Trauma Network North-West – Improving Holistic Care for Trauma Patients by Means of Internet and Mobile Technologies

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Abstract. The Trauma Network North-West as an initiative seeks to improve the initial and follow-up care for severely injured patients in need of immediate intensive care. The main goals are intensification and optimization of exchange of information, expertise and knowledge among participating clinics. By (a) foundation of the network itself and (b) establishment of a sophisticated IT infrastructure for web-based and mobile communication, instantaneous and concomitant care for trauma patients shall be significantly improved. The network’s workflow incorporates participating clinics within a central platform, including parameters such as level of health care, geographic coordinates, overstrained care units and defective medical devices. Mobile components allow locating nearby clinics based on an emergency physician’s coordinates and automatic triggering of disposition via coordination offices. A tight interplay between server components and location-based services shall reduce unnecessary transportation as well as financial expenditure. The central web-based system is currently established and evaluated in an initial test phase.

Keywords. wounds and injuries, telemedicine, internet, cellular phone, emergencies, allied health personnel

1. Introduction

Each year ~6.5 million people in Germany are injured in accidents, of which ~20,000 are fatal cases. Extrapolated to the German Federal State of North Rhine-Westphalia, constituting the main area of the Trauma Network North-West, at least two severe accidents take place per day, with one person dying on average. Apart from the tragic social consequences the socio-economic relevance is grave. Involvement of often young individuals in severe incidents inflicts a loss of productivity of ~5 billion Euros per year. Corresponding trauma care, excluding rehabilitative measures, generates costs of about 10 million Euros. One patient saved from invalidity would reduce costs for insurance carriers by approximately 900,000 Euros. A decrease in mortality by ~18%, as found in [1], would therefore free a substantial amount of resources. Comparable positive effects have been found for trauma networks in various settings [2–4].

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2. Trauma Network Elements

The newly founded “Trauma Network North-West” (TN-NW) consists of several individual modules aiming to optimize cross-clinic health care for trauma patients in North Rhine-Westphalia and adjacent Dutch areas. With 42 German and two Dutch clinics participating it poses the largest trauma network in Germany, seeking optimal trauma care through the following measures:

- Establish and harmonize adequate organizational structures and standards (with respect to trauma care, communication and training of individuals) [5].
- Setup of a telematics infrastructure including central and mobile components, offering location-based services (see section 3).
- Increase efficiency of care and cost by utilization of resources already existing in participating clinics.

State of Development and Implementation

The TN-NW is currently in a state of early development. The central IT infrastructure in the form of a web-based platform used by clinics and coordination offices (cf., section 3.1) is implemented and tested with some clinics and users. Inter-institutional workflow and communication with coordinating offices is monitored and optimized based on evaluations and suggestions by users. The mobile application (see section 3.2) is currently in an early prototyping phase and has yet to be fully developed and tested.

3. Telematics Infrastructure and Networking

The telematics infrastructure developed for the TN-NW, and to be further developed in the future, consists of both hardware and software components. To reduce cost and maximize benefit for all involved, it seeks to optimize the following parameters:

- Time until disposition and admission to suitable hospitals and trauma centers.
- Relocation time and frequency of trauma patients.
- Severity of long term effects, such as in [6].
- Length of hospital stays.

Consequently, the infrastructure consists of central servers and mobile components.

3.1. Central Web Platform

The central web platform serves the purpose to collect and provide information about participating clinics as well as to deploy a “disposition portal” used by coordinating offices for optimally routing emergency physicians to the most suitable hospital (cf., section 3.2). Each clinic maintains an online profile, comprising contact information (phone, fax, etc.), maximum possible level of care, special care units (e.g., burn units) and notable medical devices. In contrast, the care level and geographic location [7] of a clinic are independently assessed by notified bodies.
Figure 1. Central web-based platform: a prototype disposition view (using Google Maps) of an emergency case for coordination offices, including distance estimations. The locations of hospitals and corresponding care level, along with fire departments and helicopter sites, are indicated by e.g., balloons of different color.

In a second stage of expansion of the TN-NW, the central system is to be complemented with an electronic patient record (EPR), enabling exchange of trauma patient data (see section 4.2). Security of data is assured by implementing a data security concept developed by the German Telematics Platform for Medical Research Networks (TMF e.V., Berlin) [8]. Identifying and data diagnostic are stored physically and logically separate. This concept, considered as “best practice in data security” by German authorities, was adapted to the specifics of web-based platforms.

3.2. Mobile Component

The mobile component of the trauma network is comprised of GPS-capable smartphones and custom software. This component is to be used by emergency physicians and will allow straightforward location of nearest hospitals with suitable care level in emergency situations. By activating the mobile application a request is sent to the central system including the smartphone’s current coordinates and level of care requested by the emergency physician for the case at hand (see next section 4.1).

4. Results: Workflow

4.1. Disposition and Admission Based on Location-Based Services

The mobile application and thus the GPS positioning system are not permanently active but only when needed, in order to save battery and prolong device operability. In case of need, emergency physicians are given the opportunity to directly place disposition requests in the central system via the mobile application, linked with geospatial information about the emergency. Associated coordinating offices are immediately informed about incoming disposition requests via the interactive web interface as well
as via short messages and emails. This enables them to take further action, such as contacting the requested clinic and corresponding department or scheduling rescue helicopters and fire departments.

**Figure 2.** Illustration of the trauma network’s workflow in case of an emergency. The chronological order of individual steps is indicated by circled numbers and supplemented by descriptive texts. Communication carried out via mobile services from and to emergency physicians is indicated by dashed lines. The coordinating offices of the Trauma Network North-West pose the very central instance in disposition of trauma cases, with immediate access to up-to-date information such as a clinic’s capacity and direct contact information of adequate departments, as well as e.g., workload and whereabouts of rescue helicopters.

### 4.2. Communication and Data Sharing Concepts

In a second stage of expansion, the central telematics system shall be used not only for disposition of trauma patients but also for communicating and sharing patient and diagnostic data among participating clinics. Thus, when relocating e.g., a stabilized patient from a clinic carrying out the primary intensive care (e.g., stopping blood loss in surgery) to a clinic with suitable special care units (e.g., a burn ward), patient data is shared by transmitting access rights to the corresponding EPR to the target clinic and physicians, respectively. The EPR of the TN-NW is initially intended to be limited to trauma network boundaries, though interfaces to e.g., radiological systems of participating clinics are planned.

As a consequence, local special units and corresponding expert knowledge is made available to patients within the whole area of the trauma network. By utilizing existing resources of hospitals, other clinics are prevented from costly assembly of own units and personnel, saving cost without compromising overall health care quality [9, 10].

Concepts for optimal patient relocation and issues like expense compensation are currently under investigation. Since several parties are involved, such as individual
physicians, clinics and health insurances, this is a complex issue. Once a satisfactory and generally accepted scheme has been agreed upon, the second phase of the Trauma Network North-West, as described before, will start.

5. Conclusion and Expected Results

By agitating geospatial information of emergencies with centrally provided information of a trauma network (i.e., clinic locations and level of care, positions of helicopters and fire departments, etc.), similar to what is described in [11], logistic problems and disaccords in trauma patient disposition as well as relocation shall be significantly reduced. In the long run patient mortality, rate and degree of invalidity and thus overall expenses in health care and follow-up treatment are expected to decrease. By an improved initial admission of trauma patients to clinics of a suitable care level the number of undiagnosed injuries is expected to decrease as well [6].

The actual impact of the newly founded Trauma Network North-West on trauma care in the Federal State North Rhine-Westphalia is subject to evaluation once sufficient data on parameters such as patient numbers, transportation time and relocation frequency are available from first periods of productive operation. These results will be published in regular intervals as the network’s workflow and its telematics infrastructure are optimized under consideration of previous findings and statistics.

References


