Editorial

Knowledge-Based Information Management in Intensive Care and Anesthesia

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The care of critically ill patients hospitalized in Intensive Care Units (ICUs) and Anesthesia wards is becoming increasingly complex. Clinicians are required to rapidly interpret and respond to a large number of clinical parameters, selecting appropriate treatment for the patient among many different options. New measurement technology has increased the demand for improved information management, as has the need to monitor and assess the quality of care provided. Despite their enormous potential to facilitate bedside management, the practical role of computers in critical care environments is generally restricted to the storage and the retrieval of data coming from electronic medical devices and hospital information networks. The benefits of the use of computers in health care will be delivered if we design computerized medical assistants which can efficiently relieve the clinical staff of repetitive tasks and, more important, to really support practitioners in decision making in real time. In the ICU, for instance, the progressive introduction of computerized protocols to standardize in some way the bedside decision making for mechanical ventilation and to reduce unnecessary variation [5], emphasizes the potential impact of computerized medical assistants. In a sense, this movement towards standardization and reduction of variation is in contrast with the views of AI researchers in the 1970s and 80s who thought they had found in Medicine a domain which was full of uncertainty and variation and whose goal was to design programs to handle this.

Designing such computerized medical assistants for intelligent monitoring, diagnosis and therapy planning tasks in Intensive Care and Anesthesia is a challenging goal that requires the modeling of several levels of knowledge starting from low-level data interpretation to high-level cognitive tasks such as planning. In previous issues of *Artificial Intelligence in Medicine*, several papers have addressed, in the specific context of ICU, three relevant AI research topics: (i) temporal reasoning and temporal abstractions with respect to real time constraints; (ii) distributed architectures, agent models and communication protocols; (iii) knowledge acquisition and representation (for a review see [2]).

The four articles we selected for this special issue are mainly concerned with the third topic - knowledge acquisition and representation. Two articles propose data-driven techniques to improve the exploitation of raw data coming from medical devices present at the patient's bedside. Clearly, a set of
relevant indices has to be derived for the efficient detection of dangerous situations. Starting from a collection of annotated neonatal recordings, Tsien et al. [6] present an exploratory study on decision tree induction to integrate multiple signals for detecting false alarm in one of those signals. In the same vein, to minimize the introduction of a priori knowledge, Calvelo et al. [1] describe a data-oriented methodology for the extraction of local trends from a set of raw physiological data and report its on-line application in their working Aiddiag platform. The resultant models proposed in these two papers could constitute a first preprocessing step for symbolic computation, such as performed by machine learning techniques, and for automatic recognition of complex clinical scenarios. Interestingly, these papers discuss the inherent limitations of any techniques which process raw data, such as granularity of the data, time windows and missing or incomplete data.

Besides these data-driven techniques, the second pair of articles introduce a knowledge-based dimension. To facilitate the construction of decision support systems, Morik et al. [4] propose for knowledge extraction, a tight coupling between data-driven (statistical learning technique) and knowledge-driven (standard knowledge acquisition technique) approaches. The target application of this methodology is the development of computerized protocols based on explicit methods of decision making. With the last paper, Lucas et al. [3] demonstrate nicely how probabilistic networks and decision theory offer a natural way for modeling medical knowledge which is uncertain in some respect. Here again, the authors are motivated by solving a real clinical problem: the definition of the optimal antibiotic treatment of nosocomial pneumonia.

In the last special issue devoted to "Decision support in the operating theatre and intensive care", one of us [2] noted that "achieving routine use of our systems must surely be our ultimate objective". Clearly, researches we present in this issue are motivated by this objective.

Acknowledgments

We would like to express special thanks to the editor and to the associate editor of Artificial Intelligence in Medicine (Kazem Sadegh-Zadeh and Elipida Keravnou) and to the following referees for
their collaboration in producing this special issue: Steen Andreassen, Marie-Christine Chambrin, Benoit
Dawant, Catherine Garbay, Werner Horn, Isaac Kohane, Robert Kosara, Jan Eric Larsson, Peter Lucas,
Ramon Otero, Christian Popow, Steve Rees, Silvia Schleutermann, Andreas Seyfang, Friedrich Steimann.

[1] Calvelo D, Chambrin M, Pomorski D and Ravaux P. Local trend extraction and visualisation for ICU
monitoring, in this issue.


[3] Lucas P, de Bruijn N, Schurink K and Hoepelman A. A probabilistic and decision-theoretic approach to
the management of infectious disease at the ICU, in this issue.

validation in intensive care, in this issue.


[6] Tsien CL, Kohane IS and McIntosh N. Multiple signal integration by decision tree induction to detect
false alarms in the intensive care unit, in this issue.