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FAKULTÄT FÜR !NFORMATIK
Faculty of Informatics

Electronic Health Records in Prehospital Care

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an der Fakultät für Informatik
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Betreuung: Univ.Prof Geraldine Fitzpatrick, PhD

Wien, 1. Februar 2017

Katharina Rohrer	Geraldine Fitzpatrick

FAKULTÄT FÜR !NFORMATIK
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Electronic Health Records in Prehospital Care

DIPLOMA THESIS

submitted in partial fulfillment of the requirements for the degree of

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in

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by

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Registration Number 0751759

to the Faculty of Informatics

at the TU Wien

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Erklärung zur Verfassung der Arbeit

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Wien, 1. Februar 2017

Katharina Rohrer

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Kurzfassung

Dokumentation ist ein wesentlicher Bestandteil jedes klinischen Umfeldes. Vorgehensweisen, wie das Dokumentieren auf Papierstücken oder Handschuhen, wurden durch diverse elektronische Dokumentationssysteme ersetzt, die sich bereits als Standard durchgesetzt haben.

Neue Konzepte, wie Elektronische Gesundheitsakten, etablieren sich langsam in unseren Alltag und bringen Transparenz in unsere Gesundheit. "ELGA" (kurz für "Elektronische Gesundheitsakte") ist die österreichische Elektronische Gesundheitsakte und speichert medizinische Dokumente, wie beispielsweise Arztbriefe oder Laborbefunde. Weiters ist die aktuelle Medikation in einer klar strukturierten Liste zugänglich. Jeder österreichische Bürger und jede österreichische Bürgerin hat einen Eintrag in der ELGA, kann aber den Zugriff nach Belieben beschränken.

ELGA repräsentiert eine interessante Informationsquelle, die eine große Menge an Daten beinhaltet. Diese sollen zur Unterstützung im klinischen Alltag und der Entscheidungsfindung dienen. Der Anwendungsfall einer Integration der ELGA in ein präklinisches Umfeld wurde jedoch noch nicht definiert, obwohl ein komplettes Dokumentations- und Kommunikationssystem in der Präklinik unabdingbar ist, um einen hohen Qualitätsstandard zu ermöglichen.

Diese Arbeit beschäftigt sich mit den speziellen Anforderungen in der präklinischen Versorgung. Das Ziel der Forschung ist notwendige Informationen am Notfallort zu identifizieren, um entsprechende Entscheidungen über Diagnose, Behandlung und Transport treffen zu können. Dazu wird ein tiefes Verständnis der Prozesse und Arbeitsabläufe während eines Einsatzes benötigt. Weiters soll der oben beschriebene Anwendungsfall einer Integration einer Elektronischen Gesundheitsakte in ein präklinisches Umfeld analysiert werden. Dafür werden verfügbare Datenfelder in ELGA zu den benötigten Daten am Notfallort zugeordnet.

Das Ziel der Forschung wird durch einen exploratorischen Ansatz erreicht, der einerseits durch Beobachtungen und Experteninterviews als auch durch eine systematische Analyse der Ergebnisse geprägt ist. Die Ergebnisse werden mithilfe des "thematic analysis approach" strukturiert und analysiert.

Es war möglich wertvolle Einblicke und Geschichten zu realen Fällen zu erhalten. Die Ergebnisse wurden in Ablaufdiagrammen dargestellt, um die Prozesse und Arbeitsabläufe zu veranschaulichen. Es konnte gezeigt werden, dass ein Notfall eine stressige Situation ist, die durch Entscheidungen unter hohem Zeit- und Ressourcendruck geprägt ist. Die Situation ist unvorhersehbar und kann sich jederzeit dynamisch ändern. Daher benötigt ein Einsatz eine Struktur, welche die Arbeit der Einsatzkräfte nicht behindert.

Basierend auf den Ergebnissen wurden die benötigten Informationen am Notfallort zu verfügbaren Datenfeldern in ELGA zugeordnet und in einem nächsten Schritt in einem Datenmodel (Entity-Relationship-Model) dargestellt. Das ermöglicht die weitere Diskussion einer Integration einer Elektronischen Gesundheitsakte in ein präklinisches Umfeld und erlaubt die erste Definition von möglichen Anwendungsfällen.

Abstract

Documentation is an essential part and duty in all clinical settings. Approaches, such as writing on pieces of paper or on gloves, have been replaced by various electronic documentation systems which already established as the state-of-the-art approach to satisfy documentation requirements.

New concepts, such as Electronic Health Records, start to emerge in our daily life by bringing transparency to our health. "ELGA" (short for "Elektronische Gesundheitsakte") represents the Austrian Electronic Health Record and stores medical documents, such as medical letters or lab findings. Moreover the current medication is accessible in a clearly organized list. Each Austrian citizen has an entry in ELGA but can restrict the access.

ELGA represents therefore an interesting information source with a huge amount of data available that is intended to support the process of clinical decision-making. However the use case of integrating ELGA to out-of-hospital settings, such as prehospital care, is not defined yet although the need of a complete documentation and communication system is indispensable for providing highest quality standards.

This thesis explores the special requirements in prehospital care. The aim of the research is to identify needed information at the emergency scene to establish appropriate decisions about diagnosis, treatments and transport. To achieve correct conclusions a deep understanding of the processes and workflows during an emergency is required and needs to be established. Moreover the use case of integrating an Electronic Health Record to an out-of-hospital setting is discussed by mapping available data fields in ELGA to the required data at the emergency scene.

To satisfy the research goal an exploratory research using field work and expert interviews was done as well as a systematic analysis of findings. The field work and expert interviews were analyzed and structured with a thematic analysis approach.

It was possible to gain valuable insights and collect real-life cases during research. The findings of this phase are arranged in flow charts to illustrate the processes and workflows. With this approach it was shown that an emergency is a stressful setting

characterized by fast decision-making under high time- and resource pressure. The situation is unpredictable and can change dynamically at any time. Therefore an emergency requires a structure that does not restrict the work.

Based on the findings the needed information at an emergency scene is mapped to available data fields in ELGA and, as a further step, organized in an Entity-Relationship-Model. This enables the basis for the discussion of the potential integration of an Electronic Health Record to an out-of-hospital setting and allows the first definition of possible use cases.

Contents

CHAPTER 1

Introduction

Almost all people know what they need to do in case of a medical emergency: call the ambulance. Dialing ”144”, the Austrian emergency number, brings a workflow into motion that is characterized with high dynamics, decisions under time- and resource-pressure and high social competences. Ambulance service providers assure a competent and moreover complete prehospital care nationwide.

In all clinical settings documentation is an integral part of the daily business. The needs are satisfied in different ways, such as handwritten on pieces of paper or put into electronic systems. We are surrounded by electronic devices and digital issues in our daily life. The digital age has brought up new areas of interest and has made us reconsider ”old” approaches and solutions. The internet has become an essential part of our everyday life and our daily routines can't be imagined without it anymore.

Also in rather old crafts, such as the art of healing, the electronic systems have finally arrived. New solutions have taken the special requirements into consideration and created supporting systems, such as hospital information systems or electronic patient records.

Electronic documentation has already emerged as the standard way of satisfying documentation needs. Existing workarounds, such as writing on pieces of paper or on gloves and transferring it afterwards to the electronic patient record, are needed fewer every day and are replaced by the usage of mobile devices. These devices offer a huge amount of useful features to ease the clinical daily work, such as the ability to dictate or character and speech recognition. Furthermore a complete documentation is encouraged without losing important information due to discarding accidentally written paper or gloves.

However the digital age seems to remain in the hospitals but has not arrived yet in

out-of-hospital settings, such as prehospital care. Only few emergency service providers take advantage of electronic documentation systems and moreover there is no organization known at the time of research that supports ambulance services with additional information of the patient, such as medical history or current medication. This data is stored in Electronic Health Records, which provide an overview of the patient's health. The Austrian Electronic Health Record, "ELGA" (short for "Elektronische Gesundheitsakte"), is available for all Austrian citizen and represents therefore an interesting information source that is not considered for out-of-hospital settings, such as prehospital care.

This master thesis analyzes the special requirements for electronic documentation and support systems in prehospital care, which represents a very dynamic setting with high importance for clinical treatments. Based on the need of a complete documentation system in prehospital care the research goal of this thesis is to point out which data is required at the emergency scene, especially in cases when such important information cannot be collected.

Furthermore it should be identified if the data, which is stored in the Austrian Electronic Health Record, ELGA, covers the found requirements and how it is therefore applicable for prehospital care. The expected result is a detailed understanding of required data at the emergency scene. Based on the exploited data a data model is created that captures the needed information on the emergency scene. With this result a descriptive conclusion about applicability of ELGA in prehospital care can be achieved.

There is a noteworthy amount of literature available on the topics of interest, such as Prehospital Care, Electronic Patient Records and Electronic Health Records. This represents the theoretic basis of the research and helps to understand issues and approaches in various context of medical care. The first chapters describe the topics of interest in a general way and link state-of-the-art approaches to the Austrian context. Furthermore special attention is paid to the characteristics in Austria.
For this matter a broad literature research was done as well as expert interviews due to the still emerging concepts in Austria, especially in case of ELGA. The Austrian Red Cross, i.e. the association of the federal state Lower Austria, provided the handwritten emergency- and transport protocol and permitted the usage and analysis in this thesis. For analyzing an Electronic Patient Record the system "MEDEA" was chosen. It is implemented and hosted by the company "ilogs mobile software GmbH". An expert interview by telephone was done to ensure a complete understanding of the system and its features. The company moreover enabled to use screenshots of the system in this thesis.

The Austrian Electronic Health Record is an emerging topic, where little literature is available. In order to assure a justifiable review also an expert interview with the responsible company, "ELGA GmbH", was done. This supported the overall understanding of the Electronic Health Record.

After establishing the theoretical basis of this thesis Chapter 5 describes the Methodological Approach which is done with an exploratory research using mixed methods. The qualitative research aims to gather a deep understanding of the work in prehospital care and to gain insights. This provides the basis for setting the findings into relation to the available data in ELGA and derive a meaningful data model.

Chapter 6 processes the main findings of the qualitative research and guides through the emergency from the perspective of ambulance personnel. After reaching a deeper understanding of the daily work in prehospital care the collected data at the scene is mapped to the available data in ELGA. In Chapter 7 the resulting data model is illustrated and described that reflects the required data on scene and represents a possible basis for the integration of ELGA to a prehospital setting.

The discussion in Chapter 8 deals with the critical reflection of findings and current challenges of this approach.

CHAPTER 2

Prehospital Care

In case of an emergency it is essential to provide qualified first-aid within a short time, e.g. stop a bleeding or do chest compressions in case of cardiac arrest. To achieve this emergency services are established all over the world. The treatment the patient receives from trained and educated staff outside the hospital is called ”prehospital care”.

Prehospital care is a challenging environment, characterized by decision-making under uncertainty and high pressure in time and resources. Urgent emergencies such as trauma, stroke or heart attack have a critical time frame, i.e. the first hour after the emergency has happened is the so called ”golden hour”. In this time the patient has to get appropriate treatment, otherwise the probability to die is increasing rapidly. The decisions on the diagnosis and treatments have to be done in a very short time.

In such severe cases it is also important to inform the hospital in advance about the arrival of the patient. So the clinical staff is able to establish appropriate treatment and environment, such as emergency room and equipment, in order to assure a smooth takeover of the patient. These emergencies are usually high critical ones, where elapsing of the ”golden hour” would result in a very high probability of death. [[1], [2]]

After a patient has been transported to the hospital the emergency staff does a so called ”clinical handover” where the most crucial and critical information about the patient, the emergency and the already performed treatment is given to the clinical staff [3].

It is feasible that required data cannot be elicited on the scene, e.g. current medication or important pre-diseases. This circumstance can occur whenever the patient is unconscious and there is no relative nearby or whenever the patient has simply forgotten about this information. It is to note that an emergency is also a stressful situation for

the patient, where the temporarily oblivion is not always an additional symptom.
In this case the emergency personnel has to treat symptoms and not the cause which can result in diagnosis and treatment errors what furthermore might also decline the patient's outcome significant.

In the following sections these issues are discussed in detail and special attention is paid to the characteristics in Austria. Moreover an overview of documentation in prehospital care is provided and common approaches of handwritten and electronic documentation in Austria are introduced. Electronic documentation approaches in clinical settings are discussed in detail in Chapter 3, *Electronic Documentation Approaches*.

2.1 Organization of Prehospital Care

Prehospital care can be classified in 3 different levels of care [p. 2, [4]]:

1. first responder
2. basic prehospital care
3. advanced prehospital care

First responders are civilians with special skills in first-aid. They are able to take first actions and start with an appropriate treatment until the ambulance unit arrives. It is to note that first responders often have a training in BLS ("Basic Life Support") or even ALS ("Advanced Life Support"), but they usually do not have the same equipment in order to take all needed actions.

Basic prehospital care can be classified as BLS - "Basic Life Support". Personnel working in this level of prehospital care is trained to take actions which usually extends the abilities of first responders. They are also called "Emergency Medical Technicians" (hereinafter abbreviated to EMTs).

The highest level of prehospital care is the so called *advanced prehospital care*. The ambulance staff is allowed to perform "Advanced Life Support (ALS)", which requires a high level of specialized education. This includes all BLS actions and extends it with more invasive skills, such as airway management, drug administration and intravenous cannulation [5]. Only physicians and paramedics have the needed skill-level to achieve advanced medical support.

The different level of prehospital care are used in two main concepts of emergency services [p. 12ff, [6]]:

- "Angloamerikanisches Modell" - Scoop and Run
- "Frankogermanisches Modell" - Stay and Play

The concept ”Scoop and Run” is very common in the USA. The idea is to stabilize and transport the patient as fast as possible without a physician on scene. Therefore also the education of the ambulance staff is higher than in other countries. So called ”paramedics” treat the patient and are allowed to execute competences that are usually in the responsibility of physicians, e.g. securing the airway.

In most European countries, such as Germany, Austria and France, ”Stay and Play” is the commonly used concept. Here the doctor is brought to the scene to stabilize the patient and decide upon treatment. It is obvious that the education of the non-medical emergency personnel does not necessarily need to be as high as in ”Scoop and Run”, where usually no physician is on scene.
Various literature deals with the advantages and disadvantages of both concepts but none of them can be classified as ”the best”. It is also feasible that the delivering organization evolves over time and changes the model due to the latest medical research or strategies like it was done in the Netherlands [5].

Beside the concepts also the organization of emergency services is different all over the world. In some countries, such as Belgium, France or Ireland, the responsibility of providing an emergency and rescue service is on the state. Whereas in other countries, e.g. Austria or Finland, the responsibility is split all over the federal states or provinces. The emergency services can be separated from patient transport which is done, e.g., in the USA or France. In other countries, such as Austria, the services are delivered from the same provider and staff. Furthermore the legal basis is different in each country [7]. The specifics of Austria are explained in detail in Chapter 2.3, *Prehospital Care in Austria*.

2.2 Importance of Prehospital Care

It is important to provide first aid to critical patients before they are transported to the hospital [8]. Especially when it comes to some incidents, such as cardiac arrest, it is essential to provide help as soon as possible. The most critical incidents beside cardiac arrest are (craniocerebral) trauma, stroke and heart attack. Their cause has to be treated within 60-90 Minutes from the beginning of the first symptoms, depending on the disease [9]. The treatment has to be done in a hospital, where special devices, such as computer tomography or endoscopy, are available. After elapsing of the ”golden hour” the mortality is increasing rapidly.

Spearpoint et al. pointed out that early defibrillation improves the patient outcome in cardiac arrest. During their 6 year lasting study they showed, that cardiopulmonary resuscitation (CPR), including chest compression, mouth-to-mouth resuscitation and defibrillation, can reduce the mortality. So it is important to train these skills in an efficient and satisfying way [10]. If efficient CPR is established and actions are taken, early defibrillation can improve the survival rate up to 50 % in case of ventricular fibrillation,

which is classified as cardiac arrest [11]. Berg et al. showed very similar to Spearpoint et al. that the recognition of a cardiac arrest is in most cases the essential problem where too much time is lost. In most cases the witnesses do not act due to insecurity or fear. This reduces the reality of the survival rate of an "optimal" setting from 50 % to 5 - 50 % [p.686, [11]], whereas the average survival rate is 6.7% - 8.4% [p. 74, [12]]. The survival rate is highest, if the actions, such as chest compressions and defibrillation, are done within the first 5 minutes after the patient has collapsed. Furthermore only 32% of cases of cardiac arrest, that are actually witnessed by a bystander, are receiving appropriate CPR [12].

The need for an established prehospital care is also shown by Vyas et al. in India, which is a fast growing country. The development of industry and economy caused an increase of motor vehicle utilization which furthermore results in a rising number of accidents and trauma emergencies. The percentage of trauma emergencies caused by accidents rose up to 90%. In case of trauma it is essential to provide proper clinical treatments to the patients within the first 60 minutes after the occurrence. Severe accidents often cause major trauma, or so called polytrauma, where a combination of injuries or a major injury is seriously life-threatening. In India the concept of "First Responders" has established. They are stabilizing the patient until the ambulance arrives and picks the patient up [13].

The basis of prehospital care is illustrated as the "chain of survival" in Figure 2.1 [14]. The survival rate is directly depending on the research in medicine, the spent education of the forces and the ability to establish the latest research in the local organization.

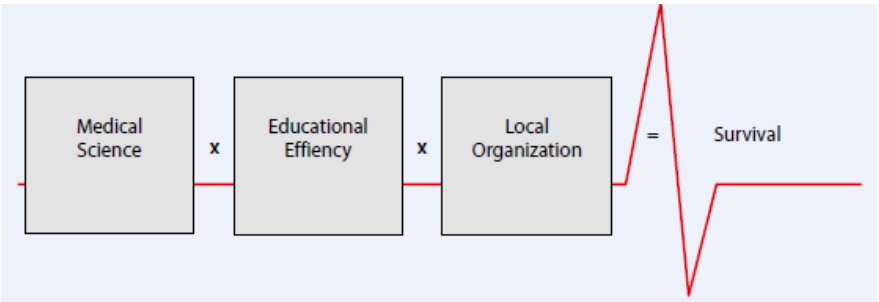


Figure 2.1: Chain of survival [Fig.1, p.109 [14]]

2.3 Prehospital Care in Austria

Prehospital care in Austria is achieved with "Stay and Play". As already mentioned in Section 2.1, *Organization of Prehospital Care*, the treatment is based on non-medical and medical personnel on scene. If necessary, a physician is attending the emergency scene as well as non-medical personnel, so called EMTs or paramedics. The severity of an

emergency is evaluated by the dispatch center, that furthermore coordinates the available forces.

In Austria there are several levels of education known, which are similar to the already mentioned levels of prehospital care [4]:

- **First Responders** are trained EMTs or paramedics, which are called off-duty if an emergency occurs near their homeplace.
- **EMTs** or so called "Rettungssanitäter" are trained with skills of "Basic Life Support".
- **Paramedics** or so called "Notfallsanitäter" are trained with skills of "Advanced Life Support". There are several levels of competences that paramedics can acquire with additional training.
- **Physicians** or so called "Notärzte" are physicians with a special training in emergency care.

The ambulance units, i.e. called "Rettungswagen (RTW)", are usually staffed with a mix of EMTs and paramedics. The medical ambulance services, which are staffed with 1 physician and 2-3 paramedics, are known as "Notarztwagen (NAW)" or "Notarzteinsatzfahrzeug (NEF)". Depending on the severity of the emergency the medical ambulance service is sent to the scene as well. [[15], [16]]

The services which are offered can be distinguished as follows [[15], [16]]:

- **einfacher Krankentransport**: This service is part of patient transport services and mainly for ambulatory patients.
- **qualifizierter Krankentransport**: This service is part of patient transport services.
- **Rettungstransport**: The patient needs qualified first-aid treatment and transport to a hospital or other care facility. This can only be done with a "RTW".
- **Notarzttransport**: The patient needs medical treatment and transport to a hospital. This can only be done either with a "NAW" or a combination of "RTW" and "NEF".
- **Sekundärtransport**: The patient needs to be transported from a care facility or hospital to another care facility or hospital.
- **Intensivtransport**: The patient needs to be transported with medical treatment from a care facility or hospital to another care facility or hospital.
- **Sondertransport, Bluttransport**: Needed artifacts, such as devices or blood, are transported with this service.

2.3.1 Legal Situation in Austria

In Austria the responsibility of assistance and rescue services is on federal state level, which is regulated in a federal law (Art 118 B-VG). Each federal state has to define its own legal regulations with a federal state law. The legal basis for the profession of ambulance staff, i.e. EMTs and paramedics, on the other hand, is regulated within a federal law from 2002, the so called "Sanitätergesetz (SanG)".
Furthermore some other federal laws are applicable for the personnel, such as "Straßenverkehrsordnung (StVO)" for drivers or "Strafgesetzbuch (StGB)" for, e.g., taking action on the patient without consent. Other laws hold for patients and can be executed by empowered forces if necessary, e.g. "Unterbringungsgesetz (UbG)" or "Sicherheitspolizeigesetz (SPG)". This is especially important in case of mental illnesses or if the patient is a threat to his own or others. Furthermore patient decrees have to be considered, e.g. DNR-orders ("Do-Not-Resuscitate") or patients under trustees. [15]

The "Sanitätergesetz (SanG)" regulates the field of activity of non-medical personnel. It holds for EMTs and paramedics, regardless if volunteers or professionals. The field of activity for the EMTs is described as qualified first aid and covers actions to provide medical support, rescue techniques and the ability to make a (suspected) diagnosis to give a proper treatment (§9 SanG, [17]). The field of activity of paramedics covers the same areas as EMTs with additional competences, such as support of a physician and administration of specified drugs (§10 SanG, [17]). There are furthermore additional trainings which enrich the competences of the paramedics (§11ff SanG, [17]).
Beside the field of activity also the duties are defined, e.g. the duty of documentation and the duty of confidentiality (§4ff SanG, [17]). The documentation in prehospital care is discussed in detail in Chapter 2.6, *Documentation in Prehospital Care*.

All used devices need to be certified according to the "Medizinproduktegesetz (MPG)". Personnel need to have a proper training before they are allowed to put them into operation. [15]

2.3.2 Emergency Service Providers in Austria

As already mentioned in Section 2.3.1, *Legal Situation in Austria*, the responsibility to establish assistance and rescue services is on federal state level. There exist several emergency service providers which serve the needs of the population. In this section the known organizations in Austria are briefly introduced.

Arbeiter Samariterbund Österreich (ASBÖ)

The presence of the ASBÖ is widely spread over Austria, whereas the intensity varies from federal state to federal state. It is well known in Vienna, Lower and Upper Austria as well as in Salzburg. In Vienna the ASBÖ forms together with three other providers (Johanniter-Unfall-Hilfe, Malteser Hospitaldienst Austria, Österreichisches Rotes Kreuz)

the association called "Vier für Wien".

Grünes Kreuz

The organization "Grünes Kreuz" is not present in every federal state in Austria. Each local branch, e.g. Styria or Vienna, is organized independently and just uses the brand "Grünes Kreuz".

Johanniter-Unfall-Hilfe (JUH)

The JUH is established in Vienna, Tyrol and Carinthia. The JUH are well known in Vienna, where they are also providing emergency services, whereas in Tyrol only patient transport is established.

Malteser Hospitaldienst Austria (MHDA)

The MHDA is staffed only with volunteers. It is the only organization in Austria that renounces to employ any professionals or alternative civilian servants. Therefore it provides mainly patient transport services in Austria, e.g. in Styria, Vienna or Tyrol.

Österreichisches Rotes Kreuz (ÖRK)

The ÖRK, or Austrian Red Cross, is the most known provider in Austria. In almost all federal states in Austria the Austrian Red Cross is responsible for the assistance and rescue services. The only exception is in Vienna, where a professional service is established. The Red Cross is staffed with professionals and volunteers and provides emergency and patient transport services all over Austria.

Wiener Berufsrettung (Magistratsabteilung 70)

In Vienna a professional emergency service is established. There are no volunteers employed. They are working closely with the association "Vier für Wien" to assure a complete rescue chain for the population in Vienna.

2.3.3 Ethics in Prehospital Care

Ethic plays a great role in emergency services. The emergency staff faces issues and problems of patients every day and have to treat them equally, no matter who they are or what they've done to be in such a situation. Furthermore personal issues of the ambulance staff need to be pushed aside, such as racism, disgust or contempt. The patients need their help and haven't decided who is coming to treat them. So the personnel of emergency services is encountering ethical dilemma during their daily work which they have to deal with.

Beside personal opinions the dignity of the patient has to be assured. This is important in case of helpless people, e.g. naked or mentally ill patients, as well as in case of death. Every negative outcome in the daily work of ambulance staff is burdening, especially if children are involved.

In the work of this master thesis respect has been given to the ambulance staff and ethics in conducting the methodological approach, described in Chapter 4, *Methodological Approach*, have been considered.

2.4 The Emergency

In this section the whole process of an emergency is illustrated, from the call of the dispatch center to the transport to a hospital or care facility. First the process is illustrated in general and important parts of it described in detail to give an overall understanding of the daily work of ambulance staff based on literature research.

2.4.1 Illustration of the process

In various literature the process is called the rescue chain ("Die Rettungskette"). It describes interacting components from the emergency call to the transport to a hospital and is shown in Figure 2.2. The outcome of the patient is directly related to these

Figure 2.2: Rescue chain [Figure 6, p.1159 [15]]

components and a smooth interaction. The main actors are civilians, the dispatch center and the ambulance personnel which have to interact to establish the rescue chain. The first and most important component is the recognition of an emergency and the emergency call. This is usually done by a lay person without medical knowledge. The dispatch center picks up the call and gives first aid instructions which are needed to provide immediate help before the ambulance unit arrives. Due to the severity of the emergency the dispatch center sends the required forces to the emergency scene. The decision process of the severity is introduced in Section 2.4.2, *Dispatch Center*.
After the ambulance personnel arrives the qualified first aid and medical treatment starts. Therefore the staff follows medical guidelines to assure a complete and correct care. The

guidelines are discussed in Section 2.4.3, *Supporting Guidelines*.

2.4.2 Dispatch Center

The Dispatch Center is staffed with two important functions, the so called "calltaker" and the "dispatcher". The calltaker takes the call and tries to raise the most important information from the caller. As soon as the essential data is collected the emergency is shifted to the dispatcher, who coordinates and dispatches the resources. In some dispatch centers these functions are combined and the calltaker also dispatches the resources. [[18], [19]]

The provided information by the caller is naturally in a chaotic order because an emergency is always a stressful situation. The caller is not used to such situations and furthermore not used to give objective and appropriate information to the calltaker. Therefore most dispatch centers started to introduce guidelines for taking calls. Before the guidelines have been established the dispatcher had to base the decision of the severity of the emergency on his subjective impression of the call. This often led to misinterpretation of the severity and resulted in wrong resources at the emergency scene [20]. In some cases help could not be provided as fast as it would have been needed.

In 2004 the dispatch center in Lower Austria introduced a dispatching system called "Advanced Medical Priority Dispatch System (AMPDS)" [21]. This system is a structured interview, which guides the caller through the emergency call. The structure is based on short and precise questions about the caller, the emergency environment and the patient. The structure is licensed and not available for public use.

The rough process can be described as follows [[22], [23], [24]]:

- **Where** is the emergency?
- What is your **number**?
- **What** has happened?
- How **old** is the patient?
- Is the patient **awake** and conscious?
- Is the patient **breathing**?
- Detailed information of **security**
  e.g. Have guns been involved? Is there a fire? Is there a dangerous animal?
- Detailed information of **emergency occurrence**
  e.g. Has the patient fallen?

Code	Description	Regulation of Dispatch
RD-3B2	animal bite/animal attack-strong bleeding	non-medical emergency unit (RTW)
RD-3D5	animal bite/animal attack-big animal	non-medical emergency unit with upgrade option for a physician (RTW, NAW/NEF optional)
RD-3D2	animal bite/animal attack-clouding of consciousness	non-medical emergency unit + physician (medical emergency unit, RTW and NAW/NEF)

Table 2.1: Samples of emergency codes and regulations of dispatch, [25]

- Detailed information of the **condition** of the patient
  e.g. How intense is the bleeding? Is the skin cold and sweaty?

- first-aid **instructions**

Depending on the given answers emergency codes are generated. These codes are connected with regulations of dispatch, i.e. which resources are needed for this severity. The emergency codes consist of a combination of numbers and characters, where the characters (A-E) indicate the severity and priority of the emergency. In Table 2.1 an example of different emergency codes and connected regulations for the same incident is shown. The example shows an animal bite which can cause a strong bleeding and lead to clouding of consciousness because of blood loss or an infection. Depending on the answers the severity of the emergency is classified and resources dispatched accordingly.

The original system was adapted to fit the Austrian regulations and needs. After the AMPDS was established in Lower Austria Trimmel et al. conducted a study in 2006, where the impact of the new dispatch system on the air rescue service was analyzed [21]. During this study it pointed out that the regulation of dispatch hasn't been optimal defined because the medical unit was dispatched although the situation on scene wouldn't require medical attendance. Trimmel et al. showed that the amount of wrong dispatch decisions raised up to 183,3 % compared to 2002. The regulations of dispatch are a changing process based on such studies where the emergency codes are compared to the severity of the situation.
In Germany, i.e. Hamburg, the dispatch center established AMPDS in 2005 and was able to observe an improving outcome for the patients [26]. The same positive result has been shown in the United Kingdom, London, after the introduction of AMPDS in 2008 [27].

In Austria the use of a structured interview is depending on the dispatch center and the hosting organization. In order to dispatch resources TETRA (terrestrial trunked radio) is used, which represents a standard for encrypted radio signal based communication. The alarm call is sent to pagers and to a tetra receiver in the units. Nowadays also additional alerts with SMS (Short Message Service) or even individual apps are common. [15]

2.4.3 Supporting Guidelines

It was already pointed out that time is the most critical factor in any out-of-hospital setting. It is obvious that any kind of structure will help to achieve the needed information on which decisions can be based. Therefore algorithms and guidelines play an important role [28].

There are many different guidelines for clinical emergencies, such as the so called "ABCDE" approach. It is applicable for all clinical emergencies and for all out-of-hospital emergencies [29]. The history of the approach goes back to the 1950s where it formed the basis of "Advanced Trauma Life Support (ATLS)". Especially in case of major trauma it is important to get an accurate overview of the injuries very fast. ATLS is a clinical decision-making model and gives a guideline to prioritize injuries and treatments as part of the primary survey. [[30], [28]]

There are three essential preconditions in ATLS [p.136 [30]]:

1. Prioritize injuries and treatment by their potential threat to life
2. The treatment needs to be done even if the diagnoses can not be established
3. The patient history is secondary

In Austria the "ABCDE" approach is the state-of-the-art tool to evaluate the condition of the patient and to decide within a very short time whether the patient is critical or not. The approach guides through the first examination of the patient with 5 steps. If the ambulance personnel encounters problems in any examination step, the problems need to be treated first and stabilized before they can go on with the next step. The process of the approach is illustrated in Table 2.2. If any problems are encountered during the examination of 'ABC' which could potentially be life threatening, additional forces are needed. Therefore after few moments the ambulance staff is able to decide upon the need of a medical emergency unit on scene.

It is noteworthy that the approach forms a guideline and the ambulance personnel is able to overcome this guideline in case the first impression of the patient indicates the need of a physician on scene or not. Beside the decision of criticality furthermore the tactical decision of transport needs to be done. The staff has to decide in case of a critical patient whether to wait for the physician, to meet the physician on the way to the hospital (if the condition of the patient enables a transport) or to transport the patient to the hospital (if no medical emergency unit is nearby or available).

In addition to the "ABCDE" approach the so called "SAMPLE(R)"-Schema is used. The schema is used to achieve a focused patient history which may revise the decision about criticality and is furthermore important for further treatment [[32],[31]]. An illustration

A - Airways	Does the patient speak, answer? Are there any airway obstructions?
B - Breathing	Has the patient sufficient breathing? Is cyanosis visible, e.g. blue lips? How fast is the respiratory rate? How is the movement of the chest/thorax, e.g. parallel, paradox?
C - Circulation	How fast is the heart rate? Is there any bleeding? How is the skin, e.g. sweaty, cold, warm? Which color does it have? How high is the blood pressure? Is the ECG (Electrocardiogram) normal?
D - Disability	A neurological check is done, e.g. by different methods, such as GCS (Glasgo Coma Scale) or AVPU (Alert, Voice responsive, Pain responsive, Unresponsive); Is the patient oriented? Does the patient know where he/she is? Who he/she is? What time it is? Are the pupillary reflexes normal? Is the blood sugar normal?
E - Exposure	Examine the patient completely by scanning. Are there any trauma signs, bleeding, fractures, bruises or any other external signs of injury?

Table 2.2: ABCDE approach, [[29],[31]]

of the ”SAMPLE(R)”-Schema is shown in Table 2.3.

In Lower Austria these guidelines are reflected in the transport and emergency protocol of the Austrian Red Cross which is shown in Section 2.6, *Documentation in Prehospital Care*. In Sweden scientists tried to integrate a computerized decision support system to a simulated prehospital setting, which included the ”ABCDE” approach and the ”SAMPLE(R)”-Schema. They aimed to make such guidelines more applicable for a dynamic setting, such as prehospital care [33].

2.5 Clinical Handover

The most important information about patient condition and already performed treatment has to be transferred to the hospital in an appropriate way in order to assure the continuity of the correct treatment [[34], [35]].

In severe cases the alert of the emergency department in the hospital is done in advance with the help of a telephone or radio phone. It is obvious that these communication channels have limitations which are reached fast whenever critical information has to be

S - Symptoms / Signs	What is the leading symptom? When did it start? Did it change over time? Is the patient in pain?
A - Allergies	Are there any allergies known?
M - Medication	Does the patient take any drugs? Is there any long-term medication?
P - Patient History	Is the patient history known? Are there any known diseases?
L - Last Intake	When did the patient eat/drink last? What was the last intake?
E - Event	What did the patient do when the problem occurred?
R - Risk Factors	Are there any known or observed risk factors?

Table 2.3: SAMPLE(R)-Schema, [[32],[31]]

exchanged. Anantharaman et al. showed using telephone or radio phone the most common mistakes are misunderstanding vital signs, treatments and condition, understanding issues and loss in time because of bad connection and incomplete transmission of ECG (short for Electrocardiogram) reports, which have been faxed to the hospital. [1]

Therefore most information is given after a patient has been transported to the hospital. There the ambulance staff does a so called ”clinical handover” where crucial and critical information about the patient, the emergency and the already performed treatment is given to the clinical staff [3]. Depending on the emergency the importance of information can differ, e.g. for trauma the mechanism of the accident is essential [36].

In most cases, the clinical handover does not follow a defined structure and represents a summary of mixed information sources [37]. Wood et al. concluded that a well structured and complete clinical handover is essential because it has a direct impact on patient safety, record keeping, continuity of patient care and improvement of decision making [3, p.3].
Furthermore it was shown that one of the biggest issues in the clinical handover is the attention of the clinical staff. As soon as they see the patient the focus is on the patient and the current condition [37]. But the previous treatment which has led to the

condition is important and essential. Wood et al. showed that only 73 % of information is documented by the clinical staff, the other 27 % are missed, forgotten or not seen as relevant to be documented. [3]

But the lack of information between emergency scene and hospital is not only in the responsibility of the clinical staff. The clinical handover is a verbal action, which means information can be easily forgotten to be given by the ambulance personnel. They try to capture everything in short time and often document in workarounds, such as writing vital signs on their gloves. If the data doesn't get transferred to the protocol it might gets lost.

Sarcevic et al. pointed out that not all information is needed at handover but might be relevant in a later phase of the treatment. If it is not recorded during clinical handover it might gets lost and cannot be used anymore. She showed that in case of trauma the medical history is secondary because treating life threatening injuries is of top priority. However it would be necessary to know whenever new prescriptions of medication is aimed [37]. If additional data is not available the staff bases the decisions on experience and medical education [36].

In order to be able to assure a smooth handover of the patient a structured organization of the emergency department is needed. Walz et al. pointed out that there are three common organization forms [38]:

- Expert Emergency Department / "Fachspezifische Notaufname (FNA)"
  It shows a high degree of specialization in one discipline.
- Interdisciplinary Emergency Department / "Interdisziplinäre Notaufnahme (INA)"
  It acts as a kind of triage system. After the assessment of a physician and primary care the patients are passed to the specialized wards/departments.
- Centralized Emergency Department / "Zentrale Notaufnahme (ZNA)"
  It is a structured combination of more than one discipline, whereas the disciplines work as far as possible autonomously.

Efficient primary care and correct triage in an emergency department is essential for the patient outcome. Bur showed the importance of correct triage with the help of the Vienna General Hospital. The emergency department is structured as a combination of disciplines and is organized as a part of the Department of Emergency Medicine. Due to the increasing number of emergency patients they decided to introduce a triage-system in order to differentiate between priorities of care. The decision is based upon a standardized interview with collecting most important vital signs and additionally, depending on the emergency, measuring blood sugar, urin probes or ECG (Electrocardiogram, measuring heart activity) in order to get an overview about the condition of the patient. The staff has to be able to decide within the first 2-5 minutes upon the following procedure. [39]

It is obvious that the correct triage can improve the survival rate and reduces costs for the hospital due to the correct transferring to specialized stations [38].

2.6 Documentation in Prehospital Care

As already pointed out in Section 2.3.1, *Legal Situation in Austria*, documentation is an essential duty in prehospital care.
Documentation in prehospital care is directly connected to the patient's outcome. The more information is documented on the emergency scene and the more complete the handover to the clinical personnel is achieved, the lower the mortality rate in hospital for patients. [[40], [41]]

The WHO (World Health Organization) defined 2005 the information which should be collected in case of an emergency [p.38, [4]]:

- who was injured and who provided care?
- what caused the injury and what was done to treat it?
- when did it occur?
- where did the injury occur?
- how did the patient respond to treatment (outcome)?

This can be summarized that the collected data needs to contain information about the patient condition, the emergency and the treatment performed by ambulance personnel. More or less this is also covered by the protocols which are used in prehospital care.

Beside the needed data the layout of the protocol is of great interest. The protocol should be structured with respect to the importance of data, i.e. the most important information should be acquired at the beginning and therefore also located at top of the protocol. It influences directly the completeness of data. Furthermore the habits and attitude of the staff impacts the documentation quality [42].

2.6.1 Documentation in Austria

The Austrian Red Cross in Lower Austria makes use of a handwritten emergency and transport protocol. It is a double-sided protocol which needs to be filled by the ambulance staff. Figure 2.3 shows the frontside of the protocol. Here the most important information about patient, such as patient name, address, insurance data, and information about the transport, such as organizational data, target hospital, need to be collected. Furthermore a possible refusal of transport or treatment from the patient has to be documented.

In Figure 2.4 the backside of the protocol is illustrated. Here the condition of the patient and the performed treatment has to be documented. The documentation of the condition of the patient is done with the "ABCDE" approach and "SAMPLE(R)"-Schema, which was introduced in Section 2.4.3, *Supporting Guidelines*. The protocol reflects these guidelines on the left side and therefore the emergency personnel is urged to examine it step-by-step. On the right side of the protocol records about the performed actions, treatments and executing person have to be taken.

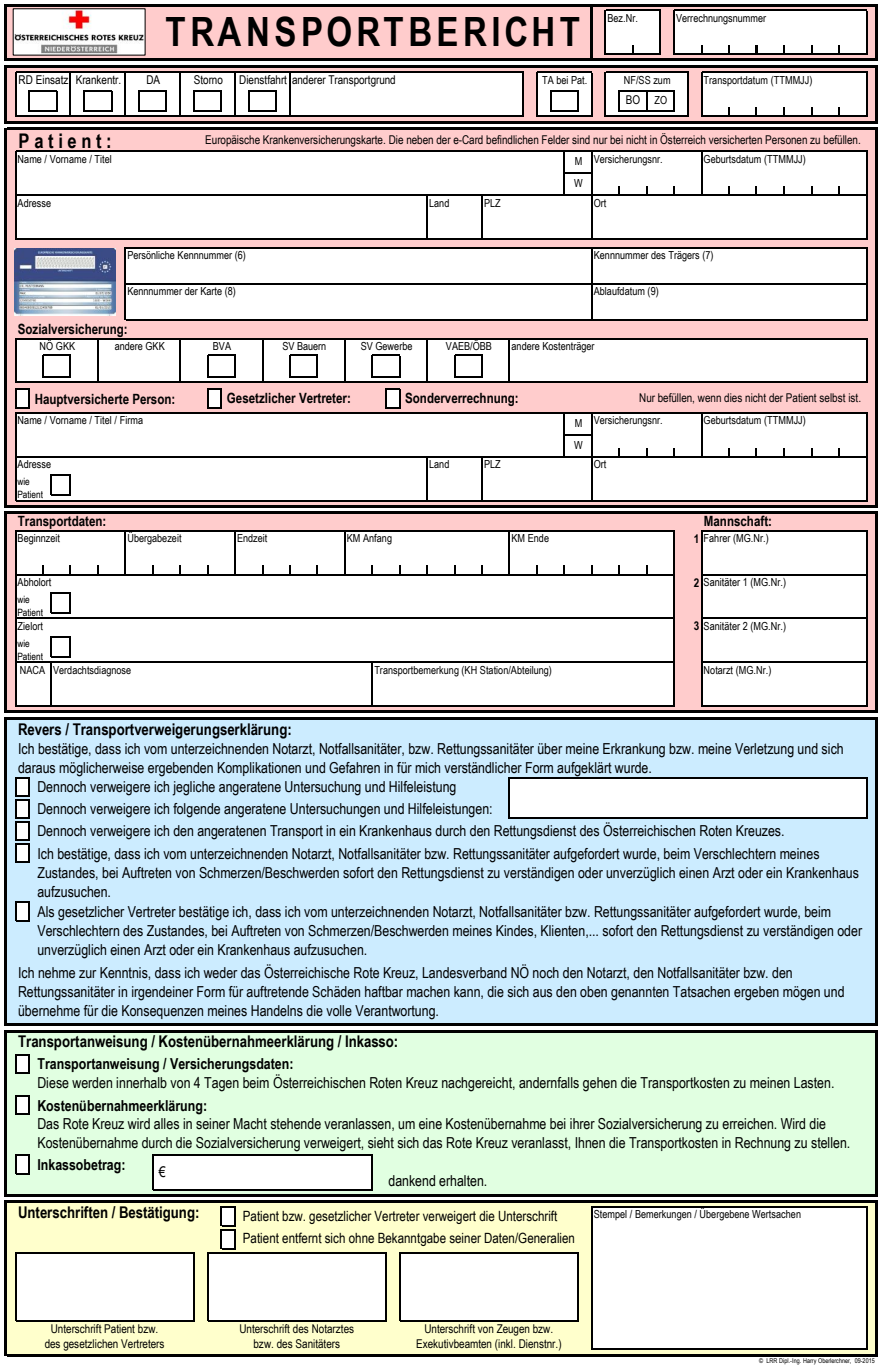
The documentation is finished after the patient is handed over to a nurse or physician in the target hospital.

Reng showed already 2002 that electronic data processing has many advantages compared to paper-based approaches. He pointed out that electronic data processing is faster in searching, sorting, comparing and calculating complex issues without fatigue. Furthermore this approach is independent from localization and time. If just these advantages are considered a huge amount of use cases appear in (prehospital) emergency care. It starts with documentation in prehospital care and ends with quality assurance in hospitals. He furthermore claims that efficient collection of sensitive patient data requires a definition of a basis dataset. [43]

Paper-based approaches combined with a verbal handover have fast reaching limits. So Anantharaman et al. suggested to introduce electronic documentation to the ambulances in order to ensure a reliable information transmission. To proof the assumption a link between the emergency department and emergency ambulance was established in Singapore. The patient record has to be completed by the emergency personnel and submitted to the hospital over the wireless public mobile data network.
The outcomes of this 3-months-lasting study were significant. They showed that after introducing the electronic documentation to the emergency ambulances the clinical handover could be done on-the-fly, because all relevant information was already submitted before. The ambulance personnel spent less time in writing patient records compared to paper-based-protocols (appr. 90 seconds compared to 7 minutes) and less time in the hospital as well (8 minutes after compared to 15 minutes before introducing the electronic record). Furthermore the average waiting time of the patients was almost cut in half. [1]

In Austria prehospital care providers have different standards of documentation. Meanwhile in Lower Austria the protocols are handwritten, the professional emergency service in Vienna (MA 70) uses an electronic documentation system called "MEDEA".

This system is running on laptops, so called "Toughbooks", which are adjusted for the rough environment at the emergency scene with, e.g., a touchscreen to enable fast navigation. The system is organized in tabs, which represent the different phases of the emergency.
The first tab, shown in Figure 2.5, shows the emergency data from the dispatch center and collects patient information. The patient data can be easily read with an integrated



ÖSTERREICHISCHES ROTES KREUZ
NIEDERÖSTERREICH

TRANSPORTBERICHT

Bez.Nr. | Verrechnungsnummer

RD Einsatz | Krankentr. | DA | Storno | Dienstfahrt | anderer Transportgrund | TA bei Pat. | NF/SS zum BO ZO | Transportdatum (TTMMJJ)

Patient: Europäische Krankenversicherungskarte. Die neben der e-Card befindlichen Felder sind nur bei nicht in Österreich versicherten Personen zu befüllen.

Name / Vorname / Titel | M W | Versicherungsnr. | Geburtsdatum (TTMMJJ)

Adresse | Land | PLZ | Ort

Persönliche Kennnummer (6) | Kennnummer des Trägers (7)

Kennnummer der Karte (8) | Ablaufdatum (9)

Sozialversicherung:

NÖ GKK | andere GKK | BVA | SV Bauern | SV Gewerbe | VAEB/ÖBB | andere Kostenträger

Hauptversicherte Person: **Gesetzlicher Vertreter:** **Sonderverrechnung:** Nur befüllen, wenn dies nicht der Patient selbst ist.

Name / Vorname / Titel / Firma | M W | Versicherungsnr. | Geburtsdatum (TTMMJJ)

Adresse wie Patient | Land | PLZ | Ort

Transportdaten:

Beginnzeit | Übergabezeit | Endzeit | KM Anfang | KM Ende

Abholort wie Patient

Zielort wie Patient

NACA | Verdachtsdiagnose | Transportbemerkung (KH Station/Abteilung)

Mannschaft:

1 Fahrer (MG.Nr.)

2 Sanitäter 1 (MG.Nr.)

3 Sanitäter 2 (MG.Nr.)

Notarzt (MG.Nr.)

Revers / Transportverweigerungserklärung:

Ich bestätige, dass ich vom unterzeichnenden Notarzt, Notfallsanitäter, bzw. Rettungssanitäter über meine Erkrankung bzw. meine Verletzung und sich daraus möglicherweise ergebenden Komplikationen und Gefahren in für mich verständlicher Form aufgeklärt wurde.

- Dennoch verweigere ich jegliche angeratene Untersuchung und Hilfeleistung
- Dennoch verweigere ich folgende angeratene Untersuchungen und Hilfeleistungen:
- Dennoch verweigere ich den angeratenen Transport in ein Krankenhaus durch den Rettungsdienst des Österreichischen Roten Kreuzes.
- Ich bestätige, dass ich vom unterzeichnenden Notarzt, Notfallsanitäter bzw. Rettungssanitäter aufgefordert wurde, beim Verschlechtern meines Zustandes, bei Auftreten von Schmerzen/Beschwerden sofort den Rettungsdienst zu verständigen oder unverzüglich einen Arzt oder ein Krankenhaus aufzusuchen.
- Als gesetzlicher Vertreter bestätige ich, dass ich vom unterzeichnenden Notarzt, Notfallsanitäter bzw. Rettungssanitäter aufgefordert wurde, beim Verschlechtern des Zustandes, bei Auftreten von Schmerzen/Beschwerden meines Kindes, Klienten,... sofort den Rettungsdienst zu verständigen oder unverzüglich einen Arzt oder ein Krankenhaus aufzusuchen.

Ich nehme zur Kenntnis, dass ich weder das Österreichische Rote Kreuz, Landesverband NÖ noch den Notarzt, den Notfallsanitäter bzw. den Rettungssanitäter in irgendeiner Form für auftretende Schäden haftbar machen kann, die sich aus den oben genannten Tatsachen ergeben mögen und übernehme für die Konsequenzen meines Handelns die volle Verantwortung.

Transportanweisung / Kostenübernahmeerklärung / Inkasso:

- **Transportanweisung / Versicherungsdaten:**
  Diese werden innerhalb von 4 Tagen beim Österreichischen Roten Kreuz nachgereicht, andernfalls gehen die Transportkosten zu meinen Lasten.
- **Kostenübernahmeerklärung:**
  Das Rote Kreuz wird alles in seiner Macht stehende veranlassen, um eine Kostenübernahme bei ihrer Sozialversicherung zu erreichen. Wird die Kostenübernahme durch die Sozialversicherung verweigert, sieht sich das Rote Kreuz veranlasst, Ihnen die Transportkosten in Rechnung zu stellen.
- **Inkassobetrag:** € dankend erhalten.

Unterschriften / Bestätigung:

- Patient bzw. gesetzlicher Vertreter verweigert die Unterschrift
- Patient entfernt sich ohne Bekanntgabe seiner Daten/Generalien

Unterschrift Patient bzw. des gesetzlichen Vertreters | Unterschrift des Notarztes bzw. des Sanitäters | Unterschrift von Zeugen bzw. Exekutivbeamten (inkl. Dienstnr.)

Stempel / Bemerkungen / Übergebene Wertsachen

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Figure 2.3: Frontside of the emergency- and transport protocol of the Austrian Red Cross

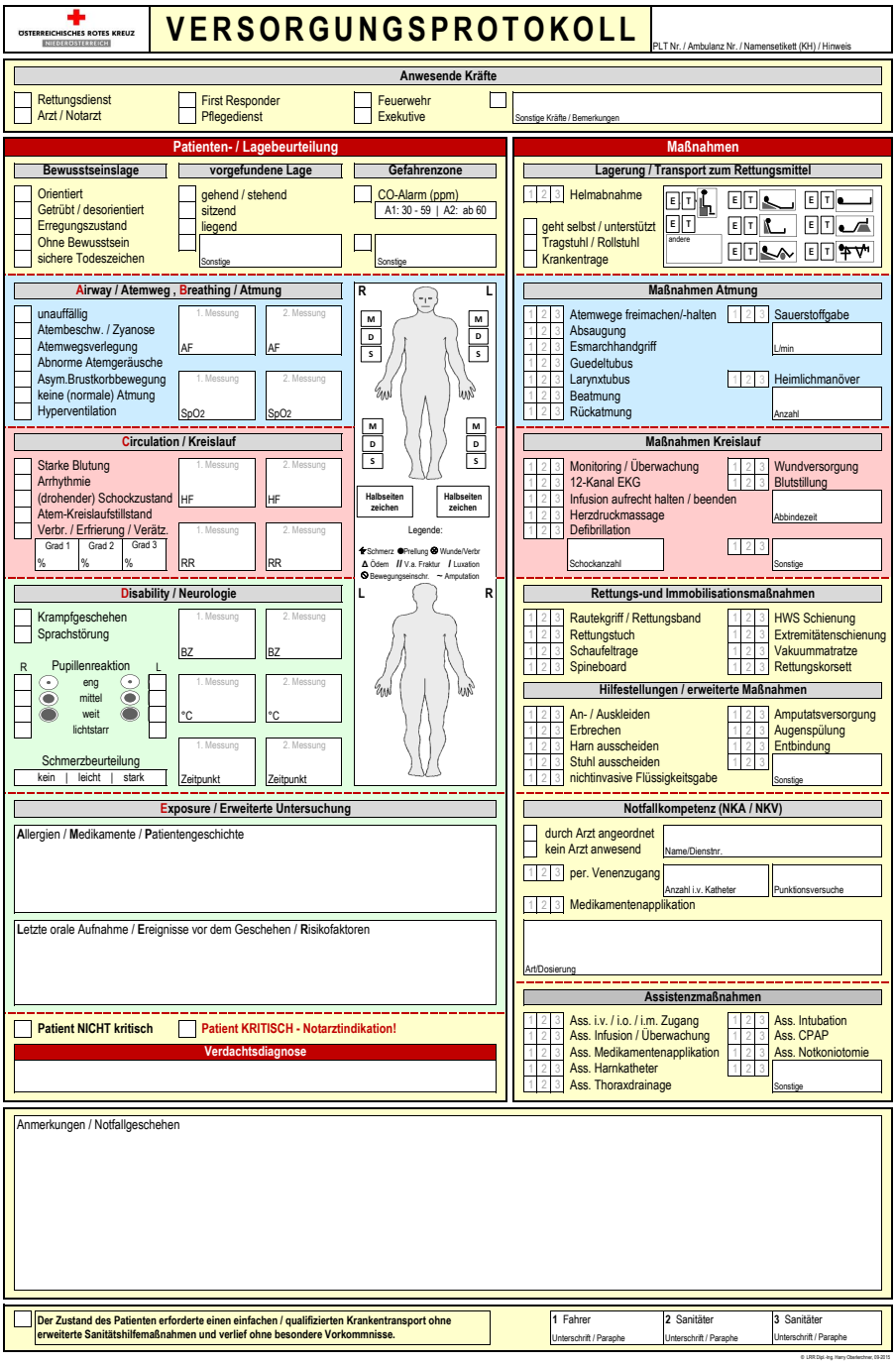
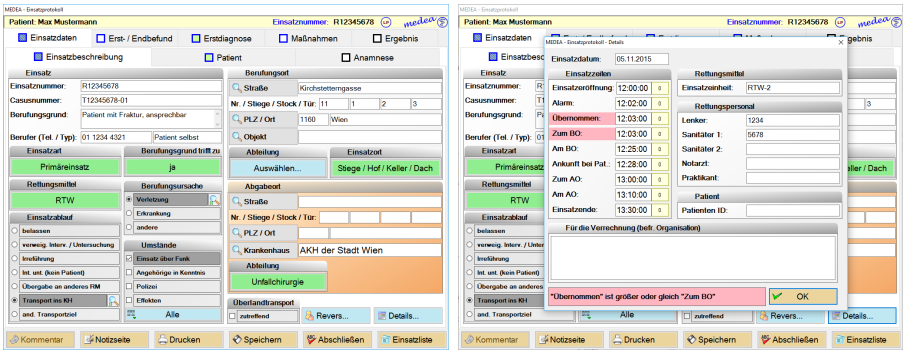
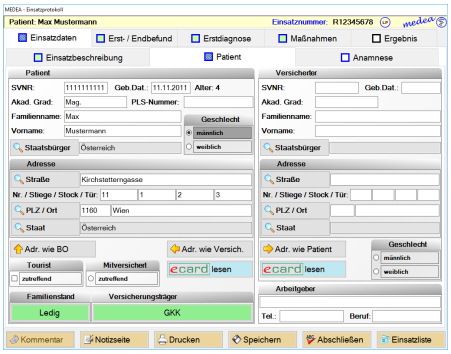


Figure 2.4: Backside of the emergency- and transport protocol of the Austrian Red Cross



(a) Emergency data (b) Emergency data details



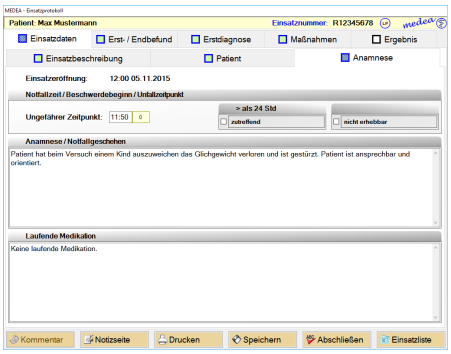
(c) Patient data

Figure 2.5: MEDEA screenshots of emergency data

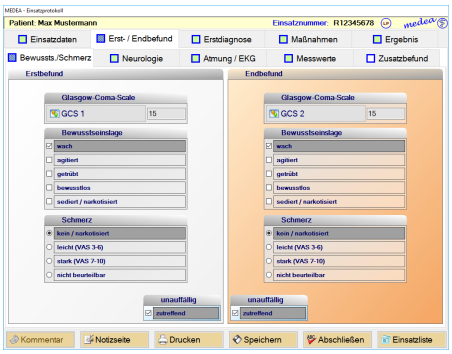
smart card reader from the insurance card, the so called ”e-Card”. More information about the ”e-Card” is given in Section 3.3, *Austrian Electronic Health Record: ELGA*. This data can be compared to the frontside of the paper-based protocol from the Austrian Red Cross, which is shown in Figure 2.3.

The second tab evaluates the patient condition. Here information about consciousness, breathing, neurological deficits and vital signs should be provided. It is noteworthy that the system considers the primary patient condition at the beginning of the emergency and the condition at the end, e.g. on transport or handover in hospital. This enables the ambulance staff to document possible changes in vital functions easily. Screenshots of this tab are provided in Figure 2.6.
After assessment of patient condition and collection of patient history the diagnosis needs to be made. This is done in the third tab, which is shown in Figure 2.7. Beside the diagnosis also the observed injuries have to be documented. Therefore an illustration of a human body is provided to enable fast documentation.
In Tab 4, Figure 2.8, the executed treatment and administered drugs are collected.

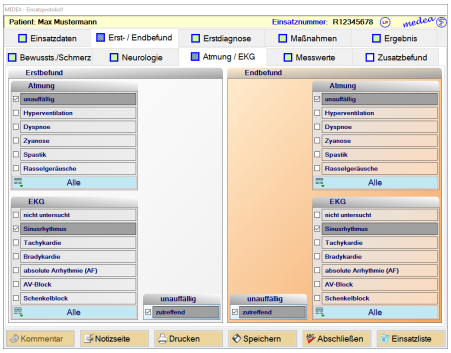
At the end a graphical curve indicates the process of the emergency and shows all taken



(a) Patient history

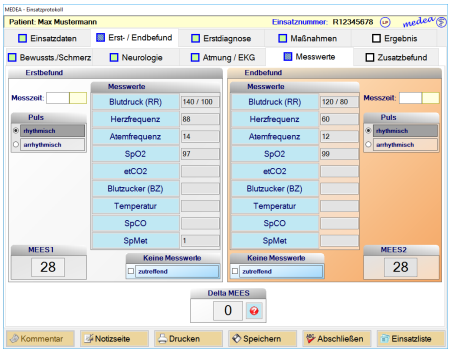


(b) Consciousness check

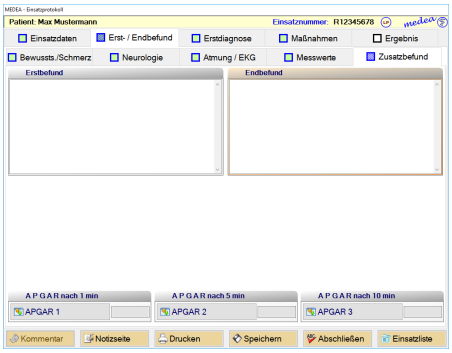


(c) Breathing check

(d) Neurological check

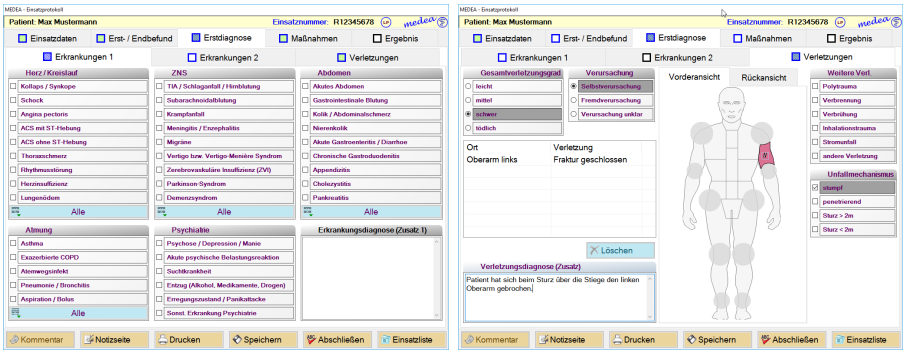


(e) Vital signs



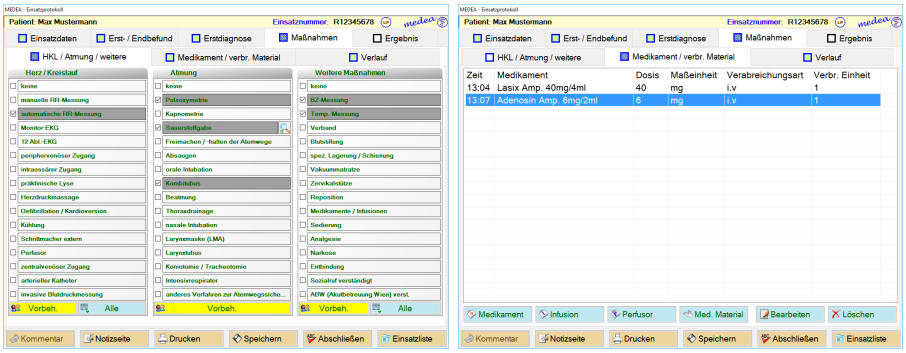
(f) Additional assessment

Figure 2.6: MEDEA screenshots of patient condition data



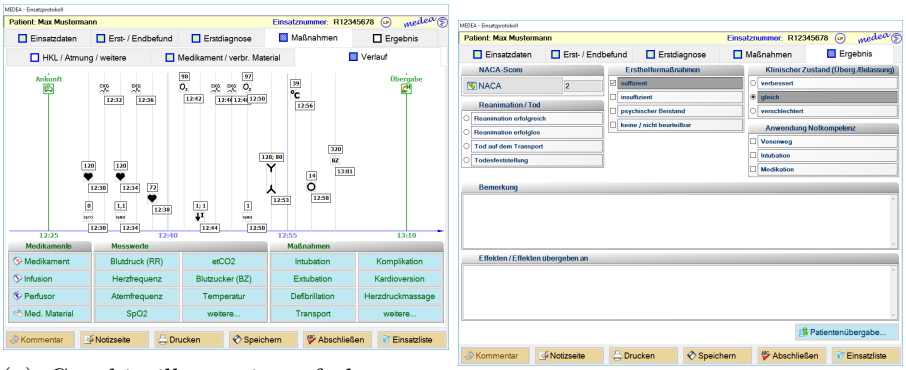
(a) Suspected diagnosis (b) Observed injuries

Figure 2.7: MEDEA screenshots of diagnose data



(a) Executed treatment (b) Administered medication

Figure 2.8: MEDEA screenshots of treatment data



(a) Graphic illustration of the emergency (b) Result

Figure 2.9: MEDEA screenshots of final data

actions in a time-depending axis. This is illustrated in Figure 2.9.

The clinical handover is done with the help of a copy of the entered data. Therefore all units are equipped with mobile printers to printout the protocol.

MEDEA is inspired by the so called "DIVI"-Protocol from Germany which is described in the following section.

2.6.2 DIVI-Protocol

Germany has a leading role for innovative documentation strategies in emergency care systems. The innovations are supported by an association called "DIVI", abbreviation for "Deutsche Interdisziplinäre Vereinigung für Intensivmedizin".
They have defined a minimal amount of information which needs to be collected on the emergency scene, the so called MIND ("Minimaler Notfalldatensatz"). It represents the basis for development of documentation systems and furthermore offers ability to compare data. It is structured with modules, which are partly mandatory and partly optional.

The basic module contains only mandatory data which needs to be acquired on every emergency mission:

- organizational data
  e.g. name and number of emergency personnel, data of mission
- patient data
  e.g. gender and age
- patient condition data
  e.g. condition of the patient on arrival
- diagnosis data
  acute illnesses and injuries of the patient
- scores
  e.g. NACA-Score[1]
- therapy data
  performed treatment and administered drugs
- patient condition at the clinical handover
- any additional information about the mission

[1]The NACA-Score is an used scoring system to indicate the severity of the emergency. It rates from I - VII, whereas I indicates a slight injury and VII the death of the patient.

Depending on the emergency the basic module can be extended with additional modules, e.g. to serve specific documentation requirements for resuscitation, major trauma or interhospital transports. MIND represents the basis for medical documentation and is widely used in Germany. It includes furthermore assessment guidelines, such as the "ABCDE" approach. [44]

The so called "DIVI Notfallprotokoll" is a protocol for prehospital emergencies in Germany. It is based on the MIND and can be used either paper-based or integrated in an electronic documentation system. Figure 2.10 shows the "DIVI Notfallprotokoll" in Version 5.1. [45]

Helm et al. analyzed 2007 an innovative approach to integrate MIND and the DIVI protocol to an electronic documentation system. Instead of heaving a device like a laptop or tablet, a digital pen with digital paper was used [46]. A more detailed overview of electronic documentation approaches is given in Chapter 3, *Electronic Documentation Approaches*

The personnel of an air rescue service in Germany was asked to use the new devices, i.e. to write with the intelligent pen on the digital paper. The paper represented the already known and used protocol with no visible difference. There was a fine pattern on it which was hardly visible with the eye. The digital pen worked as a usual pen with one additional feature, completely imperceptible to the user. The written text was coded with coordinates for each point. The pen saved the set of coordinates and transmitted them to a computer after plugging the pen at a usb-docking-station, where a blank protocol was available. In fact it worked like a scan but without manually scanning the document. After the complete transmission the text needed to be verified and corrected, if necessary.

The approach had one big advantage: The personnel didn't have to change the habits or learn a new system. They continued working in the same way, just with new paper and new pens. It was furthermore a user-friendly solution, which needed to be very robust against the environment.
Usually after every mission the medical staff had to review and complete the protocol. Furthermore they had to enter the most important data manually to a computer system. With the new approach the post-processing was done much faster. The existing database and interfaces made it possible to integrate the devices without much effort.

But there was no link to the hospital, which led to handing over the protocol as a duplicate copy. There have been different approaches evaluated, such as mobile printers, sending faxes or printouts to hospital, but none of them represented a satisfying solution. [[46], [47], [48]]

Figure 2.10: The protocol "DIVI Notfallprotokoll v5.1" [45]

CHAPTER 3

Electronic Documentation Approaches

Documentation is an essential duty in every clinical setting as already shown in the previous chapter. Patient data is captured to base and justify decisions, to remember previous cases and actions and to assure an optimal treatment. Documentation needs are satisfied in different ways, such as handwritten on pieces of paper, electronically documented on mobile devices or automatically captured with special medical devices. In this chapter the electronic documentation of patient data in "Electronic Patient Records" and "Electronic Health Records" is introduced with special attention paid to the specific requirements in prehospital care. Furthermore the existing concept in Austria, i.e. the Austrian Electronic Health Record "ELGA", is described in detail.

3.1 Electronic Patient Records

An Electronic Patient Record (hereinafter abbreviated to "EPR") is defined as a summary of all data from a patient. It includes condition of the patient, e.g. vital signs, patient history, aso. and furthermore also the performed treatment. It is available electronically and in clinical settings usually integrated in a hospital information system. The Electronic Patient Record replaces the paper-based patient record by overcoming the limitations which have been faced.

Paper-based documentation is bound to a location, i.e. it is only available at one place and one time. It can not be easily passed to other stations and it might gets lost as well. There is no record who has looked at the the patient information beside the fact that there is no possibility to check authorities before opening it. Medical data of persons represents sensitive data which must be protected.

Also the lack of completeness and correctness of patient records is a well known issue. Paper-based patient record often represent a mix of information, written on pieces of paper in a hurry, with no provided structure and lack of readability. Medical staff has to manage stacks of paper in order to find one single detail they are searching for. [49]

EPRs can support documentation. Access to electronic documentation can be restricted due to legal requirements and therefore it overcomes issues in data privacy which represents a topic of relevance whenever sensitive data, such as patient information, is stored. EPRs prevent doubled assessment of the patient and force complete records by validating the correctness and completeness. Furthermore EPRs provide a structure which enables searching and - what is more important - locating of important information in short time. Also medical devices, which generate automatically data, can be attached to a patient record easily. Even after the patient has left the hospital, the data can be used for quality assurance and for controlling. [50]

The introduction of an electronic system has high initial costs due to equipment acquisition and training of the medical staff. It is not always given that electronic documentation is less expensive than paper-based if just the hard facts are considered. The soft facts, such as structure, data security and the ability to achieve quality assurance, represent a qualitative benefit that cannot be quantified. Moreover legal requirements force the use of EPRs regardless of their costs. [49]

In order to achieve a complete and efficient documentation EPRs are suggested in a noteworthy amount of literature. Furthermore also the usage of telemedicine can improve the patient's outcome. (see also [51], [52], [53], [2])

Deckelbaum et al. even pointed out that electronic records can reduce the mortality in hospitals for trauma patients because the trend of vital signs can be accessed easily, every change in the condition of the patient is recognized early and can be treated with appropriate actions, e.g. medication, and communication is effective. [54]
Furthermore information will get lost if it is not documented properly and passed in an appropriate way between team members or during the clinical handover from the ambulance services [55].

Electronic systems should support the user and not impede their daily work. Douglas et al. pointed out that "complexity is seen as the enemy of usability". [56, p.1] In this field it is useful to achieve a *user-centered design approach*. It was tried to formulate some principle guiding practices for introducing EPRs based on an electronic documentation system in South Africa, Malawi. It proved that a touchscreen is the most intuitive way of achieving the highest outcome of learnability, usability and simplicity. The staff got used to the device really fast and accepted it. Furthermore the size of the screen was of big interest. It has to fit the environment, i.e. a big screen will not fit in an already reduced or crowded space. On the other hand the screen needs to have a specific minimum size

in order to be able to work with it.
Douglas et al. found out that there are some simple guiding principles [56, p.3]:

- usage of wizard interfaces to guide the staff through collection of data
- low information density on one screen
- minimization of free-text data
- error prevention before recovery
- meeting critical clinical needs

Of course these are guiding principles which may not work in any other environment. Introducing electronic documentation is always an individual approach and depending on the involved parties and people.

3.1.1 Electronic Patient Records in Prehospital Care

As described in Section 2.3.1, *Legal Situation in Austria*, documentation is an essential duty in prehospital care. Similar to a clinical setting for an emergency department the environment in prehospital care is busy and stressful. Therefore the requirements for Electronic Patient Records have to be met in order to support the staff and not impede patient care.

Landman et al. analyzed motivation and challenges on using EPRs, so called e-PCR (short for "electronic patient care report") in prehospital care in the US and Canada. The overall motivational factors for using electronic documentation in emergency ambulances were identified as follows [57]:

- improved legibility
- improved billing
- available charts (often lost before due to amount of paper)
- support quality assurance

On the opposite to the motivation also challenges were analyzed:

- fear of spending more time on documenting than on treating patients
- link to hospital is not trivial - isolated applications make it almost impossible to have a working interface

- lack of funding
- lack of leadership and responsibility in case of failures
- antiquated organizational structures
- poor design of user interfaces
- concerns about privacy and security

Initial objections are high whenever it comes to the introduction of a new technology, especially in such a dynamic environment where errors are not allowed and cannot be undone. Documenting is done under high time pressure while the patient has to be treated. The attention of the staff should always be on the patients and their condition beside documenting the needed data in order to assure a smooth handover in the hospital and an improved outcome of the patient. The system needs to be stable and fail-safe because there is simply no room for failure. Emergency staff has to be able to handle a new system within a very short time like they have never worked with any other before. [58].

In literature various approaches have been analyzed in order to investigate the existing challenges in prehospital care. The adaption of a new system usually needs time and resources. It might also result in higher costs at the beginning in order to achieve a more efficient daily work afterwards. In prehospital care the fear of spending more time on the scene and for documenting is ubiquitous because this would directly result in a reduced outcome of the patient. Therefore an EPR is needed that is capable to handle the requirements and needs of all emergencies which have different documentation requirements [[41], [59]].

In order to overcome initial rejections against new technologies Helm et al. analyzed the use of the digital pen and digital paper, as already introduced in Section 2.6.2, *DIVI-Protocol*. They aimed to establish a new system with the least impact on habits of the personnel. This approach is also used in clinical settings in order to reduce spent time for documentation [60].

Furthermore the time spent on measuring and tracking of vital signs can be reduced with the support of new technology. There are already various devices available for automatically measuring blood pressure, heart rate or blood oxygenation. Gao et al. investigated the use of such devices in prehospital care as part of the documentation with an EPR. Vital signs, such as blood pressure, heart rate and blood oxygenation are measured and automatically transferred to the patient record and stored as part of the history. Whenever a value reaches a critical limit the staff receives an alert. Moreover they also suggested the use of a web portal which is directly connected to the EPR. A tele-consultation physician or staff of the emergency department can logon and get real-time data in advance. [61]

Combined approaches can also improve the patient outcome. Already established documentation can be enriched with new solutions, such as digital images as part of the documentation on scene. Especially when it comes to trauma emergencies the mechanics of the accident are important and impact the therapy and diagnosis. For internistic issues the environment is not necessarily directly connected to the emergency. In these cases the patient condition and history is of great interest and information, such as measured ECG, medical reports and medication, should be transmitted to the hospital in an appropriate way. Taking pictures of these data and sending them to the emergency department in advance could be a possible solution which results in a faster clinical therapy and an improved patient outcome [[53], [2]].

These approaches of electronic documentation support a complete documentation system but none of them provides the ambulance personnel additional data of the patient. They still have to collect information on scene from the patient or relatives nearby. In cases when such important information cannot be collected it can not be provided to the hospital as well and lead to an incomplete documentation and, what is more important, to an reduced outcome of the patient. Electronic Health Records have the potential to provide an overview of the patient's health in all clinical settings.

3.2 Electronic Health Records

Electronic Health Records (hereinafter abbreviated to "EHR") contain a collection of the whole history of a patient. In literature this term is also known as "Electronic Medical Record" and often mixed up with Electronic Patient Records. EHRs focus on the overall health of a patient including information of different organizations or health care facilities, where the patient has been treated. In contrast the EPR is a summary of information of a patient within an organization or health care facility. So an Electronic Health Record can be defined as a summary of health information about a patient, based on existing EPRs from all organizations. [[62],[63]]

EHRs are used to exchange information about the patient between health care providers, such as hospitals or care facilities. They contain the whole history of a patient, such as patient information, history, medical reports, medical images and legal documents, e.g. DNR order or organ donation regulation. There are different parties and providers which may have interest in accessing the EHR of a patient, i.e. physicians, hospitals, other health care facilities and pharmacies.

In order to assure a complete and correct treatment of a patient all necessary information has to be provided. It is feasible that this data is not collected within the health care facility where the treatment takes place. The responsibility to provide the required information is on the patients, which need to collect all former medical records and medical images. EHRs can support the optimal healthcare by bringing these data to the

attending physician without forcing patients to carry stacks of paper with them. They assure keeping records over a long time and avoid loosing important pieces of paper.
EHRs reduce the risk of complications by providing the whole history of a patient. Physicians can base their medical decisions on previous therapy outcomes in order to assure the optimal treatment for the patients. [62]

The picture of EHRs can be drawn big. EHRs are seen to overcome issues with the lack of interoperability of systems. Important medical data was not able to be transferred due to the lack of compatible interfaces or standards.

The European Commission formed a picture of a connected network of EHRs, where "all Europeans have access to online medical records anywhere in Europe by 2020" [62, p. 503]. When it comes to sensitive data special requirements for data protection have to be considered. So the European Union formed a legal basis on which the establishment of EHRs is made.

The next section analyze the situation in Europe in detail with special attention paid to the legal basis. Moreover the Austrian Electronic Health Record, "ELGA", which is based on the European regulations, is introduced.

3.2.1 EHRs in Europe

The picture, drawn by the European Commission, is big: whole Europe should be connected. If a European citizen needs to get treatment in any European country there should be no barriers.

The European Commission bases this big picture on several studies, such as analyzing the availability of computers and computer systems in Europe. They've conducted a study in 2007 where it was showed that 87 % of all GPs ("General Practitioner") in Europe already have the needed hardware establishment and are furthermore using a computer system for administering their patients [62, p. 504].

Austria was one of the first countries to take advantage of the European big picture by setting up a concept for "ELGA", the Austrian Electronic Health Record. Already in 2006 a feasibility study provided the basis for establishing ELGA.

The Scandinavian countries are one step ahead in providing connected healthcare. All healthcare facilities in Denmark are connected over a national network where all medical data of patients is exchanged. They have created a standardized format for letters to assure a fast and easy location of required information.
The access to the medical data is provided online over a web portal where every single log-in is tracked. The patient can access his medical history as well as nurses or physicians. Furthermore the web portal enables a kind of teleconsultation, where the patients can communicate with their physician in case of minor issues, i.e. if there is no need to visit

the doctor.
An intelligent decision support system is established in the background which notifies the user if there might be complications due to, e.g., new prescriptions. Such a module, called "ePrescription", is already available and in use in Denmark, Sweden and the Netherlands. [62]

Kern et al. pointed out that EHRs will only bring advantages for patient care if they are used correctly. If the doctors would just use them for documenting there will be no improvement but high costs for the establishment. EHRs have to be considered in the decision making process to provide the optimal care for patients. [64]

3.2.2 Legal Basis

Data protection represents a fundamental right of humanity. It is embedded in Article 8 of the European Convention Protection of Human Rights. There are several Data Protection Directives which regulate data privacy. The most important ones are the Data Protection Directive 95/46/EG and 2002/58/EG.

In fact health data is not explicitly defined in the Data Protection Directives, but it is included in the definition of personal data in Article 8(1) of the Directive 95/46/EG [65].

> Member States shall prohibit the processing of personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, trade-union membership, and the processing of data concerning **health** or sex life.

Processing and working with medical data, that represent sensitive personal data, has to be justified with reasons of public interest. The patient has to give explicit consent for processing before the data is actually processed. The provided information for the patient needs to be clear and easy understandable so that the explicit consent is given with full awareness. In case there is threat to vital interests of the data subject, such as risk of death, the explicit consent is not necessary. [65, Art. 8(2)]

The latest legal regulation, the Patient Rights Directive 2011/24/EU, forms the basis on patient's rights in processing and collection of data [66].
There are two different models of patient agreement, so called "Opt-Out" and "Opt-In". In the "Opt-In" mode the explicit agreement of the patient on creating an Electronic Health Record has to be given. This is used in member states of the European Union, such as Belgium, Spain, Switzerland and partly in Germany. The other possibility is to create an Electronic Health Record for each citizen without explicit agreement and give the ability to disagree on the whole record keeping or just parts of it afterwards. This

mode is used in, e.g., Austria.

Germany has a mixed option, where the administrative patient information for insurance companies are provided for all citizens but the collection of sensitive medical data has to be granted explicitly from the patient [67]. The German Health Record, also called "Elektronische Gesundheitskarte eGK", plans to enable a minimum dataset for emergencies, i.e. "Notfalldatenmanagement" [68]. This fact is contributing to the work of this thesis and will be analyzed in more detail in Chapter 7, *Discussion*.

The idea behind these modes is to establish a legal framework to secure patient's rights. The patients need to have the ability to decide which data is stored, shared and to whom it is accessible. Furthermore patients can restrict general access to categories of data, which they do not want to share at all. This framework has a lasting impact on the relationship between patient and physician where the effects are not known so far.

Introduction of EHRs need to consider national laws as well. When it comes, e.g., to special protected data, such as mental illnesses, the access is restricted by law and should not be modifiable or accessible by default. Moreover the national regulations on documentation standards need to be considered. [[62], [69]]

Another important issue is the clarity of information. Patients need to access and process their data easily, in order to maintain their rights on decision about restriction. Schwartz et al. [70] conducted a study in the USA where they tried to investigate the behavior on restriction habits of patients. It has proven that the patients are not likely to restrict their data. Most of the patients are willing to share information with health care providers. They see a good reason in providing their medical data to experts.

Furthermore trust in the health system and in a health provider support the unrestricted access of Electronic Health Records. The more trust is established the more likely are patients to grant access. Moreover they are afraid that the relationship to their physician could be affected if the access is restricted. In case of bad experiences on visits patients are more likely to restrict access for this special health care provider or physician. It depends on the skills and experience of the patients if the whole access or just specific categories or data is prohibited. In case of uncertainty patients are more likely to restrict the whole access. [70]

Beside the restriction of data also the strategy of storage is of great interest. There are several approaches known [67]:

- central approach
  All the data is stored in one central establishment. This enables an easy maintenance but needs to be protected in a special way. This approach is chosen in, e.g., Czech Republic.

- decentral approach
  The data is distributed over many decentral systems and a smooth connection of these networks is forced. This approach is less expensive because to new central system needs to be established. The Austrian Electronic Health Record, ELGA, is based on a decentral approach.

- host-based approach
  The storage of data is done by host-providers, which have to fulfill strict requirements and prove an official certification. A host-based approach is followed by France.

3.3 Austrian Electronic Health Record: ELGA

The Austrian Electronic Health Record is called "ELGA - Elektronische Gesundheitsakte". The history of the electronic record goes back to 2006 where IBM conducted a feasibility study [71]. Goal of this analysis was to get a basis for the decision of the introduction of an Electronic Health Record in Austria.

The definition of ELGA is basically the definition of any Electronic Health Record, which is already described in the introduction of this Chapter [71, p. 31]:

> Die elektronische Gesundheitsakte umfasst die relevanten lebenslangen multimedialen und gesundheitsbezogenen Daten und Informationen bezogen auf eine eindeutig identifizierte Person. Die Daten und Informationen stammen von verschiedenen Gesundheitsdiensteanbietern und vom Patienten selbst und sind in einem oder mehreren verschiedenen Informationssystemen gespeichert (virtueller Gesundheitsakt). Sie stehen orts- und zeitunabhängig (kostengünstig) am Ort der Behandlung allen berechtigten Personen entsprechend ihren Rollen und den datenschutzrechtlichen Bedingungen in einer bedarfsgerecht aufbereiteten Form zur Verfügung.

ELGA implements specifications from the European Union and is based on the legal regulations described in Section 3.2.2, *Legal Basis*. In order to realize the establishment a national legal basis was created, the so called "ELGA-Gesetz" and the "Gesundheitstelematikgesetz". It holds for all Austrian citizens. [[67], [72]]

Every Austrian citizen has a smart card, the so called "e-Card". This card represents a non transferable identification card which contains the most important patient insurance data, such as insurance number, patient name, patient address and insurance information. ELGA uses this smart card to uniquely identify a patient. [71]

The unique identification of a patient requires an active participation of the patient [72, §18]. Usually this is done by inserting the smart card to a special station that reads the data from the chip and connects to the central database to identify the patient (so called

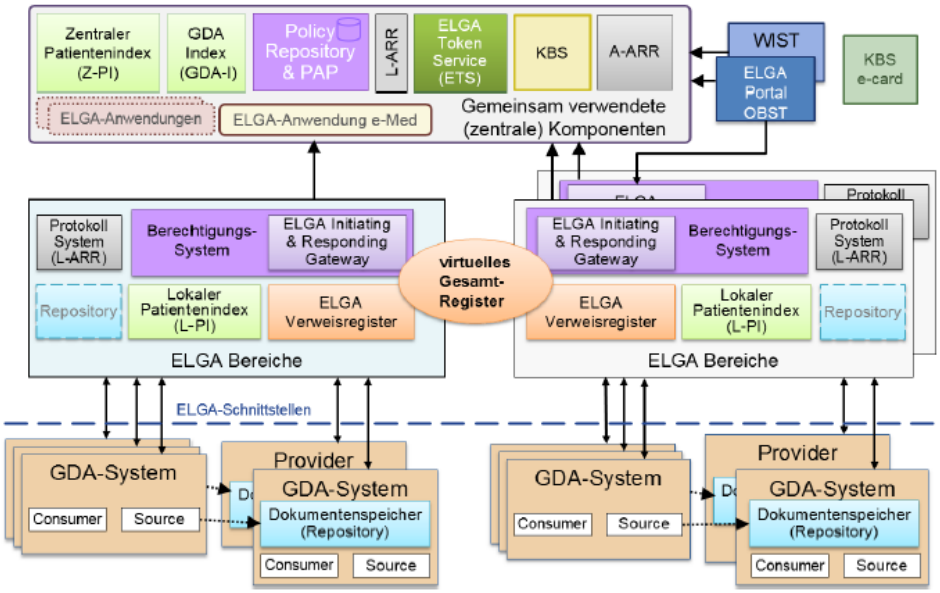


Figure 3.1: Architecture of ELGA [73, ELGA-Gesamtarchitektur, p. 9]

"Zentraler Patientenindex"). After a successful connection and verification the health care provider will be granted access to the medical records.
Every patient in Austria has an Electronic Health Record and can restrict the access to the medical data. This is done in the web portal, which is provided. If the patient disagrees with the storing and sharing of his information, a so called "Opt-Out" can be claimed (described in Section 3.2.2, *Legal Basis*). The disagreement can be situational, e.g. just for one stay, or for the whole participation.

Therefore also health care providers need to uniquely identify themselves on accessing. There are several technical issues which health care providers need to deal with, e.g. interfaces or identification of patient. The main architecture of ELGA is shown in Figure 3.1. These topics will not be paid special attention in this thesis.

At this time ELGA stores information about stationary and outpatient cases in public hospitals (i.e. discharge letters), lab findings, medical letters for radiology and medication data.

The medical data stored in ELGA is organized with the help of a standardized structure, so called "Clinical Document Architecture (CDA)" in Version 2. CDA Release 2 is used for structuring clinical documents, such as medical letters, lab findings, aso. It was developed to enable the exchange of documents between different parties of interest, such as health care providers.

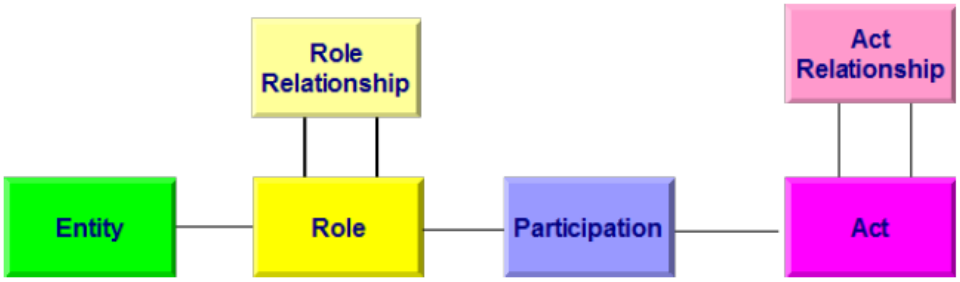


Figure 3.2: Reference Information Model classes [74, Arztbrief, Figure 1, p. 14]

CDA Documents represent a XML-based [1] structure where each content field is encoded with respect to the Health Level Seven Version 3 (HL7 v3) framework and Reference Information Model (RIM). The Reference Information Model describes a process by defining the interaction of different classes, e.g. "Act", "Role", "Entity", aso. In Figure 3.2 the basis classes of the RIM are illustrated. A process is defined as an activity (="Act", e.g. treatment) where several classes, such as "Entity" (e.g. person) and "Role" (e.g. physician, nurse, patient) participate. Activities can furthermore interact with other activities (e.g. laboratory request). [74]

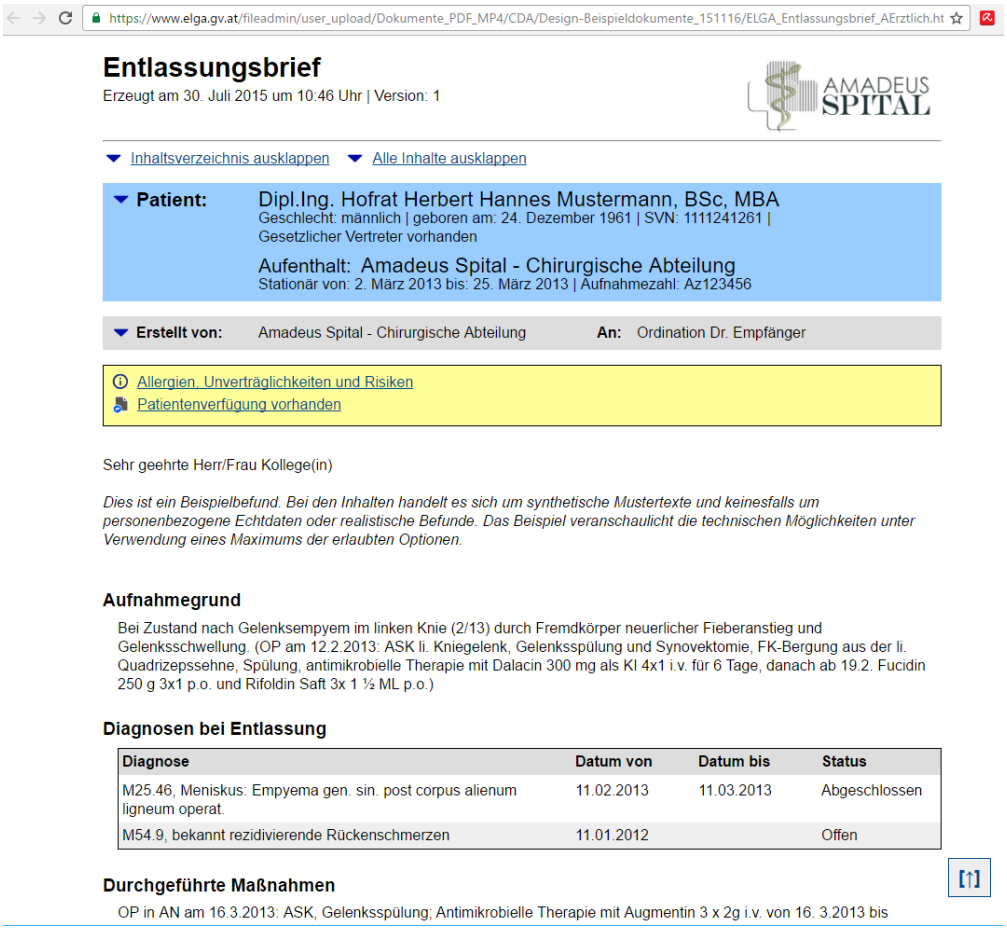
This structure enables moreover the export to more known data formats, such as PDF (Portable Document Format) or DOC (Microsoft Word Document). Health Level Seven determines the required structure by providing implementation guidelines for health care providers. [75]

ELGA is based on the CDA 2 structure and provides its own implementation guidelines for health care providers, who have to establish the compatible implementation of required data. ELGA does not specify how the integration to existing information systems should be done, but mainly focus on the specification of the interface.

The provided data is displayed in the web portal in a consistent way. The documents are represented as websites with integrated hyperlinks to enable fast and easy navigation through the medical data. This is achieved with the help of the underlying structure. In Figure 3.3 the first part of a medical discharge letter is shown. Every document consists of a defined set of data, e.g. admission reason, diagnosis on discharge, performed treatment, aso., which is defined as mandatory or optional, as freetext or with a given structure. In Chapter 6, *Design and Model*, the documents of interest will be analyzed in detail which contribute to the work of this thesis.

There are several studies on the acceptance of Electronic Health Records, which indicate

[1] XML is short for 'Extensible Markup Language' and is a markup language to enable easy and fast exchange of documents between operating systems.



https://www.elga.gv.at/fileadmin/user_upload/Dokumente_PDF_MP4/CDA/Design-Beispieldokumente_151116/ELGA_Entlassungsbrief_AErztlich.ht

Entlassungsbrief

Erzeugt am 30. Juli 2015 um 10:46 Uhr | Version: 1

AMADEUS SPITAL

Inhaltsverzeichnis ausklappen | Alle Inhalte ausklappen

Patient: Dipl.Ing. Hofrat Herbert Hannes Mustermann, BSc, MBA
Geschlecht: männlich | geboren am: 24. Dezember 1961 | SVN: 1111241261 |
Gesetzlicher Vertreter vorhanden

Aufenthalt: Amadeus Spital - Chirurgische Abteilung
Stationär von: 2. März 2013 bis: 25. März 2013 | Aufnahmezahl: Az123456

Erstellt von: Amadeus Spital - Chirurgische Abteilung **An:** Ordination Dr. Empfänger

Allergien, Unverträglichkeiten und Risiken
Patientenverfügung vorhanden

Sehr geehrte Herr/Frau Kollege(in)

Dies ist ein Beispielbefund. Bei den Inhalten handelt es sich um synthetische Mustertexte und keinesfalls um personenbezogene Echtdaten oder realistische Befunde. Das Beispiel veranschaulicht die technischen Möglichkeiten unter Verwendung eines Maximums der erlaubten Optionen.

Aufnahmegrund

Bei Zustand nach Gelenksempyem im linken Knie (2/13) durch Fremdkörper neuerlicher Fieberanstieg und Gelenksschwellung. (OP am 12.2.2013: ASK li. Kniegelenk, Gelenksspülung und Synovektomie, FK-Bergung aus der li. Quadrizepssehne, Spülung, antimikrobielle Therapie mit Dalacin 300 mg als KI 4x1 i.v. für 6 Tage, danach ab 19.2. Fucidin 250 g 3x1 p.o. und Rifoldin Saft 3x 1 ½ ML p.o.)

Diagnosen bei Entlassung

Diagnose	Datum von	Datum bis	Status
M25.46, Meniskus: Empyema gen. sin. post corpus alienum ligneum operat.	11.02.2013	11.03.2013	Abgeschlossen
M54.9, bekannt rezidivierende Rückenschmerzen	11.01.2012		Offen

Durchgeführte Maßnahmen

OP in AN am 16.3.2013: ASK, Gelenksspülung; Antimikrobielle Therapie mit Augmentin 3 x 2g i.v. von 16. 3.2013 bis

Figure 3.3: Example of a medical discharge letter [73]

that the citizen have a great interest in the establishment [[76], [73]] but the medical personnel, such as physicians, share a common rejection [77]. The motivational factors will not be paid too much interest in this thesis.

ELGA represents an interesting data source which intends to satisfy information needs in clinical settings. Due to the fact that every Austrian citizen is registered for ELGA and the implementation is organized with standards, ELGA can potentially also be used in out-of-hospital settings, such as mobile or prehospital care.

The research aim of this master thesis is to define needed data on scene which could potentially improve the outcome of the patient. Moreover it should be identified if the required data can be retrieved from ELGA, that provides an overview of the patient's health and includes medical history.

CHAPTER 4

Methodological Approach

Based on the need of a complete documentation system in prehospital care the research goal of this thesis is to point out which data is required at the emergency scene, especially in cases when such important information cannot be collected. Furthermore it should be identified if the data, which is stored in ELGA covers the found requirements and how it is therefore applicable for prehospital care.

This master thesis was done with an exploratory research using mixed methods and a systematic review of findings. The thesis is build based upon three phases which are described in detail in the next Sections:

1. Research
2. Data Collection and Understanding the context
3. Analysis

The phases were conducted sequentially with minor overlappings.

4.1 Phase 1: Research

The main focus in Phase 1, Research, is on state-of-the-art literature and ELGA, the Austrian Electronic Health Record. Chapter 2-4 represent the main findings of this phase.

4.2 Phase 2: Data Collection and Understanding the context

The main goal of the data collection was to achieve a deep understanding of prehospital care and the daily work of the staff. Therefore two approaches have been chosen to satisfy the information needs, observations and expert interviews. The observations are considered as very useful to get special insights and to enrich the literature research with experience. Whereas the expert interviews are providing detail information about the daily work and focus on giving the staff an ability to tell their stories in a comfortable setting.

Observations

The observations have taken place as part of the volunteering activity of the author of this thesis from May 2016 until November 2016. The aim of the observations was to get insights how ambulance staff works at the emergency scene and how they handle their documentation duty. Furthermore informal talks with the staff was done to support the overall understanding of decisions and actions at the emergency scene. During the informal talks the ambulance staff has been informed about the thesis and the aim of the observations. It was possible to get different opinions on ELGA as well as on the integration scenario and workability.

The collected data was processed after the observations and put down as notes from memory. The informal talks have not been documented because they are considered to gain insights and opinions but not processable data. This supported that no sensitive information, such as patient data or provider data, was collected or used in this thesis at any time. The data was organized as a basis for phase 3, the analysis, together with the collected data from the expert interviews.

Interviews

The interviews have been achieved with experts of different educational levels. The categorization of experts was done along the definition in Section 2.3, *Prehospital Care in Austria*, as follows:

- *Group 1:* Paramedics
  In this group the experts are educated as "Notfallsanitäter" with at least two additional competences. The experts are located in Vienna and Lower Austria.

- *Group 2:* Physicians
  In this group physicians of the union "Medizinercorps" in Styria, Graz, have been interviewed.

Expert	Education	Group
E1	Physician	Group 2
E2	Paramedic w. competence: NKA, NKV	Group 1
E3	Paremedic w. competence: NKA, NKV, NKI	Group 1
E4	Paramedic w. competence: NKA, NKV	Group 1
E5	Physician	Group 2
E6	Physician	Group 2
E7	Paramedic w. competence: NKA, NKV	Group 1

Table 4.1: Assignment of experts to groups

In Table 4.1 the assignment of interview partners to one of the groups is shown.

It was decided to exclude Paramedics with only one additional competence due to the expected information content. The additional competences allow the personnel to administer special drugs and perform more qualified treatments.

Three competences can be acquired [15]:

- ”NKA” - Allgemeine Notfallkompetenz Arzneimittellehre
  With this competence the staff is allowed to administer special drugs.
- ”NKV” - Allgemeine Notfallkompetenz Venenpunktion und Infusion
  With this competence the staff is allowed to administer special intravenous drugs and furthermore to establish an intravenous catheter. The competences are based on each other, i.e. without having the competence ”NKA” it is not possible to acquire ”NKV”. ”NKA” is therefore a prerequisite in achieving ”NKV”.
- ”NKI” - Besondere Notfallkompetenz Intubation und Beatmung
  This competence is built upon the former competences, ”NKA” and ”NKV”, and enriches them with more qualified treatment actions, such as securing the airway with endotracheal intubation.

The interviews have been done face-to-face to get qualitative insights. The interview has been designed as semi-structured with an interview guideline to gather required data in a broad sense by giving the experts space for storytelling. In Appendix A the structure of the guideline is shown. As interview location a comfortable setting was aimed therefore the talks took place at home of the experts or at home of the author.
At the beginning all interview participants have been asked to sign a consent form where the surrounding conditions of the interview and the processing of gathered data is explained. Appendix B shows a blank consent form. Furthermore the contact data of the author is provided in case there are any questions or further suggestions.

The interviews have been audio recorded and supported with taking notes on the

survey and afterwards transcribed to be able to achieve an analysis. In Appendix C the transcription of one interview is shown.

4.3 Phase 3: Analysis

This phase is split up into two steps. In the first step the gathered data from Phase 2 (Data Collection) is structured and analyzed with a thematic analysis approach as suggested by Braun and Clarke [[78], [79]]. The aim of the analysis is to discover whether the decision about treatment and diagnosis changes with additional information about the patient and moreover what data should be provided to be able to do so. Furthermore it should be tried to give an insight on the special needs and requirements of the usage of electronic health records in pre-hospital care. The methodological approach for the data analysis is described in Section 4.3.1, *Data Analysis*.

The second step tries to put the content findings from qualitative research into an easy understandable structure. It represents an overview of the needed data during an ambulance call and illustrates the whole process from the call in the dispatch center until the possible transport to a hospital. Therefore an Entity-Relationship-Model and a Flow Chart was developed, which is described in Section 4.3.2, *Data Model*.

4.3.1 Data Analysis

The analysis is based on the transcripts of the interviews and on the notes from the observations. It is guaranteed that no patient-identifying information or personal information of the participating persons or organizations is processed.

The approach for thematic analysis is achieved in six phases [79, p. 60ff]:

1. Familiarizing yourself with the data
2. Generating initial codes
3. Searching for Themes
4. Reviewing potential themes
5. Defining and naming themes
6. Producing the report

The collected data was split up in smaller statements, e.g.:

> E4 [00:12]: [...] Also bei einem Traumageschehen sind natürlich ganz andere Dinge im Vorfeld wie wenn es jetzt ein internes Problem ist. Beim Traumageschehen, sag ich mal, sind es.. also Ursache, was ist der Notfallhergang,

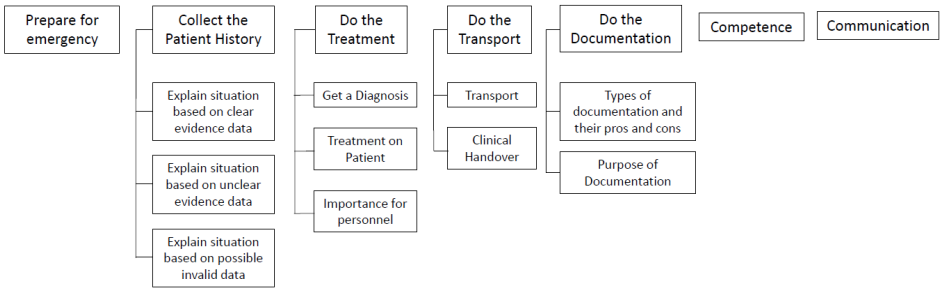


Figure 4.1: Overview of themes and sub-themes

> also auch wieder eine Unterscheidung, ob das jetzt ein, keine Ahnung, Sturz von der Leiter, weil, weiß ich nicht, unachtsam. Oder aber auch Sturz von der Leiter, weil, keine Ahnung, Synkope. Das ist natürlich auch, dass man da mal ein bisschen eine Erhebung hat. Um dann weiter herauszufinden, was ist eigentlich das ursprüngliche Problem von dem Ganzen.

Based on the information content of the statements, codes have been assigned to each of them. The codes have been chosen uniquely for each data set, e.g. interview or observation. So it was tried to get a broader view on the data and discover codes, and later on themes, which are not obvious. In case of the introduced statement above the code was chosen as "Anamnese machen", "Acquire patient history".

After each statement was assigned to a code, the codes have been grouped according to their meaning and relevance. In this steps themes like "Prepare for the emergency" or "Get a diagnosis" have been formulated. Afterwards the themes have been reviewed and tried to be assigned to more general themes, which collect the already found sub-themes. In Figure 4.1 a rough overview of the found themes, including sub-themes, is illustrated. Figure 4.2 shows the more detailed assignment of codes to an example theme, i.e. "Prepare for the emergency".

The findings of this analysis are described in Chapter 5, *Findings*.

4.3.2 Data Model

Based on the content findings from the qualitative research a data model was created that captures the requirements and needs concerning data on the emergency scene. To provide easy and understandable access to this information also for ambulance personnel, which are mainly lay persons to data modeling, an Entity-Relationship-Model [80] was chosen. Furthermore the development of a database is not intended in this thesis therefore an abstract modeling of the meaning of the collected data satisfies the information requirements.
The ER-Model should give an overview of the needed data during an emergency call

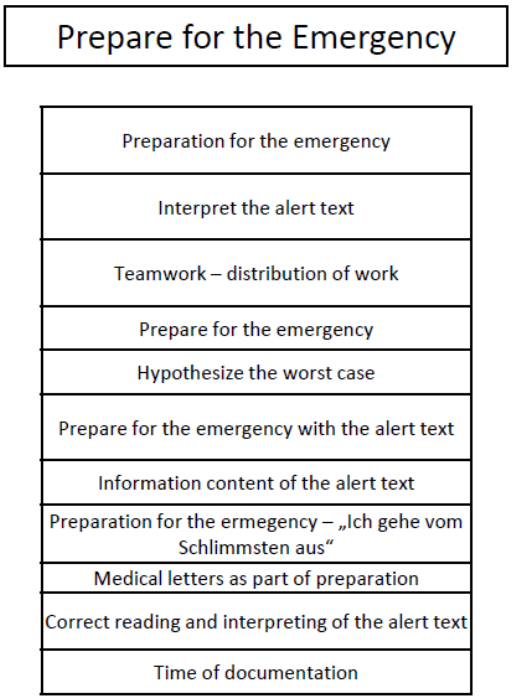


Figure 4.2: Overview of the theme ”Prepare for the emergency” with assigned codes

and represents a basis on which further development of an Electronic Health Record for prehospital care can be achieved.

Beside the gathered data during an emergency call the work on scene is of great interest too. In order to model the process a flow chart was generated. Flow charts are very common to illustrate algorithms and processes in any medical setting, because it simplifies the often very complex process into an understandable series of steps [28].

In this step the huge amount of content findings was tried to be structured. It pointed out that the outlined process from interview partners overlapped with the observed process in the observations. Based on this findings the flow chart was generated, which focuses on the structure of the process on scene.
In many literature the process before arriving or after transporting is not paid much attention to. It was tried to derive an integrated flow chart, from the beginning until the end of an emergency. The interviews and observations have showed that there is no real process which can be deduced because the ambulance staff acts very different due to the severity of the emergency or due to the traveling time. In contrast the process on scene has pointed out to be very similar, mainly because of the associated guidelines, which are partly described in Section 2.4.3, *Supporting Guidelines*. Therefore the flow chart was created with focus on the work on the emergency scene.

The importance of collected data is already visible in the flow chart but it doesn't represent an approach to fulfill all information needs. As a next step a mind map was created where the patient represented the center. Important information out of the data analysis which may contribute to the patient's condition or outcome was organized around the center in the mind map. Here also the findings from the flow chart have been considered.

Based on mind map an Entity-Relationship-Model was generated which was enriched afterwards with the analyzed data from the Austrian Electronic Health Record, ELGA. It has shown that there are many overlapping data objects, which already have been organized in the data model in a way it may support a future integration of an Electronic Health Record to a prehospital setting. The data model was reviewed with one expert, who has a technical education and furthermore is a paramedic. This assures the correct content and feasibility of the data model.

This thesis does not cope with technical issues of a possible future integration of the Austrian Electronic Health Record to any prehospital setting. During the expert interview with the company "ELGA GmbH" it pointed out that the integration of ELGA to prehospital care is not planned, but rather explicit excluded from known plans. For this reason the data model represents a model for a possible integration which considers the current reality but may be outdated due to changes of ELGA.

CHAPTER 5

Findings

In Figure 4.1 an overview of the found themes is provided. The themes represent the process of an emergency call beginning with the receiving of an alert and ending with the finalization of the mission, i.e. the transport to a hospital and documentation. Each top-theme is organized as a section in order to enable a structured reading. This chapter describes the findings of the qualitative research which was conducted with interviews and observations.

5.1 Prepare for the Emergency

An emergency call for ambulance staff starts with receiving an alert over a pager and/or over mobile phone. It provides the forces the needed information in order to prepare for the emergency. All interview experts pointed out that the actual situation on the emergency scene does not necessarily need to overlap with the given information in the alert.

Due to a lack of standardization in Austria the received texts differ from dispatch center to dispatch center and often from calltaker/dispatcher to calltaker/dispatcher. Furthermore the content of the alert is depending on the person who calls the ambulance. People are not used to act focused in stressful situations like an emergency. Therefore they tend to exaggerate because they often are not able to differentiate. E3 stated during the interview that an alert for a hand injury with strong bleeding turned out to be a torn toenail with little bleeding [E3 10:07]. Another extreme example was shown by E4, who received an alert of cardiac arrest, prepared himself for CPR (cardiopulmonary resuscitation) and the patient welcomed him standing in the door, waiting for the ambulance to arrive [E4 07:37].
The quality of the information content provided is different for this reason.

Once the ambulance staff receives an alert they have to get immediately into the car and on the scene. The traveling time is depending on the location of the emergency but can take up to 10-15 minutes. The teams handle their preparation different. This is influenced by the traveling time and severity of emergency. Some communicate a lot and organize the distribution of work, such as role management or equipment management, i.e. what is needed on scene. In case the teams have much experience in working together the communication effort is less because roles are clear anyway. The roles are not defined strictly, but rather are yield from the severity of the emergency.

Here tactical considerations are very important which determine the process of following work. The environment, e.g. weather, is of great interest for the work on scene. If the weather is unstable it might not be suitable for an emergency rescue helicopter. Furthermore extreme cold or heat have to be considered because they might contribute to the patient condition.

In case of special emergencies the teams try to check on the way if additional forces are alerted as well, such as fire fighters or police. This is especially important to establish personal safety for the ambulance staff.

Based on the textual description all interview experts stated that they start thinking about the severity of the emergency and what could be expected on scene. The actual decision about treatment is done at the scene, as soon as the teams had a look on the patient and his/her current condition. Depending on their educational level they furthermore think about possibly needed algorithms, e.g. medication, where a conversion of administration may be needed and possible contraindications have to be considered. Due to the varying quality of the alert most of the teams pointed out that they usually try to prepare for the worst possible case because they simply never know what exactly has happened.

Depending on the traveling time and the severity of the emergency furthermore documentation is also likely to start on the way to the emergency scene. In some cases some patient information (patient name, address) is already provided in the alert text beside the organizational information, such as emergency number or personnel numbers. If it is possible this data is already documented on the protocol.

When it comes to providing additional information for the preparation for the emergency, the interview experts have different opinions. Some stated that they would like to have a look on previous medical letters on the way to the patient. E5 said that it would ease his work at the scene because it gives a complete overview of the patient and would save time in examining the patient [E5 13:41]. Furthermore it was compared to the work in a hospital where the patient history is usually read in advance before medical rounds start [E5 13:50].

E3 pointed out that depending on the emergency the patient history would be use-

ful in advance. He showed that in case of stomachache it would be possible that the reason is a heart attack. If the patient has already visited his General Practitioner who has diagnosed a gastritis, the suspected diagnosis on the way would not be a heart attack anymore [E3 11:46].

On the other hand E2 and E7 stated that having too much information about the patient in advance would narrow the view. With the alert a leading symptom is provided which already forces the staff into a direction that may not be correct. On scene the suspected diagnosis are excluded stepwise until just one remains. An example was given by E7 where a patient suffered from affected mobility in one side of the body. The patient has been a diabetic patient for 10 years, so the symptoms could point to hypoglycemia (very low blood sugar) or to a stroke. If he would have had the information about the diabetes in advance he may would have suspected a hypoglycemia instead of a stroke [E7 06:45]. Stroke is one of the severe emergencies where time is a crucial factor and clinical treatment has to be provided within the first 60-90 minutes. Especially in such cases it is important to consider all circumstances.

5.2 Do the Anamnesis

As soon as the ambulance staff arrives at the scene they get a first impression of the emergency. They quickly analyze the environment with their senses, such as seeing the patient and his/her bodylanguage, checking his/her home, smelling unusual smells and feeling cold or heat. The first impression of the emergency is leading the way through the following work, especially in cases where the circumstances are unclear. In these cases the senses can help to explain the condition of the patient and identify possible risk factors, such as alcohol, drugs or smoking.

Moreover additional forces could be needed due to the environment, e.g. if the patient is stuck in a car or the emergency scene is not safe. This occurs specially in emergencies in areas of trains or where dangerous goods, e.g. toxic substances, are involved.

Beside the first impression of the situation on scene the anamnesis, or often also known as patient history, plays an important role for further work. It pointed out that the collection of information follows a defined structure, the so called "ABCDE" approach and "SAMPLE(R)"-Schema, which is described in Section 2.4.3, *Supporting Guidelines*.

With the help of a structured questionnaire the patient is examined to decide whether additional forces are needed or not. E6 stated that the first thing on scene is to decide if the patient is critical or not and which severity the emergency has. For this matter the examination of vital functions is done, such as checking breathing, pain and vital

signs [E6 02:25]. If any problems during the checks occur, immediate actions have to be taken. This goes along with the guidelines, i.e. the "ABCDE" approach, where the next examination step can only be done, if existing problems in the current one are solved.

On examination of the patient the ambulance team tries to find out what exactly has happened. In case of trauma the mechanics of the accident are of great interest because injuries can be derived from this information, even not immediate visible ones. For diseases the "SAMPLE(R)"-Schema is essential for collecting information of the symptoms and pain. Moreover the duration and changing of symptoms and pain is important. E2 showed that with the amount of information the suspected diagnosis can be formed. With the textual information in the alert a leading symptom is given, e.g. stomachache, which could indicate to a high amount of suspected diagnosis. By examining the patient and collecting information of the emergency unlikely diagnosis can be excluded until a suspected diagnosis remains which is very likely [E2 15:51].

If the patient history cannot be collected from the patient itself it gets tricky for the ambulance personnel. In the best case there is a relative or friend nearby, that is informed about the emergency and can give proper information. In some cases it is feasible that needed data cannot be gathered, e.g. if the patient collapses at a public space. E4 pictures a case, where exactly this situation has happened. Fortunately the incident was witnessed by some bystanders that called the ambulance immediately. The person was unconscious without an obvious reason, e.g. bruises or bleeding. So the team started with examining the patient, i.e. try to get a response by touching and talking, check the breathing and check vital signs. When they started with "D", which includes a neurological check, they recognized unequal pupils. This has lead them to the suspected diagnosis of a bleeding in the brain [E4 03:08].

E5 showed another example where the patient collapsed at a public space without an obvious reason directly in front of an ambulance team. It turned out that the patient had a cardiac arrest, which implies immediate CPR. Fortunately the patient had a prescription in his jacket where blood thinner have been prescribed. Based on this information the team was able to start with the correct treatment, in this case a lysis therapy which is used to resolve blood clots. This quick decision might have saved the patient's life [E5 05:46].

So it is possible that clinical indicators help to manifest the diagnosis and treatment. E1 explained that there are so called 'pathognomic' indicators, i.e. 1 symptom determines exactly 1 disease. As an example the disease hypoglycemia was shown, which is indicated by a very low level of blood sugar. The symptoms of hypoglycemia and a stroke can be very similar but are different in their treatment and furthermore also in their clinical therapy. For this reason it is essential to not confuse the diseases and check the pathognomic indicator, i.e. blood sugar.

Beside the cases where crucial indicators are given it is also possible that the condition of the patient is unclear. Without having additional information about patient history, previous diseases or medication the teams have to treat symptoms. This might not solve the root cause of the symptoms but at least support to stabilize the patient to provide him clinical therapy as soon as possible. Furthermore they have to rely on their senses and experience in order to give the patient the appropriate help. Here it is crucial that the environment and circumstances are considered properly, e.g. syringes can indicate that the patient has taken some drugs or medication and blood strains can help to reconstruct the incident.

All interview experts see the collection of patient history, previous diseases and medication as an important part of their daily work. Previous diseases and their circumstances can explain the situation, whether some symptoms are usual or new to the patient. If the patient suffers from a heart insufficiency it is possible that the swollen legs are a symptom to this disease and may not contribute to the current problem. [E7 03:55]

Although the given answers by the interview experts tended to be very similar an interesting difference was able to be observed between the groups. Medical personnel is interested in finding the root cause, whereas paramedics focus more on stabilizing. Due to the medical background it is obvious that physicians have to consider more parameters in making their decision. For this reason medical letters play an important role in their work, even outside the hospital.

5.3 Do the Treatment

The treatment goes hand in hand with the examination of the patient. As pointed out in the previous section experienced problems during examination have to be treated right away before continuing with collection of information.

The ability for achieving treatment is limited in prehospital care. The ambulance units are equipped with some medical devices, such as defibrillator, suction unit and different measurement devices for vital signs. Depending on the unit furthermore an ECG machine, respirator or perfusor is on board as well. In some units are also ultrasound devices available. The carried equipment is regulated by the organization itself and therefore different all over Austria.
For this reason the ability to establish a diagnosis and a proper treatment is limited.

Patient history, especially previous diseases and medication are of great interest for making a diagnosis and basing the treatment on evidence data. The interview experts stated that this information can be found in medical letters, such as discharge letter of the last stay in a hospital. This additional information is used to explain the situation and can round the overall picture. Moreover it is crucial for finding the root cause of the

problem. The treatment could be affected by known circumstances, as pointed out by E2. If the patient suffers from high blood pressure he would usually think about giving a drug to lower it. A known right ventricular infarction would represent a contraindication for the drug and therefore he is permitted to administer it in this case. This disease would need a clinical setting and appropriate devices for diagnosing correctly. If the patient is not informed about his/her previous diseases and no medical letters are available E2 would rather not give the drug because the risk of complications is too high [E2 18:17].

Well-known unions, such as the European Research Council (ERC), provide guidelines for clinical settings. Some of them are already described in Section 2.4.3, *Supporting Guidelines*. The guidelines are well established and provide efficient patient care also in cases where additional information cannot be collected, e.g. unconscious patients as described above. Following the guidelines a suspected diagnosis and a proper treatment can be established. Depending on the educational level of the staff different competences can be executed to treat the patients. Especially physicians in Group 2 are concerned with calculation of needed medication, mainly also in advance before arriving at the scene.

The ambulance personnel is forced to follow the defined guidelines, which is also reflected in the used documentation systems, i.e. handwritten and electronic protocol. The guidelines are directly integrated in the protocols with easy methods to document the examination of each step.

Beside the treatment the decision about the target hospital is depending on additional information. It makes a huge difference if the problem is known, i.e. chronic, or if it happened the first time. The choosing of the target hospital should consider if the patient receives already treatment for the suspected cause, e.g. patient has lung cancer and has right now problems with breathing. So the patient should be advised to the already treating hospital.

Furthermore previous diseases or recent stays in hospitals are of interest. E3 described a case where the knowledge about a recent stay in a hospital changed the decision of transport. The patient suffered from nosebleed which would have advised him to a hospital with a specialized department for ENT (ear-nose-threat). During the collection of patient history it pointed out that the patient was just discharged some days ago from hospital after a heart surgery. Therefore the transport to a hospital with a specialized department for ENT and cardiology needs to be done in case the condition of the patient gets worse [E3 03:45].

It is noteworthy that not all medical letters or previous stays in hospitals are of interest. Group 2 stated that the last relevant medical letter would satisfy their information requirements. All needed information about previous diseases, previous diagnosis and medication is provided with a good overview. Group 1 does not agree upon a unique statement, but rather agreed that medical letters are important. If they cannot derive

any actions from the additional information they would provide the information to a physician in order to assure a correct clinical treatment. Furthermore medical letters tend to be pretty long and it is time-consuming to read them. It pointed out that skimming medical letters is not possible if the ambulance staff is not used to the structure. E4 suggested to provide the required information as a well structured summary to help to establish a suspected diagnosis and treatment [E4 12:28].

In some cases the patient history, such as previous diseases or medication, is of secondary importance, e.g. when it comes to trauma. Here the life threatening injuries have to be treated and the patient needs to be transported as soon as possible to an emergency department. The interview experts stated that the cause of the accident is of great interest but does not change their treatment. It is feasible that an internal issue, such as a heart attack, has caused a car accident but the treatment of the life threatening injuries is at top priority. This is reflected in the guidelines as well as also observed during interviews and observations.

Patients contribute to the decision of treatments and transport by giving the teams the needed information. It is feasible that in some cases patients are not informed well enough about their diseases. They know that they have to take a daily medication but they have no idea why they need to do so. So patients and their relatives are often not aware which previous diseases they are suffering from. Tricky cases also occur if the patient suffers from amnesia which might not be known in advance. This makes it difficult for ambulance personnel to base their decision. The medical interview partners stated that from existing medication it is possible to derive diseases which ease their work a lot. The same consideration was achieved in the observations during informal talks to physicians.

The opposite case of poorly informed patients are too well informed patients or relatives. In this cases it could happen that the patients cover up symptoms and shorten their duration. If the pain has been lasting for weeks the indication for an ambulance is often not given if the pain hasn't increased extremely. Here the staff encounters a dilemma. The symptoms and current condition of the patient would lead to a suspected diagnosis which does not form a complete picture. An example was observed during the observation, where the staff decided to treat it as an acute incident. The decision had to be made without additional information because no medical letters have been available. In the hospital it pointed out that this is a chronic disease due to previous patient history.

Patients often don't tell the whole truth, especially when it comes to special diseases, such as hepatitis or AIDS. In this case the patients are ashamed and therefore try to keep it secret. The interview experts pointed out that this information would usually not change their treatment but they would exercise more caution, e.g. take a second pair of gloves. So it would be necessary to know in order to keep all participants safe.

Some patients also behave differently and give different information to the staff. During the research the so called "Physician Phenomenon" ("Arzt-Phänomen") was defined. In this case the patients gave varying answers to the same questions, especially whenever a physician asked. Fortunately in no case the wrong response would have changed the treatment or decreased the outcome of the patient.

Furthermore relatives or nursing staff do not always support the optimal treatment of the patient. E2 pointed out some cases where the nursing staff in care facilities handed out the wrong medical letters, i.e. for another patient, or where the medical letters are not available because a relative is keeping them [E2 05:59]. In other scenarios the relatives insist on the transport to a special hospital which might not be equipped properly for handling the situation. In such cases the ambulance staff has to solve the dilemma of providing optimal care for the patient by convincing the relatives. This could cost precious time which is missing afterwards in the clinical setting [E3 04:52]. Another case was described by E1 where the patient refused to hand out the medical letters although they would have been available. The symptoms indicated a cardiac problem but the patient insisted on a lymph problem. Medical letters, especially previous ECG measures, would have given clarity to the staff and maybe also disclosure for the patient.

During the treatment it is important to monitor the condition of the patient. All interview partners pointed out that the condition can change rapidly and that they need to be prepared to react and take needed actions. Even if the situation is different as indicated by the alert text, E4 stated to always keep the worst case scenario based on the emergency in mind [E4 10:00].

5.4 Do the Transport

The transport is highly depending on the diagnosis. The ambulance staff has to decide in a team if the patient needs a specialized station for receiving proper clinical therapy. Usually the patient has to be transported to the next available hospital that offers the specialized station. In case there is shortage of resources, e.g. no beds available, the transport needs to be done to another hospital.

Not every disease can be treated appropriate in every hospital. In case of a stroke a specialized station, a so called stroke-unit, is needed. If a patient suffers from a heart attack a cardiology department is needed that is able to perform special therapies, e.g. cardiac catheter. If the injuries are caused by an accident, the patient needs a trauma department.

The patient history, i.e. known diseases, medication, anamnesis, and the patient data, i.e. age and gender, determine significant the decision about the target hospital. Due to the limited diagnostic clarification previous diseases have to be considered as well as a possible contribution to the cause of the current problem. In the example shown above

by E3 the known heart disease and recent operation can influence the clinical therapy. Therefore the transport of the patient should be done to a hospital that offers ENT and cardiology departments [E3 03:45].
E7 pointed out it furthermore depends on the disease itself. He showed an example where the patient suffered from epilepsy. It makes a difference if it is a known disease or if the spasms occurred the first time. In case the patient can handle the disease and is stable he would not necessarily take him to the hospital, but rather advise the patient to visit his/her doctor. If it is new to the patient or relatives he would choose a hospital with a department of internal medicine and a department of neurology [E7 02:44].

Known diseases can impede or encourage special therapies or risk factors can force the clinical staff to exercise more accuracy. Even if the collected information does not change the treatment on scene it might influence the clinical therapy. E2 pointed out that the patient history is of high relevance if the patient suffers from a stroke. In some cases this information could decide about the admission of the patient in a stroke-unit [E2 08:12].

Beside the implied specialized station it is also feasible that patients are transported to desired hospitals, which are not nearby. In these cases the patients are usually already in treatment in this hospital, e.g. patients suffering from cancer. The ambulance staff has to decide whether the patient's condition allows to take a longer journey. If the patient is critical and there is a vital threat the transport is done to the next available hospital.

In special cases the ambulance staff tend to call the desired department or hospital in advance in order to get permission and moreover inform the physician on duty about the severity. There is no other way to provide information about an upcoming arrival.

If no additional information is possible to be gathered the hospital is chosen in order to the current symptoms and suspected diagnose which may lead to transporting to a hospital without a needed specialized station.

As soon as the ambulance arrives at the hospital a so called "clinical handover" is done. The clinical handover is a verbal, non-structured action where the most important information about the patient is passed from the ambulance personnel to the clinical staff. Usually the handover is done to a physician or a nurse in charge. The quality of the handover is highly depending on the participating people and their attitudes. The observations showed that during handover no one is taking notes of the passed information. It seems like the focus is immediately on the patient and his/her current condition. Depending on the severity of the case and the amount of available resources some data is copied from the emergency protocol, i.e. vital signs or administered drugs.

In some organizations the clinical handover is supported by providing a duplicate of the emergency protocol for the hospital. In case the ambulance staff is equipped with an electronic documentation system the protocol is printed and handed over to the clinical

staff. Another approach is to send the protocol in advance to the hospital with the use of fax. The documentation habits and possibilities are described in detail in Section 5.5, *Do the Documentation.*
The handover of the patient has to be confirmed by the clinical staff by signing the protocol. This is done either on the handwritten paper-based protocol or on the touchscreen laptop.

E4 described the necessary handed over information as patient history, current incident or problems, performed treatment at the scene, especially administered drugs, and the trend of the vital signs. If the patient is stable at handover and the vital signs haven't changed during the transport he stated that they might not be relevant to the staff [E4 18:28]. In case of trauma the mechanics of the accident are of great interest. It makes a difference if the patient has just slipped or has fallen from a ladder [E4 19:33]. During the observation it pointed out that if the patient suffers from a head injury the clinical staff always asks about known medication. If the patient is taking blood thinner they are very likely to keep him/her overnight at a station to exclude possible implications, e.g. bleeding.

5.5 Do the Documentation

Documentation is an essential duty in prehospital care, as described in Section 2.3.1, *Legal Situation in Austria.* There is no standardization in Austria which leads to many different approaches, as also pointed out in the interviews. All in all the interview partners described four different systems with which they are working.

The documentation approach is highly depending on the organization. In Lower Austria the Austrian Red Cross uses handwritten protocols, which are described in Section 2.6.1, *Documentation in Austria.* The ambulance staff is guided through the examination by checkboxes and freetext fields. There are no strict regulations how to fill the freetext fields. Most of the teams are writing sentences or keywords to assure a complete documentation of all circumstances, e.g. situation, environment, forces at the scene, changes in condition, reasons for transport decision, possible phone calls with physicians or hospitals, aso. During an informal talk in an observation a paramedic stated that it should be detailed enough to be able to remember the case in the future by reading the passages again. The protocol itself remains at the station and is archived.
It is noteworthy that the freetext field seems to be pretty small when it comes to special cases, such as unclear incidents or mental illnesses. In this case the ambulance staff tends to document very detailed.

The documentation in parts of Styria is very similar. They use a handwritten protocol as well, but are providing by default two duplicates. The original is handed over to the hospital and contains patient information. The duplicates are anonymized and do not contain any patient-identifying information, assuming that the protocol was filled

correctly. One duplicate remains at the station and one duplicate can be used for training issues or taken home by the ambulance staff. In Styria, i.e. Graz, there is a special situation because there are a lot of medicine students active in prehospital care. Therefore the training and education seems to be at a higher level.

The medical unit in Lower Austria uses a web-based electronic system. The physician is able to document with the help of a tablet, i.e. iPad, and to send the documentation to the hospital as a fax. The staff is encountering problems with this approach because it works only with mobile internet connection. If there is no connection, the documentation cannot be done. Furthermore the sent faxes do not always arrive at the correct department beside the fact that not every hospital keeps a device for fax, which represents a rather outdated technology.
E4 pointed out that in his opinion the physician spends too much time in documenting what should better be used for treating the patient [E4 22:13]. The same issues have been witnessed during observations. The physician had obvious troubles in navigating through the system and was focused on the documentation. In another observation the same physician was not distracted anymore by the tablet and focused on the patient. Unfortunately there was not enough time to have an informal talk to get more insights in the changed habit but it seems like the physician was able to improve the handling of the electronic documentation. Furthermore the severity of the emergency might also contribute to the changed handling. Whereas in the first observation the patient was 'just' critical the second patient had a cardiac arrest where the physician had to perform an endotracheal intubation and administer drugs.

In Vienna and in other parts of Styria (i.e. a medical unit in Graz) an electronic system is used, which is also described in Section 2.6.1, *Documentation in Austria*. "MEDEA" runs on special laptops, so called "Toughbooks", which are located in the ambulance units. They are equipped with a touchscreen and a pen to ease navigation through tabs of the system. Furthermore checkboxes can be checked easily. It is possible to insert the e-Card, a smartcard described in Section 3.3, *Austrian Electronic Health Record: ELGA*, and read required patient information, such as patient name, birth date and insurance information. E3 and E7 stated that this helps them a lot in documenting because they just need to ask for the card and have all information available. Furthermore the units are equipped with a mobile printer that allows the ambulance personnel to print the protocol for the target hospital. On clinical handover the clinical staff confirms the takeover of the patient directly at the notebook by signing on the touchscreen.
In some cases, especially cardiac arrest, the protocol is used for candidates in training. Here also the ECG protocol, which can be printed independently from the electronic protocol, is forwarded.

In case an emergency physician is on scene and attends furthermore the transport the documentation of the ambulance staff is not relevant for the hospital. The protocol is completely filled out nevertheless due to the legal duty.

The documentation starts with receiving the alert. Depending on the traveling time and the severity organizational data, such as numbers of staff, number of emergency, date, aso., is already filled out until arrival at the scene.
If enough resources are available the documentation is done directly during the examination by one team member. This is defined as part of role management, which was already described in Section 5.1, *Prepare for the Emergency.* It is the optimal way to be able to capture all conditions and changes. In case there is a threat to life, e.g. cardiac arrest or major trauma, every pair of hands is needed to treat the patient appropriate. The documentation is done after arrival of additional forces and completed after the mission has ended.

In less severe cases the documentation is started at the scene and completed on transport to the hospital or after the mission has ended.

Some units are also equipped with medical devices having an integrated mobile printer, e.g. ECG monitoring device. In this case the measurements and trends of vital signs can be printed, attached to the protocol and/or handed over to the hospital.

The documentation is not only an essential duty, but rather a way to justify the performed treatment. In case of legal consequences the ambulance staff has to be able to provide a reason or indication for the taken actions and decisions. Sometimes the circumstances are complex and it could happen that no medical unit is available, although the patient is critical and would need medical therapy. In this case the ambulance staff has to decide to transport the patient without medical attendance, meet a far away medical unit half-way or wait at the scene, if the condition of the patient does not allow a short transport. It is feasible that the decision has a direct impact on the outcome and therefore a complete documentation is required.

5.6 Additional Findings

Communication is an important asset in prehospital care because acting in stressful situations acquires smooth team work. The habits in communication are depending on the teams and the participating characters. Some people need to communicate a lot, others tend to discuss only most important things. This is partly to be blamed on the individual experience and experience of the teams working together. There are no standards provided by the organizations, but rather informal standards formed within each team.

The definition of roles and role management on scene is also depending on the communication. In every single emergency the roles have been clear for all team members during the observations. It has never been necessary to argue or discuss at scene for responsibilities.

Some teams are discussing the distribution of work on the way to the emergency, e.g. a team member would like to practice the patient handling and therefore takes the part of examination. For others the roles are clear due to their educational and experience level. It is noteworthy that the roles are not strictly defined and depending on the actual situation at the emergency scene the roles can be dynamically changed. Important decisions, such as decision about treatment or transport, is then again discussed and decided with consent of the team.

Ambulance staff is encountering ethical dilemma in their daily work. They have to treat each patient equally, no matter what has caused his/her current condition. And although they act in a human and graceful way they sometimes have to face unfriendly and demanding patients. It seems like some people take ambulance services for granted. On the other hand the observations showed also many thankful patients who have been cooperative. Such cases compensate the exhausting work for ambulance staff and give them support for every day.

Beside the attitude of patients also situations can cause a dilemma as pointed out by E5. He described an example where they have been alerted to a cardiac arrest. On scene it pointed out that the patient is already in palliative care and has little expectancy of life due to a severe disease. In fact until the patient does not show clear signs of death the legal regulation determines to start with CPR which may extend the patient's sorrow if there would be a positive outcome [E5 04:42]. Especially in case of cardiac arrest ethic plays an important role. If the outcome is negative and the patient cannot be resuscitated it has to be assured that relatives can give a dignified goodbye.

In legal regulations also DNR orders ("Do Not Resuscitate" orders) are existing, which may prohibit the treatment. If the ambulance staff is informed about such orders they have to consider and respect them. This could mean that the are not allowed to perform CPR on a dying patient.

5.7 Summary of Findings

The findings satisfy the research goal to identify the needed information at the emergency scene. Furthermore they provide an overall understanding of the daily work in prehospital care by giving the ambulance staff the ability to tell their stories.

There have been two main workflows found that can be analyzed separately. The first begins with receiving the alert text and ends with the arrival at scene. This process is very dynamic and not supported with any guidelines or algorithms. The preparation on the way to the emergency is depending on the severity of the incident and the traveling time. Furthermore the experience of the team working together and their educational level make an impact on the organization of, e.g., resource and equipment management.

The more the team is used in working together and the higher their educational level the less discussion of organizational things on the way to the emergency is needed.

The second workflow starts with arriving at the scene and ends with the transport of the patient to a hospital or health care facility. Prehospital care is a stressful setting embossed with high dynamics. Each patient and each emergency is different and demands remarkable social skills of the ambulance staff. It is obvious that anything that can be structured is supporting the work of the medical personnel, e.g. guidelines. The findings showed that guidelines are not only seen as recommendations but rather followed strictly.

The collected data on scene does not differ for this reason. Independent from the educational level of the ambulance staff the same data is gathered and documented. Differences occur only in using the data which can be explained by the medical background. The higher the medical education and therefore the higher the medical background the more important is the collection of additional data, such as medical history or medication. Medical personnel can interpret and understand this data which might not be possible for non-medical ambulance staff. This was also confirmed during observations by one emergency physician: "That is what I am here for." / "Dafür bin ich ja da.".

Before and during the emergency tactical decisions considering weather, additional forces or environmental circumstances have to be made. The situation on scene can differ from the expected situation indicated by the alert text. Therefore tactical decisions are finally made after arriving at the emergency scene although first considerations are already achieved as part of the preparation. Especially when it comes to additional forces, such as police or firefighters or the availability of the emergency rescue helicopter.

Collected and experienced data contribute to the decision of treatment and transport for medical and non-medical staff. Especially the decision about the need of a specialized department is depending on additional information, e.g. medical history and patient data.

It is noteworthy that the emergency service providers have just little impact on the behavior and the actual workflow on scene although the setting is characterized with high dynamics. The reason therefore can be found in the common used guidelines which seem to represent an easy and nice way to give a stressful situation structure without restricting it.

CHAPTER 6

Design and Model

Based on the findings, described in the previous chapter, it was possible to conduct a flow chart which tries to capture and summarize the workflow of an emergency. Flow charts are commonly used in medical settings to illustrate complex processes in an easy and understandable way. To reduce complexity the emergency is split to two processes, the workflow before arriving and after arriving at the emergency scene.

During literature research it has shown that there is little attention paid to the process starting with the receiving of the alert and ending with arriving at the emergency scene. Whereas there are various guidelines for the actual work on scene. Some of these guidelines, i.e. "ABCDE" approach and "SAMPLE(R)" schema are described based on literature research in Section 2.4.3, *Supporting Guidelines*. This interesting observation was also reflected by the findings. The workflow before arriving at scene is highly dynamic and depending on different conditions, whereas the actual work on scene follows defined guidelines.

After the flow charts have been done an overall understanding of an emergency and the needed information at scene was achieved. Based on the findings and the flow charts the first part of the research question, which data is collected and needed at scene, can be answered. It was possible to further process this data and develop a data model which was compared and mapped to available data fields in ELGA. For this purpose already stored documents in ELGA have been analyzed with the help of implementation guidelines and mapped to the findings from qualitative research [81]. This enables the ability to make a conclusion on the applicability of ELGA to out-of-hospital settings, such as prehospital care. The main discussion of the research question is achieved in Chapter 7, *Discussion*

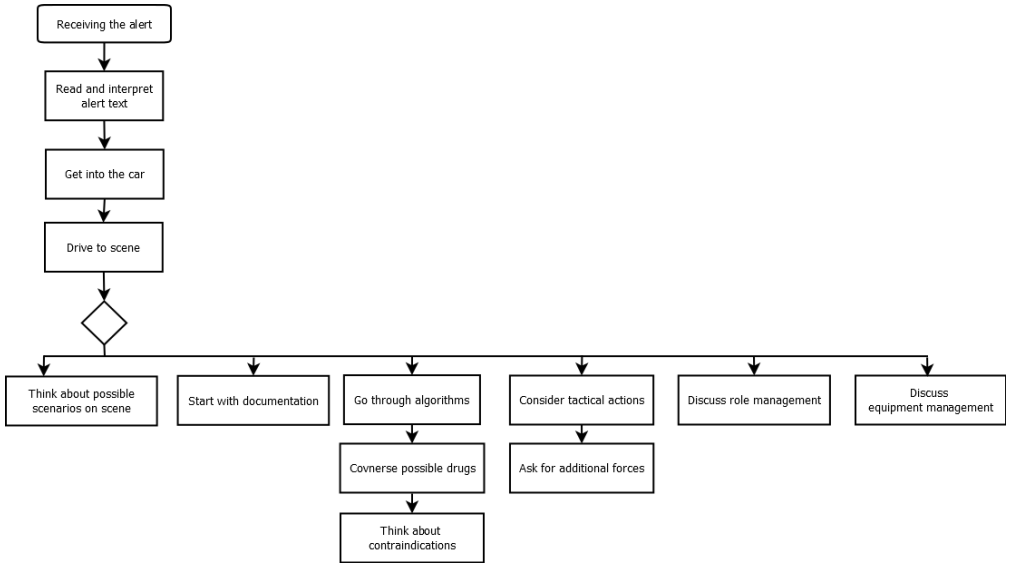


Figure 6.1: Flow chart of the process before arriving at emergency scene

6.1 Modeling of the Process

Based on the findings it was possible to conduct a flow chart, starting with the arrival at the emergency scene and ending with the transport to the hospital. It pointed out that the process before arriving at scene is highly depending on the severity of the emergency and the traveling time. So several actions can be executed in parallel but do not follow a protocol or guidance. In Figure 6.1 an attempt of the modeling of this process is done. It is obvious that this process is embossed with high dynamics and furthermore also not contributing to the patient's outcome.

On the other hand the workflow after arriving at scene is implied by different standardized guidelines and therefore it was possible to derive a flow chart that fits the workflow which is illustrated in Figure 6.2.

As soon as the ambulance staff arrives at scene the environment is analyzed and the decision about additional forces, such as police or fire fighter, is done. The personal safety of the ambulance personnel is essential and for this reason they have to wait until the scene is safe.
If the scene is safe they get a first impression of the patient and start with examining him/her according to the guidelines. The goal is to decide very quickly if the patient is critical or not and if additional forces, e.g. a medical unit, is needed. Therefore the already introduced "ABCDE" approach is achieved and immediate needed actions are set.

Beside the physical examination the ambulance staff tries to find out what exactly

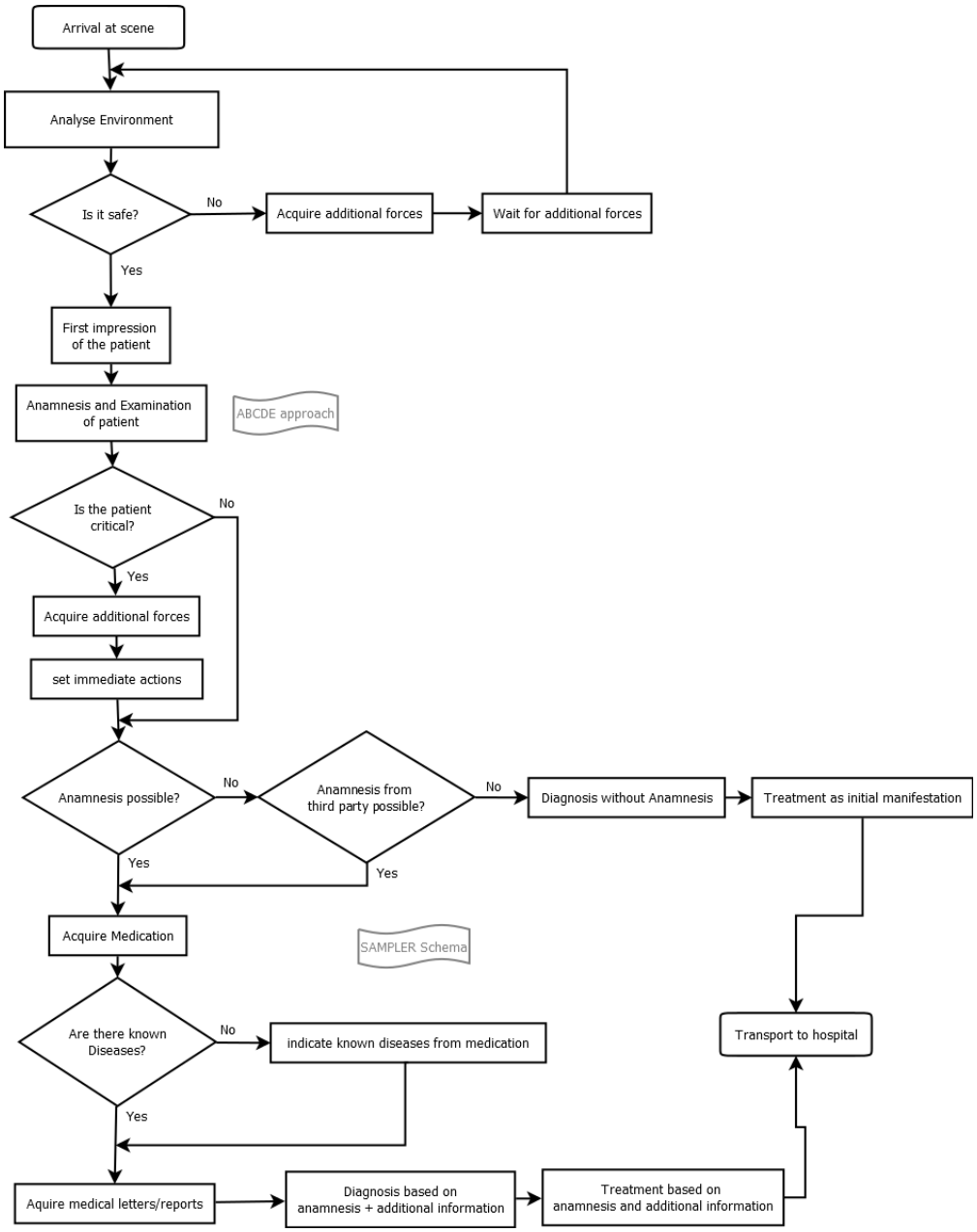


Figure 6.2: Flow chart of the process on emergency scene

has happened to reconstruct the incident. For this matter different possibilities are available: The patient himself/herself or a third party (e.g. relative, friends, bystander) is able to give appropriate information or no information can be collected, e.g. if patient is unconscious without witnesses.
In case it is possible to gather additional information the medication of the patient is of great interest. In this case the personnel asks the patient or relative about known long-term or current medication. As a next step the staff tries to find out known diseases. If the patient doesn't know his/her diseases exactly but has a list of current medication the medical personnel is able to derive the diseases out of the medication. For this reason the medication represents an essential information to the physicians.
If there is time left, the "SAMPLE(R)"-Schema is achieved in detail to check furthermore risk factors and allergies.

If the patient hasn't already provided available medical letters, such as discharge letters from a recent stay, to the ambulance staff, they would ask as a next step for them. It is also feasible that attending relatives are instructed to search for them in order to keep them busy while continuing with the examination.

Based on the collected information during examination and anamnesis the staff achieves a suspected diagnosis and bases the treatment upon it. Furthermore the decision about hospitalization and if a specialized department is needed is done.
In case it is not possible to acquire information the suspected diagnosis, the treatment and the transport is based upon the symptoms and treated as an initial occurrence of the problems.

In fact it pointed out that the process is pretty straight forward and can be modeled in common. The groups differed only in the usage of additional information which is depending on their educational level.

6.2 Designing the Model

The flow chart, illustrated in Figure 6.2, already illustrates the most influencing data on the emergency scene that can have an impact on the patient's outcome. In a handwritten mind map these findings were tried to arrange around the center, which is represented as the patient.
The main findings have been seen as:

- Environment
  The environment needs to be considered in order to make tactical decisions.
- Patient Data
  Here mainly organizational data are of interest, such as patient name, address, age, gender and insurance data.

- Patient History
  This represents the collected information at scene about the incident, e.g. what has happened, symptoms, pain, aso.

- Vital Signs
  This information is measured at the scene.

- Medication
  The current medication is of special interest as well as the potential administered drugs, their conversions and contraindications.

- Medical history
  Usually the forces use medical letters to collect the medical history, e.g. from recent stays at a hospital. Here the reason for the stay, the diagnosis, the treating hospital, performed treatments, DNR orders, allergies, risk factors, aso. have been defined as data if interest.

This list represents the needed and collected information on scene and satisfy the information requirement of the first research aim.

The findings show that the priority and the importance of these data are depending on the emergency and its severity. Some data, especially environmental data, is not explicitly collected but implicitly experienced and contributes to each emergency. The staff always brings in their senses and experience which influence their decisions.
Furthermore patient data always has to be collected in order to assure a smooth handover in the hospital and enable accounting. In some cases personal data of the patient might play an important role for ambulance personnel, e.g. when it comes to risk groups for special diseases. In these cases the age and the gender can lead from pain chest to a heart attack.

In case of trauma patients the medical history, including medication, is of secondary importance because it is not likely to affect the treatment. Whereas incidents of internal medicine require a detailed medical history to assure an optimal treatment of the patient.

The patient history represents the most important information that is collected on scene. It can explain the condition of the patient, lead from the mechanics of an accident to possible injuries or establish the information basis on which decisions can be based on. In most cases it is possible to receive the data from the patient or his/her relatives. Otherwise the ambulance staff has to make conclusions out of the available information.

Based on the data, no matter if available or not, a diagnosis is established and the treatment performed. To be able to fully answer the research question the required data on scene is tried to be mapped to available data fields in ELGA. For this purpose existing ELGA documents are introduced and analyzed in the next section.

6.3 ELGA Documents

ELGA offers the ability to store and access medical documents, such as medical letters or lab findings of a patient. These documents are forming all together an overview of the patient's health and provide valuable information in clinical settings, e.g. information about previous stays in hospitals or health care facilities, information about implications and outcome of former treatments and information about current medication of the patient.

As already introduced in Section 3.3, *Austrian Electronic Health Record: ELGA*, the Health Record is based on documents, which are implemented with international HL7 standards. The company "ELGA GmbH" provides implementation guidelines for health care providers where the documents are defined in detail. Beside the special implementation guidelines for each document a general reference is offered as well which contributes also to the correct implementation of the ELGA documents. All CDA documents consist of a header and a structured body with entries as shown in Figure 6.3.
The underlying HL7 standard structures documents with XML-encoded content fields whereas each used field has a unique code assigned. The used Coding Framework is called LOINC, Logical Observation Identifiers Names and Codes, which is widely used for clinical systems. In order to understand the structure it was necessary to compare it against some LOINC-codes, e.g. "11490-0" is the code for "Discharge summarization note [physician] and represents the basis for the CDA document "Arztbrief" (medical letter) [74]. This enables an easy machine-readable ability to process the data.

In this section special attention is paid to the medical discharge letter and the e-Medication which contain valuable data fields that are put into relation to the findings of qualitative research in order to achieve the research goals.

6.3.1 The Medical Discharge Letter

The document is organized with a defined amount of sections that are mandatory, required or optional. In a first step the logical content of the document was analyzed to identify if it contains relevant information. Figure 6.4 shows an overview of all available sections in the document. The column "Opt" implies the conformity, precisely "M" for mandatory, "R2" for required and "O" for optional. Mandatory fields need to be filled, required fields have to be offered to the user but not necessarily filled and optional fields can also be excluded if not necessary [74].

A possible integration model should be based mainly on mandatory fields because the data is present in any case. If the data is provided not only in mandatory fields also required fields can be considered, whereas it is not guaranteed that these fields contain a value. The content of optional ones is likely to be empty or not even available therefore they should not be considered at all. For this case the sections of interest were analyzed in detail to check if they satisfy the requirements.

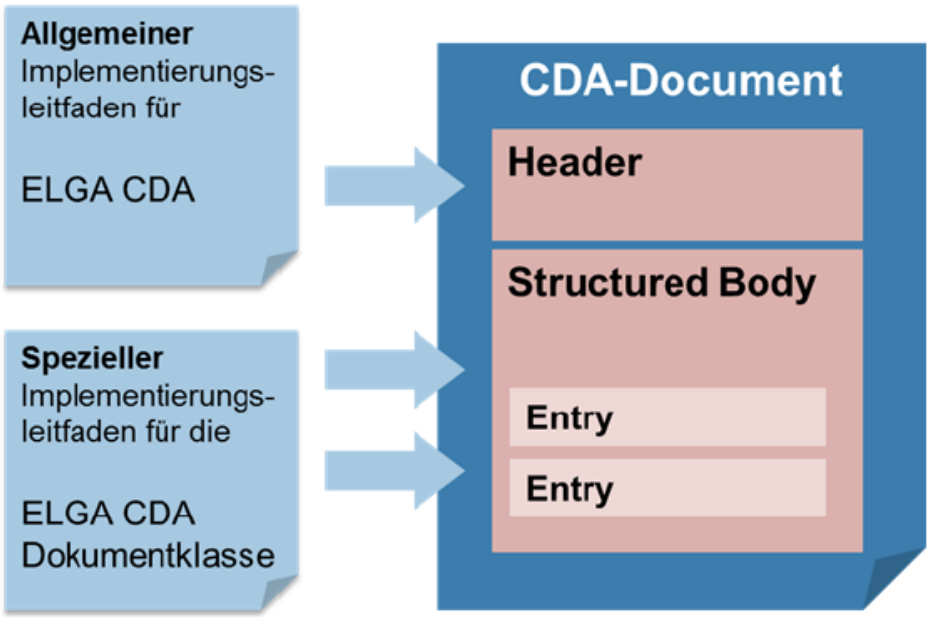


Figure 6.3: Structure of a CDA document [81, ELGA Implementierungsleitfaden Entlassungsbrief(Ärztlich), Chapter 4.1.3.2, p.31ff]

Organizational data, such as patient data, can be collected with the help of the e-Card which is needed in any case for processing of the data. Following sections pointed out to be relevant compared to the findings:

- "Aufnahmegrund", i.e. reason for referral
- "Diagnose bei Entlassung", i.e. discharge diagnosis
- "Durchgeführte Maßnahmen", i.e. performed treatments
- "Letzte Medikation", i.e. last administered medication
- "Empfohlene Medikation", i.e. recommended medication
- "Allergien, Unverträglichkeiten und Risiken", i.e. allergies, intolerances, risk factors
- "Frühere Erkrankungen", i.e. previous diseases
- "Patientenverfügungen und andere juristische Dokumente", i.e. DNR orders

The reason for referral should contain a short summary of the incident and observed problem and symptoms. Furthermore a suspected diagnosis can be stated. This can give a summarized information about the last recent stay of the patient.

Opt	Sektion			Kap	Pos
[O]	Brieftext			4.4.1	1
[M]	Aufnahmegrund		Epikrise	4.2.2	2
[M]	Diagnose bei Entlassung			4.2.3	3
[O]	Durchgeführte Maßnahmen			4.2.4	4
[M][3]	Letzte Medikation			4.2.5	5
[M][4]	Empfohlene Medikation			4.2.6	6
[M]	Weitere empfohlene Maßnahmen. Mögliche Subsections:			4.2.7	7
	[R2]	Termine, Kontrollen, Wiederbestellung		4.2.7.4	
	[R2]	Entlassungszustand		4.2.7.5	
	[R2]	Empfohlene Anordnungen an die weitere Pflege		4.2.7.6	
[O]	Zusammenfassung des Aufenthalts			4.2.8	8
[O]	Abschließende Bemerkungen			4.4.2	9
[R2]	Allergien, Unverträglichkeiten und Risiken		Sekundäre Sektionen	4.3.1	10
[O]	Erhobene Befunde Mögliche Subsections:			4.3.2	11
	[O]	Ausstehende Befunde		4.3.2.4	
	[O]	Auszüge aus erhobenen Befunden		4.3.2.5	
	[O]	Beigelegte erhobene Befunde		4.3.2.6	
	[O]	Vitalparameter		4.3.2.7	
[O]	Anamnese			4.3.3	12
[O]	Frühere Erkrankungen			4.3.4	13
	[O]	Untersektion „Bisherige Maßnahmen“		4.3.4.4	
[O]	Medikation bei Einweisung			4.3.5	14
[O]	Verabreichte Medikation während des Aufenthalts			4.3.6	15
[O]	Patientenverfügungen und andere juridische Dokumente			4.3.7	16
[O]	Beilagen			4.3.8	17

Figure 6.4: Sections of the medical discharge letter[81, ELGA Implementierungsleitfaden Entlassbrief, Figure 2, p.16]

It has shown that there are several sections for medication available, e.g. last administered medication and recommended medication. In case of a transfer to another care facility, which would also require a discharge letter, the last administered medication has to be filled but the recommended medication can remain empty. If the patient is discharged without transferring to another facility it is the opposite, i.e. the recommended medication needs to be filled, but the last administered can remain empty. This represents a huge insecurity due to the missing information. Therefore both sections may need to be considered.

Some relevant sections pointed out to be defined as optional, e.g. performed treatment, previous diseases, allergies and risk factors and DNR orders. In this case it cannot be assured that the information is really available. Depending on the amount of relevant fields classified as optional another source for the data has to be found. Unfortunately it was not possible to assure the availability of data provided by ELGA because these fields are not mandatory in any of the offered documents. Due to the importance of data, such as previous diseases, it was decided to keep the fields in the data model and discuss the implications as part of challenges in Chapter 7, *Discussion*. As a workaround based on currently provided information, the section "Diagnose bei Entlassung" was identified to contain possible valuable information. It represents a list of all found issues, i.e. diagnosis, during the stay. If the section for previous diseases appear to be empty also the discharge diagnose may give appropriate information.

It is noteworthy that the content of all these sections does not follow a defined structure and is depending on the documentation habits of the physicians. They represent freetext fields and even if they point out to be mandatory, the implementation guideline offers default texts, such as "Aufnahmegrund wird nicht bekanntgegeben" in case of the reason for referral. Therefore the quality content of the fields may be low.

6.3.2 e-Medication

In case of medication another useful data source has been found, the so called e-Medication. This module represents a young phase of the roll-out of ELGA, where the pilot has just started in 2016 in parts of Austria.
E-Medication is a list of the current medication of the patient which consists of prescriptions and administered medication. The parties of interest for this document are physicians, hospitals, health care facilities and pharmacies.

A prescription is considered to be depending on a recipe, whereas more than one prescription can be included in the same recipe. The prescriptions are stored in ELGA and can be retrieved from the pharmacies themselves. Furthermore the patients get a printout of the recipe, where a unique ID, the so called "eMED-ID", is provided. The pharmacies are able to change the status of the prescriptions either with the eCard or with the unique ID on the printout. Furthermore a time range in which the recipe is

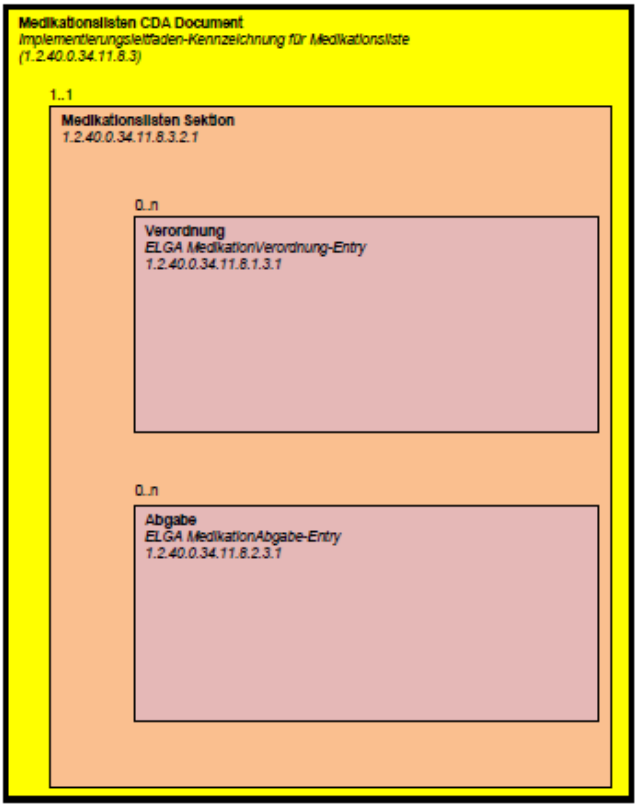


Figure 6.5: Structure of the e-Medication [81, ELGA Implementierungsleitfaden e-Medikation, Chapter 4.2.1.1, p.49]

valid is provided.

Beside prescriptions also administered drugs are collected in the list of current medication. Administered drugs are defined as "over the counter" (OTC, no need to have a prescription), administering of a sample from the physician, belated documenting of already administered drugs or if no prescription is available in ELGA although the patient has a printout.

This document is based upon sections, as well as the discharge letter. In Figure 6.5 the structure of the document is illustrated. It is shown that the sections consist mainly of 0 to n prescriptions and 0 to n administrations. Recipes, which contain 1 to n prescriptions, and Administrations, which contain exactly one drug, are also organized as documents. Beside the list of current medication also a document for a pharmaceutical recommendation is described which was excluded from the analysis due to little relevance.

6.4 The Resulting Data Model

After the development of the mind map and the analysis of available data fields in ELGA it was possible to conduct a data model. The findings of the qualitative research have been mapped to valuable content in ELGA which results in an Entity-Relationship-Model that is shown in Figure 6.10. This section describes step-by-step each logical module of the data model.

The first and furthermore the module of the biggest interest is the mapped ELGA data. Based on the analysis of relevant CDA documents and assigned LOINC-codes the data was successfully set in relation to the achieved findings as shown in this chapter above.

Figure 6.6 illustrates the resulting model of the relevant ELGA data combined with findings. All entities are logically depending on the entity "patient".
The patient has DNR orders, risk factors, allergies, known diseases and medication independent from a possible stay, i.e. case. It was decided to split the provided ELGA field "Allergien, Unverträglichkeiten und Risiken" due to legibility and different contribution to the medical treatment. Allergies can impede the administration of a drug, whereas risk factors are seen as not directly related to the treatment at scene and intolerances aren't even considered in prehospital care.
The identified sections "Aufnahmegrund" and "Durchgeführte Maßnahmen" represent fields that are dependent on a stay or case at a care facility. For this reason they are logically not related to the patient, but rather on the case as part of a medical letter.
The needed information about medication is illustrated as a list of current medication, which is based on the CDA documents of the ELGA module "e-Medication". The provided relationships between recipes, prescriptions, administration and drugs are considered.

Based on the findings of qualitative research also the emergency itself was modeled. For this matter all relevant information, such as the leading symptom provided by the alert, environmental factors, patient history and measured vital signs are considered. An emergency results in a diagnosis which leads to several treatment actions, such as administration of drugs, transport to a specialized department, aso. The treatment is performed according to guidelines. The modeling of emergency data is illustrated in Figure 6.7.

An emergency closes with an emergency protocol which represents a document in which the whole emergency data has to be collected. Furthermore also the medical history is provided within several documents, e.g. medical letters or medical reports. A medical report can be, e.g. a lab finding or medical images, that are on the one hand autonomous' documents and on the other hand often attached to a medical letter, such as a discharge letter. This information depends on a case, e.g. a stay in a hospital or visit at a general practitioner. It was decided to model this logical content on a superficial basis because

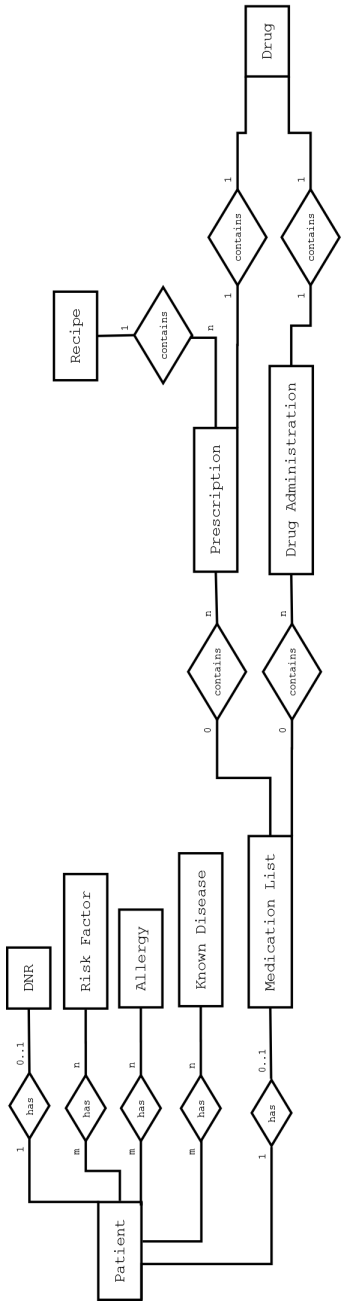


Figure 6.6: Modeling of medical data

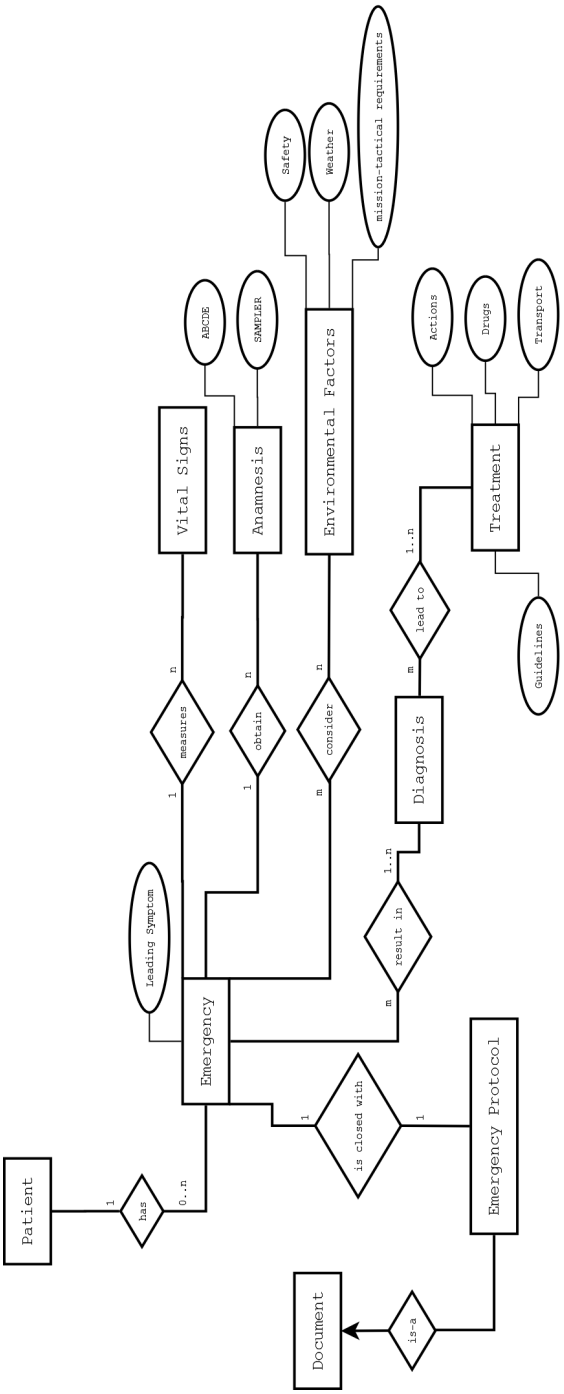


Figure 6.7: Modeling of emergency data

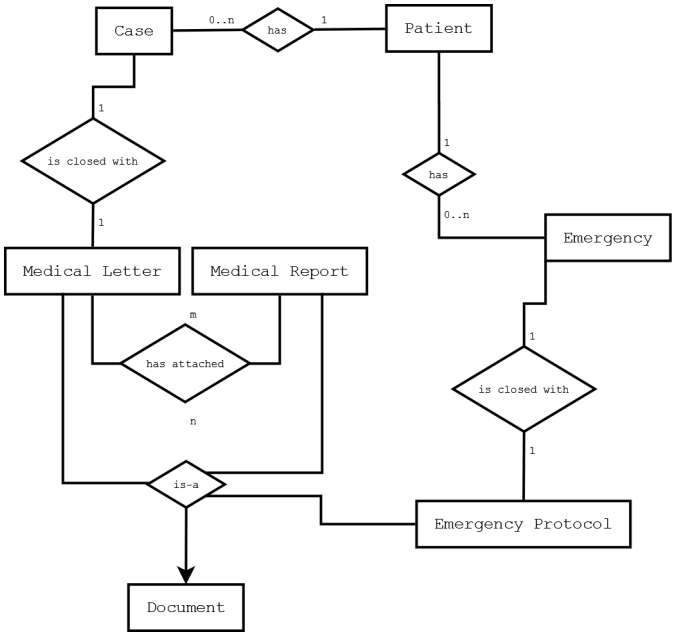


Figure 6.8: Modeling of case data

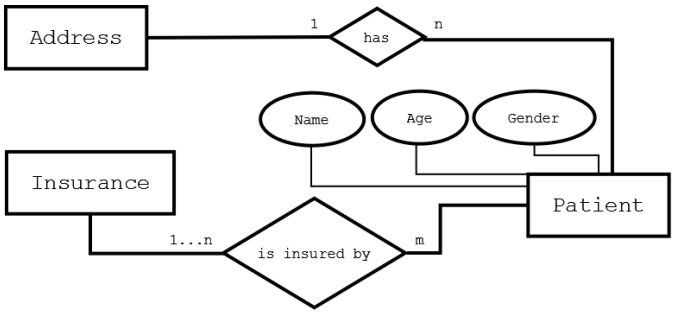


Figure 6.9: Modeling of patient data

the findings provide less information on case management in clinical settings. Figure 6.8 shows the rough data model of the case data.

Beside the medical information also patient data is collected during an emergency, such as patient name, address, gender, age and insurance data. Figure 6.9 models the necessary patient information.

All of these modeled information form the finalized data model which is shown in Figure 6.10 and disussed in detail in the next chapter.

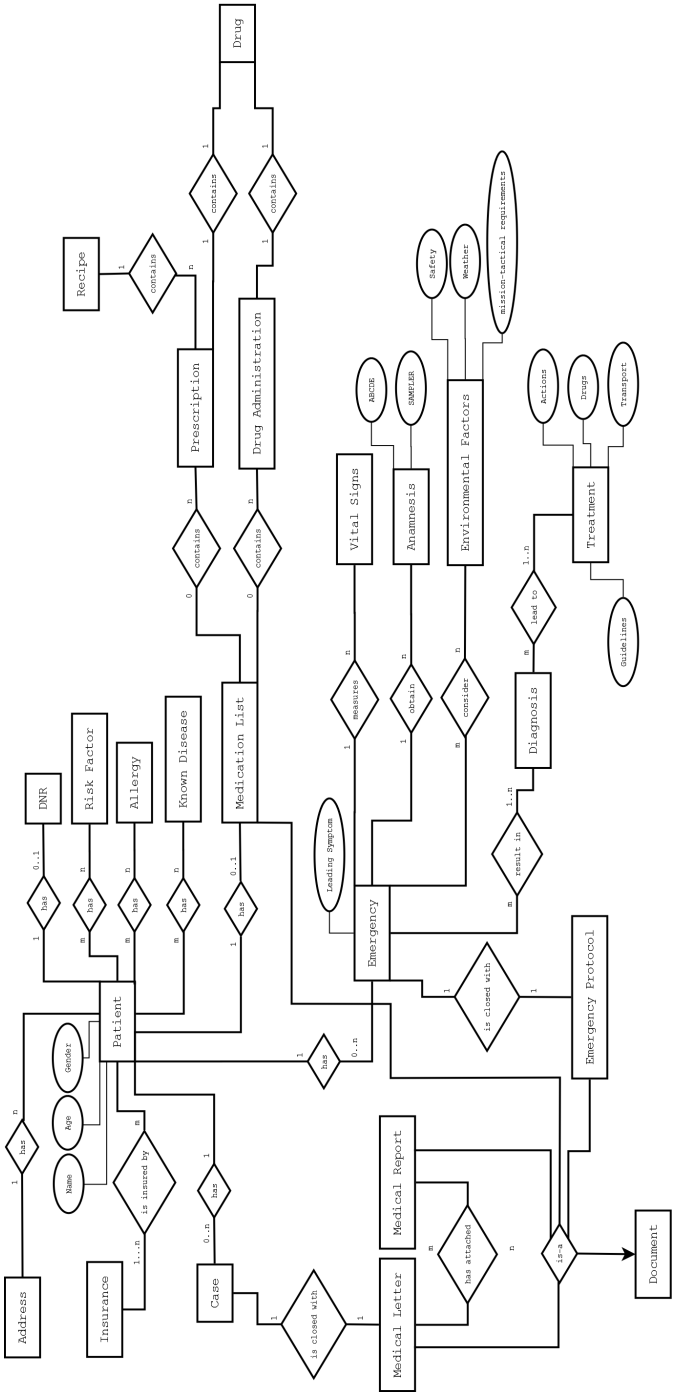


Figure 6.10: Overall data model of needed data on emergency scene

CHAPTER 7

Discussion

This chapter discusses the results of this master thesis and shows current challenges which might require future work.

7.1 Discussion of Results

The first research goal of this thesis is to identify the needed information at an emergency scene, especially in cases when such important information cannot be collected. The findings described in Chapter 5, *Findings*, achieve this goal and provide a deep understanding of the collected data and how it is actually used and processed.

The second aim of this master thesis is to point out whether available data stored in ELGA is suitable to satisfy the information needs in prehospital care. The data model illustrated in Figure 6.10 represents the required information at scene resulting from findings of the qualitative research mapped to available data in ELGA. It can be shown that ELGA is suitable to support several use cases during an emergency, such as providing evidence data for decision-making and preventing the loss of important information after handing over the patient to a hospital or health care facility. The approach is accompanied with several current challenges which are discussed as well.

This section answers the research questions by critically reflecting findings and the resulting data model against existing literature.

7.1.1 Prepare for the Emergency

The preparation for the emergency is depending on different circumstances, e.g. severity of the incident, traveling time and experience of the teams. The findings showed that the

situation on scene can differ from the expected situation indicated by the alert text. This can be blamed to the stressful situation for the caller who is usually not used to call an emergency which was also shown by Culley et al. [20]. For this reason different protocols have been established to give the emergency call structure as shown in Section 2.4.2, *Dispatch Center*. It was not possible to identify differences in the quality of received alert texts that could be blamed to the used algorithm in the dispatch center although the hosting organizations are using different approaches. The findings showed that also using a strict algorithm can result in a different situation on scene as expected.

Supporting the preparation for the emergency by enabling the ambulance personnel to have a look at the medical history of the patient before arriving on scene has led to inconsistencies in the findings. ELGA can potentially provide additional information as part of the preparation, such as medical history or medication of the patient that have been found as needed data. A similar approach was shown by Shirali et al. where medical history of the patient was sent with SMS ("Short Message Service") to the dispatch center in advance to enable the dispatching of appropriate resources [8].

On the other hand 3 out of 7 interview experts pointed out that too much information would narrow their view and might furthermore exclude possible diagnosis in advance. There was no trend of the expert groups visible that would allow a conclusion depending on educational level. Here a more detailed analysis with more experts is needed in order to be able to achieve a qualified statement as a part of future work.

7.1.2 Do the Anamnesis

Prehospital care represents a setting where sharpened senses are an essential asset as well as experience and educational background. It is obvious that these data cannot be provided from an electronic system, e.g. environmental factors, such as situation on scene or current condition of the patient.

Each emergency has its own dynamics and is therefore unique. The used guidelines, introduced in Section 2.4.3, *Supporting Guidelines*, represent a common used way to ease the chaotic situation at scene and give the emergency structure as also pointed out by Kovacs et al. [28].
The findings showed that the ambulance staff follows the guidelines to collect a structured patient history and to be able to decide upon the severity of the incident and whether the patient is critical or not. It pointed out that in almost all observed and described cases the same medical data is collected. Beside the patient data, such as name, address, gender, age and insurance data, the medical history of the patient is of great interest. Here especially current medication and previous diseases influence the decisions of the ambulance personnel.

The data is usually gathered directly from the patient. In case it is not successful

because the patient is not able to give appropriate information the staff tries to talk to relatives or friends nearby. It is feasible that the ambulance staff is not able to collect all needed data. The patient could have simply forgotten about medication or diseases, keep some facts secret, is unconscious or not able to talk.

In almost all cases automatically providing of important information from an information source, such as patient data (name, address, insurance data), medical history (medical letters of recent stays, especially previous diseases, allergies, risk factors, personal declarations, e.g. DNR order) and current medication, would save time at scene, establish clarity and, most important, improve the outcome of the patient.
This data is already available in ELGA in the medical discharge letter and the e-Medication and can therefore improve the decision-making process in out-of-hospital settings. It is obvious that the current visualization of the data in ELGA will not support the ambulance staff on scene. The data has to be preprocessed and structured in a way that the most important information is visible at one single overview.

Moreover it will not be useful to introduce a new electronic system but rather to integrate ELGA data to existing approaches, e.g. MEDEA. By accessing the e-Card of the patient the patient data is already loaded and put to the electronic protocol. All important additional data, such as medical history and medication, could be requested as well and put to specified fields in the protocol. In this case the staff would not have to learn a new system or change their habits what results in less effort for training and high acceptance of the ambulance staff.

A similar successful approach was shown by Helm et al. who aimed to keep the times for training and rejections to the new system low by introducing the digital pen [60]. Especially in clinical settings, such as preshospital care, the time for training and learning is limited what is also pointed out by Sarcevic et al. [58].

7.1.3 Do the Treatment

The border between collecting patient history and treating the patient is blurred. The introduced guidelines require immediate action in case of problems during the examination.

The findings showed that the collected data contributes to the decision of diagnosis, treatment and transport. Especially medical personnel is interested in treating the root cause of the observed problems and for this reason a complete medical history is needed.

7.1.4 Do the Transport

In some cases a transport to a specialized department is needed. This decision has to be achieved with an enormous amount of time pressure because in severe cases, such as

stroke, heart attack or major trauma, the patient has to get appropriate clinical therapy before elapsing of the golden hour [9]. After this time frame the mortality of the patient is increasing rapidly.

The decision is based on the collected data and influences directly the outcome of the patient. Furthermore the ambulance staff tends to inform the hospital in advance about the arrival in order to give the emergency department enough time to establish resources what is also confirmed by Anantharaman et al. [1]. There is no efficient way existing to establish a link between the ambulance and the hospital although there are many approaches, such as mobile printers, handing over copies or sending the protocol in advance to the hospital via fax. This is also shown by Helm et al. in various publications [[46], [47], [48]].

This gap could be filled with the help of ELGA. Beside supporting the ambulance staff with appropriate medical data of the patient to establish a diagnosis and execute a proper treatment, the emergency protocol could be an integral part of ELGA. It could be organized as another document which is stored directly in the health record of the patient and is accessible by the clinical staff. In this case all performed actions, administered medication or documented anomalies during emergency or transport are transparent to the hospital in advance.

This approach would also ease the clinical handover, which is usually a verbal, non-structured action. During the observations it has shown that the clinical staff is not likely to take notes while the ambulance staff describes the emergency. Sarcevic et al. pointed out that information will get lost in emergency departments if it is not documented properly during clinical handover [55]. Furthermore she showed that lost data during handover might be needed at a later point of treatment [37].

Although the clinical handover is a non-structured action, an invisible and non-evident structure emerged during the research. Patient data, current incident, collected patient history and performed actions are reported during all handovers. Sarcevic et al. confirmed this findings and pointed out that in trauma departments the patient history is less important and therefore provided in a superficial manner. On the other hand she concedes that this information could contribute to the patient's outcome during clinical therapy [37].

The clinical handover represents an important action that has a direct impact on the patient outcome as shown by Wood et al. [3]. Therefore it should be a major goal of emergency services to give this verbal action structure. The observations showed that the quality is highly depending on the participating people and their attitudes. Providing the emergency protocol as a part of ELGA could help to overcome the information gap and support the clinical handover.

7.1.5 Do the Documentation

Section 2.6, *Documentation in Prehospital Care*, already points out that documentation is an essential legal duty in prehospital care. To satisfy the documentation requirements different approaches are existing, such as handwritten protocols or electronic systems.

The ambulance staff has to examine and treat the patient beside providing an appropriate documentation before arriving at the hospital. The patient has to be monitored during the transport in order to be able to react in case of critical changes of the condition of the patient. Electronic documentation system can satisfy the documentation needs and save time on scene and during transport by bringing in new technologies and features, such as automatically capturing of vital signs as shown by Gao et al. [61]. Deckelbaum et al. furthermore pointed out that capturing the trend of vital signs and giving an alert in case of critical changes can reduce the mortality of the patient [54].

The findings showed that the medical devices already have nice features to document, e.g. the trend of vital signs or administered drugs. It furthermore pointed out that this features are not used frequently because the handling of different systems is not possible in prehospital care. Coping with different systems, e.g. handwritten protocol and electronic medical monitoring device, is not suitable in such a stressful setting. The need of a complete documentation and communication system is obvious and indispensable for providing optimal care.

Moreover the use of electronic systems have to ease and not impede the work. The observations showed that just the introduction of an electronic system will not overcome documentation issues what is confirmed by Katzer et al. and Kuisma et al. [see also [41], [59]].

7.2 Related Work

The importance of medical history is also shown in various literature, e.g. sending medical history with the help of SMS (Short Message Service) to the dispatch center in order to give emergency services all information they need to consider in advance [8].
Furthermore another qualitative research in Austria confirmed the findings of this thesis, where a paramedic pointed out that it would be very useful to have ELGA data available during an emergency [82].

At the time of the thesis there is only little literature available about related approaches to introduce Electronic Health Records in prehospital care. Germany has made the first step in providing additional information by saving a minimum emergency data set, ”Notfalldaten”, on the German Electronic Health Record that is accessible over a smart card (so called ”elektronische Gesundheitskarte eGK”) [83].

The minimum data set consists of following information [84]:

- **Medical Data of the patient**
  Medical data based on the existing minimum data set MIND is provided.
  - Diagnosis (i.e. Known Diseases)
  - Current Medication
  - Allergies and Intolerances
  - Special Notes (e.g. pregnancy, implants)
  - Additional Information (e.g. blood group)
- **Personal Declarations of the patient**
  In this case only the existence of a legal regulation and its whereabout is stored. There is no information provided about the content.
  - patient decree
  - organ donation regulations
  - health care proxy regulations

The overlapping of data compared to the results of this thesis, especially to the data model shown in Figure 6.10, is obvious. Known Diseases, Current Medication, Allergies and legal documents, such as DNR orders, represent the most important information needed on the emergency scene. Moreover are additional information, e.g. blood group, and special notes about the patient made available that can have an impact on the clinical therapy.

The introduction of the "Notfalldatenset" addresses three main scenarios [84]:

- prehospital emergency care
- unscheduled administration of a patient in an emergency department
- unscheduled emergency care of outpatient patients

Therefore physicians in emergency departments and in prehospital care are the main actors as well as paramedics, i.e. "Rettungsassistenten", in Germany.

The working concept of the German Medical Association explains the use case in prehospital care as the physician receiving relevant data on the emergency scene with the help of a mobile reading device. The information about known diseases and current medication can influence the decision about treatment and transport [84, Arbeitskonzept NFDM, p. 10]:

> Auslesen der notfallrelevanten medizinischen Informationen durch Notarzt, der sich mit Notarztwagen bei der Versorgung eines verunfallten Motorradfahrers auf der Autobahn befindet. Die notfallrelevanten medizinischen Informationen werden mit einem mobilen Lesegerät ausgelesen, angezeigt und zu Dokumentationszwecken (spätere Übernahme in Primärsystem oder Ausdruck) zwischengespeichert. Der Arzt informiert sich über Vorerkrankungen und eingenommene Medikamente, die die Akutversorgung des Polytrauma-Patienten oder die Wahl des Transportziels beeinflussen könnten.

It is visible that the reasons to introduce the "Notfalldatenmanagement" (hereinafter abbreviated to NFDM) are reflected independently by the qualitative research of this thesis. It was already shown in Chapter 5, *Findings*, and Section 7.1, *Discussion of Results*, that the decision about treatment and transport is highly related to additional information, such as current medication and known diseases.

Schenkel et al. showed 2015 that physicians are often faced with missing medical history of a patient. The availability of a minimum data set, that gives a summary of the required medical data of a patient, was appreciated by an overwhelming amount of interviewed physicians and paramedics. Figure 7.1 illustrates the evaluation of the benefit of data during different scenarios. The overall value of the concept was evaluated by experts as well as the single data fields. It pointed out that "Known Diseases" and "Current Medication" represented the data fields of highest relevance. Furthermore it is noteworthy that all interviewed physicians in an emergency department, 92,8 % of interviewed physicians in emergency services and 88,9% of interviewed paramedics rated the concept of providing a minimum amount of medical information as "(very) valuable". [85]

The introduction of the NFDM has just started in Germany by creating entries in the German Electronic Health Record. At the time of the thesis the outcome and usage in prehospital care will be available during the next years and should therefore be considered as part of future work.

7.3 Current Challenges and Future Work

The most obvious challenge of the approach to introduce an EHR to emergency services is the lack of standardization in prehospital care. Due to the fact that the legal regulations are in the responsibility of the federal states it is not possible to provide an overall satisfying approach. The introduction of an Electronic Patient Record is nevertheless already done in some parts of Austria as shown in the findings. To assure a smooth continuing workflow it should be aimed to include the data of ELGA directly to the electronic documentation system and combine providing of data and documentation. By inserting the smart card, i.e. e-Card, the relevant data can be read and put to specified

TABELLE

Bewertung mit „großer Nutzen“ oder „sehr großer Nutzen“*

	Ärzte Notaufnahme N = 14 (in %)	Notärzte (präklinisch) N = 14 (in %)	Rettungsassistenten N = 9 (in %)
Beurteilung des Gesamtkonzepts Notfalldaten auf der eGK	100	92,8	88,9
Beurteilung im jeweiligen Studienszenario	70,7	75,4	79,4
Beurteilung einzelner Datenfelder (in %)			
Diagnosen	69,6	75,4	77,7
Medikamente	75,6	70,8	73,0
Allergien und Unverträglichkeiten	46,2	12,5	40,0
Implantate	69,9	63,8	37,5
Besondere Hinweise	41,8	36,2	38,4

*Auf einer Skala mit den Ausprägungen „sehr großer Nutzen“, „großer Nutzen“, „mäßiger Nutzen“, „geringer Nutzen“, „kein Nutzen“

Figure 7.1: Evaluation of the benefit of providing a minimum emergency data set [85, p. 868]

textfields. In this case the staff don’t even have to change the device or system to get the appropriate data.

Beside the receiving of relevant medical data of the patient the emergency protocol could also be a document in ELGA. This would assure a standardized documentation, ease the processing of data and increase the transparency of therapy.

Austria has set the first steps into a sustainable future with the introduction of the Electronic Health Record, ELGA. The concept is still emerging and the acceptance of medical personnel needs future work to establish the correct usage of the Austrian EHR. The patient’s outcome will only improve if the medical staff takes advantage of the features and not uses the EHR just for documenting [64]. The awareness has to be established and acceptance management needs to be forced. Informal talks during observations with ambulance staff showed that they are not likely to reject ELGA in prehospital care. The need of additional information to decide upon diagnosis, treatment and transport is a fact. Providing this data from an external data source was positively welcomed and seen as highly supportive to improve the patient’s outcome.

Another aspect pointed out to possibly impact the use of ELGA as ELGA does not act as a decision support system because no background checks are done. The module ”e-Medication” puts the responsibility for prescribing drugs and considering possible contraindications on the physicians. More sophisticated approaches, e.g. in the Scandinavian countries, show the possible integration of decision support systems to electronic systems

that improve the patient outcome and assure the optimal treatment.

Due to the underlying CDA structure it is possible to uniquely identify a content field unique what allows an easy integration. The content fields in ELGA are described very superficial with the help of LOINC-Code descriptions. As an example the definition of the ELGA content field "Discharge Diagnosis" is compared to the NFDM content field "Diagnosis".
The description of the LOINC-Code "11535-2", which represents the used content field, is done as follows [86]:

> Hospital discharge diagnosis describes the patient's relevant problems or diagnoses that occurred during the hospitalization or that need to be followed after hospitalization.

Whether the LOINC-Code description nor the ELGA implementation guideline requests a specific format, but rather classifies it as a free text field.

On the other hand the working concept of the NFDM suggests to use a standardized coding system, i.e. ICD-10 (short for " International Statistical Classification of Diseases and Related Health Problems" in Revision 10). Beside the name of the diagnosis furthermore additional fields are required, such as additional marker (e.g. type of diagnosis), localization of the diagnosis (e.g. left, right or both sides) and the time of diagnosis [84, Arbeitskonzept NFDM, p. 22ff]. This assures a structured collection and furthermore more easy processing of relevant data.

For this reason the quality of ELGA data can be low and furthermore may also need to be preprocessed to give the data equal structure. Unstructured data is not suitable for prehospital care where the staff is under high time-pressure. Furthermore it cannot be guaranteed that optional data fields contain valuable information.

At the time when this thesis was conducted the rollout of medical letters was done in approximately 20% of available health care facilities in Austria [1]
There is little literature research on the outcome of the use of ELGA and furthermore on the actual handling of medical letters.

ELGA provides a powerful data collection where lots of data is available. The legal basis, described in Section 3.2.2, *Legal Basis*, is not clear about a possible usage in out-of-hospital settings, such as prehospital care. The expert interview with the company "ELGA GmbH" pointed out that the use case was not considered because it seems not to be relevant. It is obvious that an integration scenario requires legal regulations on the usage of sensible personal data and this approach might represent a start point to initiate discussions and to develop new standards.

[1] There are appr. 300 health care facilities available in Austria [87] and the rollout was done in 60 [73].

Establishing a legal basis is suggested to be the next step for providing a complete documentation and communication system in prehospital care. Processing of sensitive personal data in out-of-hospital settings is a legal grey area and needs to be discussed and defined. Furthermore a concrete implementation is part of future work and has to be evaluated with several expert groups in iterations. The expert groups should be staffed with specialists in prehospital care, data privacy, user experience, development and ELGA. The use case of a complete electronic documentation and communication system has to be discussed as well as the potentially supporting role of ELGA.

The second step should be a detailed analysis of the content in ELGA and moreover establishing coding standards for documenting to avoid effort in preprocessing of data.

Based on the work in Germany the introduction of a separate module for emergency data should be considered as well as the introduction of the emergency protocol as a separate document in ELGA. These approaches can fill the verifiable information gap during the emergency and clinical handover.

The findings represent a current status and the data model might be outdated with future work of ELGA. Furthermore no special attention was paid to the technical issues in this thesis. A possible integration might also need further investigations and designing of interfaces.

CHAPTER 8

Conclusion

This master thesis deals with the daily work of ambulance staff in prehospital care. The required data on scene has been analyzed and structured in order to be able to set it into relation to available data fields in ELGA. Moreover the application of ELGA in prehospital care was discussed and challenges were shown.

The need of a complete electronic documentation and communication system in prehospital care is obvious and indispensable. Providing assistance and rescue services is an essential corner stone of our daily life and should therefore operate at highest quality standards.

The medical devices are already equipped with automatic features to ease the workflow but are not frequently used due to the lack of a complete electronic system. The whole workflow during an emergency, including trend of vital signs or administration of drugs, could be captured by the medical devices and automatically put to the electronic protocol. This would ensure a complete documentation on the one hand and provide the ambulance staff the ability to keep their hands and focus on the patient and not on the documentation on the other hand.

Available information in ELGA can serve several use cases, e.g. by providing medical information of the patient to the ambulance staff and assuring evidence-based decision-making. Moreover the emergency protocol can be stored in ELGA to support the clinical handover and avoid the loss of information during the verbal action.

The related work confirms independently the research of this thesis and shows the importance of providing additional patient data in stressful situations. Diagnosis, treatments and transports are depending on a completely captured picture of the incident and should be based on evidence data. Making use of a powerful data collection, such

as ELGA, would overcome the information gap during the emergency and moreover during and after the clinical handover. A complete documentation improves the outcome of the patient and furthermore has the potential to save costs in avoiding unnecessary examinations and providing the optimal treatment to the patient.

ELGA is a rather young concept which could support developing of new standards in prehospital care. It could help establish a new way of efficient documentation which might increase the quality of emergency services by reducing the time spent on the emergency scene, providing evidence data to the ambulance staff and giving them the ability to focus on the patient by automatically capturing important medical data during emergency and transport and moreover bringing transparency to a very dynamic process.

List of Figures

List of Tables

Bibliography

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Glossary

ALS: Advanced Life Support

AMPDS: Advanced Medical Priority Dispatch System

ATLS: Advanced Trauma Life Support

BLS: Basic Life Support

CDA: Clinical Document Architecture

CPR: Cardiopulmonary Resuscitation

DIVI: Deutsche Interdisziplinäre Vereinigung für Intensivmedizin

DNR order: Do-Not-Resuscitate order

DOC: Microsoft Word Document

ECG: Electrocardiogram

eGK: elektronische Gesundheitskarte

EHR: Electronic Health Record

ELGA: Elektronische Gesundheitsakte

EMT: Emergency Medical Technician

ENT Department: Ear-Nose-Threat Department

EPR: Electronic Patient Record

FNA: Fachspezifische Notaufnahme

GP: General Practitioner

HL7: Health Level Seven

INA: Interdisziplinäre Notaufnahme

LOINC: Logical Observation Identifiers Names and Codes

MIND: Minimaler Notfalldatensatz

NAW: Notartzwagen

NEF: Notarzteinsatzfahrzeug

NKA: Allgemeine Notfallkompetenz Arzneimittellehre

NKI: Besondere Notfallkompetenz Intubation und Beatmung

NKV: Allgemeine Notfallkompetenz Venenpunktion und Infusion

PDF: Portable Document Format

RIM: Reference Information Model

RTW: Rettungswagen, emergency unit

SanG: Sanitätergesetz

SMS: Short Message Service

TETRA: terrestrial trunked radio

WHO: World Health Organization

XML: Extensible Markup Language

ZNA: Zentrale Notaufnahme

Appendix

A: Interview Guideline

Interview – EHR in der Präklinik

1. Vorstellungsrunde
2. Erklärung des Projektes
3. Erklärung des Interviews
4. Einverständniserklärung

Interview:

Kurze Vorstellung des Interviewpartners

Aim 1: Daten am Einsatzort

Welche Daten erhebst du als erstes, wenn du an einen Notfallort kommst?
Benötigst du all diese Daten auch für deine Diagnose und Therapie? (Lehrmeinung vs. was wirklich ausschlaggebend ist)
Welche Daten würden deine Diagnose und Therapie verändern?

Aim 2: Fehlende oder falsche Daten am Einsatzort

Kannst du dich an einen Fall erinnern, bei dem du die notwendigen Daten am Notfallort nicht erheben konntest? Was hast du da dann getan?
Wie hast du die Entscheidung zur Therapie getroffen?
Glaubst du, dass das Wissen über die fehlenden Daten deine Entscheidung beeinflusst hätte?
(Beispiel: Bewusstloser Patient, sollte dem Interviewpartner nichts einfallen oder konkretes Beispiel mit Vorher-Nachher Informationen)
Kannst du dich an einen Fall erinnern, bei dem der Patient wichtige Informationen

zurückgehalten hat bzw. Falschinformationen gegeben hat?
Glaubst du, dass das Wissen über die fehlenden Daten deine Entscheidung beeinflusst hätte?
(Beispiel: Zurückhalten von Risikofaktoren, die stigmatisierend und peinlich für den Patienten sind, sollte dem Interviewpartner nichts einfallen)

Aim 3: Vorbereitung auf Einsatz

Was passiert in dir nach der Alarmierung? Welche Gedanken hast du auf dem Weg zum Einsatzort?
Hättest du Zeit dir gezielte Informationen über den Patienten anzusehen?

Aim 4: Dokumentationsverhalten

Zum Abschluss würde ich noch gerne etwas über deine Dokumentationsgewohnheiten erfahren. Arbeitest du mit einem elektronischen System?
Wie dokumentierst du deine Einsatzdaten?
Kannst du mir zeigen, wie du dokumentierst?

B: Consent Form

TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

Einverständniserklärung

Im Rahmen der Diplomarbeit „EHRs in prehospital care“ werden Experteninterviews geführt, die ein tieferes Verständnis der Bedürfnisse an die Dokumentation und das Dokumentationsverhalten in der Präklinik vermitteln sollen.

Das Interview wird mit einem Aufnahmegerät in Ton aufgezeichnet und nachträglich durch die Interviewleiterin in Schrift gebracht. Alle erhobenen Daten werden vertraulich behandelt und nicht an Dritte weitergegeben. Die Daten dürfen ausschließlich für die Zwecke der Diplomarbeit verwendet werden.

Für die Auswertung der Daten werden alle personenbezogenen Daten anonymisiert und somit auch in der Arbeit nicht explizit verwendet. Dazu zählen vor allem persönliche Angaben zu dem Interviewpartner oder vertrauliche Patientendaten. Die Arbeit beinhaltet keine Hinweise auf persönliche Daten, die den Interviewpartner oder Patienten identifizieren könnten.

Das Interview kann an jeder Stelle abgebrochen werden. Weiters kann auch nachträglich die Streichung von Passagen bzw. Löschen des Interviews verlangt werden. In diesem Fall dürfen die Daten nicht für die Arbeit verwendet werden. Dies kann ohne Angabe von Gründen per Mail oder telefonisch veranlasst werden und hat von der Interviewleiterin umgehend zu erfolgen.

Ich, _____, erkläre mich bereit, im Rahmen der Diplomarbeit „EHRs in prehospital care“ der TU Wien an dem oben beschriebenen Interview teilzunehmen. Ich habe die Zielsetzung und die Verwendung meiner Daten verstanden und stimme der Verarbeitung zu.

_____
Ort, Datum, Unterschrift Interviewpartner

_____
Ort, Datum, Unterschrift Interviewleiterin

Kontaktdaten der Interviewleiterin:

Katharina Rohrer, BSc MSc
Technische Universität Wien

C: Sample Interview

Interview E4

Interviewer: I
Expert: E4
Length: 25:14 minutes

I [00:00]: Stell dir vor, ein ganz normaler Arbeitstag. Du fährst zu einem Einsatz hin. Welche Daten erhebst du? Was interessiert dich als erstes?

E4 [00:12]: Prinzipiell abhängig vom Notfallgeschehen, klarerweise. Also bei einem Traumageschehen sind natürlich ganz andere Dinge im Vorfeld wie wenn es jetzt ein internes Problem ist. Beim Traumageschehen, sag ich mal, sind es.. also Ursache, was ist der Notfallhergang, also auch wieder eine Unterscheidung, ob das jetzt ein, keine Ahnung, Sturz von der Leiter, weil, weiß ich nicht, unachtsam. Oder aber auch Sturz von der Leiter, weil, keine Ahnung, Synkope. Das ist natürlich auch, dass man da mal ein bisschen eine Erhebung hat.
Um dann weiter herauszufinden, was ist eigentlich das ursprüngliche Problem von dem Ganzen. Und dann halt, im späteren Verlauf halt, natürlich auch in Dauermedikationen hineinzukommen oder diese halt herauszufinden und dann vielleicht eben Herzprobleme, bla bla bla, diese ganzen Vorerkrankungen, im Sinne von internistischen Geschichten, halt einfach herauszubekommen und diese zu erheben. Im Grundsätzlich internistischen Notfall sind primär eigentlich nur die Vorerkrankungen interessant und entsprechend halt die Medikation dazu.

I [01:48]: Ist das das erste, das du erhebst, wenn du zu einem internistischen Notfall hinkommst?

E4 [01:50]: Naja, Vitalparameter, natürlich, die sind sowieso einmal primär das ganz Erste. Klarerweise, Blutdruck, Puls, allgemeines Befinden aktuell und natürlich "Was ist passiert" bevor...

I [02:06]: Also eigentlich ein bisschen die Anamnese.

E4 [02:07]: Ja.

I [02:08]: Hast du schon einmal einen Fall gehabt, wo du die Anamnese oder diese Informationen nicht vom Patienten bekommen hast können?

E4 [02:13]: Ja, also meistens.. zum Glück sind dann im Normalfall die Angehörigen da, ansonsten wäre es auch ein bisschen schwierig, dass man überhaupt hinkommt. Weil irgendwer muss anrufen. Wir haben aber auch schon das Problem gehabt, einmal haben

wir es gehabt, dass wir hingekommen sind und öffentlicher Platz, das heißt keine Angehörigen, dann wird es extrem problematisch, wenn der Patient keine Auskunft geben kann.

I [02:34]: Was war da?

E4 [02:36]: Der war bewusstlos, unklare Ursache. Also ursprünglich unklare Ursache. Dürfte dann, also offensichtlich bei der Erhebung oder der Anamnese, die man dann halt auch ohne Kommunikation durchführen kann, dürfte es eine Hirnblutung gewesen sein. Gut, Grundursache kann man dann natürlich nicht herausfinden..

I [03:00]: Wie seid ihr dann auf die Diagnose gekommen?

E4 [03:02]: Pupillendifferenz.

I [03:05]: Das heißt, ihr habt den neurologischen Status erhoben?

E4 [03:08]: Genau. Da ist halt die Abklärung, wenn er nicht mit dir redet, primär mal die Pupillen interessant. Die waren ungleich. Nachdem der Patient nicht allzu alt war, ist der 'Graue Star' auszuschließen. Das heißt, es war dann ziemlich sicher eine Blutung. Aber ansonsten muss ich gestehen, haben wir das Problem noch nicht gehabt.

I [03:29]: Das heißt, wenn der Patient nicht selbst in der Lage ist, ist immer irgendein Angehöriger da, das heißt du hast irgendeine Fremdanamnese, oder zumindest..

E4 [03:36]: Zumindest jemand, wo man die Vorerkrankungen rausfinden kann.

I [03:38]: OK. Glaubst du, dass in dem Fall mit der Hirnblutung, dir ein Wissen über Vorerkrankung oder irgendwas geholfen hätte? Oder sagen wir, hätte es..

E4 [03:45]: Hätte es einen Unterschied gemacht? (I: Ja!) Glaub ich, ehrlich gesagt, nicht wirklich.

I [03:48]: Das heißt, du hättest in dem Fall, selbst wenn du...

E4 [04:02]: Selbst wenn man es gewusst hätte, dass er Blutverdünner nimmt, (I: Ja, genau) oder was auch immer, was ja natürlich ein Grund sein könnte, glaube ich, wär man nicht viel schneller draufgekommen, was es jetzt ist.

I [04:14]: Hätte es etwas an den Maßnahmen und der Therapie geändert?

E4 [04:17]: Hmm.. Nein.

I [04:19]: Also die wäre gleich geblieben.

E4 [04:21]: Die wäre gleich geblieben. Weil intubiert, beatmet, Intensiv, Chrirurgie..

I [04:30]: Glaubst du, hätte es für den Notarzt etwas geändert? Weil er mehr Informationen gehabt hätte, zB. Blutverdünner, sagen wir, darf ein anderes Medikament nicht bekommen, Kontraindikation?

E4 [04:32]: Gibt es zum Glück auch eigentlich keine bei den Notfall... Also speziell jetzt bei der Intubation hätte es sowieso keine gegeben. Nein, hätte keinen Unterschied gemacht in diesem Fall.

I [04:51]: Wo habt ihr den Patienten dann hingefahren?

E4 [04:52]: Wo haben wir den dann hingefahren... Na, ich weiß es nicht. Da bin ich am RTW gesessen.

I [04:58]: Achso, hat den der NAW selbst transportiert?

E4 [04:50]: Ja. Weiß ich gar nicht, wo die dann hingefahren sind.

I [05:02]: Wo hättest du ihn hingefahren?

E4 [05:03]: Es wäre irgendeine Neurochirurgie gewesen, also AKH wahrscheinlich, oder ähnliches.

I [05:12]: Also aufgrund der Anamnese, die du gemacht hast, obwohl keiner da war.. das heißt, du hast dir den Patienten angeschaut, hast die Pupillen, den neurologischen Status erhoben und aufgrund dessen hast du gesagt, es muss irgendwas mit Hirn, Kopf sein. (E4: Genau) Hat der irgendwelche äußeren Verletzungen...?

E4 [05:29]: Nein, also äußere Verletzungen offensichtlich waren keine da, nein.

I [05:32]: Also ihr seid dann auch davon ausgegangen, dass der einfach umgekippt ist.

E4 [05:36]: Genau.

I [05:36]: OK. Und aufgrund des neurologischen Status seid ihr dann auch von keinem Herzinfarkt ausgegangen?

E4 [05:40]: Nein. Da hätte auch das Alter nicht dazugepasst.. Also theoretisch ist alles möglich, das wissen wir mittlerweile auch. Aber es hätte das Alter prinzipiell nicht dazugepasst und er war nicht übergewichtig. Also er wär nicht in diese typische

Zielgruppe hinein gefallen für Infarkt-Geschichten.

I [05:55]: Also du hast das eigentlich von Haus aus..

E4 [05:57]: War das eigentlich primär nicht. Und durch das, dass er wirklich nur b-los war, Frequenz war gut, er hat geatmet, was war noch.. also er war keine, noch nicht reanimationspflichtig zu dem Zeitpunkt. Das heißt, da war die Infarktgeschichte eigentlich zum Ausschließen. Zucker war in Ordnung, also solche Dinge. Zuckererhebung war in dem Fall natürlich auch noch drin.

I [06:24]: OK. Hast du schon einmal einen Fall gehabt, wo der Patient zwar, sagen wir, bei Bewusstsein war, aber dir irgendwelche Informationen vorenthalten hat? Oder einfach mal irgendetwas nicht sagen wollte, was für dich aber relevant gewesen wäre?

E4 [06:35]: Primär.. naja, es kommt schon immer wieder vor, dass die Leute halt Sachen nicht sagen, wenn man sie nicht direkt darauf anspricht. Ich will jetzt aber auch nicht sagen, dass das jetzt primär für die Versorgung vor Ort interessant wäre. Eher dann für die Übergabe im Krankenhaus, dass die in Folge dann halt wissen, was sie mit dem anstellen. Aber für die Primärversorgung jetzt eigentlich nicht, nein.

I [07:16]: OK. Dann gehen wir zu einem ganz anderen Thema. Also wir sind jetzt mit welche Daten am Einsatzort erhoben werden mal primär fertig. Jetzt würde mich interessieren, wenn du eine Alarmierung bekommst, was geht in dir vor. Was überlegst du am Einsatzort, was geht dir durch den Kopf?

E4 [07:37]: Das ist gemein. Ja, also auch wieder.. sehr situationsabhängig. Es gibt so Dinge, wo man quasi überhaupt nicht darüber nachdenkt.. Also ich meine, bei der Anfahrt vielleicht schon drüber nachdenkt schon. Was kann jetzt aufgrund von dem, was in der Alarmierung steht, wirklich sein. Weil Alarmierung und das offensichtliche Szenario am Einsatzort manchmal wirklich total auseinander geht. Also, keine Ahnung. Bekommst du eine Alarmierung auf eine Reanimation und dann kommt dir der Patient gehend entgegen. Also auch solche Dinge schon erlebt. Also man überlegt am Hinweg schon, was kann jetzt aufgrund was in der Alarmierung drin steht wirklich sein. Bis wohin kann es gehen. Geht auch primär darum, was nehme ich an Equipment mit, weil gerade der Defi zum Beispiel nicht oder die Absaugeinheit ja nicht bei 100% der Einsätze mitgenommen wird, sondern das ist ja dann schon abhängig davon, was steht drin. Das ist ein bisschen dieses Hin- und Herjonglieren am Weg zum Einsatzort. Wenn man dann einmal dort ist, dass man eigentlich draufkommt, man hat sich viel zu viel Gedanken darüber gemacht. Und mit viel zu viel gerechnet eigentlich.

I [09:15]: Das heißt, du gehst eigentlich auch immer vom Schlimmsten aus.

E4 [09:17]: Eigentlich gehe ich dann immer vom Schlimmsten aus, was kann sein,

also was passieren kann, was grad mit dem Patienten sein kann. Und wie gesagt, stellt sich dann im Normalfall heraus, dass eigentlich nicht so tragisch ist, wie man es sich am Hinweg überlegt hat. Was aber natürlich wieder positiv ist, weil man ist viel mehr vorbereitet, als man dann eigentlich antrifft. Also von dem her ist es eigentlich gut. Und der Stressfaktor am Einsatzort geht natürlich dann wieder entsprechend zurück, weil man viel entspannter sein kann. Aber natürlich trotz alledem immer dieses Im-Hinterkopf-Haben, wenn er jetzt doch instabil ist, was passiert oder was kann sein.

I [09:58]: Also eigentlich selbst wenn...

E4 [10:00]: Selbst wenn es gut ist, er gut ausschaut, ansprechbar ist, in der Alarmierung ist, keine Ahnung, drinnen gestanden, dieses Übliche, bewusstlos, bewusstseinseingetrübt, weil ich mein, das ist ja immer, und dann steht B+ drinnen. Das ist ja recht schwachsinnig, wenn man das genau nimmt. Aufgrund von, weiß ich nicht, Sturz am Kopf. Ist dann aber ansprechbar beim Eintreffen, kann aber natürlich wieder passieren, dass er natürlich wieder umkippt.

I [10:35]: Das heißt du hast immer im Hinterkopf..

E4 [10:37]: Wie kann es weitergehen, wenn es schlecht für den Patienten weitergeht.

I [10:46]: Das heißt, wenn deine Ersteinschätzung, deine Erstanamnese, sag ich jetzt mal, abgeschwächt ist, weil der Patient eh ok aussieht, hast du immer noch im Hinterkopf..

E4 [10:52]: Aber trotzdem noch was könnte weitergehen, was wäre noch.

I [10:56]: OK. Glaubst du, oder hättest du Zeit, wenn du zum Einsatzort fährst, dass du dir Zusatzinformationen zum Patienten anschaust? Wie zB. Vorerkrankungen?

E4 [11:04]: Ja, auf jeden Fall. Muss gestehen, manche Dinge sind am Hinweg sicher interessant, grad so, der letzte Krankenhausaufenthalt. Wann war der, aus welchem Grund, war der. Also speziell der letzte sag ich jetzt mal. Allergien sind immer.. Also speziell jetzt Medikamente sind immer sehr interessant, aber auch Insekten, weil das haben wir auch immer wieder. Mit Insektenstichen und keiner weiß irgendwas.

I [11:38]: Das heißt, zum Beispiel, Patient hat Atemnot..

E4 [11:40]: Hat Atemnot und ja, man kann nachvollziehen ist gestochen worden, weiß aber nicht von was. Da hat eigentlich nur so.. ja, könnte sein, dass er allergisch ist. (I: Weiß man nicht genau.) Weiß man nicht genau. In den meisten Fällen macht es dann aber schon Sinn, wenn man dann im Vorfeld ein bisschen Information hat. Ja, Dauertherapie von bestimmten Medikamenten, sag ich jetzt mal, Betablocker, Diuretika, Neuroleptika, sag ich jetzt mal, im Groben und Ganzen, um die Gruppen ein bisschen

einzuschränken. Jetzt abgesehen von den Blutverdünnern, Marcumar und Lovenox.

I [12:26]: Hättest du Zeit dir das wirklich anzusehen?

E4 [12:28]: Wenn es schön zusammgefasst ist, ja. (I: Wenn es auf einen Blick wär.) Wenn das jetzt in 20 Seiten Protokoll drin steht, ist es in Realität wertlos. Wenn es zusammengefasst ist in schöne Gruppen und man sagt, man sieht es auf, weiß nicht, ich sag jetzt mal, 20 Zeilen in Tabellenform, ja. Super. Weil dann macht es auch wirklich Sinn. Weil die Rundherumgeschicht nachher ist eigentlich schon wieder komplett uninteressant, warum nimmt er bestimmte Dinge. Das ist wieder wertlos.

I [13:04]: Das heißt komplette Arztbriefe würden dich auch nicht interessieren?

E4 [13:06]: Nein, überhaupt nicht.

I [13:07]: Sondern es würde dich eigentlich interessieren, warum war er.. (E4: Ja, genau.) Also ich weiß nicht, ob das Diagnose heißt, so wie das in den Arztbriefen drin ist.

E4 [13:16]: Ja, genau. Also eigentlich wirklich nur das letzte Ding, was war das definitive Problem, kein Ahnung, war es eine hypertensive Krise, beispielsweise.

I [13:23]: Das würde dich auch nur abhängig von der Notfallsituation, zum Beispiel für einen internistischen Fall..

E4 [13:26]: Würde es natürlich dann nur helfen.

I [13:29]: Für Trauma ist dann wahrscheinlich schon wieder..

E4 [13:31]: Ist schon wieder sehr uninteresssant, sag ich mal, weil.. Wobei man es nicht ganz außer Acht lassen darf. Trauma jetzt im Sinne von der Leiter gefallen, wie mein Beispiel vorher, und nimmt Betablocker, hat die überdosiert und dann ist es wieder interessant. Dass man einfach nur draufkommt warum.. Ich mein, machen können wir eh nichts dagegen, oder zumindest als RTW-Mannschaft nicht..

I [14:00]: Das heißt, therapiemäßig würde sich für dich jetzt nichts ändern, aber es wäre auf jeden Fall für das Krankenhaus dann..

E4 [14:04]: Ja, für die Übergabe wär es dann wieder interessant.

I [14:09]: Glaubst du, dass es auch was ändern würde?

E4 [14:10]: Ich glaube schon, dass man draufkommt während der Anamnese. Dass er Betablocker nimmt wird man draufkommen während der Anamnese, dass er vielleicht

zu viel genommen hat, natürlich dann im Zuge, da kommst du sonst sowieso nicht drauf. Das ist natürlich dann sowieso wieder Information für das Krankenhaus. Also ich glaube schon, dass man draufkommen würde. Man würd sich vielleicht ein bisschen Zeit am Einsatzort sparen. Wird sich wahrscheinlich im halben Minuten-Bereich irgendwo bewegen. Man kommt vielleicht eher.. vielleicht ist es den Patienten aber auch nicht schlecht, weil man kommt vielleicht mit Wissen hin, was einfach.. na, wie soll ich jetzt sagen.. mit dem der Patient nicht rechnet und man damit eigentlich.. Glaubst du, ich find das Wort.. (I: Vertrauen?) Nein.. kompetenter! (I: Ah, ok! Alles klar!) Man wirkt vielleicht dann komptetenter gegenüber dem Patienten. Da würde es vielleicht was bringen. Wobei jetzt bei uns in der Gegend ich nicht das Problem habe, dass sich irgendwer jetzt über irgendetwas aufregen würde. Das ganz und gar nicht. Ich glaub, das ist eher sicher in Wien ein Problem, aber bei uns.. bei uns sind eigentlich die Leute sehr offen und sehr freundlich.

I [15:54]: Perfekt. Wir sind jetzt mit den Daten jetzt mal fertig. Was mich zum Schluss noch interessieren würde, ist, wie dokumentierst du? Du hast ja als Sanitäter eine Dokumentationspflicht, wie kommst du der nach?

E4 [16:04]: Wie komm ich dem nach. Also wir haben primär eh den Vorteil, wir haben schöne Formulare, die in einem Multiple-Choice im Endeffekt hinauslaufen. Mit Ausnahme von ein paar wichtigen Dingen, weil wir eben Medikation, Vorgeschichte bzw. was habe ich am Einsatzort überhaupt getan. Ich muss gestehen, ich bin normalerweise pingelig, was die Dokumentation angeht. Also gerade was ist am Notfallort geschehen. Also, keine Ahnung, war der Patient ansprechbar, hat er wirklich adäquat reagiert oder wie waren die Schmerzen, grad bei internistischen Geschichten wie Brustschmerzen, wie waren die, ausstrahlend, punktuell, hat er wirklich hinzeigen können, wo der Schmerz ist. Oder brennend, stechend, kollikartig, was auch immer. Da bin ich schon relativ penetrant auch gegenüber meinen, der Mannschaft, die mit mir fährt, dass das wirklich dokumentiert ist.

I [17:24]: Das heißt, du dokumenierst das aber alles handschriftlich?

E4 [17:27]: Das ist alles handschriftlich dann dazu dokumentiert, ja. Eben aus dem Grund heraus, weil man ja nie so genau weiß, was kommt vielleicht in einem Jahr auf einen zu oder auch nicht. Wir wissen alle, dass zum Glück nicht viel kommt, fast nichts, aber es kommt doch immer wieder vor. Speziell, wobei sich das natürlich ein bisschen relativiert, wenn man jetzt sagt, der Notarzt ist da und hat das dem Notarzt übergeben, natürlich. Weil dann ist die Dokumentation für mich am RTW nicht mehr so dramatisch, tragisch. Da ist dann eigentlich primär zur Dokumentation nur mehr der Grund, warum habe ich jetzt einen Notarzt gebraucht. Warum sage ich, dass ich einen Notarzt gebraucht habe. Weil, keine Ahnung, Patient instabil, aufgrund von xy.

I [18:21]: OK. Angenommen du transportierst als RTW den Patienten, du dokumentierst alles, wie gibst du das dem Krankenhaus weiter?

E4 [18:28]: Naja, da haben wir jetzt das Problem, wir können nur mündlich weitergeben, weil wir keine Durchschlagsprotokolle oder elektronische Protokolle haben, die man übergeben, übersenden könnte. Ist aber an sich auch möglichst strukturiert, also kurz: was ist die Vorgeschichte zum Patienten, was ist die aktuelle Situation vom Patienten, was haben wir am Einsatzort gemacht, also sprich, Zugang, welche Medikamente, was auch immer. Und, also, ja.. Und dann noch die Vitalparameter bei Eintreffen, wenn sie grob abweichen von dem, was er aktuell hat. Wenn sie relativ ident sind, sind sie eh uninteressant.

I [19:25]: Also schlussendlich kommt es auch wieder auf die Notfallsituation drauf an, ob der jetzt eine großartige Übergabe braucht, ob da wirklich viel erhoben worden ist, viel gemacht worden ist.

E4 [19:33]: Richtig, ja. Auch wieder, eben, sehr differenziert, wenn es eine Traumageschichte ist, dann ja, keine Ahnung, ist runtergefallen von 1,50 Meter auf den Knöchel rechts, wahrscheinlich luxiert, gebrochen, was auch immer. Ja, das hält sich dann relativ in Grenzen, weil da sind die Vitalparameter sehr uninteressant, weil dem wird es soweit gut gehen, logischerweise. Im Gegensatz zu dem, wenn er jetzt sagt, er hat Brustschmerzen, ja dann wird es wahrscheinlich schon interessant sein, sollte man auf den wirklich aufpassen, oder ist es halt nur eine Intercostalneuralgie.

I [20:07]: Das heißt, also primär eigentlich ist es für dich relevant, oder sagst du, für dich ist es wichtig bei internistischen Problemen wirklich eine ordentliche Übergabe zu machen?

E4 [20:14]: Ja, eine sinnvolle Übergabe, was eben Patientenvorgeschichte betrifft und die aktuelle Situation.

I [20:21]: Hast du schon mal mit einem elektronischen System gearbeitet im Rettungsdienst?

E4 [20:24]: Ich nicht, nein. Leider.

I [20:27]: Also immer handschriftlich.

E4 [20:28]: Immer handschriftlich, nachdem es bei uns leider nichts gibt. Es wäre manchmal schon schwer interessant, grad was die Übergabe eben im Krankenhaus angeht, wobei es dann natürlich auch immer zum Überlegen ist, wann dokumentiere ich das. Eine digitale, ein digitales Protokoll dauert im Normalfall länger als ein handschriftliches. Das ist halt so. Weil du halt zum Tippen länger brauchst, als jetzt handschriftlich irgendwo etwas hin zu "krixeln". Dann ist die Frage wo nimmst du die Zeit her. Grad wenn du jetzt nur kurze Wege hast, bei uns beim Transport vielleicht den Patienten oder der Patient am Transport noch irgendwie eine Versorgung braucht, weil, keine Ahnung, Übelkeit, dann musst du dich darum kümmern und hast du die Zeit einfach nicht, ja.

I [21:22]: Das heißt, du würdest dann am Transport auch wirklich nur die wichtigsten Dinge dokumentieren.

E4 [21:25]: Es wird.. werden nur die wichtigsten Dinge dokumentiert, also da würden dann halt nur Vitalparameter drinnen stehen, wahrscheinlich und vielleicht, ich sag einmal, in zwei Sätzen zusammengefasst das Notfallgeschehen. Viel mehr wird sich nicht ausgehen.

I [21:39]: Das heißt, den Rest würdest du dann später dokumentieren?

E4 [21:41]: Der Rest würde später dokumentiert werden, weil halt die Zeit nicht dafür da ist. Also kommt sicher natürlich auch auf die Mannschaft an, ist man zu Dritt, hat man natürlich mehr Zeit. Oder kann sich einer dafür vielleicht freispielen, das zu machen. Wenn man nur zu Zweit ist, ist es unmöglich. Wird keiner dazu kommen es zu tun. Man sieht bei uns am NAW wie das mit der digitalen Dokumentation ist, sie braucht viel Zeit.

I [22:11]: Das sind die Notärzte, die digital dokumentieren.

E4 [22:13]: Genau, die Notärzte, die da eben digital dokumentieren, das sehr viel Zeit beansprucht und ich muss gestehen, meines Erachtens nach sollte sich der Notarzt um den Patienten kümmern nicht darum, dass irgendwo in irgendein, in dem Fall iPad, reingeklopft wird. Das kann nicht Sinn und Zweck davon sein, dass die Sanitäter dann die Arbeit vom Arzt übernehmen am Patienten. Auch wenn die Anamnese in Form von Kommunikation funktioniert, ja, und er das nebenbei natürlich mitdokumentieren kann, keine Frage, aber es gehören halt auch noch Vitalparameter erhoben und dann eben, keine Ahnung, Zugang, Medikamente und das ist dann halt nicht mehr.. also in dem Szenario eigentlich nicht Aufgabe des Sanitäters, sondern eigentlich des Arztes. Und der hat aber dann aufgrund von dem, dass er das digital dokumentiert, keine Zeit dafür.

I [23:07]: OK. Das heißt, er ist primär mit der Dokumentation beschäftigt.

E4 [23:10]: Genau. Und deswegen ist es halt schwierig, ob es wirklich, also über den Kamm geschert zu sagen, ist es sinnvoll oder nicht sinnvoll. Im Nachhinein wird es natürlich schon, also über den gesamten Einsatz, wird es sicherlich Sinn machen. Aber jetzt am Notfallort selbst.. Ob das wirklich..

I [23:33]: Weißt du, ob die Dokumentation, die die Notärzte machen, die digitale, ob die, wird die irgendwie weitergeschickt ins Krankenhaus?

E4 [23:39]: Ja, die wird ans Krankenhaus übermittelt, allerdings quasi nur als Dokument. In dem Fall als Fax geschickt. Das heißt, die haben das dann halt auf Papier. (I: Aber zumindest sie haben..) Aber zumindest sie haben die Dokumentation dann, ist dann

wieder Krankenhaus-abhängig, ob das dann sinnvollerweise in der richtigen Abteilung landet, oder relativ in der Nähe der sinnvollen Abteilung. Oder irgendwo im Haus und du musst das dann irgendwie über Umwege wieder dort hinbringen, wo es hingehört. Ja, also da ist.. Also wenn man es macht, natürlich mit einer vernünftigen Schnittstelle in Richtung Krankenhäuser. Dass das dann wirklich auch dort aufpoppt, wo es zur Hand ist, wo man es braucht.

I [24:29]: Dass es auch wirklich am richtigen Ort dann landet. Weil es bringt natürlich nichts, wenn es ganz wo anders ausgedruckt wird und es jemand erst holen müsste.

E4 [24:36]: Genau und dann rennt man dem erst recht wieder nach oder ich bin schon im Krankenhaus bevor das Dokument überhaupt da ist. Weil dann bringt es mir sowieso nichts mehr, weil dann kann ich es gleich selbst ausdrucken.

I [24:47]: Hat der Arzt auch die Möglichkeit das vorher auszudrucken?

E4 [24:48]: Nein, gar nicht.

I [24:52]: Das ist nur rein das iPad.

E4 [24:53]: Das ist wirklich nur online ohne irgendwas in der Hand zu haben.

I [25:06]: OK. Perfekt. Das war eh schon die letzte Frage. Wir sind eh schon fertig. Ich bedanke mich sehr. Du hast mir sehr geholfen.

E4 [25:11]: Bitte gerne, kein Problem.