the sole use of e-learning [16-18]. Furthermore, our results might also urge the use of blended-learning were e-learning is combined with face-to-face educational meetings [23]. Despite these results, the effectiveness of e-learning should be further investigated as it is widely used to educate and train emergency care professionals [23].

A third reason might be that only the handover senders (EMD and ambulance professionals) were trained. During the study period it was not possible to train the ED-staff because they already were in training for the implementation of a digital patient file. A previous study showed that information retention by ED-staff decreased from 56.6% to 49.2% if the handover model is implemented in the ambulance setting only [7]. This stresses the need to implement a handover model in the chain of emergency care.

A fourth reason is the fact that 88.6% of the professionals started the e-learning program and that 52.6% of the starters certified for the whole

program. This means that the intervention did not fully reach all intended professionals. The variation around the median time spent on the simulation test reflects the struggle professionals had with certifying for the simulation test, which was due to the accumulation of the result of scenario 1 with scenario 2. This accumulation resulted in a significant amount of the professionals who had to try several times before certifying for the simulation test which caused the high variation, and in 37.2% of the professionals who only certified for the knowledge test.

Despite relatively high adherence rates for the key-guideline recommendation, our results indicate several areas of improvement for handover from ambulance to ED. Firstly, in 26.9%-29.2% of the handovers transferred information was documented by ED-staff during handover. Most information was written down on gloves, napkins, pieces of paper or sheets, which carries the risk that this information is not integrated in medical records. In our study medical records were not checked for documented information after handover, but previous studies indicate suboptimal documentation of transferred information [9,27].

Secondly, the number of handovers in which verification was asked by ambulance staff, dropped from 15.2% to 11.4%. A previous simulation study also showed low rates of verification, although these rates increased after simulation exercises [25]. Verification of a handover indicates the end of the handover and might prevent interruptions of the handover due to questions asked by ED-staff.

Thirdly, most handovers took place after patient transfer in the ED. Handing over a patient during or after transfer, incorporates the risk that ED-staff already starts diagnostic or therapeutic actions that might distract ED-staff from the handover.

Fourthly, in 44.1%-53.9% the complete team was not present at the start of the handover. A previous study reported physician absence at 88% of the handovers [28]. Our results might be caused by lower-acuity patients for whom it is less urgent to be seen by a physician. Another explanation might be that there is no pre-hospital notification given by the ambulance crew to ED, as with 41.4% of the handovers in the pre-test and 31.1% of the handovers in the post-test a verbal notification was given. Another reason can be that the digital pre-hospital notification (N3) arrives too late at the ED sometimes, and the handover already took place.

Fifthly, the number of handovers with questions from ED-staff and interruptions significantly increased after the intervention. This might be caused by the fact that only the senders of the handover were trained, and that the receiving ED-staff had to get used to the structure. Most of the questions were related to the vital signs ('S') and treatment ('T'). The treatment given is marked by emergency nurses and physicians as an essential element of the handover [6], this might explain the questions. In this study we were not able to mark the questions and repetitions as contributing to the handover or disturbing the handover. Repetitions and questions might contribute to the handover as they can clarify treatment, and lead to hearing specific aspects of the handover again [6]. On the other hand, repetitions and questions might disturb a handover as they might reflect a lack of listening skills or inattention of ED-staff, and ambulance staff gets frustrated if they have to repeat themselves, or as their findings are questioned [6,13]. Most of the interruptions were related to the patient or patients' next of kin. There were relevant interruptions (changing or adding information), and non-relevant interruptions which that were caused by the patient talking (with next of kin or the ambulance driver), phones ringing, and the arrival of other professionals.

Strengths and weaknesses

Obviously, the absence of a control group might be a threat to the external validity. Another threat to the validity of this study is the Hawthorne effect: the ambulance crew and ED personnel could see the observers when they were present at the ED. Furthermore, not all staff participated in the full intervention, which could explain limited effects. Also, it is possible there are other determinants that influence handover which were not integrated in the e-learning program, making the e-learning program less powerful. Inter-rater reliability between 2 observers was calculated for 10% of the observations, showing a satisfying 91.9% agreement. To increase reliability between pre- and post-test, observers of the post-test were trained by observers from the pre-test, but despite this effort slight differences in observations between pre- and post-test might have occurred. Finally, statistical significance may have occurred due to multiple X^2-testing, although in the light of the low number of significant tests this did not seem a major issue.

Future research

Future research should focus on the applicability of different handover models to structure the handover in the chain of emergency care. Which models are applicable for which settings and patients groups? Also, the

additional effect of training the receivers of the handover (ED-staff) should be investigated. Furthermore, the use of multiple strategies or blended learning should be examined for their effectiveness to improve handover practice. Finally, the user satisfaction of e-learning to implement a (handover) guideline can be evaluated.

CONCLUSION

This pre-test post-test study found no effect of a tailored e-learning program on adherence to a handover guideline. The results suggest that e-learning alone does not improve adherence. Despite the relatively high baseline adherence, our results indicate room for improvement in the handover process, with regard to documentation of information during the handover, the handover moment, and the completeness of the receiving team at the start of the handover.

Acknowledgements

The authors would like to thank Wim Huijzendveld and Paul Sanders for their role in motivating the professionals to follow the e-learning program. Furthermore, the authors would like to thank all the students from the bachelor nursing and bachelor of health for their support during data collection.

Conflicts of interest

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper. The developer of the e-learning program had no involvement in study design and interpretation of the data.

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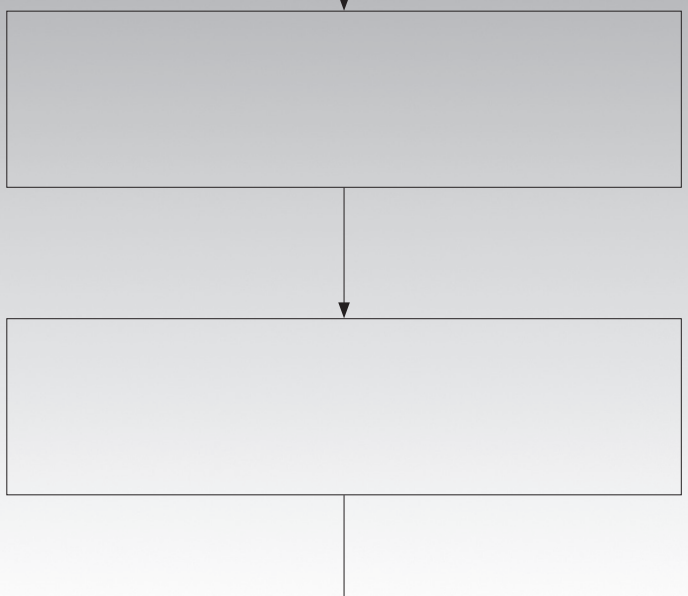
CHAPTER 7

General discussion



GENERAL DISCUSSION

This chapter will discuss the main results of this thesis in the perspective of current knowledge and emergency care practice. Also, an overview of methodological considerations will be provided. Following the main conclusions, recommendations for clinical practice, education, and future research will be formulated.

Guideline implementation in prehospital and emergency care settings is suboptimal, which might lead to a gap between recommended care and clinical practice. This might be due to the lack of evidence-based recommendations, due to suboptimal guideline adherence, due to guideline revisions not finding their way into clinical practice, or due to the delayed implementation of guidelines [1-3]. For patients, this may result in inappropriate or unnecessary care, and potential harm [4]. The studies in this thesis gave insight in the degree to which emergency care professionals adhere to guidelines and protocols, and provided insight in factors influencing adherence. Finally, an educational strategy tailored to the target group was tested for effectiveness in improving adherence to a handover guideline.

The research questions in this thesis were:

1. To what degree do professionals in the chain of emergency care adhere to guidelines and protocols?
2. Which factors influence adherence to guidelines and protocols in the chain of emergency care?
3. What is the effectiveness of a tailored e-learning program to improve adherence to a handover guideline in the chain of emergency care?

Adherence to guidelines and protocols

To gain insight in adherence to guidelines and protocols in the chain of emergency care, different research methods were used. Chapter 2 reported guideline adherence rates from reviewing 35 studies in the ambulance and emergency department (ED) settings. For the ambulance and ED settings adherence rates ranged from 7.8%-95%, and from 0%-98% respectively. Our own studies, using self-report scales (chapter 3 and 4) on ambulance and emergency nurses' adherence to their national protocols in the Netherlands, showed adherence rates of 83.4% and 38%. The adherence rates obtained through observations in our handover study (chapter 6) showed adherence rates to a handover guideline ranging between 69.9% and 77.9%.

Overall, these results indicate that adherence to guidelines in the ambulance and ED settings is highly variable and suboptimal. Our results are comparable with recent studies in the ambulance and ED settings published after our systematic review [5-8]. Similar rates were reported in studies on guideline adherence in the emergency medical dispatch center [9], intensive care unit [10,11], and the recovery room [12,13]. Literature suggests attainable adherence rates of 80-90%, as there will always be some situations where guideline deviations are desired [14]. These deviations and the justification for the deviation should be registered by the professional. From a patient perspective, as a result of suboptimal adherence rates there is a potential risk that patients requiring urgent diagnosis and treatment do not always receive optimal care [4]. Studies show that mortality and adverse event rates decreased if guideline adherence increased for patients with pulmonary embolism, ST-segment elevation myocardial infarction, acute ischemic stroke, cardiac arrest, and moderate to severe trauma injuries [15-20]. For example, a retrospective study on patients with moderate to severe injuries (n=3867) quantified this risk reduction and showed that each 10% increase in guideline adherence was associated with a 14% mortality risk reduction, and patients where guideline adherence was 100% were 58% less likely to die compared to patients where guideline adherence was lower than 100% (OR = 0.42; 95% CI 0.28-0.62) [20]. These results indicate the need for improvement in guideline adherence.

Factors influencing adherence

As our results indicate the room for improvement in guideline adherence in the ambulance and ED settings, strategies to improve adherence should be selected or developed. To be effective, it is recommended to tailor strategies to factors influencing guideline adherence. Factors can be identified through analyses of the target group, current practice, and context [21]. Studies in our review (chapter 2) showed influencing factors related to the patient (age, race, sex, weight, time of presentation, insurance status, current disease/condition and comorbidity) and to the organization (presence of an emergency physician, hospital/ED ownership (non-federal or governmental), and location of the hospital). Also, the type of guideline recommendation with regard to medical function (diagnostic, treatment, monitoring, organizational) and medical specialisms (cardiology, pulmonology, infectious diseases, neurology, etc), seemed to influence adherence.

We suspected that the influencing factors reported in the review did not entirely reflect all possible factors influencing adherence. Therefore, the

studies reported in chapters 3, 4 and 5 aimed to identify factors influencing ambulance and emergency nurses' adherence to their national protocols in the Netherlands. In these studies we used questionnaires and interviews to collect data. Results showed factors related to the professional, characteristics of the guideline or protocol, the organization, and social context. This multifactorial influence in the emergency care settings was previously reported for pain management [22], triage [23], cervical-spine clearance [24], and for physicians' adherence to guidelines in general [14,25]. The identified factors will be discussed below.

Professional
The professionals' autonomy to deviate from guidelines and protocols on the basis of their own clinical experience emerged as an influencing factor for adherence in all studies. Nurses and physicians from ambulance and ED settings indicated that professional autonomy and protocol-based care are closely related. Ambulance nurses in the interviews stated that they have the autonomy to deviate from protocols on the basis of their clinical experience (chapter 5). The role of autonomy and clinical experience are also identified in chapter 3. In this study, an increase in adherence is associated with an increase of the protocol being part of own routines, and a decrease of interference with professional autonomy.

Our results indicate that ambulance nurses integrate their individual clinical expertise into their protocols. This is consistent with a study where nurses report that their practice is influenced by guidelines in the first place, followed by their own experience, local policies and patients preferences [26]. Other studies describe the nurse as an autonomous professional who integrates clinical experience into decision making [27,28]. Our results also match two components of the concept of evidence-based practice, where integration of individual clinical expertise is necessary to tailor decision-making to the individual patient to avoid inapplicable or inappropriate diagnostics and treatment [29].

The ambulance nurses mentioned the integration of clinical experience into their protocols, in contrast to emergency nurses, who preferred their clinical experience over protocol-based care. Literature shows that 69% of nurses mark their own past experiences as the most important source of evidence [26].

There are several explanations for this difference between ambulance and

emergency nurses. Firstly, it might be that the ambulance setting in the Netherlands is historically more protocol-orientated than the ED setting. Since 1992, the National Protocol Ambulance Care (NPAC) holds a central position in the education of ambulance nurses, as well as in ambulance care health policy, and has a regulated legal fundament [30]. The National Protocol Emergency Department (NPED) was introduced over a decade later in 2006, and was not implemented in emergency nursing education, nor holds a central position in ED health policy. Secondly, many EDs have developed local protocols. These local protocols may differ in quality and applicability, as reflected in a Dutch study that concluded that acute pain protocols are lacking in many EDs, and if a protocol is available, the quality and applicability is suboptimal [31]. Other ED protocols were often based on guidelines or expert opinion from in-hospital disciplines. The absence of a protocol or other guidance may lead to reliance on clinical experience [32]. Thirdly, 45% of the interviewed emergency nurses and 56% of the emergency physicians were not aware of the NPED. In literature, awareness is also recognized as a factor influencing physician adherence [25]. Most likely, awareness came up as an influencing factor because the NPED was not implemented in the same way as the NPAC: the NPED was disseminated without an implementation strategy. This underlines that effective dissemination is necessary for effective implementation, but solely disseminating a guideline or protocol is not enough for effective implementation [33]. However, it might be expected that the emergency nurses of our sample were aware of the existence of the NPED since the sample consisted entirely of members of the Dutch Emergency Nurses Association[1] who developed and disseminated the NPED.

Summarized, the NPED was not systematically implemented, most likely resulting in emergency nurses being unaware of their national protocol. Therefore, emergency nurses have to deal with a lot of different medical conditions, without being aware of their national protocol. Furthermore local protocols are lacking, or the quality and applicability of local protocols might vary. This can result in emergency nurses relying on their own clinical experience, which might explain their preference of clinical experience. However, when individual clinical expertise is preferred over guideline-based care, inaccurate or incorrect decision-making may be the result. This is reflected in studies that show paramedics' inability to determine which patients need ambulance transportation to the ED [34,35], to correctly triage patients [36], and to assess for which pediatric patients an ED trauma team

1 Nederlandse Vereniging Spoedeisende Hulp Verpleegkundigen (NVSHV): www.nvshv.nl

should be activated [37], on the basis of their own clinical judgment. Another study compared determinations where emergency medical dispatchers' (EMDs) overruled dispatch protocols on the basis of their own experience, with determinations that were adherent to the dispatch protocols [38]. This study concluded that protocol-based dispatching leads to more accurate and consistent determinations than the subjective, or experience-based determinations made by individual EMDs. This literature underscores that although there should be room for the professionals' clinical experience, too much reliance on clinical experience may result in inaccurate or incorrect decision-making.

Guideline or protocol characteristics
In chapters 2, 3 and 4, we already saw that guideline or protocol characteristics -such as the medical function of the recommendation and medical condition covered by the guideline- might influence adherence. Almost 14% of the variability in ambulance nurses' adherence to the NPAC was related to protocol characteristics, including applicability. Our results underline these findings, since we found that ambulance and emergency nurses perceive their national protocols as (too) complex. A recent survey among professionals from prehospital and ED settings investigated preferred guideline attributes from the professionals' perspective [39]. This study showed that the preferred formats for guidelines were clinical protocols with recommendations incorporated into the workflow. Guideline key-recommendations should be clearly marked, specific, and precise. The importance of guidelines and protocols being specific and precise was shown by a study among Dutch general practitioners, that classified guideline characteristics as important influencing factor for adherence [40].

An explanation for the perceived varying applicability and complexity might be that only a few ambulance nurses and emergency nurses were involved in the development and adjustment of the NPAC and NPED. A recent Swedish study showed that protocols ended up being too complex, partly because intended users were not involved in protocol development [41]. Additionally, a recent systematic review on the contribution of nurses in protocol-based care concluded that it is difficult to identify the participation of nurses in the development process of protocols, because the nurses' contribution was modest compared to other professions [42]. Literature suggests that "guideline developers need to engage with end-users to ensure that guideline formats and information are relevant for specific settings and tailored to needs of EMS providers" [39]. Therefore, it is promising that the Dutch sector

organization ambulance care[2] has currently involved ambulance nurses more systematically during the update of the NPAC. To systematically assess the engagement of intended target users, and the applicability of the NPAC, instruments like the AGREE-instrument could be helpful [43].

On the other hand, the varying applicability might partly reflect the principle of evidence-based practice which involves judicious use of evidence in the decision-making in relation to individual patients. As the best available evidence often originates from scientific research with selected, homogeneous patient populations without comorbidities, this might not always be applicable to the specific patient, with his specific needs, and in his specific context. This is clearly reflected in a study on ischemic heart disease guideline adherence [44]. Due to the prospect of healthcare for ageing patients with increasing comorbidity, the number of situations where deviations are required might increase.

Finally, most nurses perceive their protocol as supporting for diagnosis and treatment, and believe that the protocol improves patient outcomes. Literature shows a relationship between guideline adherence and positive patient outcomes [15-19]. Next to that, the level of evidence of specific guideline recommendations influences adherence also [40]. Therefore, we believe that clear relationships between guideline adherence and positive patient outcomes, and clear evidence for recommendations within guidelines or protocols, are strong motivators for professionals to adhere. But when transforming this evidence into a guideline or protocol recommendation, the applicability should be tested. The updated version of the NPAC might be helpful in this respect, as the idea is to have a more dynamic NPAC in which evidence for specific topics is integrated whenever relevant research is published.

Organization
Our empirical studies indicated that it is important to embed protocols in (local) training and education. Ambulance nurses stated that the NPAC was well embedded, contributing to higher adherence. Emergency nurses stated the NPED was not embedded, contributing to possible non-adherence. This underlines the importance of organizations embedding guidelines and protocols -including revisions and updates- in their educational programs. Literature shows that insufficient training can lead to reliance on clinical experience [32], and that educational meetings can improve professional

2 Ambulancezorg Nederland (AZN): www.ambulancezorg.nl/Engels

practice and patient outcomes [45]. From the perspective of the chain of emergency care this implies joint training and education, because each professional should be aware of the previous and successive link in the chain.

We also found that it is important for organizations to establish 'feedback-on-adherence' mechanisms. Ambulance nurses felt the need for receiving feedback on protocol adherence, and their self-report adherence was associated with feeling safe to discuss protocol deviations. This finding is also found in other studies [22,46]

Social context
Our results indicated that the social context of the ambulance and emergency nurses influences adherence. For ambulance nurses it seemed important that colleagues (ambulance nurses, EMS-physicians, and ambulance drivers), expect they work with the NPAC, as higher expectancy of these professionals was associated with higher self-reported guideline adherence. Our results also showed that emergency nurses felt that emergency physicians were less interested in a 'nursing protocol' and that nursing colleagues mark the NPED as not important to work with. However, the interviewed emergency physicians stated they were interested in a nursing protocol so they could strive for uniformity in nursing and medical care. In general, little is known about the relevance of the social context in the implementation of nursing innovations, but a systematic review identified 15 different team characteristics [47]. For the social context in the prehospital setting, the support of EMS medical directors was identified as influencing factor for local implementation of national guidelines for prehospital termination of unsuccessful resuscitation efforts [48]. Also, support of emergency nurses is identified as factor influencing adherence to a non-ST-segment elevation acute coronary syndrome guideline [49].

These results indicate that is important to involve not only the intended target users, but also allied professionals when developing, disseminating and implementing guidelines and protocols. Literature shows that professional organizations are concerned with the development and dissemination of guidelines, and informing their members [50]. The next step can be the development of multi-professional guidelines for the chain of emergency care, with integrated training and education.

Patients
In the studies aimed at identifying influencing factors, professionals did not

mention patient related factors. Yet, observations from the handover study (chapter 6) revealed interruptions of handovers due to the patient or their next of kin, by adding or correcting information. These interruptions might reveal incomplete assessment by the ambulance nurse, but might also indicate that the patient is trying to express his preferences if not specifically asked by a professional. That patient preferences can influence guideline adherence was shown in a study where non-trauma patients' preference accounted for 78% of ED destination decisions of ambulance nurses [51], and in a study where general practitioners took into account patient preferences when caring for patients with heart failure [52]. Another study showed that 48.6% of the patients refused recommended pain treatment on an ED [53].

These results from literature support the need for integration of patient preferences in decision making in prehospital and ED care. Although this can be challenging because of the patient acuity might hinder a proper integration of patient preferences, from research we know that patient acuity has no impact on the patients' desire for information or engagement in decision making [54]. Patients not being fully capable to communicate their preference or take their role in decision making might be another challenge. A recent systematic review showed that decision support interventions (DSI) for patients in ED settings had a positive impact on patient knowledge, satisfaction, and degree of engagement in decision making [55]. Besides DSI's, another possible solution might be that patients are involved in the development of guidelines and protocols to integrate 'common patient preferences'. Further research on how patient preferences can be integrated in prehospital and ED clinical practice should be performed.

E-learning to improve guideline adherence

In the handover study (chapter 6) we assessed the effectiveness of a multifaceted tailored e-learning program - with a simulation component - to improve adherence to a newly developed guideline for the handover from ambulance to ED. Despite of the fact that we tailored the e-learning program to identified influencing factors, it did not improve adherence. Although tailoring of interventions is recommended, there is no conclusive evidence that tailoring is effective [56,57], or that a multifaceted intervention is more effective than a single-component intervention [58]. Another reason for the intervention being not effective might be due to our choice for the sole use of an educational intervention. Previous implementation research is not decisive on the effectiveness of the sole use of educational interventions [33]. On the

other hand, examples in emergency care showed moderate to good effects of e-learning alone [59-61].

This study also shows the challenge of designing multi-professional education that fits into practice. It also shed light on the challenge to develop tailored strategies for the chain of emergency care, and to apply such strategies to all professionals. Within this chain, educational and cultural backgrounds differ, the NPAC and NPED have a different background and status, and not all settings and professionals are equally familiar with e-learning. Despite these differences, a Cochrane review shows that multi-professional education can have small positive effects on patient outcomes and guideline adherence rates, although the level of evidence is low [62].

METHODOLOGICAL CONSIDERATIONS

We used various research methods to address our research questions. These included a systematic literature review, quantitative cross-sectional questionnaire studies, a qualitative interview study, and a pre-experimental study. Within each study, specific strengths and limitations were discussed. In this paragraph, we will discuss general methodological considerations for this thesis.

The first consideration relates to the model used as a framework for this thesis: the model for effective implementation that uses a stepwise approach to accomplish practice improvement [33]. The handover study (chapter 6) followed this stepwise model from identification of the guideline to be implemented (step 1), up to the execution of the implementation strategy (step 5), which leaves only step 6 (continuous evaluation on process and outcome) unaddressed. All other studies represent important aspects of one step of the model, with a focus on the analysis of the target group, current practice and setting. Results from these studies provide input for the next steps of the model. The model was useful to assess guideline adherence from different points of view, to design our studies, and to structure this thesis. Another reason to use this generic model was the absence of a model specific for the prehospital and emergency care field. To assist future implementation, it might be useful to develop such a model.

A strength of this thesis is the use of quantitative and qualitative research designs. Due to this multi-method approach, a broad spectrum of influencing factors emerged, and the results of the studies were complementary to each other.

A weakness may be that this thesis did not cover/include the patient perspective, although the Federation of Patients and Consumer Organizations in the Netherlands (NPCF) was invited to participate in the steering group. The perspective of the patient did not emerge from the interviews, and we also did not add this in our questionnaires. In emergency care the perspective of the patient is generally underexposed, as the contact between patient and professional often is short, and patients require urgent diagnostics and treatment. Nevertheless, it is inevitable that patients with acute needs have opinions and expectations about guideline adherence. Recent studies showed that 'care provision' and 'quality of care' are features of patients' expectations of ED care [63,64].

The inclusion of ambulance and emergency nurses from the Netherlands, and a focus on Dutch national protocols, might involve a threat to the external validity of the studies in this thesis. In the Netherlands, ambulance and emergency nurses have several years of clinical experience, are highly trained, and have followed additional (inter)national and local training programs. This staffing of ambulances with highly trained nurses is common in other countries such as Belgium, Finland and Sweden, but uncommon for countries that staff ambulances with paramedics or emergency medical technicans [65]. Furthermore, the protocols under study in this thesis, the NPAC and NPED, are specifically designed for the Dutch setting. By including these nurses and focusing on these protocols, we might have identified factors influencing adherence related to the nurses' specific backgrounds, or the characteristics of the Dutch protocols. Therefore, our results may be of somewhat limited value for other settings and countries.

Specifically for the systematic review in chapter 2 the first methodological consideration is the heterogeneity in designs, methods, professionals, settings, quality, and guidelines of the studies included. This heterogeneity also made it impossible to conduct a meta-analysis. The second consideration concerns our choice to include studies on adherence in the emergency medical dispatch, prehospital EMSs, and EDs. While these three settings are often regarded as the chain of emergency care, they differ with regard to personnel, scopes of practice, education, capabilities, and status of guidelines and protocols. Despite these differences, the underlying rationale is that all professionals, irrespective of setting, are expected to provide care as described in guidelines and protocols.

For the quantitative studies reported in chapters 3 and 4, some overlapping methodological considerations exist. Both studies used questionnaires on which the ambulance and emergency nurses could report their adherence on a self-rating scaling from 0%-100%. This self-report method comes with the risk of overestimation. Our questionnaires were developed on the basis of existing instruments, literature, and expert opinion. Validity and reliability were only tested on a small scale. In addition, the use of questionnaires to identify influencing factors depends on the perceptions of the nurses. Since non-adherence might not completely occur conscious, these perceptions may not accurately reflect the magnitude of the reported influencing factors. The studies reported in chapters 3 and 4 might have suffered from selection and sampling bias. The emergency nurses who received the questionnaire were all members of the Dutch Emergency Nurses Association (DENA). The members of the DENA themselves may be a selected population with characteristics that differ from non-members, such as opinion and awareness about guidelines and protocols. Also, all nurses and physicians in chapter 5 were selected through self-selection or snowball sampling, therefore it might be possible that only professionals with a strong opinion about protocol adherence were interviewed. Furthermore, all studies identifying influencing factors focused on factors as perceived by professionals. These perceived factors may not reflect the whole range of influencing factors.

The handover study reported in chapter 6 might have suffered from the socially desirable behaviors of the observed professionals, as observations were not hidden from the professionals. This may have resulted in overestimation on the degree of adherence, or observation of other barriers than normally would have occurred. As the ambulance service in the handover study was familiar with blended learning, a blended-learning intervention was considered for this study. Within the 'blended learning' concept, e-learning is used in combination with face-to-face educational meetings [66]. However, due to organizational restrictions, execution of a blended-learning intervention was not possible.

Finally, the studies described in this thesis focus on the chain of ambulance and ED settings. Although the description of the chain of emergency care in the Netherlands also includes general practitioners and the helicopter emergency medical service sometimes, which we did not include in our studies, we do think that a positive point of the current thesis is our focus on at least one part the chain of emergency care instead of just one single setting. This focus is reflected in incorporating professionals from ambulance

and ED settings in the same study, the guidelines under study (handover guideline), the intervention used (e-learning program), and multi-disciplinary composition of steering groups and committees with representatives of all professionals from the chain of emergency care. This focus provided the opportunity to study adherence to guidelines in the chain of emergency care, thus contribute to improving patient care. The focus on the total chain increased the awareness of different cultures and interests between the different departments, and the necessity of communication and integration.

CONCLUSIONS

Three main conclusions from this thesis can be drawn. Firstly, adherence to guidelines and protocols in the ambulance and emergency department settings is variable and suboptimal. Although justified reasons for guideline deviations can exist, our results indicate a need for improvement as adherence rates did not come near 100%. This might lead to a risk that patients receive inappropriate, unnecessary, or even harmful care.

Secondly, adherence is influenced by multiple factors related to the professional, the characteristics of the guideline, the organization, and the social context. The relative weight of each of these factors differs per setting and per guideline or protocol. The most important professional related factors are individual clinical experience, and awareness of the existence of the protocol. Applicability and complexity of guidelines and protocols are important guideline characteristics that influence adherence. As for organizational factors, embedding protocols in training and education, and feedback on guideline or protocol adherence, are important. The expectancy of colleagues that professionals work with their protocols is an important social factor influencing adherence. Yet, the influence of factors related to the patient is probably underexposed.

Thirdly, the sole use of an e-learning program does not improve adherence to a handover guideline, even when this is tailored to identified influencing factors. Thus, additional strategies are needed to improve care provision.

RECOMMENDATIONS

On the basis of the results in this thesis, we formulate the following recommendations to practice, education and research.

Recommendations for emergency care practice

1. Develop and measure indicators to monitor guideline or protocol adherence systematically;
2. Involve the intended target users in the development, evaluation, and adjustment of protocols and guidelines;
3. Involve patients or patient representatives in the development, evaluation, and adjustment of protocols and guidelines;
4. Whenever evidence is available for the relationship between guideline adherence and patient outcomes, use this evidence as a key-component of education and feedback on adherence;
5. Make professionals aware of patient related factors influencing adherence from the beginning of basic education;
6. Organize multi-professional education in the chain of emergency care to improve adherence to guidelines and protocols;
7. Establish feedback mechanisms on adherence;
8. Make guidelines and protocols applicable by involving intended target users in the development phase. Use the AGREE-instrument to assess the applicability of the guideline or protocol;
9. Update the NPED, develop a 'revision-cycle' for regular updates, and develop dissemination and implementation strategies for the NPED.

Recommendations for education

1. Educate professionals on the consequences of suboptimal adherence rates;
2. Embed guidelines and protocols in bachelor, master and resident training- and educational programs for professionals in the chain of emergency care;
3. Whenever evidence is available on the relationship between guideline adherence and patient outcomes, use this evidence as a key-component from the beginning of basic education;
4. Make nursing and medical students aware of the patient as factor influencing adherence from the beginning of basic education;
5. Educate professionals and students on how to use implementation frameworks to systematically implement guidelines and protocols.

Recommendations for future research

1. Assess guideline and protocol adherence for other disciplines in the chain of emergency care (GP's, helicopter EMS);
2. Identify patient related factors influencing adherence;
3. Study the relationship between guideline adherence and patient outcomes;
4. Assess adherence to guidelines and protocols in the emergency medical dispatch setting;
5. Identify the justified or non-justified guideline deviations with the aim to contribute to improvement of the guideline and its adherence;
6. Design/Develop (tailored) strategies to improve adherence and assess their effectiveness;
7. Design/adapt an implementation framework for the field of prehospital and emergency care.

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CHAPTER 8

Summary

SUMMARY

Clinical practice guidelines and protocols are developed to reduce variation of practice, to improve quality of care, and to ensure that evidence is used when appropriate. Studies show that guideline implementation in the prehospital and ED settings is not optimal, potentially leading to suboptimal patient care. The studies in this thesis provide insight into the extent to which emergency care professionals adhere to guidelines and protocols, and into factors influencing adherence. Finally, a tailored strategy to improve adherence to a guideline for handover from ambulance to ED was tested.

Chapter 1

Chapter 1 includes an introduction of the main themes, the relevance of the main themes, and the research questions. The role of guidelines and protocols within evidence-based practice in general is described, followed by a description of the gap between recommended care and care provided. The need for professionals to adhere to guidelines and protocols is discussed. Then, the need to implement guidelines and protocols in a systematic way is outlined, followed by a brief description of the model for effective implementation. Following a description of the Dutch chain of emergency care, the national protocols for ambulance and emergency nurses are described. Finally, the study aims and research designs of main projects in this thesis are presented. The introduction ends with the aim and the central research questions of this thesis:

1. To what degree do professionals in the chain of emergency care adhere to guidelines and protocols?
2. Which factors influence adherence to guidelines and protocols in the chain of emergency care?
3. What is the effectiveness of a tailored e-learning program to the improve adherence to a handover guideline in de chain of emergency care?

Chapter 2

Chapter 2 contains a systematic literature review with the main objective to provide an overview on professionals' adherence to guidelines and protocols in emergency care settings. A second objective was to explore which factors influencing adherence were described in studies reporting on adherence. PubMed (including MEDLINE), CINAHL, EMBASE and the Cochrane database for systematic reviews were systematically searched. Reference lists of included studies were handsearched for eligible studies. Thirty-five articles describing guideline adherence in the ambulance and

emergency department settings were included. No studies describing adherence to guidelines and protocols in the emergency medical dispatch settings were identified. Median adherence ranged from 7.8-95% in the prehospital setting, and from 0-98% in the emergency department setting. The type of guideline recommendation seems to influence adherence, as monitoring recommendations showed higher adherence percentages than treatment recommendations, and cardiology treatment recommendations show lower median adherence percentages. Eight studies identified patient (age, race, sex, weight, time of presentation, insurance status, current disease/condition and comorbidity) and organization (presence of an emergency physician, hospital/ED ownership (non-federal or governmental), and location) related factors influencing adherence. Three studies indicated that adherence to guidelines improves patient outcomes. We concluded that professionals' adherence to (inter)national prehospital and emergency department guidelines shows a wide variation, which indicates room for improvement. As only 8 studies on adherence reported influencing factors, future implementation research should identify influencing factors to develop strategies to improve adherence and to improve quality of care.

Chapter 3

The study in chapter 3 explored which factors influenced ambulance nurses' adherence to the National Protocol Ambulance Care (NPAC). As adherence to prehospital guidelines and protocols is suboptimal, insight into influencing factors is necessary to improve adherence. In 2012, ambulance nurses (n=452) from four geographically spread emergency medical services (EMSs) in the Netherlands were invited to fill out the questionnaire. The questionnaire included questions on influencing factors and self-reported adherence. It was developed on the basis of literature, and expert opinion. Questionnaires were returned by 248 (55%) of the ambulance nurses. These ambulance nurses' self-reported adherence to the NPAC was 83% (95% confidence interval 81.9–85.0). Results show a multifactorial influence on adherence as 23 factors had a significant relationship with adherence. These influencing factors could be related to the individual professional, organization, protocol characteristics and social context. Multilevel regression analysis showed that 21% of the variation in adherence was explained by protocol characteristics (complexity, the degree of support for diagnosis and treatment, the relationship of the protocol with patient outcomes) and social influences (expectance of colleagues to work with the national protocol). Therefore, the study concluded that these factors seem the most important to address when improving adherence.

Chapter 4

The study in chapter 4 explored which factors influenced emergency nurses' adherence to the National Protocol Emergency Department (NPED). In 2010, emergency nurses (n=200) and physicians with medical end-responsibility on an emergency department (n=103) received a questionnaire. The questionnaire included questions on influencing factors and self-reported adherence, and was developed on the basis of literature, and expert opinion. Response rate was 39% for the emergency nurses (78/200) and 49% for the physicians (50/103). Emergency nurses' self-reported adherence to the NPED was 38%. A major influencing factor for adherence to the NPED was awareness, as 55% of the nurses and 44% of the physicians were aware of the NPED. Influencing factors from the emergency nurses' perspective were interference with professional autonomy, preference of personal routines, insufficient support to implement the NPED, and the organization not expecting emergency nurses to work with the NPED. Influencing factors from the physicians' perspective were preference of personal routines, insufficient support to implement the NPED, and the NPED being too much 'cookbook-like'. The study concluded that main influencing factor for adherence seems awareness, and that factors were related to the individual, the organization and to protocol characteristics. Important factors were interference with professional autonomy, insufficient organizational support, and the EDNP's applicability were indicated as barriers for adherence.

Chapter 5

The study in chapter 5 was intended to gain an in-depth understanding of factors influencing ambulance and emergency nurses' adherence to the NPAC and NPED. To collect data, five ambulance nurses, five emergency nurses, five EMS physicians, and five emergency physicians were interviewed between September 2009 and January 2010. Content analysis was used to identify influencing factors. For both nurses and physicians, influencing factors were related to the individual, protocol characteristics, the social context, and the organization. Depending on the setting a factor could be a barrier or a facilitator for adherence. Individual related factors were individual (clinical) experience, awareness, and the preference of following local protocols instead of national protocols. Organizational or external factors were involvement in protocol development, training and education, control mechanisms for adherence, and physicians' interest. Protocol related factors were integration of the advanced trauma life support approach, the protocols being in accordance with daily practice, and the generality of the content. The study concluded that adherence is influenced by multiple factors

and to improve adherence multifaceted implementation strategies should be tailored to identified factors.

Chapter 6

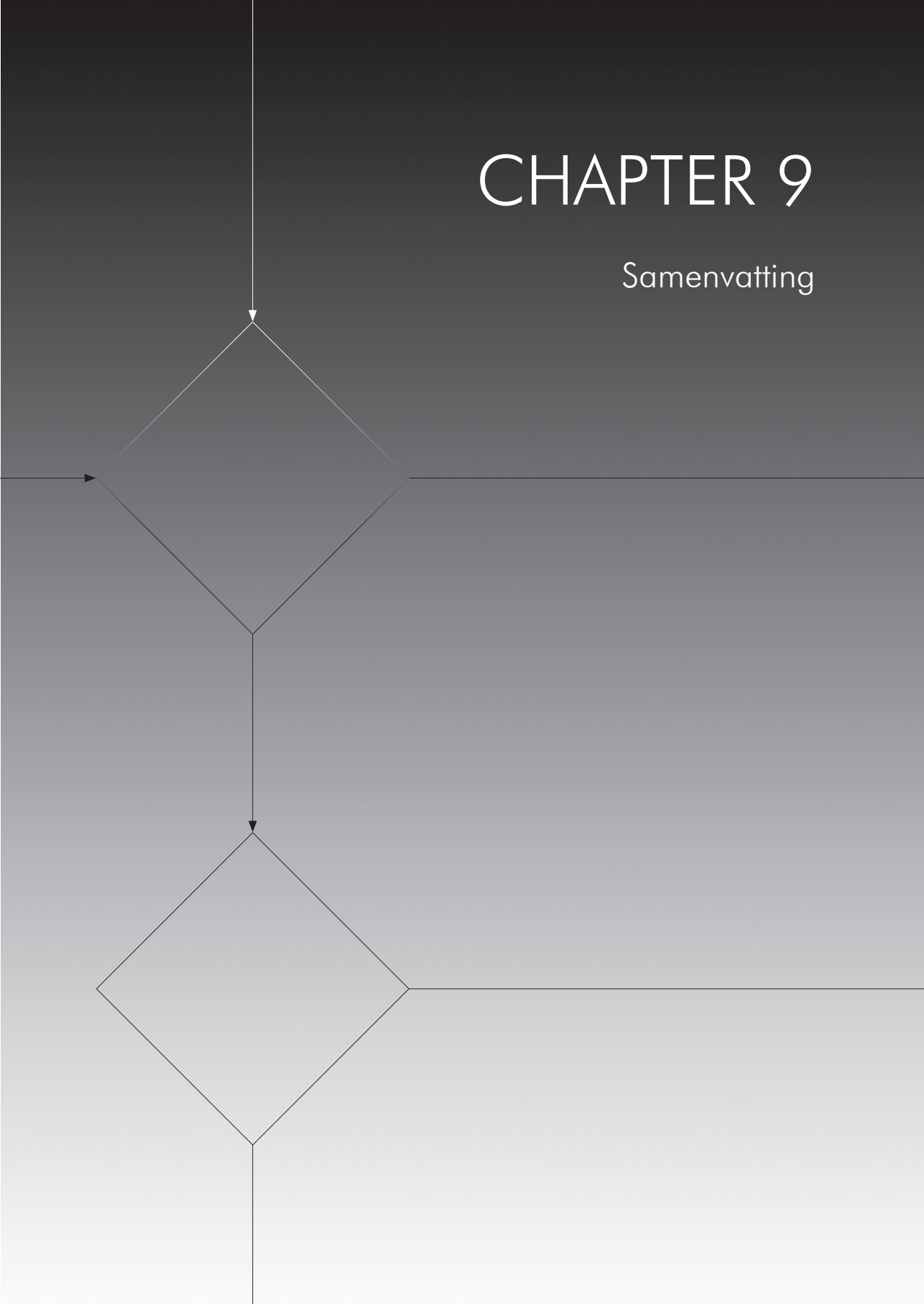
The study in chapter 6 describes a prospective pre-test post-test study to evaluate the effectiveness of a tailored e-learning program to improve emergency care professionals' adherence to a handover guideline during pre-hospital notification and handover in the chain of emergency medical service (EMS), emergency medical dispatch (EMD), and emergency department (ED). To standardize patient handover in the chain of emergency care a handover guideline was developed; the key-recommendation is to use the DeMIST model (Demographics, Mechanism of injury/illness, Injury/illness, Signs, Treatment given) to structure handover. The e-learning program was developed on the basis of the handover guideline, literature, expert opinion, and identified problems in the handover process. The e-learning program was offered to ambulance crew and emergency medical dispatchers (n=88), of which 78/88 (88.6%) followed the e-learning program. During pre- and post-test, 146 and 169 handovers were observed respectively. After the e-learning program, no significant difference in use of the DeMIST model was found. The number of questions by ED staff during handovers, and the number interruptions significantly increased. During pre- and post-test most handovers were performed after patient transfer. The study concluded that the e-learning program did not improve adherence to a handover guideline in the chain of emergency care. Improvements in the handover process can be made on the documentation of information during handover, the number of interruptions and questions, and the handover moment.

Chapter 7

The final chapter includes the general discussion of the studies incorporated in this thesis. First, the results are summarized and discussed in the context of literature, emergency care clinical practice, and the Dutch setting. Furthermore, methodological strengths and limitations are discussed. The main conclusions are that (1) adherence to guidelines and protocols in the prehospital and emergency department settings is variable and suboptimal, (2) adherence is influenced by multiple factors related to the professional, the characteristics of the guideline, the organization, and the social context, and (3) that a tailored e-learning program is not effective to improve adherence to a handover guideline. Finally, recommendations for clinical practice, education, and future research are formulated.

CHAPTER 9

Samenvatting



SAMENVATTING

Richtlijnen en protocollen worden ontwikkeld om de variatie van professioneel handelen te reduceren, om kwaliteit van zorg te verbeteren en om te zorgen dat wetenschappelijk bewijs op het juiste moment en de juiste wijze worden gebruikt. Wetenschappelijke studies laten echter zien dat implementatie van richtlijnen en protocollen in de prehospitale en spoedeisende hulp (SEH) settings niet optimaal is, wat in potentie kan leiden tot suboptimale zorg voor de patiënt. De studies in dit proefschrift geven inzicht in welke mate ambulance en SEH professionals richtlijnen en protocollen opvolgen en welke factoren deze richtlijnopvolging beïnvloeden. Daarnaast wordt getest hoe effectief een e-learningprogramma is om de opvolging van een richtlijn voor de overdracht van ambulance naar SEH te verbeteren.

Hoofdstuk 1

Hoofdstuk 1 bevat de introductie van dit proefschrift waarin we de hoofdthema's en hun relevantie bespreken en de onderzoeksvragen formuleren. De rol van richtlijnen en protocollen binnen evidence-based practice (EBP) wordt beschreven, gevolgd door een beschrijving van het gat tussen aanbevolen zorg en feitelijke zorg. Het belang dat professionals richtlijnen en protocollen opvolgen wordt bediscussieerd. Vervolgens wordt de noodzaak beschreven om richtlijnen en protocollen op een systematische wijze te implementeren, waarbij specifiek wordt ingegaan op het model van effectieve implementatie van Grol en Wensing. Hierna wordt de spoedzorgketen in Nederland beschreven, met daarin de plaats en functie van het Landelijk Protocol Ambulancezorg (LPA) en het Landelijk Protocol Spoedeisende Hulp (LPSEH). Aansluitend worden de doelen van de twee onderzoeksprojecten uit dit proefschrift geformuleerd, waarbij ook de verschillende onderzoeksdesigns worden beschreven. De introductie eindigt met de onderzoeksvragen die centraal staan in dit proefschrift:

1. In welke mate volgen professionals in de spoedzorgketen richtlijnen en protocollen op?
2. Welke factoren beïnvloeden richtlijn- en protocolopvolging door professionals in de spoedzorgketen?
3. Wat is het effect van een e-learningprogramma op de opvolging van een richtlijn voor de overdracht van ambulance naar SEH door professionals in de spoedzorgketen?

Hoofdstuk 2

In hoofdstuk 2 beschrijven we een systematisch literatuuronderzoek die als

primaire doel had om een overzicht te geven van de mate van opvolging van richtlijnen en protocollen in de spoedzorg. Het secundaire doel was om te exploreren welke beïnvloedende factoren voor richtlijn- en protocolopvolging werden beschreven door studies die richtlijnopvolging bestuderen. Met behulp van zoekstrategieën hebben we de wetenschappelijke databases PubMed (inclusief MEDLINE), CINAHL, EMBASE en de Cochrane database for systematic reviews systematisch doorzocht. Tevens hebben we referentielijsten van geïncludeerde studies doorzocht. In totaal hebben we 35 artikelen geïncludeerd die richtlijnopvolging in de ambulance en/of SEH setting beschrijven. We hebben geen artikelen over protocolopvolging, of studies in de meldkamer setting geïdentificeerd. De range van mediane opvolgingspercentages voor de ambulancesetting loopt van 7,8% tot en met 95%. Voor de SEH-setting is dit van 0% tot en met 98%. Uit de review blijkt ook dat het type richtlijnaanbeveling de mate van richtlijnopvolging lijkt te beïnvloeden. Zo lijken de aanbevelingen om te gezondheidstoestand van een patiënt te monitoren een hoger opvolgingspercentage te hebben dan de aanbevelingen om een patiënt te behandelen. Ook lijken de aanbevelingen van cardiologische richtlijnen lagere opvolgingspercentages te hebben in vergelijking tot overige specialismes. Acht studies rapporteren ook factoren die richtlijnopvolging beïnvloeden, deze factoren zijn gerelateerd aan de patiënt (leeftijd, ras, geslacht, gewicht, tijdstip van presentatie, verzekeringsstatus, huidige ziekte en comorbiditeit) en de organisatie (aanwezigheid van een SEH-arts, overheidsziekenhuis of privekliniek, en locatie van de SEH). Drie studies rapporteren dat een hogere mate van richtlijnopvolging leidt tot een verbetering van patiëntuitkomsten. Op basis van deze systematische literatuurstudie concludeerden we dat de opvolging van richtlijnen in de ambulance en SEH settings een grote variatie kent, waarbij er ruimte bestaat om de richtlijnopvolging te verbeteren. Tevens formuleerden wij als aanbeveling dat toekomstig onderzoek zich moet richten op het identificeren van beïnvloedende factoren voor opvolging van richtlijnen en protocollen om gerichte strategieën te ontwikkelen om opvolging, en daarmee de kwaliteit van zorg, te verbeteren.

Hoofdstuk 3

In hoofdstuk 3 beschrijven we een kwantitatieve, cross-sectionele studie met als doel om factoren te identificeren die de opvolging van het LPA door ambulanceverpleegkundigen beïnvloeden. Omdat richtlijnopvolging suboptimaal is, is inzicht in beïnvloedende factoren essentieel om te komen tot verbetering. In 2012 verstuurden we een vragenlijst naar 452 ambulanceverpleegkundigen die werkzaam waren bij 4 regionale

ambulancevoorzieningen (RAV) die geografisch over Nederland zijn verspreid. De vragenlijst bevatte vragen over beïnvloedende factoren en ambulanceverpleegkundigen konden middels zelfrapportage een opvolgingspercentage voor het LPA geven. De vragenlijst ontwikkelden we op basis van literatuur en expert opinion. In totaal hebben 248/452 (55%) van de ambulanceverpleegkundigen de vragenlijst teruggestuurd. De ambulanceverpleegkundigen rapporteerden een gemiddeld opvolgingspercentage van het LPA van 83% (95% betrouwbaarheidsinterval: 81,9%–85,0%). De opvolging van het LPA wordt beïnvloed door 23 factoren, deze hadden een significante relatie met opvolging van het LPA. De factoren konden worden gerelateerd aan de individuele ambulanceverpleegkundige, de RAV, de kenmerken van het LPA en de sociale context. Een multilevel regressie-analyse verklaarde 21% van de variatie in opvolging van het LPA door kenmerken van het LPA (complexiteit, de mate waarin het protocol de diagnostiek en behandeling van de patiënt ondersteunt, de relatie tussen het opvolgen van het protocol en patiëntuitkomsten) en sociale context (de mate waarin collega's verwachten dat een ambulanceverpleegkundige werkt met het LPA). We concludeerden dan ook dat protocolkenmerken en de sociale context de belangrijkste factoren zijn waarop strategieen voor verbetering van protocolopvolging door ambulanceverpleegkundigen moeten worden gericht.

Hoofdstuk 4

In hoofdstuk 4 beschrijven we een kwantitatieve, cross-sectionele studie met als doel om beïnvloedende factoren voor opvolging van het LPSEH door SEH-verpleegkundigen te identificeren. In 2010 verstuurden we een vragenlijst aan SEH-verpleegkundigen (n=200) en artsen met medische eindverantwoordelijkheid op de SEH (n=103). De vragenlijst bevatte vragen over beïnvloedende factoren. SEH-verpleegkundigen konden middels zelfrapportage een opvolgingspercentage voor het LPSEH geven. De vragenlijst ontwikkelden we op basis van literatuur en expert opinion. In totaal hebben 78/200 (39%) van de SEH-verpleegkundigen en 50/103 (49%) van de artsen de vragenlijst terug gestuurd. De SEH-verpleegkundigen rapporteerden een gemiddeld opvolgingspercentage van het LPSEH van 38%. De belangrijkste beïnvloedende factor voor opvolging van het LPSEH was of de professional op de hoogte is van het bestaan van het protocol. De resultaten laten zien dat 55% van de SEH-verpleegkundigen en 44% van de artsen op de hoogte was van het LPSEH. Verdere beïnvloedende factoren vanuit het perspectief van de SEH-verpleegkundigen zijn de professionele autonomie van de SEH-verpleegkundige, het prefereren van

individuele routines, onvoldoende steun om het LPSEH te implementeren en weinig verwachting vanuit de organisatie dat het LPSEH wordt gebruikt. Beïnvloedende factoren vanuit het perspectief van de artsen zijn het prefereren van individuele routines, onvoldoende steun om het LPSEH te implementeren en de perceptie dat het LPSEH teveel 'kookboekzorg' is. We concludeerden dat de belangrijkste beïnvloedende factor is 'het op de hoogte zijn van het bestaan van het protocol'. Overige beïnvloedende factoren zijn gerelateerd aan de individuele professional (professionele autonomie), de organisatie (onvoldoende steun voor implementatie) en protocolkenmerken (toepasbaarheid).

Hoofdstuk 5

In hoofdstuk 5 beschrijven we een kwalitatieve studie met als doel om diepgaand inzicht te krijgen in factoren die opvolging van het LPA en het LPSEH door respectievelijk ambulance- en SEH-verpleegkundigen beïnvloeden. Om gegevens te verzamelen interviewden we in de periode van september 2009 tot en met januari 2010 vijf ambulanceverpleegkundigen, vijf SEH-verpleegkundigen, vijf medisch managers ambulancezorg (MMA) en vijf SEH-artsen. Voor zowel het LPA als het LPSEH zijn beïnvloedende factoren gerelateerd aan de individuele professional, protocolkenmerken, de sociale context en de organisatie. Afhankelijk van de setting is een beïnvloedende factor positief of negatief beïnvloedend. Aan de individuele professional gerelateerde factoren zijn individuele klinische ervaring, op de hoogte zijn van het bestaan van het protocol en het prefereren van lokale protocollen boven nationale protocollen. Organisatorische en externe factoren zijn betrokkenheid bij de protocolontwikkeling, scholing en training, controle op protocolopvolging en de interesse van artsen in verpleegkundige protocollen. Belangrijke protocolkenmerken zijn integratie van de Advanced Trauma Life Support benadering (ATLS), de toepasbaarheid en de generieke inhoud. Wij concludeerden dat opvolging van het LPA en het LPSEH wordt beïnvloed door meerdere factoren tegelijkertijd en dat strategieën om protocolopvolging te verbeteren multifactorieel van aard moeten zijn.

Hoofdstuk 6

In hoofdstuk 6 beschrijven we een prospectieve voor- en nameting studie naar het effect van een e-learningprogramma op de opvolging van een richtlijn 'vooraankondiging en overdracht' door professionals in de keten ambulance, meldkamer en SEH. Om de patiëntoverdracht in de spoedzorg te standaardiseren ontwikkelden we in nauwe samenwerking met beroepsverenigingen uit de spoedzorg een richtlijn conform de

methode voor Evidence Based Richtlijn Ontwikkeling (EBRO-methode). De kernaanbeveling uit de richtlijn is om het DeMIST (Demographics, Mechanism of injury/illness, Injury/illness, Signs, Treatment given) model te gebruiken om vooraankondiging en overdracht te structureren. Het e-learningprogramma is ontwikkeld op basis van de richtlijn, literatuur, expert opinion en geïdentificeerde problemen in het overdrachtsproces. Het e-learningprogramma is aangeboden aan ambulanceverpleegkundigen en –chauffeurs en meldkamercentralisten (n=88). In totaal hebben 78/88 (88,6%) van de professional het e-learningprogramma gevolgd. Tijdens de voormeting hebben we 146 overdrachten geobserveerd, tijdens de nameting waren dit er 169. Na het e-learningprogramma bestond er tussen de voor- en nameting geen significant verschil in de mate waarin het DeMIST model werd gebruikt om de overdracht te structureren. Het aantal vragen door SEH-personeel en het aantal onderbrekingen van de overdracht namen wel toe. Zowel tijdens de voormeting als tijdens de nameting zijn de meeste overdrachten uitgevoerd nadat de patiënt was over getild op de behandeltafel van de SEH. Wij concludeerden dat het e-learningprogramma de opvolging van de richtlijn 'vooraankondiging en overdracht' niet heeft verbeterd. Verbeteringen in het overdrachtsproces kunnen worden behaald op de documentatie van de informatie tijdens de overdracht, het aantal onderbrekingen en vragen, en het moment van overdragen.

Hoofdstuk 7

Hoofdstuk 7 bevat de algemene discussie van de studies die zijn opgenomen in dit proefschrift. Eerst worden de resultaten uit de verschillende studies kort samengevat, waarna ze worden bediscussieerd in de context van literatuur, de klinische praktijk in de spoedzorg en de Nederlandse setting. Vervolgens worden methodologische sterktes en zwaktes besproken en worden conclusies geformuleerd. De eerste conclusie van dit proefschrift is dat opvolging van richtlijnen en protocollen in de ambulance en SEH settings varieert en dat er ruimte voor verbetering bestaat. De tweede conclusie is dat de opvolging van richtlijnen en protocollen in deze settings wordt beïnvloed door factoren gerelateerd aan de individuele professional, de organisatie, de sociale context en protocolkenmerken. Patiënt gerelateerde factoren zijn bekend uit literatuur en werden geobserveerd, maar kwamen niet uit de vragenlijsten en interviews naar voren. De derde conclusie is dat een e-learningprogramma specifieke gericht op het overdrachtproces niet leidt tot een verbetering in de opvolging van een richtlijn 'vooraankondiging en overdracht'. Tot slot formuleren we aanbevelingen voor de klinische praktijk, onderwijs en onderzoek.

CHAPTER 10

List of abbreviations

LIST OF ABBREVIATIONS

AMPLE	Allergies, Medications, Past illnesses, Last meal, Events
ASHICE	Age, Sex, History, Injuries, Condition, Expected time of arrival
ATLS	Advanced Trauma Life Support
AZN	Dutch Ambulance Care Organization
CBA	Controlled Before-After Study
CCU	Coronary Care Unit
CICU	Cardiac Intensive Care Unit
CRCT	Cluster Randomized Controlled Trial
DeMIST	Demographics, Mechanism of Injury, Injuries, Signs, Treatment
DENA	Dutch Emergency Nurses Association (NVSHV)
DEPA	Dutch Emergency Physicians Association (NVSHA)
EBM	Evidence-based medicine
EBP	Evidence-based practice
ED	Emergency Department
EMD	Emergency Medical Dispatch
EMS	Emergency Medical Service
ENPC	Emergency Nursing Pediatric Course
EPOC Taxonomy	Effective Practice and Organization of Care
HEMS	Helicopter Emergency Medical Service
ICU	Intensive Care Unit
IMIST-AMBO	Identification of the patient, Mechanism/medical complaint, Injuries, Signs, Treatment and treatment response/trend, Allergies, Medications, Background and Other
ITS	Interrupted Times Series
KLPS-project	Ketenbrede Landelijke Protocollen Spoedzorg
MANP	Master Advanced Nursing Practice
MeSH	Medical Subject Headings
MICU	Mobile Intensive Care Unit
NCBA	Non-Controlled Before-After study
NPAC	National Protocol Ambulance Care (LPA)
NPED	National Protocol Emergency Department (LPSEH)
NRCT	Non-Randomized Controlled Trial
PA	Physician Assistant
RCT	Randomized Controlled Trial

SOAP	Subjective information, Objective information, Assessment, Plan
SPSS	Statistical Package for Social Sciences
PRISMA statement	Preferred Reporting Items for Systematic Reviews and Meta-Analysis
STROBE statement	Strengthening the Reporting of Observational Studies in Epidemiology
TNCC	Trauma Nursing Core Course
TREND statement	Transparent Reporting of Evaluations with Nonrandomized Designs
UH	University Hospital

CHAPTER 11

List of publications

LIST OF PUBLICATIONS

Scientific publications

1. Ebben RHA, Vloet LCM, Mintjes-de Groot AJ, Van Achterberg T. Factors influencing adherence to an Emergency Department National Protocol. European Journal of Emergency Medicine. 2012;19(1):53-6
2. Ebben RHA, Vloet LCM, Schalk DMJ, Mintjes-de Groot AJ, Van Achterberg T. An exploration of factors influencing ambulance and emergency nurses' protocol adherence in the Netherlands. Journal of Emergency Nursing. 2014; 40(2):124-130
3. Ebben RHA, Vloet LCM, Verhofstad MHJ, Meijer S, Mintjes-de Groot AJ, Van Achterberg T. Adherence to guidelines and protocols in the prehospital and emergency care setting: a systematic review. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 2013; 21:9 DOI: 10.1186/1757-7241-21-9
4. Ebben RHA, Vloet LCM, Van Grunsven PM, Breeman W, Goosselink B, Lichtveld RA, Mintjes-de Groot AJ, Van Achterberg T. Factors Influencing ambulance nurses' adherence to an National Protocol Ambulance. An implementation study in the Netherlands. European Journal of Emergency Medicine. 2014: 10.1097/MEJ.0000000000000133
5. Ebben RHA, Van Grunsven PM, Moors ML, Aldenhoven P, De Vaan J, Van Hout R, Van Achterberg T, Vloet, LCM. A tailored e-learning program to improve handover in the chain of emergency care: a pre-test post-test study. Accepted for publication in Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine

Professional publications

1. Ebben RHA, Schalk DMJ, Kemps HHLM, Mintjes-de Groot AJ. Professioneel handelen in de spoedzorg. Ontwikkeling en implementatie van richtlijnen en protocollen. Triage. Tijdschrift Nederlandse Vereniging Spoedeisende Hulp Verpleegkundigen. 2009;3:17-20
2. Ebben RHA, Mintjes-de Groot AJ. Professioneel handelen in de spoedzorg. Ontwikkeling van ketenbrede landelijke protocollen spoedzorg. Vakblad V&VN Ambulancezorg. 2009;4:32-33
3. Leijtens J, Ebben RHA. Straks werken op de spoedeisende hulp of intensive care. Triage. Tijdschrift Nederlandse Vereniging Spoedeisende Hulp Verpleegkundigen. 2010;1:20-21
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CHAPTER 12

Dankwoord

DANKWOORD

Aan de finish van een promotietraject staat er maar een persoon in de spotlights. De route naar de spotlight is er echter een die je niet alleen aflegt, en naar mijn ervaring ook een route die je niet alleen af zou moeten willen leggen. De route maakt de uitkomst alleen maar rijker. Het was voor mij een route vol met vertrouwenschenkers, balansbewakers, kansenbieders, draagvlakcreërders en supporters.

Prof. Dr. T. van Achterberg Theo, kort na mijn aanstelling in juni 2009 volgde op aandringen van Joke een gesprek over een mogelijk promotietraject. Ik twijfelde over promoveren en had veel vragen: is het iets voor mij? Lukt het mij? Hoe doe je dat dan? Tijdens dit gesprek was er de 'klik' en gaf je mij het laatste zetje om te promoveren. Een zetje waar ik absoluut geen spijt van heb. Je balans tussen persoonlijke aandacht en werk, en tussen humor en serieus, waren een enorme stimulans voor het voltooien van dit traject. Zelfs toen je voorstelde om voor een studie de dataverzameling over te doen, bracht je het op zo'n wijze dat ik niet anders kon dan akkoord gaan. En eerlijk is eerlijk, het artikel is beter geworden. Mensen uitdagen en stimuleren tot het maximale lijk je te hebben gemaakt tot jouw specialiteit, zonder daarbij het individu uit het oog te verliezen. Veel dank hiervoor.

Dr. L.C.M. Vloet Lilian, balans is bij jou het sleutelbegrip. Een medebewaker van de balans tussen onderwijs, onderzoek en privé, dat was wat ik nodig had en wat jij te bieden had. In je rol als copromotor vonden wij al snel een natuurlijke samenwerking, ook hier weer een 'klik'. Ondanks de verhouding copromotor-promovendus, heb ik vaak gelijkwaardigheid en ruimte in deze samenwerking ervaren, wat mij perspectief bood om door te groeien en de lat steeds hoger te leggen. Je invloed gaat dan ook verder dan alleen dit promotietraject, voor mij ben je een voorbeeld in het leggen van de verbinding tussen onderwijs, onderzoek en de praktijk. Een beeld dat ik ook probeer uit te dragen in mijn werk.

Dr. A.J. Mintjes-de Groot Joke, nu is het officieel: ik ben je laatste promovendus. Dit traject begon op nieuwjaarsdag 2009 met een bericht op de weblog van het lectoraat: een aankondiging dat er subsidie was geworven voor een nieuw project waarvoor een onderzoeker werd gezocht. Na het bericht meerdere malen te hebben gelezen in de week daarna, heb ik gebeld naar het lectoraat voor meer informatie over de vacature. We

hebben een half uur met elkaar gesproken, en naast het project werden direct ook andere zaken bevraagd (wanneer ben je klaar met je opleiding?, wat vind je van je opleiding?). Je sloot het gesprek af met de zin: "Ik zie je sollicitatie wel tegemoet". Eind februari volgde het sollicitatiegesprek, waarin we voortborduurden op het telefonische gesprek een maand eerder. Twee uur na het sollicitatiegesprek ging de telefoon: "Met Joke Mintjes, ben je na het gesprek nog geïnteresseerd? Want wij wel en we willen graag dat je hier komt werken…." Natuurlijk was ik geïnteresseerd, het was voor mij een gouden kans om te starten als onderzoeker op een domein waar ik affiniteit mee heb. Joke, bedankt voor het bieden van de kans om de kunnen werken bij het lectoraat, bij de HAN en om mijzelf verder te ontwikkelen.

Dr. P.M. Van Grunsven Pierre, ondanks dat je officieel wat later bent aangesloten als copromotor, was je officieus al in die rol. Jouw bijdrage aan de diverse studies is van onschatbare waarde geweest. Uiteraard je inhoudelijke commentaar bij de opzet en uitvoering van studies, maar vooral het creëren van draagvlak in de praktijk. Je officiële plek was dan ook niet meer dan logisch en die heb je meer dan verdiend.

De Hogeschool van Arnhem en Nijmegen College van Bestuur van de HAN, directie faculteit Gezondheid, Gedrag en Maatschappij (GGM) en directie Instituut Verpleegkundige Studies (IVS): hartelijk dank voor deze kans om mijzelf op deze wijze te kunnen ontwikkelen. Al tijdens mijn studietijd op de HAN (2002-2006) was de slogan 'HAN geeft je de ruimte'. Een ruimte die ik de afgelopen jaren aan den lijve heb mogen ondervinden en waar ik gebruik van heb gemaakt. Het heeft mij veel plezier en voldoening gebracht om middels mijn promotie invulling te geven aan de missie van de HAN om het onderwijs, onderzoek en praktijk met elkaar te verbinden. Dat ik hierdoor ook mijn persoonlijke ambities heb kunnen verwezenlijken maakt het geheel nog beter. Tekenend voor de HAN is ook dat personen van alle lagen op enige wijze op de hoogte zijn of zelfs betrokken zijn geweest bij dit promotietraject. In de 'HAN-ruimte' hoop ik ook de komende jaren vorm te kunnen geven aan de verbinding tussen onderwijs, onderzoek en praktijk.

Begeleidingscommissie en expertgroepen project Ketenbrede Landelijke Protocollen Spoedzorg Onder onafhankelijk voorzitterschap van Prof. dr. Michiel Verhofstad (begeleidingscommissie) en dr. Rob Lichtveld (expertgroepen) hebben de volgende personen zitting gehad in diverse commissies en zo hun bijdrage geleverd aan de studies in dit proefschrift: dr. Sivera Berben (Acute Zorgregio Oost), drs. Maarten de Bont

(NVSHA), dr. Hans Bosker (NVVC), Rolf Egberink MSc. (NVSHV), Gerrit Jan Eggink (NVMMA), dr. Paul Giesen (IQ Healthcare), Ben Goosselink MANP (V&VN Ambulancezorg), dr. Pierre van Grunsven (NVMMA), drs. Margreet Hoogeveen (AZN), drs. Pieter Jochems (NVSHV), Arieke Knook (NVSHV), dr. Ton Kuijpers (CBO), Peter Lasschuijt (V&VN Ambulancezorg), dr. Piet Mout (NHG), drs. Judith Mulder (NVSHA), drs. Nadien Vieleers (NVIC), prof. dr. Arie van Vugt (Medisch Spectrum Twente) en Wim ten Wolde (AZN). Hiervoor dank ik jullie hartelijk.

Studiedeelnemers Geen praktijkgericht onderzoek zonder de praktijk. En wat voor een praktijk! Tekenend voor iedere professional die heeft deelgenomen aan een van de studies was de drive om de zorg voor de patiënt te verbeteren. En die drive is zo groot, dat er zelfs gesproken kon worden over redenen waarom een protocol wel of niet wordt opgevolgd. Mijn dank gaat dan ook uit naar alle verpleegkundigen en artsen werkzaam in de ambulancezorg en de spoedeisende hulp voor het invullen van vragenlijsten, deelnemen aan simulaties, interviews en focusgroepen, en voor het 'mee kijken in de keuken' op de ambulance en spoedeisende hulp.

Co-auteurs Ik wil graag de professionals bedanken die nog een stap verder zijn gegaan dan alleen deelnemen. Zij hebben zich ingezet voor het opzetten, uitvoeren en vertalen van de diverse studies naar de praktijk: Peter Aldenhoven, Wim Breeman MANP, Ben Goosselink MANP, Roger van Hout, dr. Rob Lichtveld, drs. Marie Louise Moors, Jordan de Vaan en prof. dr. Michiel Verhofstad. Zonder jullie inzet en (on)gevraagde adviezen waren de studies niet geweest wat ze zijn geworden.

Kenniskring acute intensieve zorg Onmisbaar tijdens het uitvoeren van onderzoek is het kunnen sparren met medeonderzoekers. Naast inhoudelijke discussies, was het vooral fijn om de kleine (en af en toe grote) hobbels te bespreken om daarna weer de energie te vinden om verder te gaan. Ik heb dan ook dankbaar mogen profiteren van de verschillende onderzoeksnetwerken waar ik onderdeel van uit heb gemaakt.

Lilian, Lisbeth, Sivera, Annelies, Ans, Boukje, Fon, Friede, Irene, Maaike, Marijke, Mark, Nanda en Veronica. Bedankt voor jullie adviezen en voor de input voor mijn discussie. Jullie vormen een meerwaarde omdat bij jullie onderzoek, onderwijs en praktijk elkaar echt raken. En ook omdat de meesten van jullie weten hoe veeleisend het onderwijs soms kan zijn en hoe lastig de balans soms te vinden is.

PhD IQ Healthcare Daarnaast de PhD-collega's van IQ Healthcare. Hier lag de focus op de wetenschap zonder de praktische zaken uit het oog te verliezen. Goede inhoudelijke discussies werden regelmatig afgewisseld met relativerende opmerkingen.

EANS The colleagues from the European Academy of Nursing Science (EANS). June 2013 we all started our 'EANS-adventure' in Nijmegen. The honorable function of group leader was 'installed' upon me. But after all the questions about trains, planes, busses, hotels, and diets, I felt tired rather than honorable. Despite all that, I had a great time talking and discussing with you about science, healthcare, similarities and differences between our counties. Thank you all for the great 'EANS-adventures'.

Collega's IVS De drukte van het onderwijs zorgt er soms voor dat we elkaar te weinig spreken over zaken die ons bezig houden naast het onderwijs. Toch zijn er genoeg momenten geweest dat een van jullie even informeerde naar mijn promotietraject. Deze aandacht gaf energie om door te gaan. Momenten van ontspanning hebben we ook zeker gedeeld, de etentjes met het team Medische Hulpverlening (met alle witten, groenen, gelen, roden en…o ja die ene blauwe) mogen hierbij zeker niet onvermeld blijven.

C2.24 Annegien, Ans, Friede, Ger, Maaike en Sanne. Hoewel ik mij hier voornamelijk heb gericht op het onderwijs, mogen we toch wel spreken van de 'onderzoekskamer' van IVS. Dank voor jullie interesse in mijn promotietraject, voor de tips en de mooie gesprekken.

De studenten Een onderzoek uitvoeren op het verbindingsvlak tussen onderwijs, onderzoek en praktijk kan niet zonder betrokkenheid van studenten. In meerdere studies die zijn opgenomen in dit proefschrift hebben studenten van de opleidingen Medische Hulpverlening en Verpleegkunde bijgedragen. Amanda, Arjan, Babs, Bo, Femke, Fieke, Ilvy, Ireen, Jessie, Loes, Marieke, Merel, Nuray, Roosmarijn, Vera en Wendy: bedankt! Los van jullie eigen leerproces was jullie inzet belangrijk voor het slagen van de studies. Jullie hebben je echte hbo'ers getoond door het bijdragen aan de kwaliteit van zorg. Succes met het vervolg van jullie studie en loopbaan!

Vrienden Met vriendengroepen van mij en Maarten en ook gezamenlijke vrienden zijn het teveel mensen om iedereen persoonlijk te noemen. Echter, zonder mensen tekort te doen, een speciaal woord van dank voor (op alfabetische volgorde) Bas, Elisa, Frank, Melle, Rick en Robert Jan. Mijn vriendschap met een ieder van jullie gaat al terug naar het tijdperk 'Doeternietoe', en heeft ons inmiddels geleid langs Arnhem, Didam, Doetinchem, Maastricht, Nijmegen, Utrecht, Argeles-sur-Mer, en Albufeira, maar ook langs trouwerijen, kinderen, verloren paspoorten, flessen wijn, martini, tequila en goldstrike, pokeren, te dure taxiritjes, festivals, piratenfestijnen, paracetamol en omeprazol… Mijn conclusie na 15 jaar: dit 'Doeterweltoe'.

Paranimfen Robert Jan en Toon: Wat mooi dat jullie mij vergezellen naar de finish. Robert Jan vanwege zijn niet aflatende interesse in het onderzoek en het promoveren, maar nog belangrijker de relativerende bezoekjes aan de kroeg waar aan het eind van de avond alles er altijd heel anders uitziet. Toon, we hadden al een symbolische band als peetoom en petekind, door het vervullen van de symbolische rol van paranimf hebben we deze band versterkt. Zo geven wij op eigen wijze een klein beetje invulling aan de wens van opa. Trotser hadden we hem niet kunnen maken.

Familie Mijn ouders en hun partners, mijn zus en haar man, de familie aan de Turfweg en mijn schoonfamilie: bedankt voor jullie interesse, jullie luisterend oor, jullie humor en afleiding. Het zorgde voor de relativering dat er meer is dan alleen werk en promoveren.

Maarten Lieve Maarten. Je staat letterlijk aan het einde van dit proefschrift, in de wetenschap een zeer belangrijke auteursplaats. Voor mij is het ook een plaats die de cirkel rond maakt want je had ook al een belangrijke plaats ruim voor het begin van het proefschrift en de keuze om te promoveren. In 2006 stimuleerde je mij al om verplegingswetenschap te gaan studeren. Zonder die keuze, was er geen promotietraject geweest. Je hebt eigenschappen die mij tegenwicht bieden en aanvullen, in mijn ogen een super combinatie. Bij alle stappen en beslissingen kan ik op je terugvallen. De afgelopen 10 jaar waren fantastisch, waarin we elkaar door dik en dun hebben gesteund. Ik kan niet anders zeggen dan dat ik uitkijk naar een toekomst met jou. Dus laat dit einde van het proefschrift een begin zijn van…

CHAPTER 13

Curriculum vitae

CURRICULUM VITAE

Remco Henricus Antonius Ebben werd geboren op 16 februari 1984 in Doetinchem. Remco slaagde in 2002 voor zijn VWO aan het Sint Ludgercollege te Doetinchem. Hierna studeerde hij hbo-verpleegkunde aan de Hogeschool van Arnhem en Nijmegen (HAN), waar hij in 2006 zijn diploma behaalde. Na zijn diplomering werkte hij een jaar als verpleegkundige in de flexpool van het Slingeland ziekenhuis te Doetinchem. Van augustus 2007 tot en met mei 2009 werkte hij als kwaliteitsmedewerker bij de GGD Gelre-IJssel (tegenwoordig GGD Noord- en Oost-Gelderland).

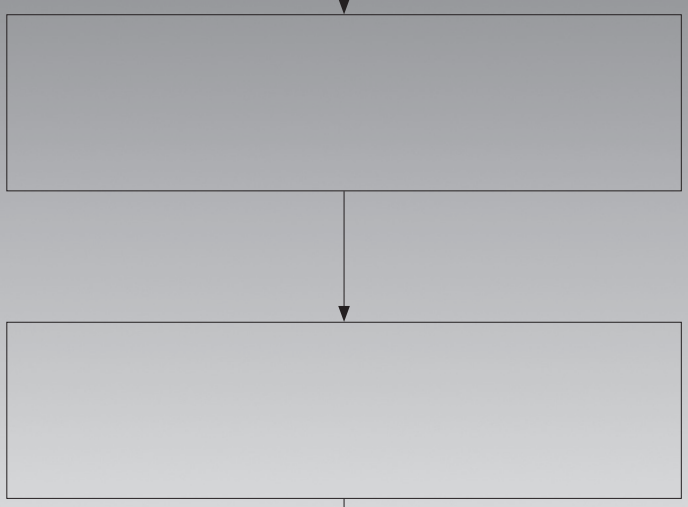
In de periode van 2006 tot en met 2009 studeerde Remco in deeltijd Verplegingswetenschap aan de Universiteit van Utrecht. Zijn afstudeerscriptie ging over factoren die ICT-adoptie door verpleegkundigen beïnvloeden. Remco diplomeerde in 2009.

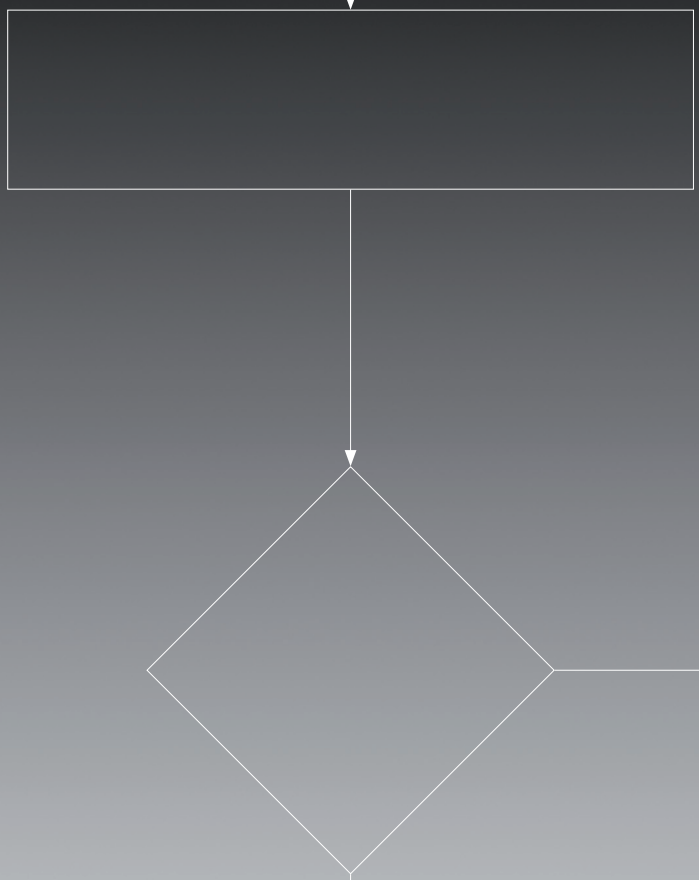
In juni 2009 werd Remco aangesteld als onderzoeker bij het lectoraat acute intensieve zorg van de HAN. Hier gaf hij uitvoering aan het project 'Ketenbrede Landelijke Protocollen Spoedzorg', wat tevens de start van zijn promotietraject betekende. In 2011 werd hij aangenomen als docent bij het Instituut Verpleegkundige Studies (IVS) aan de HAN. Hier richt hij zich op de ontwikkeling en uitvoering van de leerlijn 'kwaliteit en innovatie', waarin studenten competenties met betrekking tot evidence-based handelen en praktijkgericht onderzoek aangeleerd krijgen. Tevens fungeert hij als begeleider en examinator bij kwaliteitsprojecten voor studenten verpleegkunde en medische hulpverlening. Sinds 2013 is Remco ook lid van de examencommissie. Sinds februari 2015 is hij coördinator van de hoofdfase 2 van de opleiding verpleegkunde.

Naast docent/onderzoeker bij de HAN, vervult Remco diverse nevenfuncties. Zo is hij redactielid voor het vakblad Triage van de Nederlandse Vereniging Spoedeisende Hulp Verpleegkundigen (NVSHV) en is hij peer-reviewer voor the European Journal of Emergency Medicine, the Journal of Emergency Nursing, the Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine en the Australasian Journal of Paramedicine. Daarnaast was

hij gastdocent voor het keuzeblok ‘optimaliseren van medisch handelen’ bij de opleiding Geneeskunde bij de Radboud universiteit en is hij mede-organisator van de jaarlijkse bij- en nascholing verpleegkundig specialisten acute zorg. Remco is tevens student-member van the European Academy of Nursing Science.

NOTES





ISBN 978-90-9028916-8

Hogeschool van Arnhem en Nijmegen
HAN University of Applied Sciences