Teaching sterile skills in anesthesia
Is providing context helpful for robust skill acquisition?

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EPIDURAL ANESTHESIA
• Pan relief method during childbirth and during and after operations
• As it is an invasive technique, it carries the risk of contamination
• Residents basically learn the procedure in the clinic
• Even after 4 years of training, residents still make sterility errors (Friedman et al., 2008)
• sterility is a complex concept
• sterility is not visible

PRESENT TRAINING IS NOT OPTIMAL
• Medical skills should be flexible and robust (Cnossen, 2015)
  Flexible: applicable outside context in which it was learned
  Robust: resistant to stress and workload
• Present training of complex procedures often focuses on the order of the steps of the procedure
  • This makes learning vulnerable
  • steps may be forgotten and skipped
  • steps may be performed in the wrong order
• In practice there is no fixed order of steps
  • different procedures have different steps, equipment, medication
  • not all steps have to be performed in a strict order
  • in practice, every supervisor has their own preferred order and method
• Focus on the steps in the procedure during learning
  • does not lead to flexibility in the skill
  • what if a step cannot be performed
  • does not lead to robustness of the skill
  • in stress situation memory errors can happen

DIFFERENT APPROACH: FOCUS ON THE CONTEXT
• Taatgen, Huss, Dickison & Anderson (2005) showed that in teaching flexible cognitive skills teaching materials should draw attention to
  • the pre-conditions of actions (knowing when)
  • the post-conditions of actions (knowing the effects of actions in the environment)
• They found that Boeing pilots were more flexible and the skill was more robust after learning with a focus on these environmental cues
• learners can then rely on environmental cues rather than keeping track of all the executed steps in their mind
• We applied this approach to training preparing and executing epidural anesthesia

METHOD

37 medical students participated in simulation study
Skill preparation of epidural anesthesia
• 24 steps
• 10-15 minutes

Procedure
• Video instruction of procedure
  • Studying description of steps on paper
  • non-sterile actions were written in red
  • sterile actions were written in green
  • 15 minutes practice with materials and instruction sheets
  • Test: perform the procedure with an “non-obstructive nurse”

Instructions
• List condition
  • 24 steps in chronological, strict, order
• Context condition
  • steps arranged in sets
  • order within set was not important
  • photographs
  • pre-conditions of a set of actions (“before”)
  • post-condition (“after”)
  • description of the actions to be performed within the set

DISCUSSION
• Contrary to expectation the context condition did not result in robust skill
  • This stands in contrast to Taatgen et al’s study
  • Context condition even resulted in more sterility errors than the list condition
Why?
• Environmental cues
  • In epidural anesthesia procedure, there are also many environmental cues in list condition
    (e.g. syringe filled or empty)
  • Boeing pilots used complicated system with low usability, so possibly profit more from context
• Memory load
  • Context condition possibly imposed larger memory load on participants
  • The known advantages of the context method were at least partly offset by the disadvantages of this high memory load

Sterility
• Apparently, sterility errors are difficult to prevent, even though we explicitly noted which steps of the procedures were sterile or not
• The participants in the experiment were probably unfamiliar with the concept of sterility
• Sterility is a complex concept
  • it is not obvious for example that crossing a sterile workspace with (unsterile) bare underarms is not sterile

CONCLUSIONS & RECOMMENDATIONS
• Complex medical skills involve many steps and induce a high memory load to learn them
• Providing context when teaching a procedure may therefore not necessarily lead to better skill acquisition than learning the steps
• but the resulting skill may be more flexible and robust after context-learning
• Further research is needed to test whether it may be advantageous to first study the steps in a procedure until all steps are remembered before performing the skill
• separating studying the declarative knowledge from training the procedural skill
  • we can then also test the flexibility and robustness of the skill
• Further research is needed to test whether teaching sterility concepts separately from the procedure itself is needed

REFERENCES