SIMEDIS disaster management simulator: major road traffic accident

C. Ullrich[1], F. Van Utterbeeck[1], E. Dhondt[2], and M. Debacker[3]

[1]Department of Mathematics, Royal Military Academy, Brussels, Belgium christophe.ullrich,filip.van.utterbeeck@rma.ac.be
[2]Office for Hospital Emergency Incident Preparedness & Response, Queen Astrid Military Hospital, Brussels, Belgium
[3]Research Group on Emergency and Disaster Medicine, Vrije Universiteit Brussel, Brussels, Belgium

Abstract

We generate realistic victim profiles for medical disaster simulations based on medical expertise. We apply these profiles in a medical disaster model where victim entities evolve in parallel through a medical response model and a victim pathway model. The medical response model focuses on the pre-hospital phase which includes triage procedures, evacuation processes and medical processes. Medical decisions such as whether to evacuate or to treat the current victim are based on the RPM (respiratory rate, pulse rate, motor response) parameters of the victim. We show how such a model can be implemented in ARENA. Special care is given to a flexible implementation in order to be able to handle a wide variety of scenarios.

Keywords: Health care, medical disaster management, discrete event simulation

The research presented in this abstract is part of the SIMEDIS (Simulation for the assessment and optimization of medical disaster management in disaster scenarios for the Queen Astrid Military Hospital) project [1]. This paper focuses on the improvement of the medical response model presented in [2] and prelimiary result on our pilot case : a major road traffic accident. The specificity of our simulation model is the fact that the victim entities will evolve through both the medical response model and the victim pathway model in parallel, while the interaction between both models is ensured through triggers.

In [2], the medical response was limited to a single medical process on the disaster scene. Concerning the victim pathway the limitation was that we could have only one medical intervention trigger per clinical condition and the implementation of the victim pathway was specific to the victim profile. In this abstract we propose an improved medical disaster model. We focus on improving the implementation of the two models and their interaction.

The first extension of the pathway model is the possibility to have several medical interventions per clinical condition. This modification is used to represent incremental treatment capabilities and to avoid the situation where a medical intervention trigger is not performed because of the unavailability of one or more assets required for the intervention. Pathways with multiple medical intervention triggers allow medical experts to define several possible treatments in function of the available assets (with better treatment generally requiring more assets).

The second extension concerns the implementation of the victim pathway model. We implemented a new version in such way that it can handle all possible kinds of pathway with the same logic module. Each clinical condition (CC) can evolve by transitions, which are : time trigger (TT) and medical intervention triggers (MIT), only TT, only MITs and end CC. For the first two cases, the victim entity enters through a station (Time Trigger), passes the end CC test and goes to a delay module where it will be held until the time trigger delay for this CC elapses. The value of the time trigger delay is stored in an attribute of the victim entity. If no timely medical intervention is initiated, then the victim triggers a VBA module which updates the parameters to those corresponding with the next CC. Finally, a route module sends the victim entity to the entry station corresponding to the type of the new CC. If the clinical condition has no time trigger, the victim entity is sent to the intervention trigger station and it will be held until the next medical intervention trigger. If this is an end clinical condition, the victim entity fires a VBA module to update a log file containing all the victims and their end clinical condition and pathway ID, then it is immediately disposed of.

The third extension is the "Effect Time": for a medical intervention trigger we now define two time delays. The first one is for the delivery time of the intervention. During the delivery time medical assets are assigned to the victim. The second one is the effect time which is the time required for the intervention to have its effect on the clinical parameters of the victim. Medical assets are not seized by the victim during this time.

The medical response model represents the intervention of the rescue teams (firemen, medical staff,...) in order to rescue, treat and evacuate victims. A typical medical response model contains geographical zones relevant to the scenario and the evacuation procedures from one zone to another. Depending on the scenario and the procedure followed by the disaster manager, medical interventions can take place in each of the zones or during the evacuation process. In this paper we present a pre-hospital model which is composed of three zones: the disaster scene, the forward medical post and the hospital (emergency department).

References

[1] C; Ullrich, F. Van Utterbeeck, E. Dhondt, and M. Debacker. Towards a medical disaster management simulator In *Proceedings of ORBEL 26*, 2012, 99-100.

[2] F. Van Utterbeeck, C. Ullrich, E. Dhondt, J. L. Debacker, M. Murray, and S. Van Campen. Generating and managing realistic victims for medical disaster simulations. In *Proceedings of the 2011 Winter Simulation Conference*, 2011, 2679-2689.