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**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

**Different Approach: Focus on Optimal Present**

- Executing epidural anesthesia
- We applied this approach to training preparing and executing sterile skills
- These environmental cues
- The skill was more robust after learning with a focus on materials should draw attention to
- That in teaching flexible cognitive skills teaching Taatgen, Huss, Dickison & Anderson (2005) showed
- In practice there is on the order of the steps of the procedure
- Medical skills should be flexible and robust (Cnossen, 2015)
- Flexible: applicable outside context in which it was learned
- Robust: resistent 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

**Present Training Is Not Optimal**

- Medical skills should be flexible and robust
- Residents basically learn the procedure in the clinic after operations
- Pain relief method during childbirth and during and after operations
- 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

**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 (eg. syringe filled or empty?)
- Boeing pilots used complicated system with low usability, so possibly profited 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
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**References**