Trigger Team Activation for Acute Patients. A Cohort Study at a Level 1 University Hospital in Denmark

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Trigger team activation for acute patients. A cohort study at a level 1 university hospital in Denmark

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Abstract:

Background: While patients with major trauma, suspected ST-elevation myocardial infarction (STEMI) or stroke have implemented pathways for quick access to specialized trigger teams, other patients with time dependent diseases present with less obvious aetiology and have less documented pathways at arrival to the hospital.

Aim: To describe the number, diagnosis and prognosis of patients arriving to the trigger teams for trauma, suspected STEMI, suspected stroke, and Medical emergency patients (MEP)

Method: Retrospective cohort study of all patients who between November 2012 and September 2015 had either a trauma, STEMI, stroke or MEP trigger team activation at arrival to Odense University Hospital – a level 1 trauma centre, a direct referral centre for patients with suspected STEMI to the catheterization laboratory or stroke, and with a trigger team at emergency department arrival of MEP patients from the local area.

Results: There were 8,075 activations of a trigger team at hospital arrival, median 7.6 calls per day (range 1-18); 16.7% trauma, 28.3% STEMI, 19.7% stroke and 35.3% MEP calls. This corresponds to 161/100,000 person years (py) with trauma calls, 64/100,000 py STEMI calls, 72/100,000 py stroke calls and 340/100,000 py MEP calls.

Patients from the different calls had a 30-day mortality of 12% (trauma), 8% (STEMI), 5% (stroke), and 25% (MEP).

Whereas patients from trauma, STEMI and stroke calls were mainly discharged within a few ICD10 (International classification of diseases, version 10) main coding areas, patients from MEP calls had discharge diagnosis within many different ICD10 main coding areas.

Conclusion: Trauma, STEMI and stroke trigger teams are used at a daily base, treat a prehospitally well-defined patient population and have a relatively low 7-day mortality. Patients with MEP calls are more frequent, have a diverse aetiology and a higher mortality than patients in the other trigger teams.

Keywords: trigger team, medical emergency patient, trauma, stroke, STEMI

Background:

People outside the hospital in medical distress activate the Emergency Medical System. In Denmark, an ambulance is dispatched, and if the situation is deemed severe enough, a physician-manned unit (Mobile Emergency Care Unit) is deployed as well. However, when the patients arrive at the Emergency Hospital, their paths split.

A dedicated trauma team, headed by an orthopaedic surgeon or an anaesthesiologist, receives trauma patients (1). Patients with ST-elevation myocardial infarction (STEMI) are sent to the cardiac catheterization laboratory, and a neurologist promptly evaluates stroke patients for potential thrombolysis.

Patients with less differentiated problems, medical emergency patients (MEP), which include many of the patients with shock, respiratory distress or depressed level of consciousness, do not fall into any of these categories. They are received in the emergency department (ED) by emergency physicians.

However, they are also in an acute life-threatening situation and require immediate care (2–6). As their path through the ED is not as well defined as for patients with trauma, stroke or STEMI, many EDs have implemented each their dedicated pathway or a dedicated team to receive, assess and treat these patients (7,8). This is especially important as reliably matching patient needs with ED resources in time-dependent illness is a critical component of a coordinated emergency care system (9). In contrast to the implemented pathways for trauma, STEMI and stroke teams, most MEP teams are locally developed and are scarcely described and evaluated in a general setting. The aim of the study is to describe the number, diagnosis and prognosis of patients arriving to the trigger teams for trauma, suspected STEMI, suspected stroke, and MEP.

Methods:

This is a population-based cohort study. Odense University Hospital (OUH) is one of three centres in the Region of Southern Denmark performing stroke thrombolysis and the only centre receiving level 1 orthopaedic trauma, and patients with prehospital diagnosed STEMI. MEP can be admitted in five different hospitals in the region.

All MEP and patients with trauma, suspected stroke as well as suspected STEMI who arrived to a specialized team response at OUH between 1 November 2012 and 30 September 2015 were included in the study. Patients under the age of 18 were excluded. Data on outcome (mortality) was extracted from Danish Civil Registration System (10) and all hospital contacts from the National Patient Registry (LPR) (11). In Denmark, all inhabitants have access to universal free healthcare and use their personal identification number in relation to the contacts.

Composition of the different trigger teams is poorly defined; no international consensus exists, just suggestions for trauma teams (12).

The trauma trigger team at OUH consists of an orthopaedic surgeon, anaesthesiologist, anaesthesiology nurse, two ED nurses, radiologist, two radiology technicians, laboratory assistant, orderly and a secretary. Other specialists can be summoned to the resuscitation room as needed. Patients are received in the EDs resuscitation room. The inclusion criteria for the team call are a patient after a physical trauma with an objective or suspected life-threatening injury or an injury of more than one organ system (penetrating trauma head / torso, massive bleeding, massive blunt trauma, instable pelvis fracture, two or more major fractures, flail chest, ABCDE instable, fall >6m, trapped >30 minutes).

During the inclusion period, patients arrived from the northern part of the island of Funen, Denmark (primary trauma) and from the whole region of Southern Denmark (secondary trauma). There are 290,000 inhabitants living in the catchment area for primary trauma, and 1,220,000 for secondary trauma (figure 1).

Figure 1: Catchment area

STEMI: ST-elevation myocardial infarction patients

The OUH stroke trigger team consists of a thrombolysis consultant from the neurology department, ED nurse, neurology nurse, laboratory assistant and secretary. Inclusion criteria for the team call is a suspected acute ischaemic stroke, less than 4.5 hours after debut of symptoms, and a previously self-reliant patient. During the inclusion period, patients were received in the EDs computed tomography scanner and resuscitation room. They arrived from the island of Funen, including the outlying smaller islands, and the eastern part of southern Jutland, Denmark. This amounts to a catchment area of 754,000 inhabitants (figure 1).

The STEMI trigger team at OUH consists of an interventional cardiologist and three specialised nurses. The patients are received in the cardiac catheterization laboratory following prehospital visitation. The inclusion criteria for the team call are typical symptoms for myocardial infarction for less than 12 hours and electrocardiogram findings suggesting STEMI. Also, patients with cardiac arrest with a suspected cardiac reason are included in this group. The patients arrive from the whole region of Southern Denmark, with 1,220,000 inhabitants (figure 1).

The MEP trigger team at OUH consists of a medical consultant on duty in the ED, senior medical resident, two ED nurses, secretary, orderly, laboratory assistant and a radiology technician. If the patient's airway is threatened, or if the patient is unconscious with a Glasgow Coma scale of less than 8, an anaesthesiologist and an anaesthesiology nurse are part of the MEP trigger team. Patients are received in the EDs resuscitation room. The inclusion criteria for the team call is one or more of the following: threatened airway, systolic blood pressure < 80 mmHg, pulse rate > 130/min, respiratory rate > 35/min, oxygen saturation < 80% or Glasgow Coma Scale < 8. Also, patients with cardiac arrest with a suspected non-cardiogenic reason are included in this group. The patients arrive from the northern part of the island of Funen, Denmark, resulting in a catchment area of 290,000 inhabitants (figure 1).

Information on inhabitants in the different catchment areas are retrieved from Statistics Denmark (numbers from 1 January 2018).

Data was analyzed using Stata/IC (version 15).

Results:

In the 35 observation months, there were 8,075 trigger team activations for adult patients at arrival to OUH, range 1-18, median 7.6 per day. An additional trigger team was activated in 36 cases (0.5%), for example an initial trauma trigger call was supplemented with a MEP trigger call.

Whereas 7,568 patients (94.7%) experienced one trigger call during inclusion period, 374 (4.6%) experienced two trigger calls at different points of time, and two patients experienced 13.

The demographic details of patients involved in all trigger calls are shown in table 1. 16.7% of all trigger team activations were trauma, 28.3% STEMI, 19.7% stroke and 35.3% MEP. This corresponds to 161/100,000 person years (py) with trauma calls, 64/100,000 py STEMI calls, 72/100,000 py stroke calls and 340/100,000 py MEP calls.

Patients from the different calls had a mean age of 48 for trauma calls, and a similar mean age of around 65 for the other calls. Most of the trauma and STEMI call patients were male, whereas the female / male distribution was more even for stroke and MEP calls. Seven-day mortality was lowest for stroke patients and highest for MEP. Transferral rate for patients to the intensive care unit was lowest for stroke and highest for trauma call patients.

Table 1: Demographic information on all included patients

Trigger team	Activations	Activations / day (range $\pm$ SD)	Activation / 100,000 inhabitants / year	Sex (female / male [%])	Age (mean $\pm$ SD)	LOS (days mean $\pm$ SD)	7-day mortality (%)	30-day mortality (%)	90-day mortality (%)	ICU (%)
Trauma	1,347	1.3 (1-6 $\pm$ 1.0)	161	29 / 71	48 $\pm$ 20	10.5 $\pm$ 18.6	10.4	12	13.2	37.1

STEMI	2,284	2.2 (1-8 ± 1.4)	64	27 / 73	65 ± 13	5.2 ± 7.2	5.7	7.7	9.1	10.9
Stroke	1,594	1.5 (1-7 ± 1.1)	72	42 / 58	65 ± 16	12 ± 22	3.4	5.3	6.8	7.9
MEP	2,850	2.7 (1-9 ± 1.5)	340	47 / 53	66 ± 18	7.4 ± 11	16.9	25.1	31	26.8

STEMI: ST-elevation myocardial infarction patients; MEP: medical emergency patients; SD: standard

deviation; LOS: length of stay; ICU: intensive care unit

We found no statistical difference regarding the day of arrival for patients in all trigger teams. Looking at time of arrival, most trigger team patients arrive during daytime, with the amount of trauma patients peaking in the early evening, STEMI patients around noon, and MEP in the morning. Hardly any patients suspected for stroke arrive in the early morning hours.

Figure 2 shows the Kaplan-Meier survival graph for patients of the different trigger calls, with the highest mortality for MEP.

Figure 2: Kaplan-Meier survival estimates

The final diagnosis of patients included in the study are shown in figure 3. Whereas patients from trauma, STEMI and stroke calls were mainly discharged within a few ICD10 main coding areas, patients from MEP calls had discharge diagnosis within many different ICD10 main coding areas.

Figure 3: Final diagnosis (International classification of diseases, version 10)

a) Trauma patients, b) STEMI patients, c) Stroke patients, d) MEP

STEMI: ST-elevation myocardial infarction; MEP: medical emergency patients

Discussion:

Huge improvements regarding their outcome were made in recent years for patients with trauma, stroke and STEMI. There is a lack of national databases and guidelines for MEP to reach comparable successes for this patient group. MEP are complex, have a low chance of survival, and they are frequent.

There are well established databases for patients with trauma (Danish Trauma Registry, TraumaRegister DGU), STEMI (Acute Coronary Syndrome STEMI (ACS) Registry) and stroke (SITS – Safe Implementation of Treatment in Stroke), with published studies illuminating their mortality and outcomes (13–16).

Similar databases for MEP are lacking, and only few studies have been published describing this patient group (4,5,7,17–21). The survival rates and base characteristics for patients with trauma, STEMI and suspected stroke at OUH match those published in international databases (13,14,16).

In this study, we were able to compare the outcome of all patients admitted by trigger teams to a level 1 university hospital. There are only 21 emergency hospitals in Denmark. OUH is the only hospital in a perimeter of 50 km, as well as the only level 1 hospital in the whole region. All patients fulfilling the inclusion criteria for the different trigger calls were admitted here and could not be transported to an alternate hospital. This makes comparison of the different patient groups possible and is one of the strengths of the study.

In concordance with earlier studies (18,21) we can show a high mortality rate for MEP, higher than for the patients received by the other trigger teams. This is also true when comparing patients with suspected stroke and MEP, who show approximately the same base statistics (i.e. age and gender). From our data, we cannot conclude the reason for this, but it probably partially reflects the improved care

183 after the introduction of thrombolysis, and a therefore reduced mortality rate for stroke patients. It
184 could also be a sign for a higher multimorbidity of MEP.

185 Looking at ICU admission, two groups of patients are sticking out, trauma patients and MEP. Both show
186 a high percentage of ICU admission (37.1% and 26.8%, respectively), but more MEP die within 90 days
187 after admission (13.2% and 31%, respectively).

188 Our results illustrate that we receive more MEP per 100,000 inhabitants than patients for the other
189 trigger teams. In other studies, it was not possible to show this divergence, as there are usually multiple
190 hospitals in the catchment areas, and there could be a distribution of the patients to different hospitals
191 according to the suspected severity of their acute symptoms.

192 It is not surprising that the final discharge diagnosis for patients with trauma, suspected stroke and
193 STEMI were limited to a narrow spectrum of the ICD10 catalogue. However, that is different for MEP.
194 Here, we found a wide distribution of diagnoses, ranging through the entire ICD10 catalogue. The most
195 common diagnosis groups were those describing respiratory and circulatory diseases. This shows the
196 inhomogeneity of this patient group and illuminates the complexity of developing diagnostic and
197 treatment guidelines for MEP that incorporate all possible aspects.

198 In 2014, a national register and a definition of MEP was requested in Germany (21), to better define the
199 patient population and develop guidelines. In Germany, in 2016, a consensus document was published,
200 with focus on patients arriving at the hospital with sepsis, amongst other diseases (23). Other MEP were
201 not included in the study. An Australian study could show that MEP received by an ICU based trigger
202 team had a shorter length of stay (24). Here, the setup did not include emergency physicians.

203 A study published in 2018 reviewed the outcome of MEP admitted in a similar set up as ours, with
204 equally high mortality, but also a much higher ICU admission (25). This probably reflects different local

205 setups and lack of international guidelines. In Denmark, only one study is published focusing on MEP
206 (18).

207 MEP are heterogenic, and as there is no international agreement on their receival and treatment in the
208 ED, their path through the ED differs from hospital to hospital. A review from 2017 concluded that it was
209 not possible to suggest practice recommendations for MEP (22). Reason for this was the lack of
210 sufficient data on MEP.

211

212 Our study has limitations. Some patients with cardiac arrest could have been coded as STEMI patients or
213 MEP, thus raising the 7-day mortality. The study was composed as a single centre study and reflects the
214 local setup for the trigger teams. We have no information on base values, Charlson comorbidity index,
215 or lab findings to compare the different patient groups.

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219 **Conclusion:**

220 In this study, the amount and outcome of patients received by specialized teams for trauma, stroke,
221 STEMI and MEP at a level 1 hospital can be compared, as there is definiteness regarding the catchment
222 areas. MEP have a higher mortality and ICU admission rate than patients of the other groups. Their final
223 diagnosis ranges through the whole ICD10 catalogue.

224

225

226

227 **List of abbreviations:**

228 STEMI ST-elevation myocardial infarction

229 MEP Medical emergency patients

230 ED Emergency department

231 OUH Odense University Hospital

232 LPR National Patient Registry (Landspatientregisteret)

233 SD Standard deviation

234 LOS Length of stay

235 ICU Intensive care unit

236 ICD10 International classification of diseases, version 10

237 SITS Implementation of Treatments in Stroke

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239

240

241 **Declarations:**

242 Ethics approval and consent to participate:

243 The study was approved by the Danish Health and Medicines Authority (File no. 3-3013-1385/1) and the
244 Danish Data Protection Agency (File no. 2013-41-2435). In accordance with Danish law no further
245 approval was needed. The reporting of this study conforms to the STROBE statement (26).

246 Consent for publication not applicable.

247

248 Availability of data and materials:

249 The datasets used and/or analysed during the current study are available from the corresponding author
250 on reasonable request.

251

252 Competing interests:

253 The authors declare that they have no competing interests.

254

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258

259 Authors' contributions:

SP and AL analyzed and interpreted the patient data. SP mainly wrote the publication. AL and MB were major contributors in writing the manuscript. LF, SB and LO contributed to data collection and interpretation.

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Figures

Figure 1

Catchment area STEMI: ST-elevation myocardial infarction patients

Figure 2

Kaplan-Meier survival estimates

Figure 3

Final diagnosis (International classification of diseases, version 10) a) Trauma patients, b) STEMI patients, c) Stroke patients, d) MEP STEMI: ST-elevation myocardial infarction; MEP: medical emergency patients