Reviewer's report

Title: Comparison of Alphabetical versus Categorical Display Format for Medication Order Entry in a Simulated Touch Screen Anesthesia Information Management System: An Experiment in Clinician-Computer Interaction in Anesthesia

Version: 4 Date: 6 March 2012

Reviewer: Alexander Avidan

Reviewer's report:

General comments
The author performed a study addressing an important issue in AIMS design: How to arrange buttons for drug data entry. Data entry for drugs administered during anesthesia, next to automatic recording of data from physiological monitors and anesthesia machines, is one of the most important goals of AIMS. The success of an AIMS relies not only on its technical specifications, but on how user-friendly is the system. As drug data entry is performed frequently during the course of anesthesia, the corresponding buttons for drug entry have to be designed and arranged in a user-friendly manner. It seems logic, that a categorical display is more convenient than an alphabetical one. But not everything in medicine and computer science (and in the combination of those both) that seems logic is necessarily true. That’s why this study adds important information not only for specific anesthesia related computer systems, but for medical information systems in general.

The authors designed the study in such a way, that the simulator (iPad) resembles the two display formats in question (categorical and alphabetical) similar to the ones planned for the AIMS to be installed. The study design took into account the different levels of anesthesia practice. It includes two learning phases: one non-anesthesia specific (countries) and one specific for the study planned, in alternating orders for both display formats. The participants had to find, within 2 minute, as many as correct buttons for various consecutively displayed drugs or fluids for each display format. The results of the study showed, that more drug data entries can be made with categorical than with alphabetical display in a specific time frame. The error rate for both display types was low.

The study unfortunately does not take into account the difference stages of drug data-entry in anesthesia: During and/or after induction a fairly consistent group of drugs is entered one after the other (e.g. midazolam, fentanyl, propofol, muscle relaxant). Later during the course of anesthesia, single drug administrations are performed (adding of single dosages of fentanyl , inotrops, muscle relaxants etc). In this study, only single drug data-entry was simulated and no multiple ones. It is also not clear from the study design, what happens to the drug buttons on the different tabs after the participant presses a button: Do all the buttons disappear,
is a certain default tab displayed or does the form stay open on the last tab used? If so (the last tab used stays open with all the drug buttons), this may be one explanation why within 2 minutes with categorical display more drug data-entry are possible than the alphabetical one. For example in Trial 1, nine of the ten first drugs all appear on the common tab. If that tab stays open after a drug is chosen, it is no surprise that data entry with categorical display is faster than with the alphabetical one. The current study design does not take this into account and important information such as what making the study results stronger is missing.

Another important point are the color codes used for the different drug buttons. These color codes make it much easier to find the correct button within a list of different drugs. It would be interesting to know if the same result would be found in a study where all buttons have the same color (for example black writing on white background). This may be important in other fields of medicine where color codes for drugs are not used.

Conclusion of review

The authors conducted a study to evaluate whether alphabetical or categorical display of buttons for drug data-entry in AIMS is more effective. The study design is original, simulating closely a real-world application. The result can also be applied to other medical information systems. However, some of the methodology is not clear. I recommend revising the manuscript according to the comments.

Specific comments

Page 4, line 2:
“flows in from the anesthesia machine and the physiological monitor”: rephrase, doesn’t sound professional

Page 4, line 4:
“airway information”. Change to “information on airway management”

Page 4, line 5:
(“anesthesia provider”): remove the apostrophes.

Page 4, line 7:
“20-100 intravenous drug-dose entries”: Preferable to write “dozens of drug-dose entries” (not only intravenous, may also be PR, IM).

Page 4, line 10:
“often in less than 30 seconds”: Preferable: “often within seconds or minutes”

Page 4, line 10:
“The rate of required entry”: Change to : “The rate of required drug data-entry”

Page 4, line 11:
“relative short induction and emergence period: From my personal experience I don’t have the impression that there many drugs given during emergence period (if at all…..).
Page 4, end first paragraph and last line
Repetition that you didn’t find any information on the study subject in the literature.

Page 4, last line
“Many of the common AIMS use keyboard entry”: Where do you that from? Is that really true? Metavision from iMDsoft has keyboard and touch screen data entry.

Page 5, line 1/2
“uses touch-screen, a rapidly proliferating interface for medical systems”. Where do you that from? References? For example in our hospital, users preferred to use mouse over touch screen.

Page 5, line 2
“We therefore undertook a study to determine which of……..”. The fact that you use touch-screens should not be the reason you perform this study. The results of this study are equally important for a system with touch-screens or mice/keyboards.

Page 5, line 6
“Results were used in the design..”. Change to “Results were used for the design…”

Page 5, Methods, 2nd paragraph
As far as I understood, this is not a specific iPad application, but a website built on ASP.net technology. The study could have been performed also with any other tablet. Change accordingly. Explain what is “asynchronous”. Delete “virtually”. Delete “via a wireless connection” (not important, anyway tablets are connected to the Internet/Intranet with wireless only).

“After each selection, the database compared the time the trial started with the current time. If the difference exceeded 2.0 minutes, the entry was negated and the participant was notified that the trial had ended.” Much too complicated, far simpler to say: Each trial part lasted 2 minutes.

Page 6, line 8:
Anesthesia providers participated in the study when not doing patient care, although the study was conducted in the operating room environment. In my opinion this is not necessary. I’m quite convinced that you would not have received IRB for doing the study during patient care……..

Page 6, Testing Protocol:
“the Apple iPad”: Change to “an iPad (Apple Inc, Cupertino, CA”.

Page 6, last line:
“The participant was presented”: Change to “The participants were presented”

Page 7, line 12
Change “2.0 minutes” to “2 minutes”.

Page 9, line 3
“drugs entered via the categorical”, shouldn’t it be “drugs entered via the alphabetical”?

Page 10, line 8
Third time you mention that this is the first study…etc.etc.! Repetition, shouldn’t be in the discussion.

Page 10, line 17
Abbreviation (“CTA”) not necessary as not used a second time in manuscript.

Page 10, line 12
“Our study looked at how design variation (alphabetical versus categorical) and user variation (users with different levels of clinical experience) affects the task and the occurrence of errors.” Not part of discussion, part of introduction.

Page 11, Conclusion:
It’s a hearsay that medical records rely increasingly on touch screen interfaces. May be in the future more tablets than PC will be used, but there is no evidence. The different designs tested in this study are equally important for touchscreens and mouse/keyboard. Revise the conclusions.

Authors’ contribution
Put into past (“helped to design the study, conducted the study, analyzed the data etc.)

Legends to all figures are too short. Reader should understand the figures without reading the text.

**Level of interest:** An article of importance in its field

**Quality of written English:** Needs some language corrections before being published

**Statistical review:** Yes, but I do not feel adequately qualified to assess the statistics.

**Declaration of competing interests:**
I declare that I have no competing interests