Author's response to reviews

Title: Has information technology finally been adopted in intensive care units? A survey and review of the literature.

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Author's response to reviews: see over
Dear editor,

We would like to thank you and the reviewers for the valuable feedback allowing us to improve our manuscript: "Has information technology finally been adopted in intensive care units? A survey and review of the literature" by K Colpaert, S Vanbellegem, C Danneels, D Benoit, K. Steurbaut, S. Van Hoecke, F. De Turck and J. Decruyenaere.

We very much appreciate the useful extra referee comments. We reworked the manuscript according to the referees’ comments and also took the minor comments into account.

Below is a detailed description of how the additional referee comments were taken into account:

Please feel free to contact us with any additional questions or remarks.

Sincere regards,

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Answers to editorial requests:

1) We recommend that you ask a native English-speaking colleague to help you copyedit the paper. If this is not possible, you may need to use a professional copyediting service. Examples are those provided by the Manuscript Presentation Service (www.biomedes.co.uk), International Science Editing (http://www.internationalscienceediting.com/) and English Manager Science Editing (http://www.sciencemanager.com/). BioMed Central has no first-hand experience of these companies and can take no responsibility for the quality of their service.

We followed this advice: the manuscript is now thoroughly reviewed by another native English speaking person.

Reviewer #1 (Morris):

1. I suggest the authors change the paper emphasis and change the title.

We agree with the reviewer that the review of the literature regarding CPOE is not comprehensive. However, our focus of the review was the adoption of ICIS, and not the implementation of CPOE. For this reason, we did not include the study by Han and colleagues in the discussion. As the title is not explicit enough in emphasizing this focus, we agree to change the title to “Has information technology finally been adopted in Flemish Intensive Care Units?”

2. The use of acronyms (abbreviations) is excessive. If the authors continue to use acronyms, a table of definitions at the beginning of the paper would help readers. I would choose electronic or computer and use only one of these two terms consistently throughout the paper. I prefer “computer”.

We replaced the term electronic by the term computer consistently throughout the paper. We also decreased substantially the number of acronyms, which should be beneficial for the readability of the paper.

3. English needs to be improved.... Another example of the need for English improvement is found in the Abstract, Results, Lines 3-5: "The Electronic Patient Record (EPR) and the electronic prescription of medication are fairly widespread (65% and 41.3%, respectively), but only 27% of ICUs also computerized drug administration registration, mostly by using the features of their ICIS."

Sentences like this are complex. I advise the authors to use simple sentences (subject, verb, object) in order to more clearly communicate with their readers. I also advise the authors to avoid the passive voice and use the active voice instead. For example: "Sixty-five % of reporting ICUs used an Electronic Patient Record, 41.3% used computer medication prescriptions, and 27% used computer medication administration recording."

We are very grateful for this useful advice, which we think substantially improved the quality of our paper, and followed your advice regarding the result section in the abstract by the following:

|Sixty-five % of reporting ICUs used an Electronic Patient Record, 41.3% used computer medication prescriptions, and 27% used computer medication administration recording. The adoption rate of a dedicated ICIS has doubled over the last 3 years from 9.2% to 19%, and another 31.7% have plans to implement an ICIS within the next 3 years.|
Specific comments:

1. **P5 Para 1 Line10-12:** In the introductions the authors state: "Several organisations claim that Information and Communication Technology (ICT) could contribute in a significant way to improving the quality of health care while at the same time controlling costs [2]. This is true, but this claim is unproved and much uncertainty exists.

We agree, and added the following sentence:

> However, till now, no strong evidence has been provided.

2. **P5 Para 2 Ln 1-2:** The authors claim "this can only be confirmed" but their conclusion is an assumption. This issue has not, to my knowledge, been formally studied in the intensive care unit.

We agree, and changed the paragraph as following:

The intensive care unit (ICU) has several typical characteristics which make it favorable for computerization, as caring for the critically ill is even more complex, resulting in substantial more medical errors and higher costs [3,4]. Donchin et al. [5] reported an incidence rate of 1.7 errors per patient per Intensive Care Unit (ICU) day and several other authors confirmed that the ICU is a very unsafe environment [6, 7, 8, 9]. Additionally, the cost of intensive care medicine is exorbitant and can be as high as 0.5 to 1% of the gross domestic product [10]. The various US critical care organisations made some recommendations to the government in 2004 in answer to what they called “the critical care medicine crisis”.

3. **P 6 Para 2 Line 1-2:** I believe the authors use "intensive care informatization" here to refer to EPR in the ICU, to CPOE in the ICU, to GLIMS in the ICU, to CPOE in the ICU, to PDMS, and to ICUS or to some of these. However, it is not clear what the authors mean. One can see how confusing the use of all these acronyms is. Furthermore, I do not see how a discussion of these acronyms in Paragraph 3 of page 6 informs the survey results.

We adjusted the paragraphs 1, 2 and 3 as follows:

For the above reasons it is advisable to study on the current level of intensive care computerization, both for general and dedicated specialized ICT applications used in the ICU. General ICT applications are the Electronic Patient Record (EPR), the computer laboratory system (i.e. Global Laboratory Information Management System (GLIMS)), the computer radiology system (i.e. Picture Archiving and Communication System (PACS)), and the Computerized Physician Order Entry (CPOE) applications. The term CPOE can be confusing however, because some authors restrict its use only to prescribing medication, while using an "order communication system" for laboratory and radiology requests at the same time. In this paper, we will use CPOE in the broader sense, and specify each time we refer to medication CPOE, laboratory CPOE or radiology CPOE. The dedicated ICT solution for the ICU is often described as an ICU Patient Data Management System (PDMS), but we prefer the term ICIS, which better fits the broader functionalities of more advanced ICT programs, i.e. doing more than mere data storage and presentation. These systems are developed in order to meet the specific requirements to optimize data processing and workflow support in critical care medicine. In our survey, an ICIS has to fulfill all of the following conditions: (i) automated collection of physiological and monitoring variables from monitors and ventilators, (ii) incorporation of CPOE for medication prescription and (iii) one Personal Computer (PC) client bedside for every ICU bed.
4. **P 13 Para 2: Discussion** The authors should replace "ICU environment" (a general term with general implications) with "Flemish ICU environment" (a specific term that describes their study set).

We changed the sentence accordingly.

5. **P 13 Para 3 Ln 1-3** This is awkward English. There are a number of awkward statements in the paper - some with mixed present and past tense. Nevertheless, the text is generally understandable.

| The Flemish ICUs use medication CPOE significantly more frequently (i.e. 41.3%) compared with Canadian (22%) or American ICUs (5 to 15%) [22-24]. Possibly, the continuously increasing amount of literature regarding this topic is pushing this implementation rate forward [14-21]. However, most of the North American surveys were conducted several years ago and it remains unclear if this difference is still present nowadays. |

6. **P 13 Para 4 Ln 1-3** I think the authors could reasonably point out that the small region of Flanders, and its intensive care units, is likely to be more homogeneous than the large region represented by the United States and Canada. This homogeneity is likely to play a role in the distribution differences of intensive care unit computer systems between Flanders, the USA and Canada.

| The 19% adoption rate for ICIS in our study again exceeds the rates mentioned in the report by Lapinsky et al. [13]. In this latter survey, only 14% of 50 ICUs could capture data directly from patient monitors, and merely 6% was connected to infusion pumps or ventilators [13]. This difference in implementation rate could be explained by the small region of Flanders, and its intensive care units, which is likely to be more homogeneous than the large region represented by the United States and Canada. |

7. **P 26 Figures 2, 3** Figures 2 and 3 could be better presented as simple tables.

We agree regarding figure 2, and inserted the data presented in a table (i.e. table 1). However, we choose not to change figure 3 (in this newer version = figure 2) as, to our opinion the data regarding implementation rate according to type of hospital is more powerful if presented as a figure.

8. **P 27 Table 2** The authors list drawbacks to buying an ICIS, but fail to mention in their paper that at least one installation of an EPR in a pediatric hospital was followed by an increase in hospital mortality.

We agree with the reviewer that the study by Han regarding increased mortality in their pediatric ICU as a result of CPOE implementation will certainly increase the feeling of uncertainty towards CPOE. However, this table shows the drawbacks to buying an ICIS according to the ICU directors and is not a general list of potential drawbacks.
Reviewer #2 (Paul G Shekelle):

1.  I suspect the discussion can be substantially shortened.

We agree, and therefore we substantially shortened the discussion.