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Data Reuse Through Anesthesia Data Warehouse: Searching for New Use Contexts

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Abstract. Introduction: Due to high volumes of data routinely recorded through Hospital Information System, data reuse has become important in recent years. A data warehouse was developed in the Lille University Hospital to reuse anesthesia data. At the moment, it is mainly used for clinical research, by offering extraction of data tables to answer a clinical question. In this article, we try to identify other contexts of data reuse than the one currently provided by the data warehouse, in comparison with those in the literature. Material and methods: A semi-structured interview grid was designed so that to tackle respondents' experience with clinical data reuse, the various contexts in which the data are reused along with the information systems they currently use to proceed and the difficulties they encounter. A semi-inductive thematic analysis process was performed to identify meaningful semantic units and grouped them into thematic categories. Results: Ten anesthetists were interviewed; three main contexts emerge: research and knowledge discovery, evaluation of professional practices and organizational management. Data are accessed through complicated administrative procedures and clinicians have to perform tasks beyond their competencies. Discussion: Difficulties encountered when searching for data express the need for easy and continuous access to data.

Keywords. Data reuse, Data warehouse, Usability

1. Introduction

A clinical data warehouse was developed in the Lille University Hospital [1]. It is fed with data from two sources: Anesthesia Information Management System (AIMS) DIANE® (Bow Medical, Amiens, France) and administrative software CORA-PMSI (McKesson, San Francisco, United States). Data from the AIMS consist of patient history, vital signs (arterial pressure, heart rate, end-tidal volume...), various stages of the procedure (intubation, start of surgery...) and drugs administered. The main function of the AIMS is to provide more accurate records (e.g. in the case of a legal procedure) by automatically collecting data. It can also provide alerts and prompts according to evolution of vital signs (e.g. value outside threshold), drug administration (e.g. dosage according to patient characteristics) or the respect of key steps of the

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patient care. The administrative software records information about the hospital stay: medical acts, diagnosis and medical units.

This data warehouse enables to cross data from the two source systems. Today, it is mainly used for research purpose following a defined data reuse process and answering a clinical question [2]: 1) during a first meeting between a clinician, a statistician and the computer scientist in charge of the data warehouse, background of the study is presented by the clinician, objectives of the study are defined and data necessary to collect are listed, 2) data are extracted from the data warehouse and the statistician performs a descriptive analysis of the dataset, 3) during a second meeting, statistical plan is defined according to data quality highlighted in the previous step, 4) analysis is performed by the statistician and 5) in a last meeting, results are presented to the clinician.

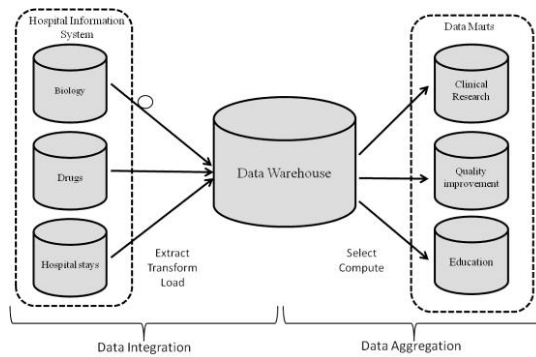


Figure 1. Architecture of a data warehouse and purposes of data marts

As reported in literature, usages of clinical data warehouses may go further than this process and purposes of data marts may include [3-7] (Figure 1): knowledge discovery, quality improvement, practice management, education or data quality. To our knowledge, the Information System Department is used to query other hospital applications, as the biology system or the payment system, mainly for decision-making. Until now, data from these different systems can hardly be combined for common analyses.

In this article, we try to identify other contexts of data reuse than the one currently provided by the clinical data warehouse, in comparison with those in the literature. We further plan to propose a new application covering these other use contexts and completing functionality of the AIMS and the existing Data Warehouse.

2. Material and Methods

Data were collected through semi-structured interviews and analyzed through a semi-inductive thematic analysis process. Participants were recruited from the two units most involved in the exploitation of the data warehouse.

2.1. Semi-structured interviews

A semi-structured interview grid was designed by one ergonomist and validated by a second one. The grid was designed so that to tackle respondents' experience with

clinical data reuse, the various contexts in which data are reused along with the information systems they currently use to proceed. The target audience of this interview grid consisted of the medical professionals from the anesthesiology unit, i.e. anesthesiologists, residents, and the head of the unit. The interview grid comprised the following questions:

- Do you look at clinical data for another purpose than a patient follow-up?
- If so, in which context? For which purpose?
- How do you proceed to access and to look at these data?
- Which information systems do you use and for which kind of data?
- Do you encounter difficulties? What kind of difficulties?
- Which kind of data search do you do? For which period and with which frequency?

Clinicians were asked to provide instances of data reuse they performed.

2.2. Semi-inductive thematic analysis process

Interviews were fully transcribed. Then, an ergonomist read carefully the verbatims to identify meaningful semantic units, *i.e.* sets of words representing a single idea that is sufficiently self-explanatory. For each question asked (e.g. type of context, difficulties faced etc.), semantic units with similar meaning were grouped into thematic categories.

3. Results

Nine anesthesiologists and one resident were interviewed representing a total of 2.21 hours of interviews (mean = 0.58h). One anesthesiologist is the head of the anesthesiology unit and two others are the heads of specialty units, respectively cardio-vascular and obstetric-pediatrics units. The remaining 6 other anesthesiologists work in the gynecology/obstetrics and heart and vascular surgery units.

3.1. Contexts

Three main contexts emerge from the interviews: 1) research and knowledge discovery, e.g. the definition of threshold values of vital signs related to post-operative complications; 2) evaluation of professional practices, i.e. the compliance with care protocols and guidelines given by learned societies, for example the administration of end-tidal volume according to ideal body weight and 3) management of care units as occupation rates of operative rooms and schedule organization.

3.2. Access to data

Currently, in order to access to anesthesia clinical data they want to reuse, anesthesiologists directly query AIMS to view individual patient data. In the event that they need patients' lab results, anesthesiologists collaborate with the hospital Information System Department to retrieve those data from the laboratory information system. They also ask the Medical Information Department to get the list of patients who correspond to specific inclusion criteria such as diagnosis or medical acts. The

anesthesia data warehouse was reported as the best way to extract anesthesia or hospital stay data as extraction process is fast and may involve huge volumes of cases and variables. The last solution to visualize data is to search and collect data manually through patient files, including paper files.

3.3. Difficulties

Several types of difficulties are experienced by the anesthetists when retrieving data for secondary use. First, they express that following complicated administrative procedures to access data is a waste of time. Then, procedures to retrieve some data by oneself require high level skills in computer science, skills they do not all have. For instance, they do not master how to collate data from different sources.

3.4. Expected data

Types of required data were the same in the different contexts. Nonetheless they differ amongst the gynecology/obstetrics and the heart and vascular units, depending on the types of interventions performed on the patients in each unit.

Main features are: number of patients, occupancy rates of operative room and/or bedroom, types of intervention, anthropometric data, epidemiological data, hospital stays length and mortality rate. Other queries are specific to each unit as they deal with typical kind of patient care procedure. Queries specific to obstetrics/pediatrics concern hypotension before delivery, fetal pH, increase of D-dimers, fibrinogen levels; in cardio-vascular unit, searches revolve around cardiac, respiratory and renal functions before / during / and after intervention, and more particularly during extracorporeal circulation.

4. Discussion

This study aimed to identify other use contexts of data than the one currently provided by the data warehouse, *i.e.* research. With the results, we have learnt that, besides patient follow-up, there exist three contexts in which anesthetists are searching for data for secondary use: research, evaluation of professional practices and management. These contexts are similar with those found in literature except education and data quality [3-7]. Even if the data warehouse has proved its usefulness to extract huge volume of data, it seems essential to dispose of another visualization tool to daily support anesthetists.

Another point highlighted by this study is the difficulties encountered by clinicians for accessing data, through the current applications. This seems also in favor of new usages of the data warehouse. About required data, anesthetists reported that besides usual data (e.g. types of intervention, anthropometric data, epidemiological data, hospital stay lengths and mortality rate), data differ in function of the specialty of the surgical department.

This study may suffer from two main limits. First, we performed interviews only with medical professionals who were already acquainted with the data reuse topic, not including anesthesiologists unaware of this kind of research and nurses. Yet, nurses also reuse clinical data, at least for nursing research purpose. Despite this limit, our results are consistent with the knowledge from the literature. Nonetheless, in order to

ensure that no contexts of use were overlooked, we will soon interview nurses and anesthesiologists not used to data reuse. The second limit is that we used only the interview method. Yet, this method allows identifying only the context of use the participating clinicians thought about. There may exist other contexts of use not made explicit by the interviewees. Moreover even if knowing the context of use is a first necessary step in order to design tools that will be usable and useful to future end-users, it is not sufficient. In each context of use, one must also identify the end-users needs [8, 9]. With this goal in mind we will perform ethnographic observations of the clinicians when reusing clinical data. This method will help us identify the information clinicians use to perform data reuse, along with the format of the information.

Based on the results of the interviews and observations, we will provide ergonomics specification for designing of a computerized tool fed by the anesthesia data warehouse that would support anesthesia data reuse by concerned clinicians. This tool will have to address common needs as well as unit specific necessities.

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