Intelligent cause and effect analysis of critical incidents in anaesthesia

P Troxler, D Sleeman

University of Aberdeen,
Research Centre in Knowledge Technologies,
Meston Building,
Aberdeen AB24 3UE

KEYWORDS: CRITICAL INCIDENT ANALYSIS, CAUSAL ANALYSIS, KNOWLEDGE-BASED SYSTEMS, ANAESTHESIA

Abstract
This study assesses the benefits of knowledge-based systems for reporting and analysing critical incidents in anaesthesia. It is based on a sample of 20 critical incidents from the incident reporting system of the anaesthetic department of a UK acute trust. Comments of three expert anaesthetists on the incidents were collected and compared. The incidents were mapped to a process model of anaesthesia and analysed in detail what activities caused the incident. The contribution of human error, equipment failure and system failure was analysed in depth.

The study showed that reporting and analysing critical incidents involve reasoning about causes and circumstances and that it often has to deal with incomplete or uncertain information. This matches a major strength of knowledge-based systems. The benefits are extended cause and effect analysis, semi-automatic analysis of groups of incidents, and the potential use of a history of cases for training and decision support.

Introduction
The purpose of this study was to assess whether anaesthesia could benefit from using knowledge-based systems for the reporting and the analysis of critical incidents. The study was based on data from an anaesthetic department of a UK acute trust. When the study started in May 2002 the critical incidents database of the department contained over 150 records covering approximately fifteen months of critical incident reporting. An expert anaesthetist acted as advisor throughout the study. Two further expert anaesthetists were involved in the analysis of the critical incidents and the validation of our findings.
Analysis of existing data on critical incidents and selected findings

For the first step, the analysis of existing data on critical incidents the advisor randomly selected twenty cases from the databases. He explained the characteristics of each case.

Each expert commented on the twenty cases. Specifically they reviewed the clinical details of each case, discussed the series of events that occurred, and assessed whether the verbal description of the case and the classification according to the standards set by the Royal College of Anaesthetists were consistent. If not they explained why and indicated what additional information would have helped to decide what had actually happened. Further they reviewed the preventability of each step of the incident. We then produced a summary of all comments made by the experts for each case, and we mapped each incident to a process model of anaesthesia for further analysis.

The experts’ judgements on the details of incidents and the classification of these details were very convergent. However, when asked to identify the primary cause of the incident as human error, equipment failure or system failure they agreed only in six cases with the opinion given by the anaesthetist who reported the case. One case did not have sufficient information to make an assignment. Therefore, the remaining 13 cases could only be classified satisfactorily after a discussion of each case with the group of experts. Further the mapping to the process model proved very helpful to understand the incidents and to analyse what activity actually caused the incident.

Proposing a knowledge based system

The first part of the study showed that reporting and analysing critical incidents involves reasoning about the cases and their circumstances and that the analysis is a heuristic process that often has to deal with incomplete or uncertain information. This matches a typical strength of knowledge-based systems. Our overall approach for critical incidents reporting and analysis, which includes a knowledge-based system, consists of the following four parts:

- Reporting an incident gives the details of its circumstances, what happened, and the recovery strategy. Reporting is done on a reporting form in English.

- The information of the incident is transferred to a database and mapped to a process model of anaesthesia. Each incident is then represented as a chain or network of events, which indicates the several causes and their outcomes. These events are then described in more detail.

- The set of cases can then be analysed using knowledge technologies to detect patterns, trends, inconsistencies etc.
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- Further the case base could be used for decision support or for training purposes.

The benefits of a knowledge-based system for critical incident analysis and reporting are the extended cause and effect analysis, the semi-automatic analysis of groups of incidents that can e.g. detect recurring patterns, and the potential use of the case base for training and decision support. An application of such a knowledge-based system in other medical specialities seems possible.

However, the successful implementation of such a system relies heavily on the cultural readiness of the department involved – reporting, analysing and discussing near misses without blaming people is a crucial prerequisite for such a project.

Acknowledgement
We greatly acknowledge the support of Dr Brian Stickle, Dr Margaret Macnab and Dr Vivek Kulkarni, Aberdeen Royal Infirmary, who acted as our expert anaesthetists, and of Dr Donald G. Ross and Kinley McDonald, Directorate of Health Informatics, Grampian University NHS Trust, who sponsored the study.