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Remote monitoring in emergency medical services

A report from so-called tele-emergency services physician in Aachen

Abstract: An increasing number of missions in emergency medical services and a progressive utilization rate of emergency physicians also require the use of the benefits of telemedicine in prehospital emergency medicine. Through modern technology, such as the transmission of vital data in real time and a secure audio-visual contact, paramedics can be quickly connected to an experienced emergency physician from a distance and supported in diagnostics and therapy of a patient. This tele-emergency services physician is established in the Aachen emergency service since 2014 and has already had numerous successful missions.

Keywords: Remote monitoring, telemedicine, emergency medicine, tele EMS physician.

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1 Motivation and background

Because of the demographic change of our society, as well as the increasing incidence of chronic diseases, a steady increase in the number of missions in the emergency services in Germany has been recorded in recent years. Although the network of emergency services (EMS) is constantly being expanded, rural regions are increasingly struggling to fill the ambulances with qualified staff. [1] Approximately 46% of the emergency cases are provided by the paramedics without medical assistance. [2] In most cases an EMS physician is needed at the site. In the dual system in Germany, this emergency physician is separately alerted or re-alerted by the local forces. Most of the time, he reaches the place of intervention only after the ambulance, creating a so-called therapeutic interval, which the paramedics must bridge. Telemedicine is already used in many other areas to shorten this interval. [3, 4] Till now mostly for some tracer diagnosis specifically designed telemedical services were used.

2 Telemedicine in emergency services

The holistic prehospital telemedicine system developed in Aachen is not restricted to individual tracer diagnoses. Rather, it can be used for various types of emergency cases. The telemedical EMS physician (tele-EMS) can be consulted for all non-life-threatening diseases. But also with all other missions, the interval until the arrival of the emergency physician can be meaningfully bridged with the help of tele-EMS.

In addition, remote monitoring can be used to supervise inexperienced emergency physicians and to provide them with guidelines-based therapy.

Table 1: Examples for the different indications for conventional and telemedical EMS physician.

Indications for conventional EMS physician	Indications for telemedical EMS physician
Resuscitation	Hypertension
ST-elevating infarction (STEMI)	Pain therapy in the limb trauma
Unconsciousness	Stroke
Seizure	Hypoglycemia
Severe respiratory distress	Help in unclear emergencies
Polytrauma, severe accidents	Inter Hospital Transport
Acute life-threatening diseases	**Non-life-threatening diseases or to bridge for EMS physician**

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2.1 Components and use

The system consists of 4 subcomponents, has a modular design and can be used differently intensively. [5] It is composed of

- a mobile communication and transmission unit,
- the tele EMS physician's center, where software-based guidelines and algorithms are used to diagnose and treat patients,
- the ambulance and
- an integrative network.

Figure 1: Ambulance with tele EMS physician connectivity in Aachen

With a mobile transmission unit (peeqBox, P3 telehealthcare GmbH, Aachen), the paramedics can reliably transfer the vital data of the patient to the tele-EMS center. This allows a remote monitoring.

At the site, the rescue team first collects the medical history and carries out the initial diagnosis. If no EMS physician is required on the spot, but measures are required that need medical expertise, the paramedics can "switch on" the tele-EMS physician at the push of a button. An audio connection between paramedic and tele-EMS physician is established by the communication unit. With a headset, the paramedic can communicate with the tele-EMS and at the same time have all hands free to handle the patient. With the start of the audio communication, ECG, blood pressure and pulse oximetry are transmitted in real time to the tele-EMS physician. For the tele-EMS to get an impression of the situation on the spot, images can be transmitted via smartphone. This is especially useful, for example, for recording drug lists or medical reports. In addition, a video camera is installed in the ambulance. This can give the tele-EMS physician even more optimal impression of the patient's status, if it is medically necessary, after the consent of the patient in HD quality. The camera control is remote controlled by the tele-EMS. In the sense of data protection, video data from the rescue vehicle are merely streamed and not stored.

Medical measures carried out by the tele-EMS physician can be documented in the tele-EMS center and finally printed out on a printer in the ambulance. As a result, the documentation itself could be improved, as well as a time saving for the paramedics on site could be achieved. Furthermore, the quality of treatment could be improved by means of a guideline-oriented therapy.

The data and audio transmission between the patients site or the ambulance and the tele-EMS center is ensured by a special network. It ensures the safe and reliable data transfer, the availability of medical data and the security according to current legal regulations. The system has a modular design and can be used in different stages - either only for a few tracer diagnoses or for full emergency applications.

2.2 Limitations

However, there are also limitations in the use of telemedicine in emergency medicine. Operations in areas with an insufficient expansion of the mobile radio network are to be analysed in the context of the planning and appropriately compensated technically (eg by satellite communication technology). Furthermore, the acceptance of patients and users are important.

A conventional EMS physician can rarely process several inserts in parallel. This is usually possible with the tele-EMS physician, but also depends on his individual level of knowledge and development. The technique cannot be used without instruction and requires appropriate training. The tele-EMS physician always supervises the team, even in critical situations, but also gives instructions in parallel. In addition to outstanding medical competences, this also requires appropriate communication skills and "soft skills", to maintain an overview even in challenging situations. Certain missions, where an on-site doctor is urgently needed, can additionally be bridged and supported by the tele-EMS physician.

2.3 Further applications

In a recent research project (AUDIME, Augmented Disaster Medicine) the use of telemedicine in disaster medicine is investigated. A telemedically connected senior emergency physician supports the emergency response personnel during triage to prioritize the treatment and transport of the affected persons, as well as in individual medical treatment. He can provide support and advice to the leading emergency physician.

Data glasses were integrated to create an audio and video connection. On the screen of the glasses additional guidelines and procedural instructions can be presented. Using the built-in camera, the tele-leading emergency physician gets a precise impression of the situation at the disaster location.

Author's Statement

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Conflict of interest: A. Follmann is part-time employee (25%) of P3 telehealthcare GmbH; J.C. Brokmann and R. Rossaint are co-founders of Docs-in-Clouds GmbH; M. Czaplik is co-founder and managing director of Docs-in-Clouds GmbH, telemedical service and consulting. Informed consent: Informed consent is not applicable. Ethical approval: The conducted research is not related to either human or animals use.

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