

The Danish quality database for prehospital emergency medical services

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Aim of database: The aim of the Danish quality database for prehospital emergency medical services (QEMS) is to assess, monitor, and improve the quality of prehospital emergency medical service care in the entire prehospital patient pathway. The aim of this review is to describe the design and the implementation of QEMS.

Study population: The study population consists of all “112 patient contacts” defined as emergency patients, where the entrance to health care is a 112 call forwarded to one of the five regional emergency medical coordination centers in Denmark since January 1, 2014. Estimated annual number of included “112 patients” is 300,000–350,000.

Main variables: We defined nine quality indicators and the following variables: time stamps for emergency calls received at one of the five regional emergency medical coordination centers, dispatch of prehospital unit(s), arrival of first prehospital unit, arrival of first supplemental prehospital unit, and mission completion. Finally, professional level and type of the prehospital resource dispatched to an incident and end-of-mission status (mission completed by phone, on scene, or admission to hospital) are registered.

Descriptive data: Descriptive data included age, region, and Danish Index for Emergency Care including urgency level.

Conclusion: QEMS is a new database under establishment and is expected to provide the basis for quality improvement in the prehospital setting and in the entire patient care pathway, for example, by providing prehospital data for research and other quality databases.

Keywords: emergency medical services, ambulance response times, emergency medical dispatch, quality improvement

Background and aim of database

The emergency care system in Denmark has been reorganized during recent years, and a Danish quality database on emergency care has been established to assess, monitor, and improve quality. The Danish quality database for prehospital emergency medical services (QEMS) is one of the three national sub-databases. The two other databases cover emergency admissions and trauma. The aim of the QEMS is to assess, monitor, and improve the quality of prehospital emergency medical service (EMS) care in the entire patient pathway and acts as basis for clinical and health-service research.

Provision of prehospital emergency care is subject to variations in organization among EMS providers, with domestic and regional as well as international differences. There are few uniform quality indicators and standards based on high-level evidence, and most standards are based on expert panel opinions.¹⁻⁴ Some specific diagnostic groups benefit from quality indicators and standards, such as cardiac

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arrest,^{5,6} myocardial infarction (MI),^{7,8} stroke,^{9,10} and severe injury. The major challenge and difficulty in emergency care, especially in the prehospital setting, is that the vast majority of patients present with symptoms and not diagnoses. Thus, EMS care has to be initiated and delivered on the basis of the symptoms with limited knowledge about the patient's objective condition and medical history.

In 2013, a working group was established by the Danish Regions with medical and administrative representatives from all five health regions, with the task of formulating recommendations on indicators and standards of EMS quality. The working group consisted of medical directors and administrative professionals from prehospital organizations from each of the five regions. The selection of quality indicators was a consensus process, based on literature and the actual availability of prehospital data in our system and national registries on specific emergency conditions, cardiac arrest, MI, and stroke. The formal Steering Committee for QEMS under "The Danish Clinical Registries – a national improvement program" was established in 2014 with medical representatives from the five public regional EMS organizations, a professor in prehospital and emergency medicine and representatives from the Danish Society of Cardiology, the Danish Society of Neurology, and a clinical epidemiologist and a statistician from the Danish Clinical Registries. An initial pilot test of indicators is currently underway in 2015. Due to lack of high evidence, we could not define all standards a priori. A process of defining the remaining standards will follow evaluation of the pilot test. Ultimately, aggregated data at a regional level will be available monthly, and national and open-source annually, and provide stimulus for EMS improvement.

The aim of this review is to describe the design and the implementation of QEMS, a new Danish clinical quality database.

Setting

In Denmark, access to health care is a tax-financed service, and access to EMS and emergency hospital care is free of charge. During the last 7 years, the Danish prehospital EMS system has undergone major changes. Five regional health care regions were established and were responsible for the prehospital EMS in their own region. These regional EMS organizations are responsible for the entire prehospital patient care pathway, from the 112 call made to the recently established emergency medical coordination centers (EMCC), through the care given on scene and during transport, and until the patient arrives at hospital, or is taken care of without being brought to hospital. At the EMCC, the 112 call is assessed by nurses or paramedics.

The national emergency number 112 covers both EMS, fire and police, and is answered by the police, except in the Capital Region. Here, the Copenhagen Fire Brigade receives 112 calls. Since May 2011, the 112 calls are forwarded to the regional EMCC. All decisions regarding medical prehospital responses are made at the EMCC, based upon a focused, structured interview of the person calling 112. Assessment is performed according to a criteria-based dispatch protocol, The Danish Index for Emergency Care (Danish Index).¹¹

The Danish EMS is a two- or three-tier system, with ambulances as the basic-level response, an intermediate level with paramedic- or nurse-manned cars, and an advanced level with dedicated prehospital doctors (consultant anesthesiologists) in cars (mobile emergency care unit) or helicopter (helicopter emergency medical service [HEMS]) in a rendezvous model. The Danish HEMS has only recently been added to the system, established as national HEMS in 2014. Ambulances are run by municipal or private companies and staffed with emergency medical technicians or paramedics, educated and trained to national minimum standards according to national regulations.¹² The regional EMS organizations contract with ambulance providers after European Union-regulated tenders. The regional EMS is responsible for the quality of care delivered in the entire EMS pathway, including the care delivered by private ambulance contractors.

All EMS providers nationwide are to use the same electronic prehospital patient record system, under implementation in 2015.

Study population

The study population consists of all "112 patient contacts" defined as patients in need of emergency help, where access to the health care system is a 112 call forwarded to the EMCC. The population in Denmark is 5.6 million. Annually, there are ~360,000 112 calls transferred to the EMCC. The corresponding number of 112 patient contacts will be lower, estimated to be 300,000–350,000 as there might be more 112 calls on the same patient. The database includes data acquired from each of the five regional EMCC and – when fully implemented – data from the prehospital electronic patient record. Data from the Danish Database for Acute Hospital Contacts will also be included in the future.

EMCC call-takers assess the level of emergency and respond in accordance with the Danish Index for Emergency Care, which consists of 37 main symptoms. The index defines five levels of urgencies: A: life-threatening or potentially life-threatening condition, immediate response required; B: urgent, but not life-threatening condition; C: nonurgent condition that needs an ambulance; D: nonurgent supine patient transport;

Table 1 Indicators for quality at regional EMS organizational level

Number	Indicator	Definitions
1	Time to arrival of first professional response on scene	The time interval is measured from the time that EMCC electronically receives the 112 call message from the police/fire brigade and until the first unit with any professional responders – that is, ambulance personnel, paramedic or nurse, or a prehospital doctor (by MECU or HEMS) – arrives at scene
2	a) Time to arrival of the first supplemental prehospital personnel and b) time to patient's first contact with a doctor	The time interval a) is measured from the time stamp that EMCC electronically receives the 112 call message from the police/fire brigade and until the arrival of first unit with supplemental professional responders – that is, paramedic, nurse, or prehospital doctor (MECU or HEMS). The time interval b) is measured from the time that EMCC electronically receives the 112 call message from the police/fire brigade and until the patients meets the first doctor, either a prehospital doctor or the first doctor to see the patient after arrival at hospital (when this variable becomes available from the Danish Database for Acute Hospital Contacts)
3	Time from arrival to the hospital until the patient has been taken over by the hospital personnel	

Abbreviations: EMS, emergency medical service; EMCC, emergency medical coordination center; MECU, mobile emergency care unit; HEMS, helicopter emergency medical service.

and E: other service or advice/instruction including taxi transportation (no ambulances dispatched). The EMCC call-taker assigns the letter appropriate for the level of urgency coupling it with a specific number to the case according to the Danish Index criteria code that corresponds to the main symptom and specific subgroup symptom. Time stamps are automatically registered electronically at the EMCC.

Quality indicators

Nine indicators were selected and defined. The indicators aim at describing quality at the regional EMS organizational level and the quality of the medical care. As the prehospital

electronic patient record has not yet been fully implemented, only some of the indicators are monitored in the initial pilot test phase.

Indicator numbers 1–3 describe quality at an EMS organizational level; these include only responses of level of urgency A (Table 1). Time from arrival until the patient is handed over to the hospital personnel (indicator 3) awaits the electronic patient record.

Indicator numbers 4–9 describe the quality of the medical care (Table 2). Concerning the three medical emergencies, cardiac arrest, ST-elevation MI, and stroke, all these await full implementation in the electronic patient record. In the

Table 2 Indicators for quality of medical care

Number	Indicator	Comment
4	The proportion of 112 calls coded according to Danish Index	The proportion of 112 calls where the EMCC staff assigned level of urgency and the specific number to the case according to the Danish Index criteria code
5	a) The proportion of 112 patients not brought to hospital by ambulance and b) the proportion of 112 patients not brought to hospital by ambulance calling 112 again within 24 hours	Total and divided into: a) patients given advice or other care by the EMCC staff or b) patients treated and released by prehospital personnel at scene
6	Proportion of patients resuscitated after cardiac arrest	Return of spontaneous circulation before arrival at hospital
7	Time to arrival at center for thrombolytic or endovascular treatment in acute ischemic stroke	The patient group is defined by the diagnosis, and data will be obtained from the national quality database on stroke
8	Time to arrival at center for primary percutaneous coronary intervention in patients with ST-elevation MI	The patient group is defined by the diagnosis, and data will be obtained from the regional and national databases on cardiac diseases or the Danish National Patient Registry
9	Proportion of 112 calls where the patient's unique civil registration number is registered	

Abbreviations: EMCC, emergency medical coordination center; MI, myocardial infarction.

meantime, data will be obtained from the national research database, the Danish out-of-hospital Cardiac Arrest Registry, and regional and national databases.⁵

Indicator number 4, the proportion of 112 calls coded according to Danish Index, was included to assure registration of the initial symptom as this is the only patient information available at time of the decision on level of urgency.

Indicator number 5 was defined in order to monitor the proportion of patients calling 112 classified as having no need for an ambulance and/or no need for hospital care, who died or called 112 again within 24 hours.

In Denmark, each citizen is assigned a unique ten-digit civil registration (CPR) number, universally used in all patient records and Danish registries, and enables unambiguous linkage between these registries. Thus, the registration of this number, as indicator 9, is essential as a key to patient care and for follow-up.

Main variables

Table 3 describes the variables included in the primary data set. Apart from being an identifier for an event and person, the variables comprise mainly date and time stamps identifying when the 112 call was received at the EMCC, when the dispatcher sent a prehospital resource, and when the first resource arrived. The Danish Index, including urgency level, is also included in the data set.

Data quality is not yet assessed because the data set is still under establishment. It is, however, a fact that the CPR number is missing in a substantial proportion of patients because it is not always possible to extract this information from the caller.

Follow-up

Patients with a valid Danish CPR number are followed from the date of 112 call and until death for up to 2 days after the task has been completed using the Danish Civil Registration System.¹³

Examples of research

The database is under establishment, and no studies have been performed yet, but there are previous studies using some of similar data from three regions comparing the Danish Index with diagnosis and outcome after hospitalization.^{11,14,15} Data will be available to researchers after application to the steering committee, provided that permissions from the Danish Data Protection Agency and/or Ethical Committee were obtained.

Administrative issues and funding

The QEMS is an approved clinical quality database (The Danish Data Protection Agency record no 2013-58-0026, the Central Denmark Region record no 1-16-02-508-14, and

Table 3 Variables registered in the Danish quality database for prehospital emergency medical services

Variable name	Definitions	Format
ID	Unique identification of the sequence of events	Number
CVR	Unique ten-digit personal civil registration number	Number (ten-digit)
Age	Age at the day of 112 call	Number
RegCode	Region code identifying the region the EMCC belongs to	Number
RegName	Region name	String
ReceivedAMKDateTime	What date and time the 112 call is received at EMCC	Date and time
DispatcherDateTime	Date and time of dispatchers sending the prehospital resource	Date and time
FirstArrivResDateTime	Date and time of the first professional prehospital resource arriving at the scene	Date and time
FirstArrivResource	Type of the first professional prehospital resource arriving at the scene	String
FirstArrivAdvancResDateTime	Date and time of the first advanced prehospital resource arriving at the scene	Date and time
FirstArrivAdvancResource	Type of the first advanced prehospital resource arriving at the scene	String
DanishIndex	Criteria-based dispatch protocol: Danish Index for Emergency Care (Danish Index), including urgency level A–E	String
ClosureType	The way in which the mission is completed: a) brought to hospital, b) treated and released at the scene, or c) by the EMCC given other advice at the 112 phone call without an ambulance arriving at the scene	Categorical
ClosureTypeDateTime	Date and time of the closure type	Date and time

Abbreviation: EMCC, emergency medical coordination center.

the State Serum Institute record no 14/18767) funded by the Danish Regions and receives administrative, epidemiological, and biostatistical support from the Danish Clinical Registries (Danish Regions). Aggregated data at regional level will be reported annually in a published report, and data will be provided monthly to the Danish Regions for use in each Regions information system.

Conclusion

The QEMS is a new database under establishment. Aggregated data at a regional level will be available monthly, and national and open-source annually, providing incentive for improvement of patient care pathways in the prehospital setting.

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