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REVIEW

The Danish Anaesthesia Database

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Kristian Antonsen[1]
Charlotte Vallentin Rosenstock[2]
Lars Hyldborg Lundstrøm[2]

[1]Board of Directors, Copenhagen University Hospital, Bispebjerg and Frederiksberg Hospital, Capital Region of Denmark, Denmark; [2]Department of Anesthesiology, Copenhagen University Hospital, Nordsjællands Hospital-Hillerød, Capital Region of Denmark, Denmark

Aim of database: The aim of the Danish Anaesthesia Database (DAD) is the nationwide collection of data on all patients undergoing anesthesia. Collected data are used for quality assurance, quality development, and serve as a basis for research projects.

Study population: The DAD was founded in 2004 as a part of Danish Clinical Registries (Regionernes Kliniske Kvalitetsudviklings Program [RKKP]). Patients undergoing general anesthesia, regional anesthesia with or without combined general anesthesia as well as patients under sedation are registered. Data are retrieved from public and private anesthesia clinics, single-centers as well as multihospital corporations across Denmark. In 2014 a total of 278,679 unique entries representing a national coverage of ~70% were recorded, data completeness is steadily increasing.

Main variable: Records are aggregated for determining 13 defined quality indicators and eleven defined complications all covering the anesthetic process from the preoperative assessment through anesthesia and surgery until the end of the postoperative recovery period.

Descriptive data: Registered variables include patients' individual social security number (assigned to all Danes) and both direct patient-related lifestyle factors enabling a quantification of patients' comorbidity as well as variables that are strictly related to the type, duration, and safety of the anesthesia. Data and specific data combinations can be extracted within each department in order to monitor patient treatment. In addition, an annual DAD report is a benchmark for departments nationwide.

Conclusion: The DAD is covering the anesthetic process for the majority of patients undergoing anesthesia in Denmark. Data in the DAD are increasingly used for both quality and research projects.

Keywords: anesthesia, quality indicators, complication, registries, epidemiology, registry-based research

Aim of database

The principal aim of the Danish Anaesthesia Database (DAD) is the nationwide collection of data on all Danish patients undergoing anesthesia. Collected data are used for quality assurance, quality development, and serve as a basis for research projects.

Study population

The database was founded in 2004 and during the last decade the national coverage has been stable around 60%–70%. In this context anesthesia is defined as any anesthesia or sedation, general, local or combined provided by a specialist in anesthesiology (medical doctor [MD]), either directly or during direct supervision (ie, nurse anesthetist

Correspondence: Charlotte Vallentin Rosenstock
Department of Anesthesiology, Copenhagen University Hospital, Nordsjællands Hospital-Hillerød, Dyrehavevej 29, 3400 Hillerød, Denmark
Tel +45 4829 7598
Fax +45 4829 4213
Email charlotte.rosenstock@regionh.dk

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or MD during specialist training). Thus, in principle, the study population is the entire Danish population undergoing anesthesia annually, and the database can comprise up to an estimated total of 400,000 unique cases per year. Data are retrieved from both public and private anesthesia clinics, large and small practices, and both single-center and multihospital corporations across Denmark. The Danish health care system is however mostly publicly funded with tax-financed universal access. In 2014, a total of 278,679 unique entries were recorded in the DAD. As a part of the Danish Clinical Registries (Regionernes Kliniske Kvalitetsudviklings Program [RKKP]), reporting of data to the DAD is in principle mandatory. In reality however, it has not yet been possible to ensure complete data coverage, but data completeness is steadily increasing.

Main variables

The DAD is a national, clinical quality assurance database containing selected quantifiable indicators, covering the full anesthetic process (from preoperative assessment through anesthesia/surgery to the postoperative recovery period). Data are gathered online by clinical personnel in the individual departments and reported through data-collection systems either directly to Tieto Klinisk Måle System or by web-based solution (SAS, web services). In 2014, 36 out of a total of 44 public hospitals reported 269,967 anesthetic cases and nine out of 19 registered private clinics reported 8,712 cases. Variables registered in the DAD include patients' individual social security number (assigned to all Danes) and both direct patient related-lifestyle factors enabling a quantification of patients' comorbidity as well as variables that are strictly related to the type, duration, and safety of anesthesia. Data covering patients' own experiences of quality are not collected. In 2014, the DAD underwent a major revision during which the scientific evidence behind previous quality indicators was scrutinized and newly defined. Recorded information is now aggregated for determining 13 defined quality indicators thereby providing a benchmark for clinical outcome. Quality fulfillments are compared with evidence-based predefined standards (see Table 1). Variables reflecting patient comorbidity include age, American Society of Anesthesiologists physical classification system I–V, sex, height, weight, smoking and drinking status. Table 2 shows registered complications in the DAD. Data and specific data combinations can be extracted within each department in order to monitor patient treatment. In addition, an annual DAD report is a benchmark for departments nationwide.

Data validity

Historically, a principal explanation for a relatively low degree of coverage has been data transfer challenges from local databases via a web interface to the DAD, often rendering it difficult to enforce the concept of mandatory registration, especially at the individual hospital/clinic level. Thus, the main reason for the low degree of national coverage may be explained by specific hospitals/clinics not reporting data at all. It is estimated that public hospitals not reporting at present comprise an estimated 70,000 cases per year. Unreported cases from private clinics are estimated to be ~50,000 to 60,000 cases per year, the majority being short duration cases

Table 1 Danish Anaesthesia Database quality indicators

Preoperative	Fraction of patients without information of preoperative risk factors, indicator standard <5%
Airway management	Fraction of patients with unanticipated difficult airway management, indicator standard <6%
	Fraction of patients with impossible mask ventilation, indicator standard <0.16%
Perioperative	Fraction of patients with insufficient regional anesthesia, indicator standard <3%
	Fraction of patients with anesthesia related complications, indicator standard <3.5%
	Fraction of patients undergoing elective cesarean section during general anesthesia, indicator standard <5%
	Fraction of patients with regional anesthesia undergoing elective cesarean section requiring a conversion to general anesthesia (emergency grade 4), indicator standard <1%
	Fraction of patients undergoing emergency cesarean section (grade 1–3) during general anesthesia, indicator standard <15%
	Fraction of patients undergoing emergency cesarean section with regional anesthesia requiring a conversion to general anesthesia (grade 1–3), indicator standard <1%
	Fraction of patients with non-emergency bleeding where hemoglobin level is measured prior to erythrocyte transfusion, indicator standard =100%
Postoperative	Fraction of patients arriving at the postoperative observation unit with hypothermia (<36°C) after a duration of anesthesia >2 hours, indicator standard <5%
	Fraction of patients with severe postoperative pain (numeric rating scale >7) in the postoperative observation unit, indicator standard <5%
	Fraction of patients with nausea requiring treatment in the postoperative observation unit, indicator standard <2%

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Table 2 Danish Anaesthesia Database registered complications

Accidental dural puncture
Aspiration
Anaphylactic shock
Prolonged neuromuscular blockade
Dental damage
Medication/device error
Malignant hyperthermia
Cardiac arrest
Unanticipated respiratory insufficiency necessitating non-invasive ventilation/tracheal intubation prior to discharge from the postoperative observation unit
Anesthesia awareness
Patient death

involving patients undergoing ear, nose, and throat surgery. Thus, the total number of private clinics providing anesthetic services is presently unknown. The information technology infrastructure of the database is presently under reconstruction. When completed, it will finally allow data transfer at all levels, thus anticipating coverage above 90% and perhaps even approaching 100% from all public hospitals by 2017.

Despite a low degree of national coverage, several surveys have demonstrated that the patients who are registered in the DAD are most likely also registered in the Danish National Health Register. In general, the DAD data coverage concerning public hospitals is considered high because entered data in addition to measuring quality is used for productivity measurement, thereby reinforcing follow-up registrations on missing patients. Thus, for specific surgical or anesthetic procedures registered in the DAD, there is a 98% to 99% correspondence to records also found in the Danish National Health Register.[1–3] Quality of data entry is controlled during the process of registration in the DAD, as most variables are predefined, mandatory for registration and are linked to user manuals that are an integrated part of the DAD interface for each variable. Further, the designs of the categories of the registered parameters in the DAD are mostly exclusive and exhaustive. However, in previous versions of the database the ability to register complications was not intuitively easy, in addition to some systems having "no complications" as a default answer. Both issues have been altered in the present version of the database in order to improve data quality. Because multiple numbers of clinical evaluators register many parameters concerning anesthetic patients in an everyday clinical set up, we cannot ensure controlled and uniform evaluation and registration of all parameters for all patients. However, the registration platform comprises several validation and completion rules, securing data completeness and preventing obscure data registration. The number of missing values (variable categorized as "unknown") range between 0% and 11% for specific variables. Generally, the completeness of variables is high with missing values less than 2% for the large majority of the variables due to the fact that the final DAD record for each patient cannot be delivered to the central server without the obligatory fields filled in.

Follow-up

All data entered are transferred to an analytic portal every 24 hours allowing for day to day reporting and follow-up at the departmental level. All data are aggregated annually and contributing departments and clinics are measured through the clinical indicators.

Examples of research

Scientific papers from the DAD have been published in several major international peer-reviewed journals and include traditional epidemiologic studies focusing on interventions, organizational- and patient-related risk factors of importance for the perioperative treatment of patients. As each patient is entered into the database with a unique identifying social security number from the centralized civil register it is possible to link information from the DAD to other research databases or population-based registries. Thus, some publications are studies based upon a merger of more data sources than the DAD,[1,3–6] and others are based upon data retrieved solely from the DAD.[7–11] In the different studies the various covariates describing comorbidity have either been retrieved directly from the DAD, or if needed parameters have been retrieved from other data sources such as the Danish National Registry of Patients. Some of the publications are primarily dealing with specific anesthetic procedures, while other studies are focusing on specific types of surgery (eg, abdominal and hip fracture surgery).

The examples of studies previously represent traditionally epidemiological cohort studies. In addition, the DAD has served as a platform for a large intervention study, the DIFFICAIR trial, which was a stratified, parallel group, cluster (cluster = department) randomized, multicenter trial involving 28 departments of anesthesiology in Denmark. Patients were randomized to two different strategies of preoperative airway evaluation before tracheal intubation in association with general anesthesia. The database was programmed so that the registration of the specific airway evaluation was mandatory for the intervention group, but invisible to control departments. Data collection is finished and the results have been accepted for publication.[12,13]

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Administrative issues and funding

The DAD is a part of the RKKP which constitutes the infrastructure of National Clinical Quality Databases as well as the funding. RKKP's primary objective is to ensure a continued improvement in the utilization of the Danish clinical registries in a clinical as well as managerial, and research oriented sense. The RKKP supports centers of epidemiology and biostatistics affiliated to specialized university departments, with the responsibility for analytical methods including defining relevant register population, indicator algorithms, risk adjustment, and relevant interpretation of results in the yearly reports. Funding is revised and granted annually and the DAD has to pass appraisal in the National Health Authority every third year, with assessment of fulfillment of national criteria on functionality, data safety, and methodology. The DAD is also approved by the Danish Data Protection Agency (file number 2012-58-0023) and Statens Serum Institut (file number 14/15955). The database is led by a steering committee with representatives (clinicians) from all five national regions in Denmark, including a member and a chairman appointed by the Danish Society for Anesthesia and Intensive Care Medicine, thus representing the main clinical stakeholders.

Conclusion

The DAD is covering the anesthetic process for the majority of patients undergoing anesthesia in Denmark. The national coverage has until now been ~70%. However, the degree of completeness and data quality will improve steadily with the latest revision of indicators and improved data entry in the following year.

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Disclosure

All authors are members of the steering committee of DAD. The authors have no other conflicts of interest to disclose in this work.

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