Chapter 11
Supporting the Allocation of Traumatized Patients with a Decision Support System

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ABSTRACT
In this paper, the authors present a business rules-based decision support system for the allocation of traumatized patients. The assignment of patients to vehicles and hospitals is a task that requires detailed up-to-date information. At the same time, it has to be carried out quickly. The authors propose supporting medical staff with an IT system. The proposed system could be used in cases of mass incidents, as it is problematic, but essential, to provide all injured with adequate healthcare as fast as possible. The contribution is a system based on business rules, which is a novel approach in this context. Its feasibility is proven by prototypic implementation. In this paper, the authors describe the development project’s background as well as the system’s requirements and implementation details. The authors present an exemplary scenario to show the strengths of the proposed approach.

INTRODUCTION
The assignment of patients to hospitals is an everyday job for emergency call center staff. However, it is no task that is free of hassle. Emergency calls mark incidents that were not expected. In most cases, accidents or medical incidents that require fast action are reported. Offering medical aid to the affected patients is not only needed for their comfort. In case of e.g., a heart attack or especially after serious accidents, fast help can save lives.

Decisions are delayed by many determinants that have to be taken into account. In general,
several transportation possibilities are available if an incident is reported. Vehicles such as ambulances or helicopters are positioned at various places and have no uniform equipment; in fact, some vehicles are equipped for *special forms of emergencies* such as sick babies. The same applies to hospitals; not all hospitals are ready for all forms of injuries. Most of them also specialize on some forms of treatment such as infant treatment or neuro surgery. Therefore, transport decisions are highly non-trivial. A patient with a severe injury might require immediate transportation to a nearby emergency room instead of a specialized hospital in order to safe his live before detailed care is possible. The allocation of traumatized patients is a task that requires medically trained personnel to work quickly on complex decisions.

The allocation of patients to vehicles and hospitals is not decided in one step. It rather has to be decided continuously *over and over again*. This requires taking into account that vehicles could be occupied and that hospitals have limited capacities both with regard to short-term availability of staff and to unoccupied beds. Circumstances could even require rescheduling of vehicles. A special form of patient allocation is required in cases of *mass incidents*. A mass incident is an event in which due to disastrous circumstances a high number of people is wounded and thus require medical care. In general, such incidents are *local* and *do not span a long time*. Consequently, many patients require medical care at the same place almost immediately. An example from Europe is the *Ramstein airshow disaster* (Martin, 1990), in which inadequate handling was demonstrated that led to 70 dead and over 1000 wounded. Apparently, the transportation of patients was extremely uncoordinated and many of them received treatment later than it would have been required. More recent examples are the *train disaster of Eschede* (Oestern, Huels, Quirini, & Pohlemann, 2000) and the *Enschede fireworks disaster* (Woltering & Schneider, 2002; van Kamp et al., 2006).

We propose to support the allocation of traumatized patients using geographically enabled decision support systems. In collaboration with a regional network for the care of traumatized patients (Spitzer, Verst, Juhra, & Úckert, 2009; Traumanetzwerk-Nordwest, 2011) we developed a system for the allocation of patients. It incorporates a business rule management system, which allows it to suggest patient allocation while being versatile and expandable.

Our paper makes the following contributions. Firstly, it describes requirements for a patient dispatching system. Secondly, it explains how these requirements can be fulfilled with a business rules-based approach. Thirdly, it highlights how further capabilities such as using geographical data can enhance patient dispatching. And fourthly, it demonstrates the effectiveness of using business rules in the healthcare context by discussing a scenario.

This article is structured as follows. In the next section we give an overview of the project and related work. We sketch the methodology used. Then the decision support system is introduced. We illustrate exemplary usage and early evaluation results. Eventually, we draw a conclusion and discuss future work.

### PROJECT BACKGROUND AND RELATED WORK

Emergency calls are answered locally in Germany (Pohl-Meuthen, Kochanda, & Kuschinsky, 1999). Larger cities and districts set up one or more *emergency call centers*. Incoming calls are answered personally. Vehicles are assigned and sent to the patient’s location; also, the hospital is informed and preparations can be made. IT support is limited to information about available vehicles and similar data. Decisions are made as arrangements after phone, radio, and sometimes fax communication. Occasionally, an ambulance takes an emergency physician with it or joins him