

Feedback between dispatch centre and ambulance

*– Strengthening
the chain of care*

Veronica Lindström



**Karolinska
Institutet**



**Karolinska
Institutet**

From Department of Clinical Science and Education, Södersjukhuset,
Karolinska Institutet, Stockholm, Sweden

**FEEDBACK BETWEEN
DISPATCH CENTRE AND
AMBULANCE** — *STRENGTHENING
THE CHAIN OF CARE*

Veronica Lindström



**Karolinska
Institutet**

Stockholm 2012

All previously published papers were reproduced with permission from the publisher.

Published by Karolinska Institutet.

© Veronica Lindström, 2012

ISBN 978-91-7457-727-3

Printed by



www.reproprint.se

Gårdsvägen 4, 169 70 Solna

“The only real mistake is the one from which we learn nothing.”

Henry Ford (1863-1947)

ABSTRACT

The emergency call to the emergency medical communication centre (EMCC) and the emergency medical dispatchers (EMD) is the first link in the chain of survival. Precise assessment of the call and exact dispatching is essential to achieve early treatment for patients with time-critical injuries or sickness. The EMDs' involvement in the patient care traditionally ends when the ambulance arrives at the scene. Therefore, the EMDs are unable to observe the progress and outcome of the patient, and regular and structured feedback is seldom available. Consequently the EMD and the EMCC organization have few possibilities to learn from errors or good assessments made by the EMD. The overall **aim** of the thesis was to develop, implement and evaluate a technical feedback system between emergency medical dispatchers and the ambulance personnel. A feedback system was developed out of a Finnish emergency medical service (EMS) model and adjusted to suit the Swedish EMS. In **study I** the feasibility of the feedback system was evaluated. The feedback system had an acceptable margin of error (8.0%) and the most commonly used feedback code was "agree with the dispatcher" (56.6 %). During the implementation of the system in the Stockholm EMS an absence of compliance in sending feedback appeared. In **study II** the aim was to identify factors influencing the implementation process. Three factors were identified; motivation, participation and encouragement. The absence or presence of these factors formed the opportunities and the barriers in the implementation of the feedback system. To evaluate how the feedback system could be used, two studies were conducted. **Study III**, an organization evaluation with performance indicators was conducted in the Finnish EMS. After the implementation of a new EMCC organization in Finland the percentage and number of high priority ambulance assignments increased. There was also a trend towards better detection of patients with life-threatening conditions in the new EMCC. In **study IV**, 100 calls to the EMCC in Stockholm were identified using the feedback system. The aim of the study was to identify overall factors influencing the assessment of calls to the EMCC. Barriers and opportunities related to the registered nurse (RN) or the caller were identified as the main factors influencing the assessment. The opportunities appeared in the callers' symptom description and the communication strategies used by the RN. Also, a barrier appeared in callers' descriptions of unclear symptoms, paradoxes, and the RN's lack of communication strategies during the call. **Implications;** the developed and evaluated technical feedback system is feasible for structured and regular feedback. Several factors, including both barriers and opportunities, influenced the implementation of the feedback system. A feedback system can be used for evaluating the EMCC through performance indicators and also when identifying and evaluating specific calls to the EMCC.

Keywords; EMS; emergency medical services, EMCC; emergency medical communication centre, EMD; emergency medical dispatcher, feedback, implementation, communication; strategies

LIST OF PUBLICATIONS

This thesis is based on the following papers which will be referred to in the text by their Roman numerals.

- I. **Lindström V**, Karlsten R, Falk A-C, Castrén M.
Feasibility of a computer-assisted feedback system between dispatch centre and ambulances. *European Journal of Emergency Medicine*. 2011 Jun; 18 (3):143-7.
- II. **Lindström V**, Bohm K, Castrén M, Karlsten R, Falk A-C, Heikkilä K.
Factors influencing the implementation process in emergency medical services. *Submitted*.
- III. **Lindström V**, Pappinen J, Falk A-C, Castrén M.
Implementation of a new emergency medical communication centre organization in Finland-an evaluation, with performance indicators. *Scandinavian Journal of Trauma Resuscitation and Emergency Medicine*. 2011 Mar 31;19:19.
- IV. **Lindström V**, Heikkilä K, Falk A-C, Karlsten R, Bohm K, Castrén M.
Barriers and opportunities in assessing the emergency call - a qualitative study. *Submitted*.

CONTENTS

1	Introduction	1
2	Background.....	2
2.1	The EMCC as part of the health care system	2
2.2	The importance of the EMCC for the patient	3
2.3	EMS in Sweden	4
2.4	EMS in Finland.....	5
2.5	Dispatch protocol.....	6
2.6	The nurse at the EMCC	8
2.7	Communication	8
2.8	Feedback	9
2.9	Implementation.....	10
2.10	Performance indicators.....	11
2.11	Rationale for the study.....	11
3	Aims of the thesis	12
4	Material and methods	13
4.1	Setting	13
4.2	Development of a feedback system	14
4.3	Data collection	18
4.4	Data analysis.....	21
5	Result.....	24
5.1	Paper I, feasibility of a technical feedback system.....	24
5.2	Paper II, implementation of the feedback system.....	25
5.3	Paper III, evaluation of the EMCC, with performance indicators ..	26
5.4	Paper IV, assessing the call to the EMCC	27
6	Discussion.....	29
6.1	Developing a feedback system.....	29
6.2	Feedback codes.....	30
6.3	The use of feedback.....	30
6.4	The implementation of a feedback system	31
6.5	Performance indicators to evaluate the EMCC	32
6.6	Assessing the call.....	33
6.7	Methodological considerations	34
7	Conclusions	38
8	Clinical implications	39
9	Svensk sammanfattning (Summary in Swedish).....	40
10	Acknowledgements	44
11	References	46

LIST OF ABBREVIATIONS & DEFINITIONS

Abbreviations

EMCC	Emergency medical communication centre
EMS	Emergency medical services
EMD	Emergency medical dispatcher
OHCA	Out- of- hospital cardiac arrest
RN	Registered Nurse

Definitions

In this thesis, registered nurse (RN) is used when a specific topic is described or when the RN has specifically been investigated in the EMS context. In other cases, emergency medical dispatcher (EMD) is used for all categories of personnel assessing the medical emergency call at the EMCC.

1 INTRODUCTION

The journey of the patient in emergency medical services (EMS) starts with the event of acute illness or injury. After recognizing an emergency, a call is made to the emergency number. The emergency medical dispatcher (EMD) assesses the call and responds by dispatching the right resources. This is the first link in the chain of survival. The EMD seldom knows what happens to the patient after they have dispatched the rescue unit; they do not know if they made the right assessment for the patient or dispatched the right resources. As a nurse in the ambulance services I have the answers but I seldom communicate the information to the EMDs. From my clinical experiences, questions arise: how can EMDs learn and develop their profession if they hardly ever receive feedback on their assessment? Can the organization, the EMCC, secure patient safety without knowing if the EMD made the optimal assessment of the call? Is it possible to evaluate and develop the assessment protocol in use without knowing if the protocol supports the assessment or not? Without regular and structured feedback it is almost impossible to answer these questions. Therefore, the overall aim of the thesis was to develop, implement and evaluate a technical feedback system between emergency medical dispatchers and the ambulance personnel.

The thesis will first provide the reader with a background describing the emergency medical services context, methods used and then the main results and findings of the studies conducted. Finally a discussion will bring the four different studies together and the clinical implications will be highlighted.

2 BACKGROUND

The emergency medical services systems (EMS) differ around the world (1-7), even within the Scandinavian countries (8). Regardless of the EMS system, the patients’ journey in the EMS is similar in all urbanized countries (figure 1). The journey of the patient in EMS starts with the event of acute illness or injury. After recognizing an emergency, a call is made to the emergency number. The emergency medical dispatcher (EMD) assesses the call and responds by dispatching the right resources (9). The EMD sometimes also provides medical advice to the caller (10). The dispatched resources arrive at the scene and then the ambulance personnel assess the patient, start treatment, and transport the patient to the next level of care (9).

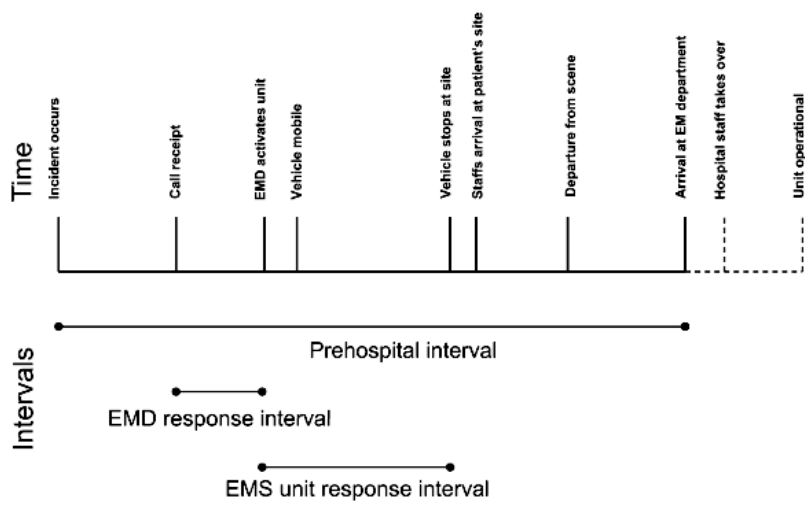


Figure1 *The patient’s journey in the EMS* (9).

2.1 THE EMCC AS PART OF THE HEALTH CARE SYSTEM

The emergency call to the EMCC and the EMD’s assessment and prioritization are the first and most important parts of the chain of survival (figure 2) (11, 12). Precise assessment of the call and exact dispatching is essential in ensuring early treatment of acute illness or patients with time-critical injuries (13-16). Ideally the optimal EMCC should match the level of care with the medical needs.

There should be no under¹- or over-triage² (17). Nevertheless, the EMCC and EMD have for a long time been considered as the weakest links in many EMS systems and together the least researched area of the EMS (13, 18).

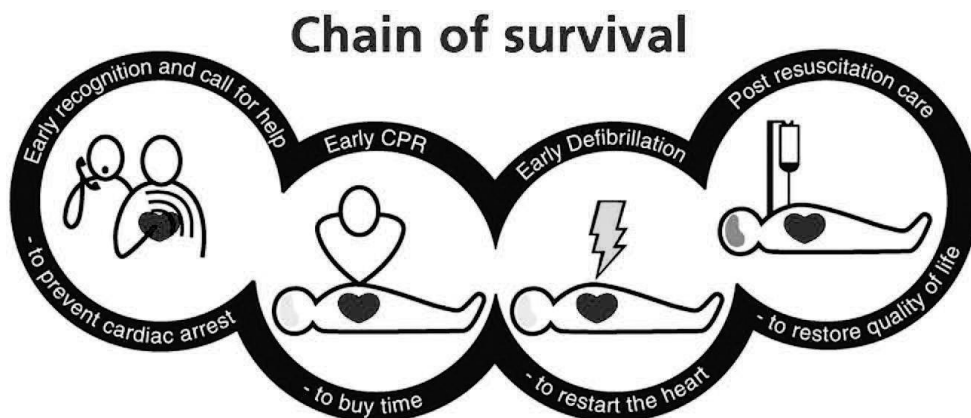


Figure 2 *The chain of survival* (11).

2.2 THE IMPORTANCE OF THE EMCC FOR THE PATIENT

The EMD can ensure that those who call the EMCC receive the medical care that they actually need (19). It is known that early identification and treatment of patients suffering from cardiac arrest reduces mortality (20). Delayed identification of acute myocardial infarction may cause increased time of reperfusion and treatment (21). It is also known that the EMD plays an important role in giving pre-arrival instructions to the caller (10, 22-25). The EMD's initiation of telephone-guided cardiopulmonary resuscitation may result in a better outcome for the patient (26). The EMD at the EMCC can also strengthen the patients feeling of safety and trust since they can speak to the patient while waiting for the ambulance arriving (10, 27-29). However, there are difficulties in identifying patients' medical conditions from a telephone call, without visual contact, and there are studies describing how EMDs did not recognize patients' serious medical conditions (30-32).

¹ Under-triage is underestimating the severity of an illness or injury

² Over-triage is overestimating the severity of an illness or injury

At present, the EMDs identify 45-83 percent of patients suffering from stroke (32, 33), approximately 70 percent of patients with acute myocardial infarction (21) and 70-83 percent of patients suffering from cardiac arrest (20, 23, 34). Other groups of patients are not as well studied.

2.3 EMS IN SWEDEN

Sweden covers an area of 450,295 km², and has a population of 9.4 million (35). The EMS system in Sweden as in other countries has been developed and designed to professionally respond to acute illness and injury.

2.3.1 The EMCC in Sweden

In 1950, Sweden introduced a single emergency number for the whole country (36). In 1973 the organization of regional emergency dispatch centres to distribute and handle all the EMS for a community was developed (37). At present there are 18 EMCCs and the majority (95 percent) of the EMCCs is managed by the publicly owned company, SOS Alarm.

An EMCC handles all 112 emergency calls (police, fire and medical) and has the sole responsibility for dispatching all ambulances (36). The EMDs at the EMCC also assess and dispatch all pre-ordered non-acute ambulance transport. At present the EMCC is manned by personnel without medical education, and by assistant nurses and RNs, and in some EMCCs there are physicians available for medical consultation. The EMCCs manned without RNs can use the RN from another EMCC for medical consultations (36). Currently in Sweden, there is no regulation or consensus about how the EMCC should be manned. The national trend is to increase the medical competence of the EMCC.

At SOS Alarm, the EMDs have used the Swedish Medical Index since 1997, as a support tool when assessing emergency calls (36). The Swedish Medical Index is criteria-based and consists of 34 main chapters. It provides the EMDs with a series of questions to ask the caller. There are four levels of acuity in the assessment protocol (38):

Priority 1; acute life-threatening situation/condition

Priority 2; acute but not life-threatening

Priority 3; transportation to hospital required

Priority 4; no medical need during transport

Unlike priorities 1-3, the fourth priority is not regulated by the Swedish National Board of Health Care (12, 39).

2.3.2 The ambulance services in Sweden

There are approximately 700 ambulances operating in Sweden (36). The ambulance service has in recent years developed from an organization mainly transporting the sick or injured to hospital to an organization with the capability of performing advanced care and medical treatment in addition to transportation to the emergency department (40, 41).

Since September of 2005, in line with a regulation of the Swedish National Health and Welfare Board, every ambulance has had to be manned by at least one RN. The reason is that only the RN is permitted to administer drugs, so without an RN in the ambulance no drugs can be used to treat acutely ill or injured patients (40, 42). Nowadays it is common that the County Councils employ specialist nurses in emergency care (who have been studying for one additional year after becoming an RN) in the ambulances, but there is no government regulation on this.

2.4 EMS IN FINLAND

Finland covers an area of 338,424 km², and has a population of 5.4 million (43). As in Sweden the Finnish EMS has been developed and designed to professionally respond to acute illness and injury.

2.4.1 The EMCC in Finland

In 2006 a new, nationwide EMCC organization was implemented in Finland and the Finnish National Health Care Services became responsible for all the EMCCs. Before the new EMCC reform, there used to be 45 municipality-based centres handling each community's emergency calls and there were no official criteria or consensus about how these centres should be organized, and the local rescue departments were responsible for the centres. After the reform, every EMCC was considered equal concerning the education level of personnel and the organization structure. At present there are 15 EMCCs responsible for dispatching EMS, fire and police in Finland (44). The dispatchers are full-time employees and have passed a one and a half year medical dispatching training program (14). The dispatchers at the new EMCCs use the same urgency categories as before the re-organization (44, 45). The urgency categories relate to the patients' or situation's acuity and have four different levels, A-D (44).

A; The highest priority, the patient has a life-threatening symptom or is in a life-threatening situation. The response should be immediate and the nearest physician unit and ambulance should be dispatched to the scene.

B; There is suspicion of failure of vital functions. The response should be immediate and the nearest ambulance should be dispatched to the scene.

C; The patient needs assessment by an emergency care team. The ambulance should arrive at the scene within 30 minutes.

D; There is no suspicion of failure of vital functions. The ambulance can arrive at the scene within 120 minutes (44).

2.4.2 The ambulance services in Finland

There are approximately 350 ambulances operating in Finland (8). The EMDs use fire engines as the first responding units when closest for A (highest priority) and B- calls (8, 14, 45). The basic life support ambulances (BLS) are manned with personnel trained for 1.5 years at a national emergency services college. The skills of the BLS ambulance personnel include; knowledge of using semi-automated defibrillators, tracheal intubation of lifeless persons, and vascular access. No intravenous drugs are used at the BLS level. The advanced life support level (ALS) is manned with an RN and specialist nurses working in pre-hospital care with four years of training. The physician-manned EMS units (ambulances, helicopters) act as second or third responders in the EMS system (8, 44).

2.5 DISPATCH PROTOCOL

A goal of the EMS is to balance the resources available to attend emergencies against the needs of patients for those resources (18). In order to support the EMDs in their assignment of assessing emergency calls, different protocols have been developed (38, 46, 47).

The aim of using dispatch protocols is described as; balancing specificity with sensitivity³ in identification of the patients' medical conditions (48).

³ Sensitivity measures the proportion of actual positives which are correctly identified as such (the percentage of call to the EMCC who are correctly identified). Specificity measures the proportion of negatives which are correctly identified (the percentage of healthy people who are correctly identified/assessed as not having an acute illness during the call to the EMCC).

2.5.1 Medical priority and criteria-based dispatch protocol

The dispatch protocols used can be categorized into two broad groups; medical priority and criteria –based dispatch protocols. The medical priority protocol differs from the criteria-based type by using algorithms rather than reminders.

Medical dispatch protocols described in the literature are; MPDS (The Medical Dispatch System International Academics of Emergency Dispatch[®] Salt Lake city, UT), which categorizes calls into standardized complaint-based codes and further classifies them as Alfa, Bravo or Charlie (no light and siren response), Delta or Echo (light and siren response) or Omega (referral or alternate care) (47). A criteria-based assessment protocol is the Swedish Medical Index developed in Norway (38). Finland uses urgency categories in prioritizing the emergency call. The prioritization is based on the seriousness of the patient's chief complaints and on the patient's current condition (14, 44, 45). There are studies that describe the effects of using assessment protocols. The assessment protocol may reduce the dispatching of advanced medical support personnel or fire department first-responder to the scene (46, 49). Nevertheless, there is no clear evidence for which assessment protocol is the best support for the EMD to identify a patient's medical condition or the patient outcome (50, 51). But Clawson et al. argues that automated protocol-based call taking may be more accurate than subjective assessment made by the individual EMD (52).

2.5.2 Evaluation and use of dispatch protocols

When evaluating the dispatch protocol's effectiveness in identifying medical acuity and a patient's need of care, different types of outcomes are measured. Some use diagnostic accuracy at the hospital as an endpoint (32, 33, 53). Other use clinical findings, such as what kind of interventions the ambulance personnel used in the treatment of the patient (30, 54) or the ambulance personnel's assessment of the patient (34, 52, 55, 56) or the ambulance personnel assessment if the patient actually needs an ambulance (57). Previous studies indicate that the evaluated dispatch protocol has a high sensitivity but a lower specificity to identifying the patient's need for care and medical attention (32-34, 53, 54, 58, 59). Regardless, as Karlsten & Elowsson argue, the assessment made by the EMD may be "correct based on the situation at the time of dispatching" (60). And a high identification rate of patients suffering of cardiac arrest seems to be reachable despite low protocol compliance by the EMD (23).

2.6 THE NURSE AT THE EMCC

The personnel competence at EMCC in Sweden varies (36). There is no governmental regulation stating that an RN should answer the medical emergency calls. Today most personnel assessing medical calls in the EMCC are RNs who have received additional training in dispatching, interview techniques and computer systems. Annually, the RN at an EMCC receives at least 16 hours of continuing education and their skills and knowledge are also re-tested every year (36, 61). Evaluation of using the RN for assessing emergency calls is limited. But increasing the medical competence of the EMCC is described as important (Swedish perspective), especially when assessing unclear emergency calls (62). The RN at EMCC is also described as useful when assessing calls requiring an alternative response to emergency ambulance dispatch (63) or assessing low priority calls to the EMCC (64). Some also argue that professional judgement as RN may be useful in EMS context where the demand for EMS services often go above the availability of resources (65).

2.7 COMMUNICATION

Communication can be defined as a process in which information is exchanged by using language, gestures, and signs, and it can be done both verbally and non-verbally (66). Communication is an essential part of health care, where the caregiver and patient relationship is established (67-69). Studies show that communication between health caregivers and patients has great importance for how the patient perceives the care (70-72). A gap in communication may cause a breakdown in the continuum of care, and patients may be exposed to unnecessary risks (73, 74). When the communication is face to face, there is a possibility of observing the non-verbal communication and reacting to the response to a question (66). In communicating without seeing the patient, the RN needs other non-verbal signs to interpret the patients' answers to questions (61, 69).

2.7.1 Call to the EMCC

The telephone call has a natural place in our daily lives. By using the telephone we can speak worldwide and across different barriers, and people also know how to use the telephone to get help quickly if necessary. The response at the emergency number 112 in Sweden starts with a call-taker assessment including establishing the type of emergency (medical, police fire department) and securing the address (12). An emergency call about a suspected medical problem is directed to an EMD for further assessment (36). The EMD assignment is to interview the caller and decide the level of priority (12). If the call is assessed by the EMD as a life-threatening situation a dispatcher is also connected to the call.

The dispatcher's task is to direct the rescue unit and communicate with the ambulance personnel. In the meantime, the EMD who assessed the call obtains the address again and if possible gives pre-arrival instructions to the caller for the immediate care of the patient. The dispatcher communicates with the ambulance personnel through a technical communication system (Rakel[®]) and provides them with relevant information regarding the assignment (36).

2.7.2 Communication between care-seeker and EMD

The communication between the care-seeker and the EMD at the EMCC is mainly by telephone, with no visual contact. The care-seeker calls for help for different reasons (60, 75). It is not always the patient that makes the call (30, 53, 57, 60). Sometimes the EMD's ability to detect serious illness depends on who makes the call (76, 77). If the caller is the patient or if the caller has direct access to the patient, the possibility of detecting serious illness increases (56). The symptoms available to the EMD at the EMCC are reduced to those the caller describes (7, 78). And the non-verbal signs such as coughing, breathing (exhaling-inhaling sounds), and sighing that may appear during the call (61, 79). Sometimes the RN does not get any direct information about the problem; instead, the RN has to rely on the interpreted version of the information (80). There are factors and circumstances that can be related to obstacles when communicating without visual contact. Misunderstanding between EMDs and callers may appear if there are: language and communication problems (76, 81-84), second hand information (7, 76, 85), dialog problems when callers are emotional, upset or speaking too quickly (7, 76, 83, 86), or when the caller is intoxicated (87). There may also be misunderstandings if the EMD underestimates the situation described by the caller (31, 76, 88). If the EMD do not ask the questions required by the dispatch protocol (77, 78) or when the caller provides wrong information to the EMD (89). Other factors that may affect the communication between the RN and the caller are the nurse's own feelings about the caller and the situation the caller is in (90).

2.8 FEEDBACK

Feedback can be defined as a verbal or non-verbal reaction or response to a particular process or activity (91). According to Hattie and Timperley's pedagogical perspective, feedback can focus on different levels: the assignment, the process, self-regulation and personal. They conclude that the most effective feedback focuses on assignment and process (92).

In this thesis, feedback is focused on the assignment process and defined as non-verbal, structured and regulated reporting from ambulance personnel concerning their assessment of the patient at scene, as close in time as possible to the EMD assessment of the emergency call.

2.8.1 Feedback in the EMS

There are few studies evaluating the effect of using feedback in the EMS and it is not possible to draw any conclusions from them since the studies were conducted in different areas of the EMS (93-96). However, a systematic review regarding the effects of feedback in overall health care concludes that feedback may improve professional practice. The effects may be greater if baseline adherence to recommended practice is low and the intensity of feedback is high (97). Despite a few studies concerning evaluation of using feedback in the EMS context some studies describe the need of feedback. Some argue that feedback can be used as a control system for the assessment of protocols and dispatching (7, 55, 94), while others argue that the EMD needs feedback on patient outcome after telephone cardiopulmonary resuscitation (28), and that feedback is necessary for good performance by individuals and is integral to effective teams (98, 99). Lack of feedback may also become a barrier in the caring of the patients in the EMS (96). The EMDs also describe how they need feedback to know if the assessment was done appropriately (83, 84, 100), but it is seldom available (100). However, giving or sending feedback in the chain of care is not always easy, considering the factors of: ensuring patient confidentiality, providing the feedback as close as possible to the event, and creating a permanent system for regular and systematic feedback (101).

2.9 IMPLEMENTATION

Overall in the health care system there is probably no single conclusive method that helps a specific implementation strategy to be efficient under different circumstances (102-104). Different strategies such as audit and feedback, producing educational materials, creating reminder systems and using facilitators have been used with various results (105-107). Contextual factors such as environment, organization, capacity and high burden of work may also have an impact on the implementation of some innovations (107-109). Implementation research out of the EMS perspective is limited. Factors influencing implementation of innovations in the EMS are described as: the health care providers' attitudes (96, 110, 111), lack of applicability (110-113), decision-making delays (112) and lack of motivation (114).

2.10 PERFORMANCE INDICATORS

The attempt to identify performance indicators assessing the efficacy of the EMS is an ongoing and complex process (115, 116). Traditionally the most common measures of quality in the EMS are response-time intervals and cardiac arrest outcome since they are easily measured, and are easy to understand for the decision-makers (117). Nevertheless, there is still a need to develop other ways to evaluate the EMCC. A performance indicator can be defined as a measurable characteristic of a structure, process or outcome that represents quality for the EMS and for the patient (118, 119). An outcome performance indicator should answer the question *“how are we doing”*. The aim of using a performance indicator is to evaluate and assess the system function and the desired effect (120).

2.11 RATIONALE FOR THE STUDY

The emergency call to the EMCC and the EMD's assessment and prioritization are the first and most important parts of the chain of survival (figure 2). The EMD's involvement in the patient's care traditionally ends when the ambulance arrives at the scene. Therefore, naturally, the EMDs are unable to observe the progress and outcome of the patient. At this time, in Sweden, regular and structured feedback concerning the EMD assessment is seldom available. Consequently the individual EMD and the organization of the EMCC have few possibilities to learn from errors or good assessments that have been made. At present there is no structured way to evaluate the Swedish Medical Index and it is not known if the assessment protocol supports the RNs assessment of the emergency call. Structured and regular feedback from ambulance personnel to the EMDs may be a way of solving these problems.

3 AIMS OF THE THESIS

The overall aim of the thesis was to develop, implement and evaluate a technical feedback system between the ambulance personnel and the emergency medical dispatchers.

The research had the following purposes:

1. Evaluate a developed computer-assisted feedback system between dispatch centre and ambulances personnel in Stockholm, Sweden.
2. Identify factors influencing the implementation processes of a technical feedback system in the ambulance organization.
3. Analyze feedback from ambulances to dispatch centre to determine if the quality of the emergency medical dispatch process improved with the changes in the dispatch organization in Finland.
4. Out of calls selected from the developed feedback system, identify factors influencing the registered nurses' assessment of calls to the emergency medical communication centre.

4 MATERIAL AND METHODS

All four studies had a retrospective observational study design, with a quantitative (I, III) or qualitative (II, IV) method. The structure of the research questions and the methods used in the studies is presented in figure 3.

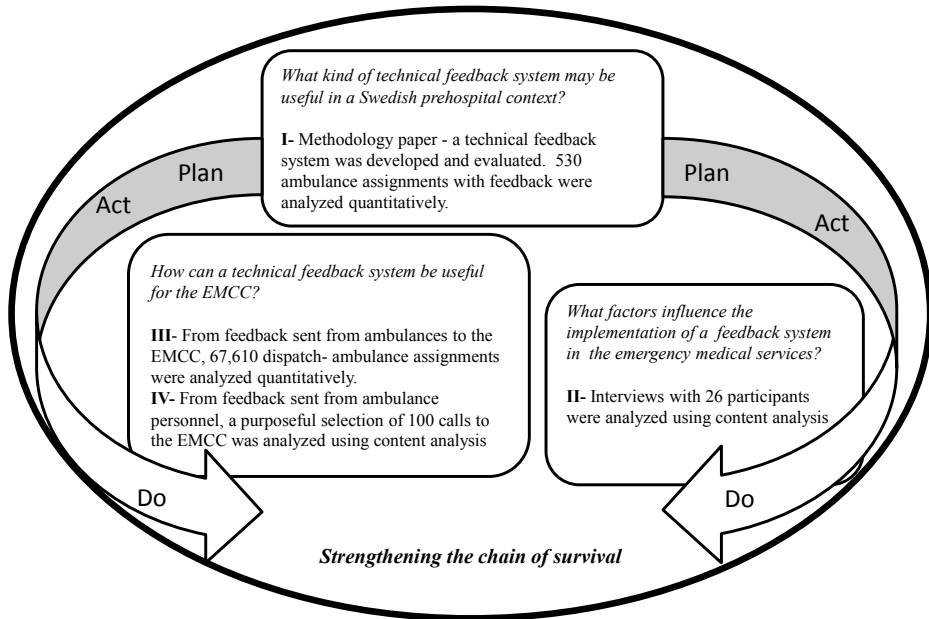


Figure 3 *The research questions and methods used in the studies, included in this thesis.*

4.1 SETTING

Three of the studies were conducted in the county of Stockholm in Sweden (I, II, IV) and the fourth study was conducted in East and Central Uusimaa, an area of southern Finland (III).

4.1.1 Emergency medical services in Stockholm

Stockholm is the capital of Sweden and has a population of 2.1 million (35). The regional County Council is responsible for the entire EMS in Stockholm. During the study period, the single EMCC in Stockholm, SOS Alarm, received all emergency calls, and the total number of calls to the EMCC was approximately 315 000 per year, and of these, around 150 000 resulted in an ambulance being dispatched (36). The personnel at the EMCC coordinated 55 ambulances, one physician-manned emergency car, two emergency cars with anesthesia nurses, and one helicopter (two during the summer) (121). The ambulance service was provided by the organizations within the county and private companies contracted by the County Council. During the study period there were three private ambulance companies (Falck Ambulance, Samariten Ambulance AB & Sirius Humanum AB) and one ambulance company owned by the County Council (AISAB) (36). There were seven emergency hospitals in Stockholm during the study period and of these, one was a trauma level one hospital (122).

4.1.2 Dispatch centre in East and Central Uusimaa

East and Central Uusimaa, is an area of southern Finland where four municipality-based dispatch centres operated during 2002-2005 and covered about 273 000 inhabitants. In 2006 a new single EMCC covered the same area of four municipality-based dispatch centres and the population had increased to 281 000 inhabitants (43). The estimated number of emergency calls in the area during the study period was 32 600 per year. During the study period (2002-2005) the local rescue departments were responsible for the local municipality-based centres and there were no regulations governing how they should be organized. In 2006 the Finnish National Health Care Services became responsible for the EMCC organization and introduced nation-wide regulations about how the EMCC should be managed (44).

4.2 DEVELOPMENT OF A FEEDBACK SYSTEM

To answer the first research questions as displayed in figure 3, a model for developmental work and interventions was used as a framework for identification and adoption of a feedback system (123, 124). The developmental work included *seven steps* as displayed in figure 4.

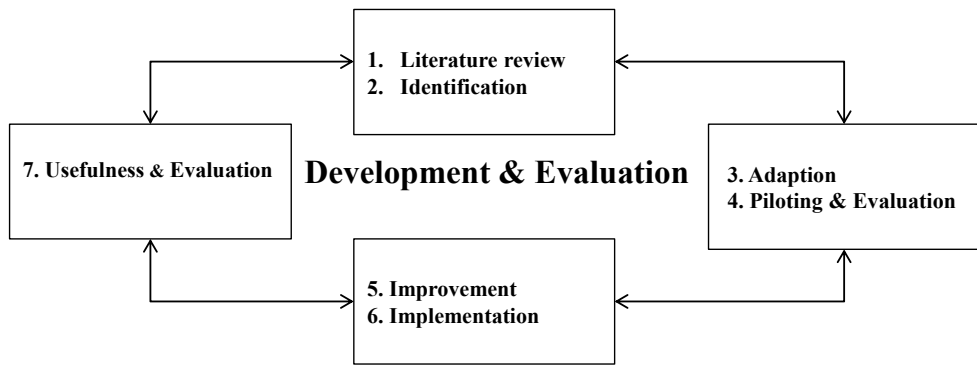


Figure 4 *The developmental work of identification and adaptation of a feedback system.*

Firstly, a review of current literature was carried out with the aim of identifying how feedback had been used previously in the context of EMS. The literature review illuminated a lack of knowledge describing and evaluating structured feedback in the context of EMS. The review also highlighted the EMDs' request for feedback (7, 28, 76, 100).

Secondly, in 2007 an established Finnish feedback system was identified through an EMS network group in Scandinavia. This feedback system had been in use for over 20 years in the Finnish EMS organization, mainly as a quality improvement system and to support medical supervisors when introducing new dispatchers into the organization (125). The availability and quality of EMS in Sweden and Finland is similar but the systems do not use the same technology and terminology for priority and assessment of emergency calls (36, 38, 44). The Finnish feedback system was recognized as a possible framework for the development of a Swedish technical feedback system. The feasibility of using the identified feedback system was evaluated by an expert panel of technicians and EMDs from the EMCC, and by emergency medical technicians, emergency physicians and RNs from the ambulance organization in Stockholm. The group agreed to use the feedback system as a framework.

Thirdly, the feedback from ambulance personnel to the EMCC aimed to include: feedback concerning the patients' primary symptoms before receiving any treatment and the acuity of the assignment, or information about why not transports the patient to the emergency department after evaluation and treatment.

The EMDs and the emergency physicians in the expert group started the work of identifying feedback codes out of the Swedish Medical Index and descriptions used in the ambulance services to describe the patient's primary medical condition in the medical record system (38, 126). The number of codes was limited to 45, due to technological limitations of the computer system used at the EMCC. The group identified a total of 42 feedback codes that aimed to describe the patients' condition, acuity, and reasons for not transporting the patient to the emergency department. All the members of the expert group then individually analyzed these identified feedback codes, aiming to finding potential codes that were missing. The results of the individual review were then discussed within the expert group to reach consensus. Feedback codes with total agreement were accepted for inclusion and overlapping codes were deleted. This consensus discussion resulted in a total of 41 codes to be used in the feedback system. To evaluate the applicability and to ensure understanding of the developed feedback codes, they were thoroughly discussed with three RNs and three emergency medical technicians from the ambulance services in Stockholm. They all agreed that the identified feedback codes could be used for feedback to the EMCC.

Fourthly, the first version of the feedback system was piloted in 2008. For the ambulance personnel, the participation in the pilot study consisted of assessing the patients' primary symptoms and acuity or leaving the patient home (after evaluation and possible treatment). Then send the information to the EMCC by selecting and pressing two buttons on a hand-held computer with a touch screen and a built-in 3G/GPRS modem (SAAB Performat, Paratus Pocket[®]). Before the pilot study, the ambulance personnel participated in a one-hour seminar describing the aim of the pilot study and how to use the feedback system. During the pilot study the ambulance personnel had access to online communication with the expert group. When the feedback system had been in use for one month the participants answered a questionnaire about it and how they experienced the system in their daily work. After considering the responses to the questionnaire the feedback codes were reviewed again and the expert group suggested some changes that could provide greater clarity. The changes consisted of adding a word from the descriptions used in the ambulance services to already chosen feedback codes, and adding one feedback code, fever/infection. Finally 42 codes were decided by the expert group to be used in the feedback system, displayed in table 1.

Table 1 *Identified feedback codes (I).*

Level of priority	Assessment of primary condition	Assessment of primary condition
Priority 1	Abdomen - urinary tract	Convulsions
Priority 2	Accident	Diabetes
Priority 3	Traffic accident	Disease/injury to limbs- minor injuries
Priority 4	Workplace accident	Drowning, underwater diving accident
No transport by the ambulance	Agree with dispatcher assessment	Eye - ear - nose – throat
Other transport i.e. police	Back problems	Fever- infection
Dead at scene	Birth after 20th week of pregnancy	Gynaecology
Interrupted mission	Bleeding, non-trauma	Headache - fainting – dizziness
Cancellation of mission	Breathing difficulties	Poisoning – overdose
No need for ambulance care	Burns- el. Injuries	Psychiatric problem
No patient at scene	Cardiac arrest, OHCA	Stroke – paralysis
Treat at scene	Chest pain - heart diseases	Transport order health institutions
Transport to other level of care	Child - illness	Unconscious
Refuse care	Child - poisoning 0-8 years	Undefined problems - difficult assessment
		Violence – assault

Fifthly, to ensure the proper use of feedback codes by ambulance personal, the used feedback codes were reviewed by an emergency physician and ambulance nurse. To decide if the correct codes had been used, a comparison between ambulance records and sent feedback was made in study I.

Sixthly, after adjustment of the feedback system the implementation of the system started year 2008 in Stockholm. The implementation strategy used was a structured intervention and implementation strategy described by Grol, Wesning et al; *awareness, understanding and acceptance* (127). To achieve *awareness* of the developed feedback system the medical supervisors, the managers at the EMCC and the managers of the ambulance companies in the EMS in Stockholm were given an overall description of the purpose of the feedback system. All agreed the system was a good project. After the information was given to the managers the ambulance personnel in Stockholm EMS provided their first information about the feedback system by answering a questionnaire concerning whether they were willing to send feedback to the EMCC. To create *understanding* of the system, instruction materials were developed based on the company managers' requests and according to their routines of informing their personnel. The ambulance personnel then received information and instructions on how the feedback system should be used from their company managers through the companies' normal channels of information.

The instruction material was also distributed to each ambulance when the SAAB Performit, Paratus Pocket[®] devices were installed in the ambulances.

After the installation of the SAAB Performit, Paratus Pocket[®] system and with the aim of developing an *acceptance* of the feedback system, follow-up meetings to discuss the feedback system was arranged, and 16 of 29 ambulance stations took part in the meetings. During the implementation and monitoring of the feedback system the research group revealed differences in the frequency of sending feedback to the EMCC. No single company stood out in the frequency of sending feedback; it was single ambulance stations in different companies. This absence of compliance reflected an implementation failure (124). Therefore, an evaluation was conducted in study II, aiming to identify factors influencing the implementation of the feedback system.

Seventhly, in the developmental work two studies were conducted to describe how the implemented feedback system could be used (III, IV).

4.3 DATA COLLECTION

The data collection differed depending on the research questions, as displayed in figure 3.

4.3.1 Feedback codes

To collect the feedback sent by ambulance personnel to the EMCC, a mailbox system administered by the Karolinska Institutet was used (Microsoft[®] Outlook Webb App). For each assignment dispatched by the EMCC to the ambulance an e-mail was created after the assignment ended. This contained: an assignment number, date, time, assessment according to the Swedish Medical Index, priority, and ambulance personnel's feedback regarding the primary assessment and priority of the patient. To ensure patient confidentiality when using the feedback system, no patient data was transferred between the EMCC and ambulances. In the first study, 530 ambulance assignments with feedback to the EMCC were identified and consecutively collected. In the last study 100 calls were identified and selected through the mailbox system. From the Finnish municipality-based centres and the new EMCC a total of 67 610 assignments with feedback were collected between 2002-2005, and January 1 to May 31, 2006. The data collection during 2002-2005 was made from several different databases, since there was not a single system used for collecting feedback sent by ambulance to the municipality-based centre.

The data from 2006 were from one EMCC. The collected data in study III contained: the EMD assessment concerning priority of the dispatched assignment, feedback from ambulance concerning priority and whether the patient had died at the scene.

4.3.2 Ambulance medical records

To evaluate how the feedback codes had been used by the ambulance personnel and to examine the margin of error in the feedback system a convenience sample of 240 ambulance medical records was collected in study I. The convenience selection was from the available ambulance records from the ambulance companies in Stockholm and was intended to reflect different use of the feedback codes by the ambulance personnel. The selection of ambulance medical records included: assignments in which a mismatch was seen between the ambulance nurse and the EMD, assignments in which the ambulance nurse sent the feedback code, ‘no transport to hospital’, and a sample of the most commonly used feedback code, ‘agree with the dispatchers’ assessment’.

4.3.3 Interviews

Open-ended and focus group interviews were conducted in study II, since the purpose was to identify and understand factors influencing the implementation process. Focus group interviews have advantages when gathering information on what people say when exploring opinions, experiences and practices (128). Another advantage of using focus group interviews is that the dynamics in the group help the participants to follow-up on each other’s answers and to question each other’s ideas or answers (129, 130). These strengths make focus groups ideal when discussing the implementation of the technical feedback system. Open-ended interviews with the managers were conducted since they were identified as having special knowledge of the area, and the open-ended interviews aimed to discover their perspectives on the implementation process. Open-ended interviews is a way to obtain a richer picture and deeper understanding of the investigated phenomena (129, 131, 132), in study II factors influencing the implementation process of a technical feedback system. The interviews with the two managers started with an open-ended question “*Why or why not do your personnel send feedback to the EMCC?*” The open-ended questions allowed the managers to respond in their own words, in a narrative fashion. Probing questions such as: *Can you describe? Can you explain?* and *Can you give an example?* were used to elicit more information and to encourage a more complete response to the open-ended question (131, 132). The opening question to the two focus groups was also open-ended “*Why or why not sending feedback to the EMCC?*” and aimed to encourage the participants to speak freely.

Follow-up questions such as: *Can you describe?* *Can you explain?* and *Can you give an example?* were used to develop the answers and to clarify the communication in the group (129). Both the open interviews and the focus groups interviews lasted about 60 minutes and field notes were written directly after the interviews. The interviews were tape-recorded and transcribed verbatim.

4.3.4 Interpretive description & participants

An interpretive description approach was used for selecting the managers and the participants in the focus groups interviews (130, 133). A problem, not sending feedback, was identified during the implementation of the technical feedback system and the questions were asked to those who were working in the area where the identified problem occurred. Interpretive description as a method is inspired by grounded theory, ethnography and phenomenology, and acknowledges the contextual knowledge of the human experiences (130).

Thorn and co-writers argue that health care researchers may carefully modify established methods and develop analytical approaches that better align with the clinical research questions. Interpretive description may be one method by which health care professionals may derive clinical knowledge applicable to developing clinical practice (130, 133).

The selection of the ambulance companies and the ambulance stations was stratified (134), according to the extent to which the ambulance personnel sent feedback - high extent (> 80%) and low extent (<40%). The process of selecting participants began by contacting and interviewing two managers of ambulance companies with ambulance stations that had a high and/or low frequency of sending feedback to the EMCC, in order to obtain their perspective on why their personnel had or had not used the feedback system.

After the interviews, the managers were asked to select personnel from their ambulance companies to participate in the study. They were encouraged to select participants with various backgrounds concerning years in the EMS, different positions and different education levels, so both personnel from a station with high compliance (>80 %) of sending feedback and from a station with low (< 40%) compliance would participate. This selection of participants was intended to obtain responses to the question that were as varied as possible, from different EMS personnel perspectives. Two equal sized focus group interviews were conducted, one from each ambulance company. Twelve ambulance nurses, nine emergency medical technicians and three local supervisors participated. The professional education of the participants was evenly distributed between the two groups. The duration of employment in prehospital care ranged from 2- 20 years among the participants, equally distributed between the groups.

4.3.5 Tape-recorded emergency calls

To evaluate how feedback can be used, in study IV there was a purposeful sample of 100 calls to the EMCC analyzed. The health care professionals at the EMCC work under the same regulations as any other health care professionals in Sweden, and calls to the EMCC are saved for at least 10 years in accordance with the national regulations (135, 136).

Therefore, it is possible to collect and analyze the calls received by the EMCC retrospectively. A purposeful sampling of calls was conducted aiming to obtain an insight into how RNs assessed calls to the EMCC (129). The calls to the EMCC were collected from the feedback sent by ambulance to the EMCC. To archive a variety of information rich data, two equal-sized groups of calls were collected: 1) The first 50 calls to the EMCC dispatched as highest priority and where the ambulance nurse at the scene agreed with the priority and the assessment made by RN at the EMCC. 2) And the first 50 calls in which the RN at the EMCC and the ambulance nurse at the scene made a totally different assessment concerning the patient's problem and the priority (under-triage). The sampling of calls started 1st of March 2011 and ended 31st of March 2011. The number of 50 calls in each group was considered to be sufficient and manageable for a qualitative analysis aiming to identify factors that could facilitate or hinder the RN assessment of calls to the EMCC (129).

4.4 DATA ANALYSIS

The data analysis differed depending on the quantitative (I, III) or qualitative (II, IV) approach used in the studies.

4.4.1 Content Analysis

Content analyses were conducted in studies II and IV. Content analysis is a method that enables a systematic categorization and description of data from visual, verbal or written text (134). The analysis of the collected data can also range from a manifest to latent level, or from a concrete to an abstract level, and the analysis may vary in level of depth (137). When using content analysis the analyst can also quantify specific phenomena (138-140). In studies II and IV the data was analyzed at a manifest level by using content analysis as described by Elo & Kyngäs (141). In both studies the first part of the analysis consisted of listening to and transcribing the tape recordings. During the transcription, comments on feelings and reflections derived from listening to the interviews and tapes were noted and followed up during the analysis to ensure that all identified aspects were included in the analysis.

The second part of the analysis consisted of reading all the transcribed material several times to obtain a sense of the whole. The next step in the analysis consisted of an open coding of the text (141). Underlining was used to illuminate text describing all aspects, and headings were written down to describe the content. After this open coding, a coding sheet with all headings was created and then categorized into broader and higher order categories (sub-categories). The sub-categories with similar content were then grouped together as generic categories, and finally the generic categories were grouped as main categories (141).

4.4.2 Emotion content and cooperation score

Studies describe how the caller's emotions and ability to cooperate during the call may affect the assessment of the emergency call (7, 76, 83, 86). Previous studies in the context of the EMCC have used the emotion content and cooperation score in order to describe the level of cooperation of the caller calling the EMCC (142, 143). The score is divided into five categories (142, 144):

1. Normal conversational speech
2. Anxious but cooperative
3. Moderately upset but cooperative
4. Uncooperative, not listening, yelling
5. Uncontrollable, hysterical

In study IV, during the listening and transcription phase of the recorded calls the callers were classified according to the emotion and cooperation score.

4.4.3 Performance indicators

In study III, the identification of performance indicators was based on the consensus in the research group, which is an established method of developing performance indicators in the EMS context (118-120, 145). The used performance indicators were based on the presumption that any large population will generate a similar equal rate of emergency calls, and if the EMD follows a predefined protocol, it should lead to the same assessment concerning priority in similar emergency calls. Two performance indicators were identified and used in study III: priority distribution and underestimation of risk to detect life-threatening situations by the EMD. Both aimed to measure the outcome and answering of the question "*How are we doing?*" (118-120). The performance indicator underestimation of risk to detect life-threatening situations has also been described as "*key –performance accuracy of risk assessment*" in a previous study (45).

4.4.4 Descriptive statistics

In studies I and III the data from collected feedback were used as input for statistical analysis. In study I, frequency tables and percentages were used for describing assessed assignments and reasons for not transporting patients to hospital. Percentages were used for describing margin of error in the feedback system. In study IV, frequency tables, percentage and mean value were used to describe the analyzed calls. The collected categorical variables (priority A-D and dead at the scene) in study III were compared by means of Pearson's chi-square test, a test used for assessing differences between groups (131). To analyze the EMD's ability to detect patients in life-threatening condition, Risk Ratio (RR) and 95 % confidence intervals (CI) were calculated by logistic regression (131).

4.4.5 Ambulance medical record compared with feedback code

The ambulance medical record contains a description of the patient's condition when the ambulance arrives at the scene. To analyze whether the feedback codes were used as expected, the used feedback codes and the ambulance medical records were compared. Incorrect use of a feedback code was defined as 'sent feedback code not matching ambulance medical records'. The analysis was made by an ambulance nurse with experience of the EMS. Records with indistinct assessments were re-reviewed and compared with the feedback code. This was done by an emergency physician with experience of the EMS, and the results were presented as percentages and frequency tables.

5 RESULT

The papers included in this thesis describe the feasibility of a developed technical feedback system (I), the challenges and possibilities of implementing the system (II), and how the feedback system can be used (III, IV).

5.1 PAPER I, FEASIBILITY OF A TECHNICAL FEEDBACK SYSTEM

The feasibility of the developed feedback system was evaluated from the feedback sent by the ambulance personnel. Out of 530 analyzed feedback events, the most commonly used feedback from ambulance personnel was “*agree with the dispatchers*” (56.6 %).

In 30 percent (n=160) of the assignments the feedback revealed a mismatch between EMD assessment and the assessment by the ambulance personnel. The greatest mismatch appeared when the assignments were dispatched as: undefined problems- difficult assessment (n=37), chest pain- heart diseases (n=19) and disease/injury to limbs – minor injuries (n=14).

Under-triage appeared in three percent of the feedback events. Under-triage is when the ambulance personnel assessed the patient as having a life-threatening situation but the ambulance had been dispatched to a non-life-threatening situation. There was no single condition in the EMD assessment where the ambulance nurse gave a higher priority.

The feedback also showed how the ambulance personnel in 8.8% (n=60) of the dispatched assignments did not transport the patient to hospital. Feedback “no transport to hospital” was most common in assignments dispatched as: accident- traffic (n=11), injury to limbs – minor injuries (n=8) and undefined problems (n=7). The margin of error of the system was estimated as eight percent (n=20) of the 240 compared ambulance medical records and the used feedback code. One identified cause of error was technical problems in using a touch screen to send feedback, but most errors had no apparent explanation according to the ambulance medical records. Twelve of the ambulance records were missing and were thus not available for analysis.

The main findings in the study were: The developed technical feedback system has an acceptable margin of error. Most of the assessments made by the EMD were in line with ambulance personnel assessment at the scene.

5.2 PAPER II, IMPLEMENTATION OF THE FEEDBACK SYSTEM

Three factors were identified as influencing the implementation processes in the ambulance: motivation, participation and encouragement. The presence of these factors created opportunities in the implementation of the feedback system, while absence of the factors created barriers in the implementation.

Motivation

The factor of motivation was described by the participants as a need to communicate information on different levels in the organization, using both formal and informal facilitators to follow up the given information. They also described the need for training, support, feedback and pedagogical models to create conditions that motivated the individual and the group. Another motivation factor described by the participants was to create motivation through mandatory measures to ensure feedback was sent to the EMCC. They discussed and described the importance of having a well-functioning technical system before starting to use the feedback system.

Encouragement

As encouragement the participants described their own momentum, how they created their own reasons for sending feedback to the emergency medical communication centre. They described how they actively looked for information to create their own understanding. They also described how they saw benefits in being involved in developing the ambulance organization. They identified how they thought the feedback system could improve their own working environment, and how the EMD could get better at identifying the caller's problem. The participants also described pre –understanding as an encouragement factor and said the research and development conducted should be part of the clinical practice, and could improve patient care. Providing better patient care encouraged them to be involved in the project.

Participation

The factor of participation includes descriptions about being a part of the context and the chain of care. The experience of being involved in development work also influenced participation. Disenchantment due to fatigue at participating in development or research without receiving any feedback had also influenced participation.

Participation was described as others deciding what they had to do, and how external factors affected their work. They also said they saw no point in participating. The participants described an attitude of “*It does not matter for the patient if I participate*”. They described the feeling that the feedback system had no effect on patient care and their participation was not needed.

The main findings in the study were: There are different factors influencing the implementation process: motivation, encouragement and participation. The presence or absence of these factors created both opportunities and barriers in the implementation of the feedback system.

5.3 PAPER III, EVALUATION OF THE EMCC, WITH PERFORMANCE INDICATORS

To describe how systematic feedback can be used an evaluation of a new EMCC organization in Finland was conducted based on performance indicators. A total of 67 610 emergency calls were analyzed, and of these, 54 026 (79.9%) were collected from before the EMCC reform in 2006, and 13 584 (20%) were from the new EMCC. Performance indicator *priority distributions* indicated that the priority distributions had changed after the reform.

The EMD in the new EMCC dispatched more priority A (7.4 vs. 3.6 percent) and less priority C (31.6 v s 37.5 percent) ambulance assignments compared to the municipality-based centres before the reform. In priorities B and D there was no difference between the new EMCC and the municipality-based centres. There was no statistically significant difference when comparing the performance indicator *priority distributions*.

When comparing the municipality-based centres and the new EMCC with the performance indicator *underestimation of priority* there was a significant difference ($p < 0.001$), and the Risk Ratio (RR) for underestimation was higher (RR 1.46) for the new EMCC compared to the municipality-based centres. Concerning the EMDs' ability to detect patients in life-threatening situations, in the municipality-based centres there were 122 patients who died at the scene and of those, 23.5 percent were associated with low-priority calls (C & D).

In the new EMCC there were 166 patients who died at the scene and of those 13.9 percent were associated with low-priority calls (C & D). The difference was not statistically significant ($p = 0.27$, CI 0.50- 1.22 and RR 0.78).

The main findings in the study were: After implementation of a new EMCC organization in Finland, the percentage and number of high priority calls increased. There was a trend for better detection of life-threatening conditions in the new EMCC.

5.4 PAPER IV, ASSESSING THE CALL TO THE EMCC

To describe how the implemented feedback system could be used, a purposeful sample of calls to the EMCC was collected based on the feedback system. The analysis aimed to identify overall factors influencing the RN assessment of calls to the EMCC.

“Barriers” and “Opportunities” were identified as the main factors influencing the assessment of the call. These main factors were related to the caller or the RN. The identified generic categories of opportunities related to the caller were: normative symptoms, patient looks, time-line, repetition of symptoms, and information without questions. The opportunities related to the RN were: closed loop communication, support systems and questions. The identified generic categories of barriers related to the caller were: paradoxes, lack of information and no primary problem. For the RN, the barriers were identified as: no analysis of information and no structure to the call.

Opportunities

The opportunities in the result refer to a favorable or advantageous circumstance or combination of circumstances of assessing the call to the EMCC. The opportunities were identified both from the callers’ and the RNs’ perspective. An identified opportunity in assessing the call to the EMCC was the *normative symptom* description made by the caller and when the callers’ symptom descriptions were presented immediately in the call. Another identified opportunity was when the caller described how the *patient looked* and how the patient’s skin felt. Besides a clear description of symptom and the patient’s look a *time-line* description was identified as an opportunity. Another advantageous circumstance was when the caller *repeated the symptoms* several times and when the caller gave more *information without questions* concerning the previous medical history. Another identified opportunity was when the sounds and the patient talking during the call confirmed the information and given symptom description. The opportunities related to the RN were when the RN used *closed loop communication*, meaning that the RN repeated and/or concluded the information given by the caller. The caller confirmed the conclusions, and if the RN made a conclusion not in line with the given information the caller corrected the RN.

Another identified opportunity was if the RN used some form of *support system* for assessing the call, such as contacting an expert in the area (i.e. midwife or Swedish Poisons Information Centre) or using *questions* related to the information given by the caller.

Barriers

The barriers in the results refer to something that prevented the assessment of the call to the EMCC. Like opportunities, the barriers were identified both from the caller and the RN perspective. Different types of *paradoxes* related to the caller were identified as barriers. If the information was contradictory concerning symptom description and the background sounds in the calls, this prevented the assessment. Another paradox seemed to arise when the patient was relatively young and the symptom description indicated severe illness but the caller was not anxious. The third paradox arose when the caller made the call about one problem and then described symptoms of something else. Another identified barrier in assessing the call was the *lack of information* when the caller could not see the patient or could not answer the RN's questions. Lack of information was also caused by the patient being unable to explain the problem because of previous cerebral injury. In other calls, the amount of information given by the caller could also be unmanageable.

When *no primary problem* was presented it also became a barrier in assessing the call. From the RN perspective *no analysis of the information* was identified as a barrier when the RN seemed to focus on the primary problem presented by the caller instead of analyzing the more serious symptom description presented by the caller. Another barrier was when the RN repeated the information and asked questions about the given information but did not analyze or take any action based on the collected information. When the RN had a *lack of structure* in what was said to clarify the patient's breathing, circulation and/or consciousness, this prevented proper assessment of the call. The lack of structure when assessing the calls was also evident in calls made by other health care providers.

The main findings in the study were: There are both barriers and opportunities in assessing the call to the EMCC. The main discrepancies between the opportunities and barriers appeared in symptom descriptions made by the caller and in communication strategies used by the RN.

6 DISCUSSION

This thesis describes the development and implementation of a technical feedback system between ambulances and the EMCC in Stockholm, Sweden, and considers how the feedback system can be used to evaluate the work in the EMCC. It is not a thesis based on a theoretical concept; instead the thesis refers to clinical and practical aspects of developing and implementing a feedback system.

6.1 DEVELOPING A FEEDBACK SYSTEM

During the developmental work of the technical feedback system a model for developmental work and interventions was used (123, 124). By using a model there was a known structure for the participants and there was transparency during the whole process (124).

This makes it possible for others to develop other feedback systems based on our experiences. More systems for feedback are likely to be introduced in the future since there is a need to use feedback for quality assurance and quality development of the EMS as previous studies describes (7, 28, 55). By using the Finnish feedback system as a framework for developing the Swedish system the possibility of comparing the two EMS systems arose, which was an advantage since, both nationally and internationally, there is an interest in developing quality indicators for comparing EMCCs (118-120, 145). The developed feedback system has other clinical advantages, for example concerning out-of-hospital cardiac arrest (OHCA) patients. Currently there are difficulties in evaluating the used assessment protocol for OHCA patients since the researcher or health care manager at the EMCC need to use the hospital's medical records to identify true OHCA calls to the EMCC. The feedback system may be one solution to this problem. From the feedback sent by the ambulance personnel the researcher or health care manager can directly identify true or false OHCA cases or other specific calls to the EMCC as shown in studies III and IV. Despite the described possible advantages of using the developed feedback system, feedback may also cause an overreaction (146).

The feedback needs to be carefully evaluated before any changes are made at the EMCC. The trustworthiness of the feedback system is also dependent on the fact that the feedback to the EMD is based on the immediate assessment of the patients' primary condition when the ambulance arrives at the scene. Otherwise, the feedback will not be on the EMD assessment, and hospital records may be used as feedback instead. However, in that case time and treatment may have affected the patient's condition and the feedback would not be on the assessment made by the EMD.

The feedback system needs to be well monitored so possible system errors can be identified; the feedback system will never be better than the users using it.

6.2 FEEDBACK CODES

In the developed system the margin of error was estimated to be approximately eight percent in paper I, but whether this margin of error is acceptable or if the result is comparable to the Finnish or other equal systems is not known since there is a lack of previous studies evaluating feedback systems. The decision to use a technical system with pre-defined codes and no patient data, instead of using verbal or written feedback made it possible to focus on the assignment instead of feedback on a personnel level (92). It also made it possible to guarantee patient confidentiality (101). But pre-defined codes have their limitations, and different personnel in the ambulance may have different interpretations of using the codes. From the results in paper I it appears that the ambulance personnel interpret and used the feedback codes in a similar way. The most commonly used feedback code was *'agree with the dispatcher assessment'* and most of the assessments made by the EMD were in line with the ambulance personnel feedback after arriving at the scene (I). This result is in line with other studies results (85, 100, 147). This may imply proper use of the feedback codes or it may indicate that EMDs assess the emergency calls in a proper way and in a comparable fashion to other EMCCs. The ambulance personnel did not use the feedback code *"transporting patient to other levels of care than dispatched"* in study I. This may indicate a problem of using this specific code or it may indicate the lack of tradition in the context of transporting patient to other levels of care, regardless of whether there is a need to evaluate the codes one by one to ensure the proper use of the feedback codes.

6.3 THE USE OF FEEDBACK

Studies III and IV in this thesis show how the feedback system can be used.

Theoretically, the feedback system may also be used in other ways. Previous studies found that the EMDs wanted feedback on their assessments in order to improve their professional skills (83, 84, 100). How the feedback supports professional development in the EMCC is unclear. However, an implemented feedback system enables a structured evaluation of the effects of using regular feedback on the professional learning in the EMS. At present, EMDs rarely receive any feedback, so starting regular feedback may cause the positive effects that previous authors conclude (97). Structured and regular feedback between ambulance personnel and the EMCC may also be used as a control system (7, 55, 94).

The supervisors at the EMCC have the opportunity to monitor the quality of changes in the assessment protocols and they can identify difficulties for the individual EMD in assessing specific calls. If the chain of care between the EMCC and the ambulance is strengthened by a feedback system there are also opportunities for the medical supervisors within the ambulance organization. They would have the possibility to identify weaknesses and strengths of the ambulance organization by analyzing the sent feedback. For example, is it always the same ambulance personnel who, during night shifts, leave patients at home after assessment, regardless of regulations made by the medical supervisors? However, although the above describes possible benefits of using feedback, research is needed to illuminate the effects of using feedback in the EMS.

6.4 THE IMPLEMENTATION OF A FEEDBACK SYSTEM

Implementing an innovation in a health care system is described as a complex process (102-104). Therefore, a documented implementation strategy was used when implementing the newly developed feedback system (127). Nevertheless, the selected strategy did not work out as expected and study II was conducted to identify the factors that influenced the implementation. The presence or absence of motivation, participation and encouragement created both opportunities and barriers in the implementation of the feedback system (II). The factor *motivation* in the results referred to something done from the outside, and motivation has been described as something that may grow gradually (127). The participants felt that the information concerning the feedback system needed to be communicated, and it was the lack or the availability of the communication that influenced the implementation. Since the selected implementation strategy was successful to some extent and the conditions were similar in all the places where the implementation took place, this may indicate that the implementation success or failure depends on the individual's desire to communicate the information, or the selected company's way of giving information to its personnel. Or as Grol describes it; different health care professionals may need different implementation strategies (104). However, since communication can be defined as a process by which information is exchanged, a conclusion may be that more information should have been given, and follow-up meetings to provide information should have been arranged more often. To what extent is not known since it was enough for some of the participants. Although the EMS is overall the same organization in Stockholm, the implementation strategy should be adjusted to each local ambulance station.

The factor *encouragement* in the results means something that encourages the individual to send feedback to the EMCC, and whether this is connected with the individuals' attitude, as described in previous studies is not clarified in the results (96, 110, 111). This may indicate that some individuals perceived more advantages than disadvantages when sending feedback to the EMCC. This was not taken into account when implementing the feedback system, and perhaps if more time had been spent on identifying and communicating all the advantages of sending feedback to the EMCC this could have affected the implementation.

The factor *participation* in the results described the process of being part of something when sending feedback to the EMCC. This was not something that was communicated explicitly during the implementation process. It was taken for granted that all were a part of the EMS context. Not feeling part of the same context as others becomes a barrier, and some participants participated in sending feedback to the EMCC despite not communicating the fact that they identified themselves in a context. This result may also have been caused by not being involved in the development process of the feedback system. This has been described by previous authors as a barrier (103). In conclusion, for future implementation of innovations in the EMS, more attention must be paid to motivating and encouraging all participants on different levels and at different ambulance stations to be part of the development process and the context.

6.5 PERFORMANCE INDICATORS TO EVALUATE THE EMCC

Three types of performance indicators can be used to measure the quality in patient care: structure, process and outcome (148). Traditionally, the most common measures of quality in the EMS are response-time intervals and survival of out-of-hospital cardiac arrest (117). Another way to evaluate the quality and effectiveness of the EMCC organization could be from performance indicators answering the question “*How are we doing*” (120).

In study III, two performance indicators (*priority distribution* and *underestimation of risk to detect life-threatening situations*) were identified, aiming to measure the effects of an EMCC reform in Finland 2006. These selected performance indicators evaluated the process in the EMCC, and they may be considered as direct measures of quality and as giving specific input for improvement (148). The indicators may also answer the question “How are we doing?” The indicators have limitations since they may impose strict criteria for generalization and do not always give the whole picture of the changes. There are other ways of evaluating an EMCC reform (45), but using feedback from ambulances to the dispatch centre was the solution in study III.

The differences between the organizations, before and after the reform, may have been caused by external factors such as; social, and economic changes in the area and changes in treatment protocols in the ambulance services. The small number of differences may also be an effect of poorly designed and implemented EMCC reform; the implementation may not always be successful due to different barriers (II). The increasing use of highest priority and less use of lower priority classifications may indicate an over-triage in the new EMCC organization, resulting in increased costs (149). With limited EMS resources, over-triage also may lead to unavailability of ambulances (150). Clear definitions are needed to state what over- and under-triage actually means otherwise the over- and under-triage measurement is useless for evaluating and comparing patient safety and quality in different EMS systems (17). The performance indicators *priority distribution* and *underestimation of risk to detect life-threatening situations* may be used on a regular basis to guarantee patient safety and could be continuously measured from a feedback system. If there are increasing cases of unexpected deaths in the low priority calls and the highest priority is used less, there may be an unnecessary risk for the patient. The used performance indicators were identified through consensus in the research group. Previously described performance indicators have been identified in a similar way (118-120, 145). The validation of the used performance indicators may be considered as weak since they have not been evaluated before. There is a need for more research concerning validation of performance indicators so organization or protocol changes in the EMCC can be evaluated in a structured and validated way.

6.6 ASSESSING THE CALL

The difficulties in assessing calls are well described, and the conclusions of these previous studies include the following: for an optimal assessment of the call to the EMCC and to identify the patients' need of care, the patients should make the call themselves, be calm, sober, a native speaker and have no communication problems (7, 81-87). In Study IV, the previously described difficulties of assessing a call to the EMCC were not identified as barriers. When there were communication difficulties, the RN used different communication strategies such as closed loop communication to identify the caller's need of care.

A closed-loop communication is described to support a precise and accurate communication (151). This might be one explanation for why language barriers caused by intoxication or not being a native speaker were not identified as a barrier in study IV. Could it be that the RNs have developed the skills to tackle such concrete problematic communication situations in an appropriate manner?

Is this a specific skill developed in an ad hoc way from the RNs' professional backgrounds and experience in managing interactions with callers as argued by Pettinari & Jessopp (69). This cannot be ascertained from the results of study IV but a question arises; is it possible to develop an assessment protocol supporting problematic communication situations? Further research is needed to clarify the effectiveness of communication strategies used when assessing calls to the EMCC. To increase the medical competence to assess the calls to the EMCCs is described as important, especially when assessing unclear emergency calls (62) or when the demand for EMS services exceeds the availability of resources (65).

If the RN is used because of the limitation of resources, it may cause a sense of being both caregiver and a gatekeeper, and there may appear a conflict between the ideal care and the professional reality for the RN (152). The RN often has little time to establish contact and gain a complete picture of the situation (68, 100). The mean time for assessing the call to the EMCC was approximately three minutes in study IV (table 2 in study IV). During these minutes, the RN needs to create a complete picture of the situation in order to assess the call. If there are communication difficulties, there is a risk of a professional failure (68).

The RNs are described as using different strategies to assess the call. Primarily, they use the verbally communicated information as a base for assessment but they also use non-verbal communication such as vocal behavior, background sounds and symptomatic sounds (79). In study IV there were calls with clear symptom descriptions and supporting symptomatic sounds describing a sick person but the RN did not take any action based on the information. This may indicate that there are other factors influencing the assessment of the call to the EMCC. Further studies are needed to clarify the communication patterns in assessing the call to the EMCC.

6.7 METHODOLOGICAL CONSIDERATIONS

In medical research, experimental designs of studies are traditionally preferred to observational designs, but experimental, randomized control studies are not always possible in practice or appropriate to conduct. All the studies in these thesis have an observational study design, partly because there was little possibility of conducting an experimental study in the research area concerning feedback between ambulance personnel and the EMCC and partly due to the fact that the research questions were not appropriate for an experimental study design since the questions aimed to explore the selected research area.

The generalizability of the results is thus limited, but it is reasonable to think that the results may be transferable into similar situations and contexts. However generalizability is not something that is usually discussed and argued for in qualitative and descriptive research.

And there is no hierarchy in data collection-analyze techniques whereby one method is judged to be more true and accurate (153). The results of the studies can instead be seen as part of a picture, and there is a need to have several parts to obtain a clear view of the whole picture. In this case, different aspects of develop, implement and the use of a technical feedback system. However, the results in this thesis should be seen in the light of different methodological limitations.

One factor that is both strength and a limitation of this thesis is the contextual awareness of the EMS in Stockholm. The value of working in the daily practice made it possible to discuss the feedback system with ambulance colleagues and this gave a contextual background and knowledge about who the authorities are and who may support or reject the research. But there is also a hazard in knowing the context (130). The researchers need to know and clarify what they represent in different situations. A strategy for not mixing the clinician and researcher roles has been to communicate what the participants and the colleagues can expect in the different situations. The contextual awareness has also been thoroughly discussed and reflected on in the research group aiming to manage the research integrity. This awareness about the EMS in Stockholm may in some way have affected the results in the thesis, but there has not been any direct possibility of influencing how and if the personnel in the ambulance send feedback to the EMCC (I). The individual ambulance personnel decided by themselves if they sent feedback or not since there was no mandatory demand of sending feedback to the EMCC.

In study I the convenient collection of data might be considered as a limitation, as might the decision to review 240 medical records instead of all. Using convenience sampling can be considered as the weakest form of collecting data, since there is a risk of bias and there is no way of evaluating that bias (131). Another limitation of the study is the lack of ambulance medical records. The margin of error in the feedback system may have been larger or smaller depending on the sample size and whether or not medical records were missing and thus not available for analysis. A follow-up study is needed to verify or reject the described margin of error in the feedback system. Strength of the study however is the selection of the 530 assignments. These assignments may be considered as a reflection of the most common assignments in the EMS when comparing with other EMS studies (19, 30, 46, 147).

In study II, in order to understand why the implementation of the feedback system did or did not work, an inductive study design was used. A deductive study design with, for example, multiple-choice questionnaires, requires more theoretical knowledge about implementation in the EMS than the available. At present there are few studies describing factors that may affect the implementation of innovations in the ambulance context (96, 110, 111, 113).

However, in interviews the participants have the opportunity to describe their experience without being forced into standardized questions (129). Two in-depth interviews and focus groups were conducted for collecting data. According to the literature focus group interviews should be conducted, with 6-10 informants (129). In this study, the focus groups each consisted of 12 participants. To improve and strengthen the credibility of the results, additional and smaller focus group interviews with participants from other ambulance stations could have been conducted to explore other aspects that may affect the implementation process throughout the EMS organization. The participants' experiences may not be representative of all the personnel in the EMS, but the study results reflect their perspective on using the feedback system and to some extent correspond to other implementation studies in the EMS context (96, 110, 111, 114). The factors described above may have affected the result in some way so further studies are needed to confirm or reject the results. Such further studies are also needed to obtain a clearer picture of more factors that influence the implementation process in the EMS organization.

In study III, the difference in sample size between the two groups is a limitation but not a great one since statistical procedures may have compensated for the differences in the sample size, but still there may be a bias caused by the sample imbalance (131). Another limitation is that the sample size concerning pre-hospital deaths and priority A assignments was small in both groups. Another limitation is that the data from the new EMCC was collected over a five-month period, close to the organization reform, while the data from the municipality-based centres were collected during a four-year period. During the study period changes in the diseases and other unknown external factors may have occurred. Collecting data from multiple EMCCs and/or data over a complete year would have reduced some of the bias in the study. The result of this study also (as in I & IV) depends on the correctness of ambulance personnel's use of feedback codes. However, in this study one of the measured outcomes was "dead at scene" and in this feedback group there is a small risk of misclassification by the ambulance personnel.

In study IV, the purposeful case sampling aimed to give insight into factors that influence the assessment. Purposeful case sampling is commonly used when seeking information-rich and illuminating cases (129). By selecting calls out of the feedback sent by the ambulance nurse at the scene there was a possibility of identifying different types of calls. In evaluation of these calls it is possible to learn from untypical calls that may be relevant to improving more typical calls to the EMCC. We listened to and transcribed the recorded calls, but a limitation was when there was no opportunity to put clarifying questions to the caller or the RN. More questions arose during the analyses than could be answered. Further studies with other methods are needed to explore the communications patterns between the caller and the RN. The validity of the selected sample size can be discussed. The sample size has more to do with the information rich calls and the analytical capabilities of the researcher than the quantity of the data (129). The calls were information rich, and the doctoral student making the analysis was a beginner, but the supervisors continuously made co-assessments of the analyses to ensure the validity of the results.

As a methodological conclusion, other methods could have been used but the measured outcomes of this thesis have contributed to finding the first pieces of the puzzle of creating a developed and evaluated feedback system in the EMS, and it is reasonable to assume that the results are transferable to similar situations and similar contexts, but more research is needed.

7 CONCLUSIONS

A technical feedback system has been developed out of a Finnish EMS model and adjusted to suit the Swedish EMS. The developed feedback system has an acceptable margin of error, and the most commonly used feedback code was “*agree with the dispatcher*” (I).

This developed and evaluated technical feedback system has the potential to be used for structured and regular feedback sent by ambulance personnel to the EMCC (I).

The implementation process of the system in the Stockholm EMS was influenced by different factors; motivation, participation and encouragement. The presence or absence of these factors created both opportunities and barriers in the implementation of the feedback system.

To evaluate how the feedback system could be used, an organization evaluation with performance indicators was conducted in the Finnish EMS. After the implementation of a new EMCC organization in Finland the percentage and number of high priority dispatched ambulance assignments increased. There was also a trend that the EMDs’ ability to detect patients with life-threatening conditions increased in the new EMCC, even though the risk ratio for underestimation was higher in the new EMCC (III). From the implemented feedback system, 100 calls to the EMCC were identified and selected for analysis (IV). Barriers and opportunities related to the registered nurse (RN) or the caller were identified as the main factors influencing the assessment. The opportunities appeared in the callers’ symptom description and the communication strategies used by the RNs. The barriers appeared in callers’ descriptions of unclear symptom- paradoxes and the RNs’ lack of communication strategies during the call

8 CLINICAL IMPLICATIONS

Research and developmental work must continuously be conducted to determine and reduce errors in the EMS, and it is vital to ensure and increase patient safety through science. The developed technical feedback system is feasible for feedback between the ambulance personnel and the EMCC. By using the developed feedback system it is also possible, in a structured way, to evaluate organizational changes from identified performance indicators and to identify and evaluate specific calls and assignments. Using the feedback system on a daily basis could increase the possibility of identifying systematic or individual errors in the EMS. The feedback system makes it possible for the individual EMD to obtain information on the best way to assess the call. If the feedback shows that the assessment of the call was not optimal for the patient, the EMD can go back immediately to the call and evaluate the call process. By using the developed feedback system there will be benefits for patients in the first part of the chain of survival.

9 SVENSK SAMMANFATTNING (SUMMARY IN SWEDISH)

Larmcentralen och ambulanssjukvården är den första länken i den akut sjuke eller skadade patientens vårdkedja. Larmoperatörerna⁴ genomför bedömningen och prioritering i samtalen som inkommer till 112 och behövs det, eller misstänks det behövas, medicinsk akutsjukvård larmar larmoperatörerna ut behövliga resurser. För att bedöma, prioritera och ge råd till inringare⁵ använder SOS Alarm⁶ och larmoperatörerna ett symtombaserat beslutssystem⁷. Larmoperatörens bedömning och prioritering är direkt avgörande för patienten vid sjukdomar och händelser som hjärtstopp, stroke och olyckor. Det finns många studier som beskriver svårigheterna med att bedöma larmsamtal och prioritera det medicinska vårdbehovet hos patienten. Svårigheterna att bedöma vårdbehov orsakas av att larmoperatörerna inte direkt talar med den vårdsökande utan gör sina bedömningar på ibland andra och tredjehandsinformation. Detta leder av naturliga skäl till ett visst överutnyttjande av akutsjukvården, men säkerhetsmarginaler behövs för att garantera en patientsäker vård. Det är en svår balansgång mellan patientsäkerhet och att inte felutnyttja befintliga resurser. Det ställer krav på att larmcentralerna som vårdgivare utvecklas, för att tillmötesgå omvärldens ökade krav på kvalitetsutveckling och för att befintliga resurser ska användas på ett optimalt sätt. För att kunna utveckla och utnyttja befintliga resurser optimalt behövs en utvärdering av det som sker i den dagliga verksamheten. I nuvarande vårdkedja finns ingen möjlighet att sammanfoga den initiala bedömningen och prioriteringen som gjorts av larmoperatören och ambulanspersonalens bedömning vid ankomst till patient/skadeplats. Det finns studier som beskriver att återkoppling är ett möjligt redskap, som kan användas för att utvärdera det som sker i den dagliga verksamheten. En allmän bedömning inom larmcentralen och ambulanssjukvården är att återkoppling skulle kunna användas för att kvalitetssäkra och utveckla den första länken i vårdkedjan. Det finns även studier som beskriver att återkoppling kan vara ett sätt att utveckla verksamheten och att strukturerat utvärdera de bedömningsprotokoll som används av larmoperatörer.

⁴ Larmoperatör definieras som den person som besvarar, bedömer och prioriterar medicinska samtal som inkommer till larmcentralen. Det kan vara legitimerade sjuksköterskor, undersköterskor eller annan personal.

⁵ Inringare innebär i detta sammanhang den person som ringer larmcentralen, det kan vara sjukvårdspersonal, patienter, anhöriga eller andra medmänniskor.

⁶ SOS Alarm är ett samhällsägt bolag som samverkar med landsting och privata entreprenörer som bedriver ambulanssjukvård, 95 % av larmcentralerna i Sverige drivs av SOS Alarm.

⁷ Svenskt Medicinskt Index, utvecklat av Laerdal, Norge.

Idag finns inget vedertaget system som används för regelmässig och strukturerad återkoppling mellan larmoperatörer och personalen inom ambulanssjukvården i Sverige. Det övergripande syftet med avhandlingen var att utveckla, implementera och utvärdera ett tekniskt återkopplingssystem mellan ambulanspersonal och larmcentral.

Fyra studier har genomförts under perioden 2007-2011. Ansatsen studierna har varit kvantitativ (I, III) eller kvalitativ (II, IV). Tre av studierna genomfördes i Stockholm, Sverige (I, II, IV) och den fjärde studien genomfördes i Östra-Centrala Nyland, ett område i södra Finland (III).

Delstudie I: För att undersöka hur det utvecklade återkopplingssystemet fungerade genomfördes en granskning av 530 återkopplingar skickade från ambulansen till larmcentralen. Den mest använda återkopplingen var ”Stämmer med utlarmning” (56.6 %). I 30 procent av återkopplingarna var det en diskrepans mellan larmoperatörens bedömning och ambulanspersonalens bedömning, inget bedömt tillstånd utmärkte sig. De sända återkopplingarna visade även att ambulanspersonalen inte transporterade 8.8 procent av patienterna till sjukhus. I tre procent av återkopplingarna gjorde ambulanspersonalen bedömningen att patientens tillstånd var livshotande och larmoperatören hade gjort bedömningen att det inte var ett brådskande ambulansärende. Den beräknade felmarginalen i de sända återkopplingarna uppgick till åtta procent. Orsakerna var dels tekniska, men framförallt kunde det inte genomföras någon granskning och jämförelse mellan skickade återkopplingar och ambulansjournaler, då det saknades ambulansjournaler.

Delstudie II: Vid implementeringen av återkopplingssystemet i Stockholm blev det tydligt att inom vissa delar av Stockholms ambulanssjukvård hade implementeringen fungerat tillfredställande, men på andra ställen hade implementeringen fallerat, det trots samma förutsättningar. Den andra forskningsfrågan utgick från dessa skillnader. Två djupintervjuer och två fokusgruppsintervjuer genomfördes med totalt 24 deltagare. De intervjuade uppmanades att berätta varför de skickade, eller inte skickade, återkoppling till larmcentralen. Resultatet visade, att det fanns olika faktorer som påverkade implementeringen: motivation, delaktighet och uppmuntran. Närvaron eller frånvaron av dessa faktorer skapade både möjligheter och hinder i implementeringen av återkopplingssystemet.

Delstudie III: För att belysa hur återkopplingssystemet kan användas för att utvärdera en larmorganisation genomfördes en studie i Finland, där en landsövergripande organisationsförändring av larmcentralerna genomförts 2006.

För att genomföra utvärderingen identifierades två kvalitetsindikatorer: prioritetsfördelning av ambulansuppdragen och patienter med livshotande tillstånd som inte identifieras av larmoperatören. Data som samlades in var: larmoperatörens utlarmning gällande prioritering och skickade återkopplingar från ambulanser. Resultatet visade att det hade skett en förändring i antalet utlarmade ambulansuppdrag med högsta prioritet (prio A) och lägsta prioritet (prio C). I den nya organisationen ökade antalet prioritet A och prioritet C-uppdragen minskade, dock ingen statistiskt säkerställd skillnad. I den nya organisationen var det även mer ambulansuppdrag, där ambulansen larmats ut som prioritet C-D och där ambulansen transporterade patienten med blåljus och siren till sjukhus (prio A-B). Den skillnaden är statistiskt säkerställd ($p < 0,001$). I den nya organisationen fanns det även en tendens till att larmoperatörerna var bättre på att identifiera patienter som befann sig i ett direkt livshotande tillstånd, skillnaden är dock inte statistiskt säkerställd ($p = 0,27$, CI 0,50–1,22 och RR 0,78).

Delstudie IV: För att belysa hur återkopplingssystemet kan användas genomfördes en analys av 100 samtal ringda till larmcentralen. Syftet var att identifiera faktorer som inverkar på bedömningen av larmsamtal. De analyserade samtalen identifierades och valdes utifrån återkopplingar som skickats av ambulanspersonalen till larmcentralen.

Övergripande identifierades hinder och möjligheter i bedömningen av samtalet som var relaterade till sjuksköterskan eller inringaren. Möjligheterna var hur symtombeskrivning gjordes av inringaren och de olika kommunikationsstrategier som sjuksköterskan använde. Hindren uppkom när inringaren gav oklara symtombeskrivningar och när olika paradoxer presenterades, samt när sjuksköterskan hade bristande kommunikationsstrategier.

Sammanfattning

Ett tekniskt återkopplingssystem har utifrån en Finländsk modell utvecklats och anpassats till svenska förhållanden (I). Det utvärderade återkopplingssystemet har en acceptabel felmarginal och bör kunna användas för strukturerad och regelbunden återkoppling från ambulans till larmoperatör- larmcentral i Sverige (I). Vid implementeringen av återkopplingssystemet i Stockholm blev det tydligt att inom vissa delar av Stockholms ambulanssjukvård hade implementeringen fungerat tillfredställande, men på andra ställen hade implementeringen inte lyckats. Det fanns tre faktorer som påverkade implementeringen: motivation, delaktighet och uppmuntran. Närvaron eller frånvaron av dessa faktorer skapade både möjligheter och hinder vid implementeringen av återkopplingssystemet (II). För att belysa hur återkopplingssystemet kan användas utfördes en utvärdering av larmorganisationen i Finland, där en landsövergripande organisationsförändring av larmcentralerna genomförts 2006. Resultatet visade, att det hade skett en ökning av de högst prioriterade uppgifterna och det fanns en trend som belyste att larmoperatören möjligen blivit bättre på att identifiera patienter med livshotande tillstånd i den nya larmorganisationen (III). För att ytterligare belysa hur återkopplingssystemet kan användas för att utvärdera larmoperatörernas arbete, genomfördes en analys av 100 larmsamtal identifierade och valda utifrån återkopplingssystemet. Resultatet visade att det fanns både hinder och möjligheter i bedömningen av samtal. Dessa var relaterade till både sjuksköterskan och inringaren (IV).

10 ACKNOWLEDGEMENTS

Maaret Castrén, my supervisor, thank you for always supporting and believing in me. A lot of thanks for your unlimited patience, and all the opportunities you have given me. Your engagement in EMS is truly incredible. You are a source of inspiration!

Katarina Bohm, my co-supervisor, thanks for the support during the dark period :) I hope I can give back some of the time you gave me this semester, I promise to supervise the students' degree projects in higher extent next semester. I am looking forward to working with you in the future.

Lotta Falk, my co-supervisor and friend, thanks for your guidance in the academic jungle and for all the meaningless and meaningful conversations during the last 15 years. It was fantastic that you came and helped me with the ladder, otherwise I would have been sitting on the roof for hours (forever).

Rolf Karlsten, my co-supervisor, thank you for your support and guidance during these years and for the constructive and entertaining remarks in the manuscripts.

Sari Ponzer, co-supervisor during 2007-2008, you had the knowledge that was needed and made it possible for me to begin my studies 2007, thanks!

Annika Alm, my mentor and friend, thank you for believing in me and for all the telephone calls in the morning during the way to or from work.

Kristiina Heikkilä, thank you for invaluable supervising in the qualitative world of research.

Jukka Pappinen, thank you for introducing and supervising me in the Finnish EMS.

Thank you for being there, dear doctoral student colleagues in Maaret's research group at KI- Södersjukhuset, **Ahmadreza Djalali, Lars Stureson, Martin Nordberg & Veronica Vicente**.

Susanne Kalén, without you there would not have been a doctoral thesis in the context of EMS, thank you, for presenting me for Maaret. Looking forward to your dissertation! And **Ida Carlander**, thank you for kick starting me to finish this doctoral thesis.

Helene Conte, my friend and colleague thank you for introducing me to **Bill I** and supervising me to the facial and foot care. Also thanks for the good laughs in the moments of darkness, mooohooohaaa....

Helena Borovszky (and her family), thank you for the music and teaching me more about the importance (need) of structure.

Daniel Böckow, Pillan Karlsson & Robert Lundgren, dear colleagues in the ambulance services, thank you for listening to my monologues during the 24 hours working shifts in the ambulance.

All ambulance personnel from **AISAB, Falck Ambulans AB, Samariten Ambulans AB & Sirius Humanum** participating in sending feedback to the EMCC in Stockholm. And all personnel at **SOS Alarm** thank you for participating in the ÅSA I project.

My son **Axel** the joy in my life, thank you for your patience when my world has been overwhelmingly consisting of research/work and for your support throughout this unbelievable journey. **Solveig, Stefan, May, Hille, Tisa, Henry Elin & Victor**, it is good knowing you are my family.

Thanks to all my friends, for just being a friend and your confidence that I would finish this thesis, specially; **Barbara David, Agneta Witalisson, Turid Olsson, Nilla Bornhall, Camilla Smedberg, Birgitta Olgren, Inga-Märta Petersen & Ulla Prag**.

Suore di Santa Brigida, Camaldoli, thank you for the possibility to stay in your convent, the silence, the food and the wine made the final writing possible.

This work was supported by grants from; SOS alarm, Lars Hierta foundation and The Non Profit Foundation for the Red Cross Hospital and the Red Cross University College. Financial support was also provided through the regional agreement on medical training and clinical research (Pick-Up/ALF) between Stockholm County Council and Karolinska Institutet.

11 REFERENCES

1. Pozner CN, Zane R, Nelson SJ, Levine M. International EMS system: The United States: past, present, future. *Resuscitation*. 2004 Mar; 60(3):239-44.
2. Sikka N, Margolis G. Understanding diversity among prehospital care delivery system around the world. *Emerg Med Clin North Am*. 2005 Feb; 23(1):99-114.
3. MacFarlane C, van Loggerenberg C, Kloeck W. International EMS systems in South Africa- past, present and future. *Resuscitation*. 2005; 64(2):145-8.
4. Black JJ, Davies GD. International EMS systems: United Kingdom. *Resuscitation*. 2005 Jan; 64(1):21-9.
5. Timerman S, Gonzalez MM, Zaroni AC, Ramires JA. Emergency medical services: Brazil. *Resuscitation*. 2006 Sep; 70(3):356-9.
6. Tanigawa K, Tanaka K. Emergency medical service system in Japan past, present and future. *Resuscitation*. 2006 Jun; 69(3):365-70.
7. Nemitz B. Advantages and limitations of medical dispatching; the French view. *Eur J Emerg Med*. 1995 Sep; 2(3):153-9.
8. Langhelle A, Lossius HM, Silfvast T, Björnsson HM, Lippert FK, Ersson A, et al. International EMS Systems: the Nordic countries. *Resuscitation*. 2004 Apr; 61(1):9-21.
9. Castrén M, Karlsten R, Lippert F, Christensen EF, Bovim E, Kvam AM, et al. Recommended guidelines for reporting on emergency medical dispatch when conducting research in emergency medicine: The Utstein style. *Resuscitation*. 2008 Nov; 79(2):193-7.
10. O'Cathain A, Turner J, Nicholl T. The acceptability of an emergency medical dispatch system to people who call 999 to request an ambulance. *Emerg Med J*. 2002 Mar; 19(2):160-3.
11. Nolan J, Soar J, Eikeland H. The chain of Survival (Image in Resuscitation). *Resuscitation*. 2006 Dec; 71(3):270-1.
12. National Board of Health and Welfare. Medical competence in dispatching (Medicinsk kompetens i ambulansalarmering) (In Swedish). Stockholm: Socialstyrelsen 2002.
13. Fevang E, Lockey D, Thompson J, Lossius HM; Torpo Research Collaboration. The top five research priorities in physician- provided pre- hospital critical care: a consensus report from a European research collaboration. *Scand J Trauma Resusc Emerg Med*. 2011 Oct; 13:19:57.

14. Kuisma M, Holmström P, Repo J, Määttä T, Nousila-Wiik M, Boyd J. Prehospital mortality in an EMS system using medical priority dispatching: a community based cohort study. *Resuscitation*. 2004 Jun; 61(3):297-302.
15. The ESCORTT group. The identification of acute stroke: an analysis of emergency calls. *Int J Stroke*. 2012 Feb 15. [Epub ahead of print].
16. Axelsson C, Borgström J, Karlsson T, Axelsson AB, Herlitz J. Dispatch codes of out-of-hospital cardiac arrest should be diagnosis related rather than symptom related. *Eur J Emerg Med*. 2010 Oct; 17(5):265-9.
17. Cone DC, Schmidt TA, Mann NC, Brown L. Developing research criteria to define medical necessity in emergency medical services. *Prehosp Emerg Care*. 2004 Apr-Jun; 8(2):116-25.
18. Calle P, Lagaert L, Buylaert W. How to evaluate an emergency medical dispatch system and identify area for improvement? *Eur J Emerg Med*. 1996 Sep; 3(3):187-90.
19. Studnek JR, Thestrup L, Blackwell T, Bagwell B. Utilization of prehospital dispatch protocols to identify low-acuity patients. *Prehosp Emerg Care*. 2012 Apr-Jun;16(2):204-9.
20. Berdowski J, Beekhuis F, Zwinderman AH, Tijssen JG, Koster RW. Importance of the first link. Description and recognition of an Out-of- hospital cardiac arrest in an emergency call. *Circulation*. 2009 Apr 21; 119(15):2096-102.
21. Fourny M, Lucas AS, Belle L, Debaty G, Casez P, Bouvaist H, et al. Inappropriate dispatcher decision for emergency medical service users with acute myocardial infarction. *Am J Emerg Med*. 2011 Jan; 29(1):37-42.
22. Roppolo LP, Pepe PE, Cimon N, Gay M, Patterson B, Yancey A, et al. Modified cardiopulmonary resuscitation (CPR) instruction protocols for emergency medical dispatchers: rationale and recommendations. *Resuscitation*. 2005 May; 65(2):203-10.
23. Nurmi J, Pettilä V, Biber B, Kuisma M, Komulainen R, Castrén M. Effect of protocol compliance to cardiac arrest identification by emergency medical dispatchers. *Resuscitation*. 2006 Sep; 70(3):463-9.
24. Van Vleet LM, Hubble MW. Time to first compression using Medical Priority Dispatch System compression-first dispatcher-assisted cardiopulmonary resuscitation protocols. *Prehosp Emerg Care*. 2012 Apr-Jun; 16(2):242-50.
25. Roppolo LP, Westfall A, Pepe PE, Nobel LL, Cowan J, Kay JJ, et al. Dispatcher assessment for agonal breathing improve detection of cardiac arrest. *Resuscitation*. 2009 Jul; 80(7):769-72.

26. Bohm K, Vaillancourt C, Charette ML, Dunford J, Castrén M. In patients with out-of-hospital cardiac arrest, does the provision of dispatch cardiopulmonary resuscitation instructions as opposed to no instructions improve outcome: A systematic review of the literature. *Resuscitation*. 2011 Dec; 82(12):1490-5.
27. Ahl C, Nyström M, Jansson L. Making up one's mind:- Patients experience of calling an ambulance. *Accid Emerg Nurs*. 2006 Jan; 14(1):11-9.
28. Bång A, Örtgren PO, Herlitz J, Währborg P. Dispatcher assisted telephone CPR a qualitative study exploring how the dispatchers perceive their experience. *Resuscitation* 2002 May; 53(2):135-51.
29. Forslund K, Kihlgren M, Östman I, Sørli V. Patients with acute chest pain- experiences of emergency calls and pre-hospital care. *J Telemed Telecare*. 2005;11(7):361-7.
30. Beillon LM, Suserud BO, Karlberg I, Herlitz J. Does ambulance use differ between geographic areas? A survey of ambulance use in sparsely and densely populated areas. *Am J Emerg Med*. 2009 Feb; 27(2):202-11.
31. Calle P, Vanhaute O, Lagaert L, Houbrechts H, Buylaert W. The early access link in the chain of survival for cardiac arrest victims in Ghent, Belgium. *Eur J Emerg Med*. 1994 Sep; 1(3):145-8.
32. Buck BH, Starkman S, Eckstein M, Kidwell CS, Haines J, Huang R, et al. Dispatchers recognition of stroke using the national academy medical priority dispatch system. *Stroke*. 2009 Jun; 40(6):2027-30.
33. Ramanujam P, Guluma KZ, Castillo EM, Chacon M, Jensen MB, Patel E, et al. Accuracy of stroke recognition by emergency medical dispatchers and paramedics - San Diego experience. *Prehosp Emerg Care*. 2008 Jul-Sep; 12(3):307-13.
34. Flynn J, Archer F, Morgans A. Sensitivity and specificity of the medical dispatch system detecting cardiac arrest emergency calls in Melbourne. *Prehosp Disaster Med*. 2006 Mar-Apr; 21(2):72-6.
35. Swedish Statistical Central Board; Population Statistics [Internet]. Stockholm: Swedish Statistical Central Board; [cited 2012 16th of February]; Available from: http://www.scb.se/Pages/Product___2578.aspx.
36. SOS Alarm. Information Swedish dispatch organisation [Internet]. (Information SOS Alarm) (in Swedish). Stockholm: SOS Alarm 2012 [cited 2012 27th of January]; Available from: [http:// www.sosalarm.se](http://www.sosalarm.se).

37. Brismar B, Dahlgren BE, Larsson J. Training of emergency dispatch center personnel in Sweden. *Crit Care Med*. 1984 Aug; 12(8):679-80.
38. Laerdal. The Laerdal Foundation for Acute Medicine; Swedish Index to Emergency Medical Assistance. Stavanger: Laerdal A/S 2001.
39. National Board of Health and Welfare. Regulation, about ambulance Care etc. 2009:10 (Socialstyrelsens föreskrifter och allmänna råd om ambulanssjukvård m.m. 2009:10) (In Swedish). Stockholm: Socialstyrelsen, 2009.
40. Suserud BO. A new profession in the pre-hospital care field – the ambulance nurse. *Nurs Crit Care*. 2005 Nov-Dec; 10(6):269-71.
41. Thorn J, Öringe P, Wennmann I, Klittermark P. Open track all wins in the long run- a project between ambulance services and hospital [Internet]. Congress FLISA Leksand-Dalarna, Sweden 2010. [cited 2012 27th of January]; Available from: http://www.sahlgrenska.se/upload/SU/omrade_molndal/ambulans/%c3%96ppet%20sp%c3%a5r%20FLISA%202010%20Klittermark%20Thorn%20%c3%96rninge.pdf.
42. National Board of Health and Welfare. Regulation, about dispense and administrate drugs in the health care system 2000:1. (Socialstyrelsens föreskrifter och allmänna råd om läkemedelshantering i hälso-och sjukvården 2000:1) (in Swedish). Stockholm: Socialstyrelsen, 2000.
43. Statistics Finland. Population Statistics [Internet]. Finland's PX-Web database; [cited 2011 27th of January]; Available from: [http:// www.stat.fi](http://www.stat.fi).
44. Ministry of Social Affairs and Health, Finland. A handbook for drawing up an alarm procedures (Handbok för utarbetande av larminstruktioner) (In Swedish). Helsinki: Social- och Hälsovårdsministeriet; 2006.
45. Määttä T, Kuisma M, Väyrynen T, Nousila-Wiik M, Porthan K, Boyd J, et al. Fusion of dispatching centres into on entity: effects on performance. *Acta Anaesthesiol Scand*. 2010 Jul; 54(6):689-95.
46. Cone DC, Galante N, MacMillan DS. Can emergency medical dispatch system safely reduce first responder call volume? *Prehosp Emerg Care*. 2008 Oct-Dec; 12(4):479-85.
47. The Medical Dispatch System - International Academics of Emergency Dispatch [Internet]. Salt Lake City: IAED International Academies of Emergency Dispatch [cited 2012 1th of February]; Available from: <http://www.emergencydispatch.org/ResourcesEDS>.
48. Clawson J, Olola C, Heward A, Patterson B. Cardiac arrest predictability in seizure patients based on emergency medical dispatcher identification of previous seizure or epilepsy history. *Resuscitation*. 2007 Nov; 75(2):298-304.

49. Bailey ED, O' Connor RE, Ross RW. The use of emergency medical dispatch protocols to reduce the number of inappropriate scene responses made by advanced life support personnel. *Prehosp Emerg Care*. 2000 Apr-Jun; 4(2):186-9.
50. Sayre MR, White LJ, Brown LH, McHenry SD; National EMS Research Strategic Plan Writing Team. The national EMS research strategic plan. *Prehosp Emerg Care*. 2005 Jul-Sep; 9(3):255-66.
51. Wilson S, Cooke M, Morrell R, Bridge P, Allan T; Emergency Medicine Research Group (EMERG). A systematic review of the evidence supporting the use of priority dispatch of emergency ambulances. *Prehosp Emerg Care*. 2002 Jan-Mar; 6(1):42-9.
52. Clawson J, Olola CH, Heward A, Scott G, Patterson B. Accuracy of emergency medical dispatchers' subjective ability to identify when higher dispatch levels are warranted over a Medical Priority Dispatch System automated protocol's recommended code based on paramedic outcome data. *Emerg Med J*. 2007 Aug; 24(8):560-3.
53. Handschu R, Poppe R, Rauss J, Neundörfer B, Erbguth F. Emergency calls in acute stroke. *Stroke*. 2003 Apr; 34(4):1005-9.
54. Sporer KA, Johnson NJ, Yeh CC, Youngblood GM. Can emergency medical dispatch codes predict prehospital interventions for common 9-1-1 call types? *Prehosp Emerg Care*. 2008 Oct-Dec; 12(4):470-8.
55. Clawson J, Olola C, Heward A, Patterson B, Scott G. Profile of Emergency Medical Dispatch Calls for Breathing Problems within the Medical Priority Dispatch System Protocol. *Prehosp Disaster Med*. 2008 Sep-Oct; 23(5):412-9.
56. Garza AG, Gratton MC, Chen JJ, Carlson B. The accuracy of predicting cardiac arrest by emergency medical services dispatchers: The calling party effect. *Acad Emerg Med*. 2003 Sep; 10(9):955-60.
57. Hjalte L, Suserud BO, Herlitz J, Karlberg I. Why are people without medical needs transported by ambulance? A study of indications for pre-hospital care. *Eur J Emerg Med*. 2007 Jun; 14(3):151-6.
58. Sporer KA, Youngblood GM, Rodriguez RM. The ability of emergency medical dispatch codes of medical complaints to predict ALS prehospital interventions. *Prehosp Emerg Care*. 2007 Apr-Jun; 11(2):192-8.
59. Shah MN, Bishop P, Lerner EB, Fairbanks RJ, Davis EA. Validation of using EMS dispatch codes to identify low-acuity patients. *Prehosp Emerg Care*. 2005 Jan-Mar; 9(1):24-31.

60. Karlsten R, Elowsson P. Who calls for the ambulance? Implications for decision support. A descriptive study from a Swedish dispatch centre. *Eur J Emerg Med*. 2004 Jun; 11(3):125-9.
61. Wahlberg AC. Telephone Advice Nursing- caller's perceptions, nurse's experience of problems and basis for assessments [dissertation]. Stockholm: Karolinska Institutet; 2004.
62. Forslund K, Kihlgren M, Sorlie V. Experiences of adding nurses to increase medical competence at an emergency medical dispatch centre. *Accid Emerg Nurs*. 2006 Oct; 14(4):230-6.
63. Dale J, Higgins J, Williams S, Foster T, Snooks H, Crouch R, et al. Computer assisted assessment and advice for "non-serious" 999 ambulance service callers: the potential impact on ambulance despatch. *Emerg Med J*. 2003 Mar; 20(2):178-83.
64. Dale J, Williams S, Foster T, Higgins J, Snooks H, Crouch R, et al. Safety of telephone consultation for "non-serious" emergency ambulance service patients. *Qual Saf Health Care*. 2004 Oct; 13(5):363-73.
65. Farand L, Leprohon J, Kalina M, Champagne F, Contandriopoulos AP, Preker A. The role of protocols and professional judgement in emergency medical dispatching. *Eur J Emerg Med*. 1995 Sep; 2(3):136-48.
66. Nilsson, Waldemanson. Communication an act between humans (Kommunikation samspel mellan människor) (In Swedish). Lund: Studentlitteratur; 2007.
67. Travelbee J. Interpersonal aspects of nursing 2ed. Philadelphia: Davis; 1971.
68. Eide H, Eide T. Nursing Oriented Communications: relational ethics, cooperation and conflict resolution (Omvårdnadsorienterad kommunikation: relationsetik, samarbete och konfliktlösning) (In Swedish). 2th ed. Lund: Studentlitteratur AB; 2009.
69. Pettinari CJ, Jessopp L. Your ears become your eyes: managing the abscens of visibility in NSH direct. *J Adv Nurs*. 2001 Dec; 36(5):668-75.
70. Locke R, Stefano M, Koster A, Taylor B, Greenspan J. Optimizing patient/caregiver satisfaction through quality of communication in the pediatric emergency department. *Pediatr Emerg Care*. 2011 Nov; 27(11):1016-21.
71. Rupp-Wysong P, Driver E. Patients perception of nurses skill. *Crit Care Nurse*. 2009 Aug; 29(4):24-37.
72. Shattell M. Nurse-patient interaction: a review of the literature. *J Clin Nurs*. 2004 Sep; 13(6):714-22.

73. The Joint Commission. Communication during patient hand-overs. Geneva: World Health Organization; 2007.
74. Wallin C-J, Thor J. SBAR- a model for better communication between health care professionals (SBAR-modell för bättre kommunikation mellan vårdpersonal) (In Swedish). *Lakartidningen*. 2008 Jun 25-Jul 1; 105(26-27):1922-5.
75. Palazzo FF, Warner OJ, Harron M, Sadana A. Misuse of the London ambulance service how much and why? *J Accid Emerg Med*. 1998 Nov;15(6):368-70.
76. Wahlberg AC, Cedersund E, Wredling R. Factors and circumstances related to complaints in emergency medical dispatching in Sweden: an exploratory study. *Eur J Emerg Med*. 2003 Dec; 10(4):272-8.
77. Castrén M, Kuisma M, Serlachius J, Skrifvars M. Do health care professionals report sudden cardiac arrest better than layman? *Resuscitation*. 2001 Dec; 51(3):265-8.
78. Neely KW, Norton RL, Schmidt TA. The strength of specific EMS dispatcher questions for identifying patients with important clinical findings. *Prehosp Emerg Care*. 2000 Oct-Dec; 4(4):322-6.
79. Wahlberg AC, Cedersund E, Wredling R. Bases for assessments made by telephone advice nurses. *J Telemed Telecare*. 2005;11(8):403-7.
80. Läppen V. Telephone advice in health care (Telefonrådgivning inom hälso- och sjukvård) (In Swedish). Holmström I, editor. Lund: Studentlitteratur; 2008.
81. Grow RW, Sztajnkrzyer MD, Moore BR. Language barriers as a reported cause of prehospital care delay in Minnesota. *Prehosp Emerg Care*. 2008 Jan-Mar; 12(1):76-9.
82. Meischke H, Chavez D, Bradley S, Rea T, Eisenberg M. Emergency communications with limited-English-proficiency populations. *Prehosp Emerg Care*. 2010 Apr-Jun; 14(2):265-71.
83. Wahlberg AC, Cedersund E, Wredling R. Telephone nurses' experience of problems with telephone advice in Sweden. *J Clin Nurs*. 2003 Jan; 12(1):37-45.
84. Forslund K, Kihlgren A, Kihlgren M. Operators' experiences of emergency calls. *J Telemed Telecare*. 2004; 10(5):290-7.
85. Hjalte L, Suserud BO, Herlitz J, Karlberg I. Initial emergency medical dispatching and prehospital needs assessment: a prospective study of the Swedish ambulance service. *Eur J Emerg Med*. 2007 Jun; 14(3):134-41.

86. Higgins J, Wilson S, Bridge P, Cooke MW. Communication difficulties during 999 calls; observational study. *BMJ*. 2001 Oct 6; 323(7316):781-2.
87. Tonje L, Elisabeth S, Lars W. Handling of drug-related emergencies; an evaluation of emergency medical dispatch. *Eur J Emerg Med*. 2009 Feb; 16(1):37-42.
88. Katz HP, Kaltounis D, Halloran L, Mondor M. Patient Safety and Telephone Medicine Some Lessons from Closed Claim Case Review. *J Gen Intern Med*. 2008 May; 23(5):517-22.
89. Gijzenbergh F, Nieuwenhof A, Machiels K. Improving the first link in the chain of survival: the Antwerp experience. *Eur J Emerg Med*. 2003 Sep; 10(3):189-94.
90. Runius L. Telephone advice in the health care (Telefonrådgivning i hälso- och sjukvården) (In Swedish) Holmström I, editor. Lund: Studentlitteratur; 2008.
91. Dictionary. Feedback [Internet]. Dictionary.com, LLC [cited 2012 28th of January]; Available from: <http://dictionary.reference.com/browse/feedback>.
92. Hattie J, Timperly H. The power of feedback. *Review of Educational Research*. 2007; 77(1):81-112.
93. Joyce SM, Dutkowski KL, Hynes T. Efficacy of an EMS quality improvement program in improving documentation and performance. *Prehosp Emerg Care*. 1997 Jul-Sep; 1(3):140-4.
94. Clawson JJ, Cady GA, Martin RL, Sinclair R. Effect of a comprehensive quality management process on compliance with protocol in an emergency medical dispatch centre. *Ann Emerg Med*. 1998 Nov; 32(5):578-84.
95. Persse DE, Key CB, Baldwin JB. The effect of a quality improvement feedback loop on paramedic-initiated nontransport of elderly patients. *Prehosp Emerg Care*. 2002 Jan-Mar; 6(1):31-5.
96. Berben SA, Meijs TH, van Grunsven PM, Schoonhoven L, van Achterberg T. Facilitators and barriers in pain management for trauma patients in the chain of emergency care. *Injury*. 2011 Mars;1:1-6.
97. Jamtvedt G, Young JM, Kristoffersen DT, O'Brien MA, Oxman AD. Does telling people what they have been doing change what they do? A systematic review of the effects of audit and feedback. *Qual Saf Health Care*. 2006 Dec; 15(6):433-6.
98. Croskerry P. The Feedback Sanction. *Acad Emerg Med*. 2000 Nov; 7(11):1232-8.

99. Mock EF, Wrenn KD, Wright SW, Eustis TC, Slovis CM. Feedback to Emergency Medical Services Providers: The Good, the Bad, and the Ignored. *Prehosp Disaster Med.* 1997 Apr-Jun; 12(2):145-8.
100. Leprohon J, Patel VL. Decision-making strategies for telephone triage in emergency medical services. *Med Decis Making.* 1995 Jul-Sep; 15(3):240-53.
101. Harrahill M, Gunnels D. Providing follow-up to prehospital care providers. *J Emerg Nurs.* 1999 Jun; 25(3):244-5.
102. Grimshaw JM, Thomas RE, MacLennan G, Fraser C, Ramsay CR, Vale L, et al. Effectiveness and efficiency of guideline dissemination and implementation strategies. *Health Technol Assess.* 2004 Feb; 8(6): 1-72.
103. Grol R, Wensing M. What drives change? Barriers to and incentives for achieving evidence-base practice. *Med J Aust.* 2004 Mar 15; 180(6 Suppl):S57-60.
104. Grol R. Beliefs and evidence in changing clinical practice. *BMJ.* 1997 Aug16; 315(7105):418-21.
105. Grimshaw JM, Eccles M, Thomas RE, MacLennan G, Ramsay CR, Fraser C, et al. Toward Evidence -Based Quality Improvement- Evidence (and its limitations) of the Effectiveness of Guideline Dissemination and Implementation Strategies 1966-1988. *J Gen Intern Med.* 2006 Feb; 21 Suppl 2:S14-20.
106. Wensing M, Wollersheim H, Grol R. Organizational interventions to implement improvements in patient care: a structured review of reviews. *Implement Sci.* 2006 Feb 22; 1:2.
107. Rycroft-Malone J, Kitson A, Harvey G, McCormack B, Seers K, Titchen A, et al. Ingredients for change: revisiting a conceptual framework. *Qual Saf Health Care.* 2002 Jun; 11(2):174-80.
108. Kaplan HC, Brady PW, Dritz MC, Hooper DK, Linam WM, Froehle CM, et al. The Influence of Context on Quality Improvement Success in Health Care: A systematic review of the Literature. *Milbank Q.* 2010 Dec; 88(4):500-59.
109. Camison- Zornoza C, Lapiedra-Alcami R, Segarra-Cipres M, Boronat-Navarro M. A meta-analysis of innovation and organizational size. *Organization Studies.* 2004; 25:331-61.
110. Youngquist ST, Gausche-Hill M, Squire BT, Koenig WJ. Barriers to adoption of evidence-based prehospital airway management practices in California. *Prehosp Emerg Care.* 2010 Oct-Dec; 14(4):505-9.

111. Sasson C, Forman J, Krass D, Macy M, Hegg AJ, McNally BF, et al. A qualitative study to understand barriers to implementation of national guidelines for prehospital termination of unsuccessful resuscitation efforts. *Prehosp Emerg Care*. 2010 Apr-Jun; 14(2):250-8.
112. Bigham BL, Aufderheide TP, Davis DP, Powell J, Donn S, Suffoletto B, et al. Knowledge translation in emergency medical services; A qualitative survey of barriers to guideline implementation. *Resuscitation*. 2010 Jul; 81(7):836-40.
113. Squires JP, Mason S. Developing alternative ambulance response schemes analysis of attitude, barriers and change. *Emerg Med J*. 2004 Nov; 21(6):724-7.
114. Janssen MA, van Achterberg T, Adriaansen MJ, Kampshoff CS, Schalk DM, Mintjes-de Groot J. Factors influencing the implementation of the guideline Triage in emergency departments: a qualitative study. *J Clin Nurs*. 2012 Feb; 21(3-4):437-47.
115. MacFarlane C, Benn CA. Evaluation of emergency medical services system: a classification to assist in determination of indicators. *Emerg Med J*. 2003 Mar; 20(2):188-91.
116. Siriwardena AN, Shaw D, Donohoe R, Black S, Stephenson J; National Ambulance Clinical Audit Steering Group. Development and pilot of clinical performance indicators for ambulance services. *Emerg Med J*. 2010 Apr; 27(4):327-31.
117. Myers JB, Slovis CM, Eckstein M, Goodloe JM, Isaacs SM, Loflin JR, et al. Evidence-Based Performance Measures for Emergency Medical Services Systems: a model for Expanded EMS Benchmarking. *Prehosp Emerg Care*. 2008 Apr-Jun; 12(2):141-51.
118. Dunford J, Domeier RM, Blackwell T, Mears G, Overton J, Rivera-Rivera EJ, et al. Performance Measurement in Emergency Medical Services. *Prehosp Emerg Care*. 2002 Jan-Mar; 6(1):92-8.
119. Sobo EJ, Andriese S, Stroup C, Morgan D, Kurtin P. Developing indicators for emergency medical services (EMS) system evaluation and quality improvement a statewide demonstration and planning project. *Jt Comm J Qual Improv*. 2001 Mar; 27(3):138-54.
120. Moore L. Measuring quality and effectiveness of prehospital EMS. *Prehosp Emerg Care*. 1999 Oct-Dec; 3(4):325-31.
121. Bohm K. Emergency medical services in Sweden (Prehospital sjukvård i Sverige) (In Swedish). *Scandinavian Update Magazine*. 2011;11:28-9.
122. Stockholm County Council; Guid to the Health Care System in Stockholm [Internet]. (Vårdguiden) (In Swedish). Stockholm: Stockholms Läns Landsting; 2012 [cited 2012 31th of January]; Available from: <http://www.vardguiden.se/Sa-funkar-det/Halso-och-sjukvard/Akut-varld/Sjukhus/>.

123. Polit DF, Beck CT. Undertakning Research for Specific Puposes. Generating and Assessing Evidence for Nursing Practice 7th ed. Philadelphia: Lippincott Williams & Wilkings; 2008.
124. Craig P, Dieppe P, MacIntyre S, Mitchie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions, the new Medical Research Council guidance. BMJ. 2008 Sep 29;337:a1655.
125. Castrén M. Personal contact and discussions about how they use feedback in Finnish EMS. 2007.
126. SLAS-FLISA. Assessment codes used in the ambulance sevicees [Internet]. (FLISA-Bedömningskoder ver 1.1) (InSwedish). SLAS; 2004 [updated 2011-02-11; cited 2012 31th of January]; Available from: <http://www.flisa.nu/web/page.aspx?refid=18>.
127. Grol R, Wensing M, Eccles M. Improving patient care the implementation of change in clinical practice. Philadelphia: Elsevier; 2005.
128. Kitzinger J. Focus groups research: Using group dynamics to explore perceptions, experiences and understanding. Holloway I, editor. Qualitative Research in Health Care. London: Open University press; 2005.
129. Patton MQ. Qualitative research & evaluation methods. 3th ed. London: Sage Publications 2002.
130. Thorne S . Interpretive description. Walnut Creek, CA: Left Coast Press; 2008.
131. Polit DF, Beck CT. Nursing Research Generating and assessing evidence for nursing practice 9th ed. Philadelphia: Wolters Kluwer/Williams & Wilkins; 2012.
132. Kvale S. The qualitative research interview (Den kvalitativa forskningsintervjun) (In Swedish). Lund: Studentlitteratur; 1997.
133. Thorne S, Kirkham SR, MacDonald-Emes J. Interpretive Description: A Noncategorical Qualitative Alternative for Developing Nursing Knowledge. Res Nurs Health. 1997 Apr; 20(2):169-77.
134. Krippendorff K. Content analysis. An introduction to methodology. London: Sage publications; 2004.
135. Health Care Regulation 1982:763 (Svensk författningssamling. Hälso- och sjukvårdslag 1982:763) (in Swedish). Stockholm; Socialdepartementet; 1982.

136. National Board of Health and Welfare. Regulations on information management and record keeping in health care 2008:14. (Socialstyrelsens föreskrifter om informationshantering och journalföring i hälso- och sjukvården 2008:14) (in Swedish). Stockholm: Socialstyrelsen; 2008.
137. Graneheim UH, Lundman B. Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Educ Today*. 2004 Feb; 24(2):105-12.
138. Downe-Wamboldt B. Content Analysis: Method, applications and issues. *Health Care Women Int*. 1992 Jul-Sep; 13(3):313-21.
139. Sandelowski M. Real qualitative researchers do NOT count: The use of number in qualitative research. *Res Nurs Health*. 2001 Jun;24(3):230-40.
140. Sandelowski M. What's in a Name? Qualitative description revisited. *Res Nurs Health*. 2010 Feb; 33(1):77-84.
141. Elo S, Kyngäs H. The qualitative content analysis process. *J Adv Nurs*. 2008 Apr; 62(1):107-15.
142. Eisenberg MS, Carter W, Hallstrom A, Cummins R, Litwin P, Hearne T. Identification of cardiac arrest by emergency dispatchers. *Am J Emerg Med*. 1986 Jul; 4(4):299-301.
143. Bång A, Herlitz J, Martinell S. Interaction between emergency medical dispatcher and caller in suspect out-of-hospital cardiac arrest calls with focus on agonal breathing. A review of 100 tape recordings of true cardiac arrest cases. *Resuscitation*. 2003 Jan; 56(1):25-34.
144. Clawson JJ, Sinclair R. The emotional content and cooperation score in the emergency medical dispatching. *Prehosp Emerg Care*. 2001 Jan-Mar; 5(1):29-35.
145. Chase C, Perina D. Effects of a continuous quality improvement program on helicopter liftoff times. *Prehosp Emerg Care*. 2001 Oct-Dec;5(4):384-6.
146. Schiff GD. Minimizing Diagnostic Error: The importance of Follow-up and feedback. *Am J Med*. 2008 May; 121:38-42.
147. Neely KW, Eldurkar JA, Drake MER. Do emergency Medical services Dispatch Nature and Severity Codes Agree with Paramedic Field Findings? *Acad Emerg Med*. 2000 Feb; 7(2):174-80.
148. El Sayed MJ. Measuring Quality in Emergency Medical Services: A Review of Clinical Performance Indicators. *Emerg Med Int*. 2012;2012:161630.

149. Lammers RL, Roth BA, Utecht T. Comparison of ambulance dispatch protocols for non-traumatic abdominal pain. *Ann Emerg Med.* 1995 Nov; 26(5):579-89.
150. Reilly MJ. Accuracy of a priority medical dispatch system in dispatching cardiac emergencies in a suburban community. *Prehosp Disaster Med.* 2006 Mar-Apr; 21(2):77-81.
151. Salas E, Wilson KA, Murphy CE, King H, Salisbury M. Communicating, Coordinating, and Cooperating When Lives Depend on It: Tips for Teamwork. *Jt Comm J Qual Patient Saf.* 2008 Jun; 34(6):333-41.
152. Holmström I, Dall'Alba G. 'Carer and gatekeeper' – conflicting demands in nurses' experiences of telephone advisory services. *Scand J Caring Sci.* 2002 Jun; 16(2):142-8.
153. Sandelowski M. Combining qualitative and quantitative sampling, data collection, and analysis techniques in mixed-method studies. *Res Nurs Health.* 2000 Jun; 23(3):246-55.