

# **Occupational Field Analysis of Invasive and Non-Invasive as Well as Pharmacological Measures by emergency physician Medical Service in the German Emergency Medical Service - A Retrospective Cross-Sectional Study of the Interventions Carried Out in the German Emergency Medical Service**

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**Received:** July 05, 2023; **Published:** July 26, 2023

## **Abstract**

**Background:** In Germany, an emergency patient is entitled to emergency medical assistance that corresponds to the current state of scientific knowledge. Emergency physicians are supposed to perform invasive curative measures in complex situations. Due to the shortage of specialists, staff shortages may occur. This endangers the mission of emergency physicians.

**Methodology:** In the period from 01.05.2021 to 31.07.2021, emergency physician deployments in the Erfurt rescue service area were evaluated retrospectively. Mission-specific data, invasive and non-invasive as well as pharmacological measures were examined. The data were analysed descriptively with IBM SPSS Statistics Version 25.

**Results:** A total of N = 1,760 emergency medical interventions were evaluated. A total of 1,373 invasive and non-invasive interventions were performed. The most common procedure was intravenous access with n = 1,051 (76.5%). In addition, 2,163 pharmacological individual measures were performed. The most frequently used medication was the full electrolyte solution, which was applied in n = 457 (21.1%). In more than 50% of the interventions, no measures were performed for which an emergency physician would have been necessary.

**Discussion:** The emergency paramedic learns invasive and curative measures in his training. This professionalisation of the emergency medical services makes it possible to relieve the emergency doctor. An adaptation of the emergency physician indication catalogue to the current care structures seems necessary. This enables a targeted and resource-oriented use of the emergency doctor.

**Keywords:** *Emergency Doctor; Emergency Paramedic; Pharmacological Measures; Invasive Measures; Rescue Service*

## **Introduction**

Providing care to people in acute medical emergency situations is one of the most important tasks of the German health system [1].

The rescue system is a public task of danger prevention and the state's provision of services of general interest. This system has developed into a modern rescue system over the last 60 years. The basic features of the rescue system date back several centuries [2].

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**Citation:** Sebastian Koch and Tim Sauerbier. "Occupational Field Analysis of Invasive and Non-Invasive as Well as Pharmacological Measures by emergency physician Medical Service in the German Emergency Medical Service - A Retrospective Cross-Sectional Study of the Interventions Carried Out in the German Emergency Medical Service. *EC Emergency Medicine and Critical Care* 7.5 (2023): 01-10.

As early as 1992, the Federal Court of Justice formulated the claim to nationwide, patient-oriented and qualified emergency medical assistance in the rescue service. Every patient should be treated according to current and scientific standards [3].

To ensure this nationwide care, approximately 2,000 Emergency physicians locations are operated in Germany. Most emergency physicians work part-time and are employed full-time in a hospital or as physicians in private practice. In order to functionally maintain an emergency physician location on a part-time basis, 15 to 20 Emergency physicians are necessary [3].

Due to staff shortages, the nationwide provision of Emergency physicians has been endangered for years. The shortage of personnel makes it necessary to use Emergency physicians as a scarce resource in a targeted manner [4].

The occupational profile of emergency paramedic created in 2014 qualifies non-medical staff to perform invasive and non-invasive measures as well as pharmacological measures as standard [4].

So far, however, there is a lack of empirical data from the professional field of action of Emergency physicians [5]. The aim of the following work is to investigate, using quantitative instruments of a professional field analysis, which invasive and non-invasive as well as pharmacological measures are carried out by Emergency physicians. It is to be shown in which situations the Emergency physicians can be relieved by the emergency paramedic.

**The Emergency physicians**

According to the further training regulations, the Emergency physicians is qualified to recognise imminent or actual emergency situations. He is able to treat emergency patients and restore or maintain acutely threatened vital functions.

Further tasks are the triage of the emergency, the triage of the patient and the diagnosis. In addition, the emergency physician decides on intervention measures and pharmacological therapies. He decides whether a patient should be transported to hospital or treated as an outpatient. The Emergency physicians is responsible for documenting the measures [5]. In addition, he coordinates the cooperation of the Emergency paramedics and is authorised to issue instructions to them. The indications for the use of Emergency physicians result from the country-specific indication catalogues for emergency doctor use. For the present study, therefore, the patient condition-related indications according to the State Rescue Service Plan (LRDP) for the Free State of Thuringia were used as a basis (Table 1).

Function	State	Example
Consciousness	Does not react to response and shaking	SHT, poisoning, coma, intracerebral haemorrhage
Respiratory	Marked or increasing respiratory distress, respiratory arrest	Asthma attack, pulmonary oedema, aspiration
Cardiovascular	Acute chest pain, marked or increasing circulatory insufficiency, circulatory arrest	Myocardial infarction, angina pectoris, cardiac arrhythmia, hypertensive crisis, shock
Other damage affecting vital functions	Severe injuries and bleeding, severe/acute pain, sudden paralysis	Thoracic/abdominal trauma, amputations, burns, fractures with significant deformity, poisoning, phallic injuries

**Table 1:** Patient condition-related indications.

### **The emergency paramedic**

The training objectives are defined in §4 NotSanG. After his training, an emergency paramedic is qualified to carry out medical measures in situations with an acute or imminent danger to life until the start of medical care (§4Abs. 1c NotSanG). Furthermore, the emergency paramedic is to assist in the implementation of curative measures. In doing so, they are to follow and implement prescribed algorithms. The algorithms are specified, trained, controlled and answered for by the responsible medical directors of emergency medical services (ÄLRD) (§4 para. 2c NotSanG).

In 2014, the Federal Association of Medical Directors of Emergency Medical Services BVÄLRD defined a selection of invasive measures according to §4 para. 1c NotSanG within the framework of an expert consensus called the pyramid process.

Due to concurrent legislation, the federal states are obliged to regulate the implementation of the rescue service in separate rescue service laws (Art. 72 and 74 ff GG). For the Free State of Thuringia, the Thuringian Rescue Service Act (ThürRG) was last updated in 2018 against this background. According to this, emergency paramedics do not act unlawfully when independently carrying out invasive measures within the meaning of §4 para. 2 no. 1c NotSanG. In addition to these invasive measures, the emergency paramedic should independently carry out curative measures within the meaning of §4 Para. 2 No. 2c NotSanG within the framework of cooperation after individual delegation by the medical emergency physician. The emergency medical services are to draw up procedural instructions for this purpose and review them regularly. The procedural instructions are to be based on the guidelines of the Thuringian Medical Association (§16a Para. 2 ThürRettG). The procedural instructions (VFA) applicable in Thuringia are updated annually by the Working Group of Thuringian Emergency Physicians (AGTN) in consultation with the State Medical Association.

### **Current state of research**

Several potential reasons are cited for the increasing number of ambulance operations. One is demographic change with an increase in older, multimorbid patients with degenerative diseases. On the other hand, the increase in non-emergency patients as a result of reduced availability or knowledge of the outpatient care structure is mentioned. Likewise, psychosocial problems are more and more frequently the reason for emergency services [6].

The situation of the shortage of skilled personnel is further escalated by these non-emergency patients. Emergency paramedics complain about an increasing delta between what they have learned in training and the demands of emergency operations. This leads to increasing frustration among emergency paramedics [7]. This frustration, in combination with various other factors, leads to a short length of stay of the professionals in the emergency service [6].

Compared to the many possible explanations of the shortage of specialists and the increasing number of deployments, there is little data on the actions taken by emergency physicians during emergency deployments.

A publication from the emergency medical service of the city of Leipzig between the years 2003 and 2013 shows that the number of deployments increased by 24%. Furthermore, the average age of patients increased from 66 to 70 years. The number of patients admitted also increased from 51% to 66%. However, pharmacological interventions decreased. In 2003, at least one drug was administered in 72% of emergency medical interventions. In 2013, this was only the case in 58% of the emergency medical interventions [8].

### **Problem and Objective**

The German emergency medical service, like the entire health care system, is subject to a dynamic process of change and changing framework conditions [6]. Certain emergency interventions, which are specified by the emergency physician indication catalogue, no

longer have to be provided by an emergency physician [6]. Emergency paramedics are expected to care for emergency patients within the framework of their legal requirements and procedural instructions. This can reduce the number of non-indicated Emergency physicians interventions and relieve the Emergency physicians [3]. In order for this targeted relief of the emergency physician resource to take place, a professional field analysis must be carried out in advance, which shows which measures are carried out by emergency physicians in emergency operations.

The aim of this work is to show which measures are taken by an Emergency physicians in emergency operations. For this purpose, the demographic data as well as the invasive and non-invasive measures and pharmacological measures are evaluated within the framework of a quantitative professional field analysis.

### **Study Design and Methodological Approach**

A retrospective data analysis was chosen as the study design. The study data were extracted from the deployment protocols of the rescue service of the German Red Cross District Association Erfurt e.V. and the Workers' Samaritan Federation District Association Erfurt e.V.

#### **Approval of the study**

Approval to conduct the study was granted by the two chairmen of the board of the German Red Cross District Association Erfurt e.V. and the Workers' Samaritan Federation District Association Erfurt e.V. as well as the head of the department of rescue services in March 2021. In addition, the medical directors of the city of Erfurt were asked for their approval, which was granted in April 2021.

#### **Description of the rescue service**

The rescue service in Erfurt is provided by several aid organisations. Only the German Red Cross District Association Erfurt e.V. and the Workers' Samaritan Federation District Association Erfurt e.V. staff the emergency medical service vehicles (NEF).

In 2019, a total of 45,651 documented rescue service missions were carried out in the Erfurt city rescue service area. Of these, 7,893, or 17.3% of the missions, were carried out by an NEF.

In Erfurt, two NEFs are manned for 24 hours throughout the year by the two aid organisations. In addition, another NEF is manned daily for 16 hours. This NEF is manned by the two relief organisations in weekly rotation.

The emergency doctors are provided by Helio Clinical Erfurt and Catholic Clinical Erfurt from 06.30 - 16.30 Monday to Friday. In the time from 16.30 - 06.30 as well as on weekends and public holidays, the emergency physicians are employed by the KVT as a part-time job.

#### **Implementation of the study**

For every emergency deployment of an ambulance or NEF, the emergency personnel are obliged to document the deployment in accordance with §31 ThürRettG. The demographic data as well as the diagnostic, invasive and non-invasive measures performed and the pharmacological measures are recorded on the mission logs. Depending on the suspected diagnosis, it is possible that several diagnostic, invasive and non-invasive as well as pharmacological measures are carried out in one emergency operation. A separate intervention protocol is prepared for each patient in the emergency intervention.

The emergency protocols are collected after the emergency operations and submitted to the head of the emergency service department or their deputies for checking. Subsequently, the mission logs are forwarded to the city of Erfurt and the ÄLRD for further control and billing.

Since 2020, the emergency doctor missions have also been recorded digitally at the KVT. The protocols are still written by hand and read in using a video pen. This protocol must then be checked on a tablet. The protocol can be changed digitally before it is sent to the KVT. The digital data was not available for the study.

The handwritten deployment protocols of the RTW and NEF of the two aid organisations in Erfurt were evaluated retrospectively. All emergency response protocols were evaluated. The protocols were analysed manually and written down in a table.

The objective of the study was to present the emergency medical activity. For this reason, all missions in which an ambulance was independently active were excluded. The data of the German Red Cross District Association Erfurt e.V. were collected in the period from 01.05.2021 to 31.07.2021. The data of the Workers' Samaritan Federation District Association Erfurt e.V. were collected in the period from 01.05.2021 to 31.05.2021. Due to a staff shortage, a longer survey was not possible.

### Evaluation of the survey

The data evaluation was carried out with the statistics programme IBM SPSS Statistic Version 25. After the results had been entered, 10% of the questionnaires were randomly checked. Since no errors occurred, the data were not checked completely. The evaluation was exclusively descriptive. Statistical tests were not used due to the explorative character of the data.

### Ethics

The study protocol was submitted to the Ethics Committee of the Medical Faculty of the Martin Luther University Halle/Wittenberg and positively reviewed (ref. no. 2022-102).

### Results

The results of the study are presented below. A total of N = 3,615 intervention protocols were evaluated. After applying the exclusion criteria, N = 1,760 deployment protocols, were evaluated for this study.

### Demographic data

Of the N = 1,760 emergency cases, n = 871 (49.5%) were male, n = 873 (49.6%) were female, n = 2 (0.1%) were diverse, and n = 14 (0.8%) had no gender information in the case record. The mean age of the patients was 61.2 years.

### Mission-related data

The N = 1,760 emergency interventions were divided into four specialties. Of these, n = 1,015 (57.7%) were suspected internal medicine diagnoses, n = 243 (13.8%) were suspected surgical diagnoses, n = 316 (18.0%) were suspected neurological diagnoses and n = 186 (10.5%) were other suspected diagnoses (Table 2).

	<b>Frequency</b>	<b>Percent</b>	<b>Valid Percentage</b>	<b>Cumulated Percentage</b>
Suspected internal diagnosis	1.015	57.7	57.7	57.7
Surgical tentative diagnosis	243	13.8	13.8	71.5
Suspected neurological diagnosis	316	18.0	18.0	89.5
Other suspected diagnosis	186	10.5	10.5	100.0
Total	1.760	100.0	100.0	

**Table 2:** Specialisations of the emergency missions.

Of the N = 1,760 emergency calls, in n = 1,148 (65.2%) of the emergency calls, the emergency physician arranged for the patient to be transported to the hospital. In n = 543 (30.9%) of the emergency cases, the patient was left on site. In n = 69 (3.9%) of the emergency cases, no information was given about a possible transport (Table 3).

	<b>Frequency</b>	<b>Percent</b>	<b>Valid Percentage</b>	<b>Cumulated Percentage</b>
Yes	1.148	65.2	65.2	65.2
No	543	30.9	30.9	96.1
Not specified	69	3.9	3.9	100.0
Total	1.760	100.0	100.0	

**Table 3:** Carrying out a transport.

### Implementation of invasive and non-invasive measures

In N = 1,760 of the emergency calls, an invasive or non-invasive measure was performed by the emergency physician in n = 1,083 (61.5%) of the emergency calls. In n = 677 (38.5%) of the emergency calls, no invasive or non-invasive measure was taken.

In total, 1,373 such individual measures were carried out in the n = 1,083 emergency calls with invasive and non-invasive measures. The following invasive and non-invasive measures were carried out in the n = 1,760 emergency interventions (Table 4).

	<b>Frequency</b>	<b>Percent</b>
Intravenous access	1.051	59.7
Oxygen administration	177	10.1
Endotracheal intubation	39	2.2
Full body immobilisation	28	1.6
Cervical support	13	0.7
Extraglottic airway support	9	0.5
Intraosseous access	8	0.5
Splinting extremity	8	0.5
CPAP	7	0.4
Defibrillation	7	0.4
Suction	6	0.3
Laryngeal tube	5	0.3
Wound care	5	0.3
Pelvic sling	2	0.1
Foreign body removal	2	0.1
Pacemaker therapy	1	0.1
Other	5	0.3

**Table 4:** Invasive and non-invasive measures performed.

**Performing pharmacological measures**

In the N = 1,760 emergency cases, a pharmacological measure was carried out in n = 1,051 (59.7%) of the emergency cases. In n = 709 (40.3%) of the emergency cases, no pharmacological intervention was performed.

A total of 2,163 individual pharmacological measures were carried out in the n = 1,051 emergency interventions with a pharmacological measure. The following pharmacological measures were carried out in the n = 1,760 emergency interventions (Table 5).

	<b>Frequency</b>	<b>Percent</b>
Full electrolyte solution	457	26.0
Prednisolone	141	8.0
Morphine	122	6.9
Midazolam	121	6.9
Heparin	105	6.0
Ondansetron	102	5.8
ASA	96	5.5
Reproterol	94	5.3
Nitrendipine	75	4.3
Metamizole	69	3.9
Urapidil	63	3.6
Lorazepam oral	59	3.4
Salbutamol inhalation	52	3.0
Esketamine	51	2.9
Adrenaline	45	2.6
Dipidolor	42	2.4
Glycerol trinitrate	42	2.4
Fentanyl	40	2.4
Furosemide	37	2.1
Magnesium	35	2.0
Metoprolol	34	1.9
Dimetinden	31	1.8
Glucose	27	1.5
Propofol	24	1.4
Dimenhydrinate	19	1.1
Tranexamic acid	15	0.9
Akrinor	14	0.8
Atropine	13	0.7
Clonidine	11	0.6
Butyscopolamine	10	0.6
Prednisolone rectal	10	0.6

Sufentanil	10	0.6
Noradrenaline	9	0.5
Adrenaline inhalation	8	0.5
Theophyline	8	0.5
Metamizole orally	7	0.4
Amiodarone	6	0.3
Atracurium	6	0.3
Diazepam	6	0.3
Ibuprofen rectal	6	0.3
Naloxone	6	0.3
Succinylcholine	6	0.3
Rocuronium	5	0.3
Ajmaline	4	0.2
Adrenalin intramuscular	3	0.2
Fenoterol inhalation	3	0.2
Dexamethasone	2	0.1
Flumazenil	2	0.1
Lidocaine	2	0.1
Lysis	2	0.1
Adenosine	1	0.1
Diazepam rectal	1	0.1
Dobutamine	1	0.1
Haloperidol	1	0.1
Saline infusion	1	0.1
Lorazepam	1	0.1

**Table 5:** Pharmacological measures implemented.

## Discussion

In the study, the patients were 61.2 years old on average. The difference in average age can be explained by demographic change. As patients get older, the number of chronic diseases also increases [9]. The average age is similar to the study from Leipzig. In this study, the average age of patients treated by an emergency physician was 64.4 years [5].

The ambulance service was primarily created to care for patients undergoing trauma surgery. Due to demographic change and the further development of pre-hospital emergency medicine, the indications for the deployment of the emergency physician changed. In the meantime, internal medicine patients dominate the number of emergency physician deployments [8]. Most surgical patients do not have any injuries that need to be treated by an emergency physician. In the Erfurt study on emergency ambulance missions, surgical and internal medicine patients were treated in a balanced manner, with just under 45% each. This already showed that surgical patients could



be treated without invasive or pharmacological measures in 86.9% of the emergency missions. This shows that the surgical patient has a lower priority for the emergency physician [7].

In the study from Leipzig, 72.4% of the calls were assigned to suspected internal and neurological diagnoses [5]. This corresponds approximately to the 75.7% of internal and neurological suspected diagnoses from this study. The most common suspected diagnosis was psychiatric emergency, accounting for 11.9% of emergency calls. The increase in patients with a psychosocial problem, due to insufficient outpatient resources, is cited as a reason for the rising number of emergency service calls [6]. Of the  $n = 210$  psychiatric emergencies, a total of  $n = 142$  (67.6%) patients were transported to hospital. In only  $n = 33$  (23.2%) of the transported patients was a pharmacological measure performed. Furthermore, an emergency doctor is not necessary for the compulsory accommodation of the patient in the case of an existing danger to self or others. According to §7 and §8 of the Thuringian Law on Assistance and Accommodation of Mentally Ill Persons (ThürPsychKG), the accommodation of a mentally ill patient against his will can only be arranged by the Social Psychiatric Service.

### **Implementation of invasive and non-invasive as well as pharmacological measures**

The most frequently performed measure was intravenous access. This was performed in  $n = 1,051$  (59.7%) of the emergency interventions. In the protocol evaluation from Bavaria, intravenous access was also shown as the most frequent measure with 73% of procedures [10]. Since the survey took place before the introduction of the professional profile of the emergency paramedic, it is likely that in the meantime the emergency paramedic is placing intravenous access more frequently than in 2002 [7]. In the Leipzig study, intravenous access was performed in 53.8% of emergency operations in 2013. In 2003, intravenous access was performed in 65.3% of emergency cases in Leipzig [8].

The most frequently performed pharmacological measure was the administration of a full electrolyte solution. This was performed in  $n = 457$  (26.0%) of the emergency cases. In the protocol evaluation from Bavaria, the full electrolyte solution was also the most frequently performed pharmacological measure. It was applied in 77.2% of the emergency interventions. This difference can be explained by the creation of the job description of the emergency paramedic. Medical change and the associated change in therapeutic standards may also be a cause of this difference [6].

### **Limitation of the Study**

A point of criticism of this work is the previous coverage. The study was only conducted in one ambulance service area. Furthermore, the short study period does not reflect the mission-specific events of a year.

The study is also limited by the documentation quality of the emergency physicians. It can be assumed that more invasive and non-invasive measures as well as pharmacological measures were performed but not documented.

### **Outlook**

The most frequent pharmacological measure was the application of a full electrolyte solution and the most frequent invasive measure was the creation of an intravenous line. If these two measures are not taken into account, almost one fifth of the pharmacological measures and almost three quarters of the invasive and non-invasive measures are accounted for.

These two measures can be carried out by emergency paramedics according to § 4 Para. 1c and 2c NotSanG. More extensive measures, for example the implementation of the Thuringian procedural instructions for emergency paramedics or mere transport escort, were also carried out by emergency doctors in over 50% of the missions.

The catalogue of emergency doctor indications must be adapted to the development of the rescue system. Indications covered by the pyramid process do not have to be primarily attended to by an emergency doctor.

Through a distribution of tasks adapted to the current care structures, the emergency paramedic can be deployed according to his professional competences. This enables the emergency paramedic to put into practice the measures learned during training. The first legal framework conditions for the deployment of the emergency paramedic have already been created. In addition, the emergency paramedic should be integrated into the Heilpraktikergesetz (law on non-medical practitioners) in order to establish final legal security. Likewise, the catalogue of indications for emergency physicians must be adapted to the professional profile of the emergency paramedic. A "shortage of emergency physicians", which is repeatedly presented in public, must be critically discussed in this context.

### **Conclusion for Practice**

- Establishment and adaptation of nationwide uniform recommendations for emergency paramedics according to the current state of science and technology.
- Adaptation of nationwide uniform emergency doctor indication catalogues according to current care structures.
- Establishment of a nationwide analysis of the professional fields of action of emergency doctors and emergency paramedics.
- Establishment of specialist training for emergency doctors.

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