Drug Administration Errors: How to Simplify the Anesthesia Workspace and Reduce Medication Errors

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In 1978 Coper et al used *critical incident analysis* to identify ventilation and breathing circuit issues, anesthesia machine use and medication errors as the primary contributors to adverse outcomes in anesthesia.[1] In the subsequent 40 years the anesthesia machine and monitors have undergone a series of design changes to make errors less frequent and improve patient safety like the pin-index safety system, oxygen-nitrous coupling and keyed vaporizer fillers. Medication handling, on the other hand, has stayed largely the same during this time period, but can be improved by adapting lessons from the machine design.

Anesthesiologists have a unique relationship to medications in health care by being responsible for the entire medication cycle from prescription to preparation to administration. Martin et al used *failure mode and effect analysis* to identify 19 sub-steps and 68 possible failure modes with multiple single-point failures every time an anesthesia provider handles a medication.[2] Mistake proofing comes in a hierarchy of levels from most robust to least: (1) eliminating the error, (2) detecting the error, (3) detecting the defect, and (4) cognitive aids. The gold standard is to design medication systems to physically eliminate certain errors.

Historically, specific safety incidents have inspired institutions to focus attention on the last worst event that happened, and countermeasures often add to processes and make systems more complicated without necessarily making them safer. A more effective solution is to streamline processes and simplify options. Many forms of safety countermeasures – like labels, alarms, and two-provider checklists – provide *feedback* instead of more robust *constraints*. Pre-filled syringes, for example, eliminate 6 sub-steps and 19 possible failure modes from medication preparation versus bar-coding, which does not provide a physical countermeasure but does require user compliance.

The goal of medication safety design is to eliminate unnecessary options (like excessive concentrations), automate processes (like wirelessly programming smart pumps) and physically preventing mistakes (like the NRFit connectors for regional anesthesia). At Seattle Children's Hospital segregating medication vials into specially designed trays and organizing syringes with a standardized template helped to virtually eliminate both swap and calculation errors.[3] Future efforts should focus on simplifying, standardizing and automating elements of the anesthesia medication cycle to ensure that medications are administered correctly every time.

References

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3. Grigg, E., Martin, L., Ross, F., et al. Assessing the Impact of the Anesthesia Medication Template on Medication Errors During Anesthesia: A Prospective Study. Anesth Analg 2017;124(5): 1617-1625.