"MedTRIS" (Medical Triage and Registration Informatics System): A Web-based Client Server System for the Registration of Patients Being Treated in First Aid Posts at Public Events and Mass Gatherings

Stefan Gogaert, MS;[1] Axel Vande veegaete, MS;[1] Annelies Scholliers, MD;[1,2] Philippe Vandekerckhove, MD, PhD[1,3,4]

1. Belgian Red Cross-Flanders, Mechelen, Belgium
2. Department of Anaesthesiology and Perioperative Medicine, University Hospital, Free University of Brussels, Brussels, Belgium
3. Faculty of Medicine, University of Ghent, Ghent, Belgium
4. Department of Public Health and Primary Care, Faculty of Medicine, Catholic University of Leuven, Leuven, Belgium

Correspondence:
Axel Vande veegaete, MS
Motstraat 40
B-2800 Mechelen, Belgium
E-mail: Axel.vandeveegaete@rodekruis.be

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Abbreviations:
BRCF: Belgian Red Cross-Flanders
FA: first aid
MedTRIS: Medical Triage and Registration Informatics System
MDS: minimum data set
PEF: Patient Encounter Form
PPR: patient presentation rate

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Abstract

First aid (FA) services are provisioned on-site as a preventive measure at most public events. In Flanders, Belgium, the Belgian Red Cross-Flanders (BRCF) is the major provider of these FA services with volunteers being deployed at approximately 10,000 public events annually. The BRCF has systematically registered information on the patients being treated in FA posts at major events and mass gatherings during the last 10 years. This information has been collected in a web-based client server system called "MedTRIS" (Medical Triage and Registration Informatics System). MedTRIS contains data on more than 200,000 patients at 335 mass events.This report describes the MedTRIS architecture, the data collected, and how the system operates in the field. This database consolidates different types of information with regards to FA interventions in a standardized way for a variety of public events. MedTRIS allows close monitoring in "real time" of the situation at mass gatherings and immediate intervention, when necessary; allows more accurate prediction of resources needed; allows to validate conceptual and predictive models for medical resources at (mass) public events; and can contribute to the definition of a standardized minimum data set (MDS) for mass-gathering health research and evaluation.

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Introduction

In Belgium, a wide variety of public events are being organized every day, ranging from a country village fair with a few dozen guests to mass gatherings such as music festivals where more than 80,000 people are gathered daily over four days. The majority of these events have first aid (FA) posts, where FA services mainly are provided by the Belgian Red Cross-Flanders (BRCF; Flanders, Belgium). For example, in 2013, trained volunteers of the BRCF were stand-by at 9,743 different events (football matches, festivals, and hiking and cycling events) and provided FA services to more than 64,000 people. In order to improve the quality of the medical on-site services and to assist in the planning of the management of health problems, such as on-site treatment capacity for minor conditions (patient presentation rate [PPR]) and emergency medical response capacity (medical providers, ambulances, and hospitals) when more advanced services are required, more systematic data collection and biomedical reporting is essential. The Medical Triage and Registration Informatics System (MedTRIS) database described in this report can help to address this and can contribute to building a body of evidence on large events/mass-gathering medical care ("large events" traditionally are defined as those with a number of attendees greater than 1,000, though it is also defined as an event in which crowds gather and there is a potential for delayed response to emergencies, thereby requiring preparation to improve health care).

Methods

Data Collection

The BRCF has systematically registered information on all patients treated in FA posts at public events for the last 20 years. The first registration was performed during the so called "Dodentocht" (a 100-kilometer annual hiking event) in 1994.

However, the information at that time was not gathered in a uniform and standardized way and, as a consequence, data from different events were difficult to compare. Therefore, in 2003, a working group was formed with the aim to standardize the registration procedure. The working group has analyzed not only the different ways information was collected and registered, but also has performed a literature survey to collect useful information and evidence on related practices world-wide.

As a result, the registration of patients by BRCF during mass gatherings was standardized as of 2006.

Standardized Patient Registration: The Patient Encounter Form (PEF)

The key to standardized information on patients is the Patient Encounter Form (PEF) with a unique identification code (Figure 1). One standard form is used every time a person is treated or assisted in a FA post, including people who only get "over the counter" medication and people who use the FA post to take their own medicine. Using the PEF for every person entails a heavier administrative burden but streamlines the triage process where patients enter the FA post and receive a first screening.

Using the PEF ensures: (1) standardized follow-up of the victim/patient during the stay in the FA post, allowing for retrospective statistics on different aspects, on-line follow up in a command and control center, and the usage of these data in the prediction of workload for similar events; (2) registration of complete and correct information of the treatment, ensuring that this information is forwarded in good order in case of a referral of the patient to an off-site physician or hospital; and (3) provision of (correct and complete) information to the medical personnel and psychosocial services on-site.

The PEF has been modified over time so as to minimize room for errors and to make the input of information as simple and as uniform as possible. This particularly is essential during events where patient entry rate is higher than one patient per minute. Thus, for instance, the PEF limits information to be provided in writing and, whenever possible, uses options to "tick the box" (☐) to enter data.

In 2007, PEF barcode labelling was added so that most of the information to be registered at patient entry and dismissal points simply can be scanned. This way the process is speeded up and automatically timed accurately. By scanning the barcodes on the PEF, the data automatically are entered in the database. No further manual operation is needed.

The form (Figure 1) is a two-sheet, white and yellow copy, non-carbon copy/NCR paper. The duplicate can be given to the patient when she/he is referred to her/his own physician or when the patient is transported to a hospital. The original copy remains with the BRCF and is subject to the medical confidentiality regulations and stored for at least 30 years, according to Belgian legislation.

In the top right corner, each PEF contains the information on the event and a unique identifier for the patient (also in barcode): (1) name of event; (2) Red Cross entity responsible for delivering the FA; (3) date and place of the event; (4) number of FA post (in case more than one); and (5) unique patient identifier/UPI.

The PEF is divided in four parts to be filled in at different times and/or locations.

Entry/Triage—When entering the FA post, a first triage is done where the following information is collected from each patient: (1) time of arrival at the FA post; (2) how the patient was delivered/arrived (ie, by own means, supported by others, on a stretcher, in an ambulance, or already seen by an Advanced Life Support team on-site); (3) one of four severity triage categories used (ie, #1. over the counter medication: no need for further treatment ["touch and go," own care]; #2. FA: injury can be treated by trained volunteer [Basic Life Support]; #3. medical condition: patient should be seen by professional nurse or physician; or #4. medical emergency: life threatening medical situation/injury); and (4) drawings of the human body allowing to indicate the location of the injury. This phase should take less than one minute.

Patient Identification—The second part of the PEF contains the patient information that can be filled in while waiting for treatment: name, address, gender, birthday, etc.

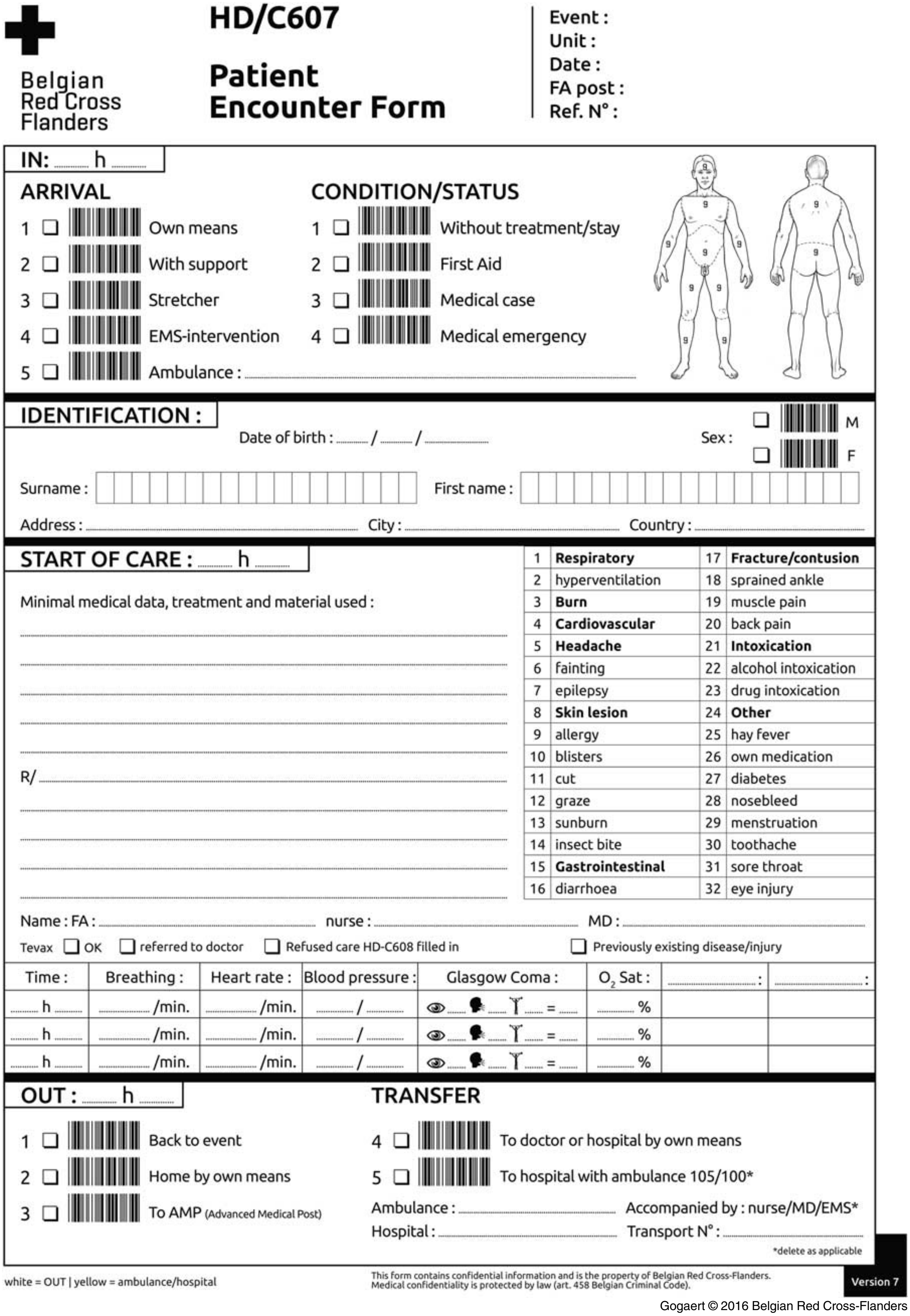
Treatment—The third part of PEF contains information on the treatment and is filled in by the care giver. The following information is filled in: (1) time treatment started; (2) basic information on the injury/illness; (3) vital medical parameters to monitor the condition of the patient (ie, breathing, heart rate, blood pressure, Glasgow Coma Scale, and oxygen saturation); (4) name of the caregiver/nurse/physician; and (5) a list of 32 most frequently encountered injuries. The list allows the caregiver to easily specify the type of injury at the time of intervention and facilitates statistical data analysis in retrospect. These 32 sub-categories are the result of data analysis performed over the span of three years.

Exit/Dismissal—The fourth part of PEF contains information on the dismissal of patient from the FA post. Specifically, the time is recorded when the patient leaves the FA post and where the patient goes to afterwards. The latter includes such options as whether the patient is returning to the event, is going home, is transported to another medical structure, is redirected to her/his physician, or is transported by an ambulance to a hospital. In the latter case, information on transport (ambulance registration and accompaniment of the patient) and referral place is recorded on the PEF. As noted earlier, in the case the patient is redirected for further medical treatment, he/she receives a duplicate of the PEF.

MedTRIS (Medical Triage and Registration Informatics System)

The BRCF has systematically collected information on paper forms from 1994 through 1999. As of 2000, information for major events with more than 10,000 attendees was also systematically entered into computers. In 2003, a uniform database and software suite was introduced and MedTRIS was born. MedTRIS is developed by the BRCF using Microsoft Access (Microsoft Corporation; Redmond, Washington USA).

MedTRIS is used within the BRCF to monitor the delivery of FA services. The access to the MedTRIS data is restricted to the persons who have developed the system, the key users, as well as the persons of BRCF involved in research. Requests for more



Belgian Red Cross Flanders

HD/C607

Patient Encounter Form

Event :
Unit :
Date :
FA post :
Ref. N° :

IN: ...... h ......

ARRIVAL

1 ☐ Own means
2 ☐ With support
3 ☐ Stretcher
4 ☐ EMS-intervention
5 ☐ Ambulance : ......

CONDITION/STATUS

1 ☐ Without treatment/stay
2 ☐ First Aid
3 ☐ Medical case
4 ☐ Medical emergency

IDENTIFICATION :

Date of birth : ...... / ...... / ......

Sex : ☐ M ☐ F

Surname : ...... First name : ......

Address : ...... City : ...... Country : ......

START OF CARE : ...... h ......

Minimal medical data, treatment and material used :

R/ ......

1	**Respiratory**	17	**Fracture/contusion**
2	hyperventilation	18	sprained ankle
3	**Burn**	19	muscle pain
4	**Cardiovascular**	20	back pain
5	**Headache**	21	**Intoxication**
6	fainting	22	alcohol intoxication
7	epilepsy	23	drug intoxication
8	**Skin lesion**	24	**Other**
9	allergy	25	hay fever
10	blisters	26	own medication
11	cut	27	diabetes
12	graze	28	nosebleed
13	sunburn	29	menstruation
14	insect bite	30	toothache
15	**Gastrointestinal**	31	sore throat
16	diarrhoea	32	eye injury

Name : FA : ...... nurse : ...... MD : ......

Tevax ☐ OK ☐ referred to doctor ☐ Refused care HD-C608 filled in ☐ Previously existing disease/injury

Time :	Breathing :	Heart rate :	Blood pressure :	Glasgow Coma :	O_2 Sat :	......:	......:
...... h	...... /min.	...... /min.	...... /	.... = ...	...... %		
...... h	...... /min.	...... /min.	...... /	.... = ...	...... %		
...... h	...... /min.	...... /min.	...... /	.... = ...	...... %		

OUT : ...... h ......

1 ☐ Back to event
2 ☐ Home by own means
3 ☐ To AMP (Advanced Medical Post)

TRANSFER

4 ☐ To doctor or hospital by own means
5 ☐ To hospital with ambulance 105/100*

Ambulance : ...... Accompanied by : nurse/MD/EMS*
Hospital : ...... Transport N° : ......

*delete as applicable

white = OUT | yellow = ambulance/hospital

This form contains confidential information and is the property of Belgian Red Cross-Flanders. Medical confidentiality is protected by law (art. 458 Belgian Criminal Code).

Version 7

Figure 1. The Patient Encounter Form.

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information on the system can be obtained from author Stefan Gogaert, who developed the database, and request for more information/from researchers to use the data should be addressed to author Axel Vande veegaete.

In 2005, a web-based version of MedTRIS was introduced at major events and mass gatherings.

Each FA post is equipped with a laptop connected through a cable or wirelessly (Wi-Fi) to a central server situated in the Red Cross coordination center on-site.

When a patient enters the FA post, all information of the PEF is entered into the MedTRIS database (using Access 2010; Microsoft Corporation). In Belgium, by law, everybody must carry a personal-ID card containing a chip. The information of this chip can be read by the Red Cross in the FA post, which facilitates the correct entry of personal details of the patient.

Information from different FA posts is centralized on the server. At the coordination center, supervisors can consult a wide range of data. This allows them to closely monitor the situation in the field and to intervene or take certain measures, if needed. At major mass gatherings, the coordination center is located in a fully equipped, state-of-the-art truck with trailer and has full access to the server with the database. To avoid breaks and inaccessibility of the database, a client-server model is used which ensures that information registration can continue in the absence of Internet connection and that synchronization takes place when the connection is re-established. All communication with the server is over an https secure link to guarantee confidentiality of transferred information. The use of passwords to consult the database during events allows for various access rights depending on a person's function. At the end of an event, passwords automatically become invalid and the local database is blocked for further use. The data on the server or a local PC can only be accessed with a special access key.

Table 1 gives an overview of the flow of data collection on paper (PEF) and in MedTRIS. Other relevant information such as temperature, humidity, and number of persons attending the event is kept in a separate database.

Results and Discussion

The science of mass gatherings is a relatively new and developing field, and it needs further research to build a sound body of knowledge[1] in order to reduce reliance on experience and expert opinion in the future. Much of the existing work is anecdotal or descriptive in character and is limited to the description of a single event or event type.[2] Furthermore, the available scientific literature is lacking in standardized biomedical data systematically collected at different public events over several years.

The MedTRIS database described in this report can help to address this and to contribute to building a body of evidence on large events/mass-gathering medical care in several ways.

Firstly, MedTRIS makes it possible to monitor the situation closely at mass gatherings in "real time" and to intervene immediately, if needed. Specifically, this can include the following: (1) consulting information on individual people; (2) observing trends in injuries; (3) monitoring the main reasons why people come to the FA post at a given time; and (4) monitoring the burden of patients in each individual FA post and take measures, if needed.

Secondly, MedTRIS allows for data analysis essential for improving delivery of medical services at mass events in general. At present, MedTRIS contains more than 200,000 patient records which have been gathered at 335 mass events over the last ten years. Such patient records contain the types of data discussed in the previous section. In addition, since 2009, MedTRIS includes information on such factors as outside temperature and humidity. In order to better compare different events and predict ratios such as PPRs and medical transfer rates, additional information on the nature of the event is registered as well, such as the average age of attendees, the event type, and characteristics (eg, heavy metal or folk music festival and indoor or outdoor event). All these parameters can be extracted retrospectively and examined for correlations, such as:

- amount of patients transported to a hospital (transfer to hospital rate);
- influence of weather conditions on the PPR;
- probability of certain type of injuries according to the nature of event (ie, sports, music, outdoor, or indoor);
- the number of patients who present themselves at a FA post more than once during the same mass event;
- the average time a patient stays at a FA post;
- the maximum number of patients present at a FA post at the same time; and
- the way patients are brought to a FA post (ie, on a stretcher, with support of a Red Cross team, or with an ambulance).

This information then can be used to better estimate, for example, the number of ambulances and transport facilities needed on-site or the number of personnel needed in the FA posts in total and at particular times of the day. Two practical examples were presented in April 2015 at the World Congress on Disaster and Emergency Medicine (WCDEM) in Cape Town, South Africa, dealing with:

- the main reason for transfer of patients to a hospital, to better determine the needs for specialized on-site medical assistance, for medical transport from the mass gathering event to the surrounding hospitals, and for increased staff needs in those hospitals;[3] and
- the duration of stay in a FA post according to the type of mass gathering, to determine the average length of stay of patients in a FA post depending on the type of injury, which allows to calculate the optimal size of FA posts.[4]

For these two examples, it also is possible to differentiate the data and further drill down according to the type of event (ie, music indoor or outdoor festival, sports event, or town festival), which allows to adapt the deployed resources in function of the type of event.

Thirdly, MedTRIS data can contribute to the validation of existing models used to predict medical resources needed during mass public events based on a range of different indicators. These models are based either on data from different events over a limited time period,[5,6] on data from one event or one type of event over a number of years,[7] or on a limited set of data collected from a range of different health care providers.[8] Although there is no general consensus on the factors that are most likely to influence the medical needs at large gatherings,[9] the most common predicting factors identified in publications are the weather, alcohol and drug use, crowd demographics, attendance and duration, event type, and venue characteristics. As many of these factors have been registered in MedTRIS, MedTRIS can be applied to validate existing models. Combining the MedTRIS data with information on other variables which can influence the

Moment of Data Collection	On Paper (PEF)	In MedTRIS Database
Entry of patient in FA post	Time of entry	Time of entry
	The way patient enters	The way patient enters
	Triage of the patient	Triage of the patient
	Identity of the patient	Identity of the patient
Patient in care zone	Time of start treatment	
	More detailed identification of the injury	
	Information on accident	
	Care given	
	Used medication	
	Follow-up vital parameters	
Patient leaving FA post	Time of exit	Time of exit
	The way patient leaves FA post	The way patient leaves FA post
		Time of start treatment
		More detailed identification of the injury
		Information on accident
		Care given
		Used medication
		Follow-up vital parameters

Table 1. Data Collection Flow
Abbreviation: FA, first aid.

provision of medical services, such as heat index and humidity, can help to validate and further improve the predictive models.

Finally, MedTRIS can contribute to the development of a universally agreed minimum data set (MDS) for research and evaluation purposes. A MDS is needed to enable the standardized collection of biomedical data across various mass gatherings, and a proposal for MDS has been published.[10] A recent Systematic Review on non-communicable health issues in mass gatherings[11] concluded that currently there is: (1) a lack of uniform standard measures; (2) minimal evidence about the effectiveness of and needs for various interventions during a mass gathering; and (3) few reports of the types of illness encountered and their severity. A MDS defining the minimum amount and type of information that should be collected consistently for research and evaluation purposes is therefore required. This will allow the possibility of meta-analysis, the comparison of events across societies and the modeling of various rates to inform health services.[12] The 20 years' experience of the BRCF in the selection and type of data collected and the information gathered in MedTRIS (and on paper forms during the first 10 years) over a wide range of events can be used to further elaborate a universal MDS.

Conclusions

The MedTRIS model presented in this report and the MedTRIS database about patients being treated in FA posts at public events and mass gatherings represents a unique source of information.

MedTRIS allows the monitoring of the situation in the field in real time and intervention, if needed; analysis of data to improve the delivery of medical services; and validation of existing prediction models.

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