**Reducing Opioid Harm by Prompting for Breaths**

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**Background:** Opioids are known to cause harm by inducing ventilatory depression and airway obstruction, especially when administered with a sedative. These events are associated with significant morbidity and mortality during the first 72 hours after surgery.[1] An automated prompting system may be useful in prompting hypopnic patients to breathe when clinician availability is limited. To that end, we explored the feasibility of computer-delivered verbal prompts and tactile stimuli to prompt sedated hypopnic volunteers to breathe. Our aim was to prompt sedated, healthy volunteers to breathe using a recorded voice and a recorded voice together with a tactile stimulus. Our hypothesis was that the device prompting success rate would *not* be inferior to the nurse prompting success rate for each stimulus type.
**Methods:** After written informed consent, 26 healthy volunteers received escalating doses of remifentanil and propofol target controlled infusions to produce increasing severity of ventilatory depression and increasing sedation. Using a cross over experimental design, once the desired state of ventilatory depression was achieved, prompting was randomized to one of two prompting techniques: a device voice prompt or a live human voice and then repeated using the other technique. Low voice was defined as 65 dB; high voice was defined as 100 dB. The device tactile shake was delivered from a mechanized massager applied to the shoulder. A positive response was defined as an increase in respiratory rate by at least 50%. We compared the proportions of success between the two groups using a 2-sample test for equality of proportions with continuity correction in R (R Foundation for Statistical Computing, Vienna, Austria).
**Results:** The device voice prompt and live human voice delivered 2,245 and 2,048 prompts, respectively. The device voice prompt was successful on 1,790 prompts (80%) and the live human voice was successful on 1,679 prompts (82%). Individual percentages of success for each prompt type are shown (Fig1). The device was slightly favored for prompts during respiratory depression in a comparison between difference between proportions of success between the device and the nurse. As propofol was increased, volunteers became less responsive to prompts to breathe. As remifentanil was increased, volunteers developed ventilatory depression, but remained responsive to prompts to breathe.

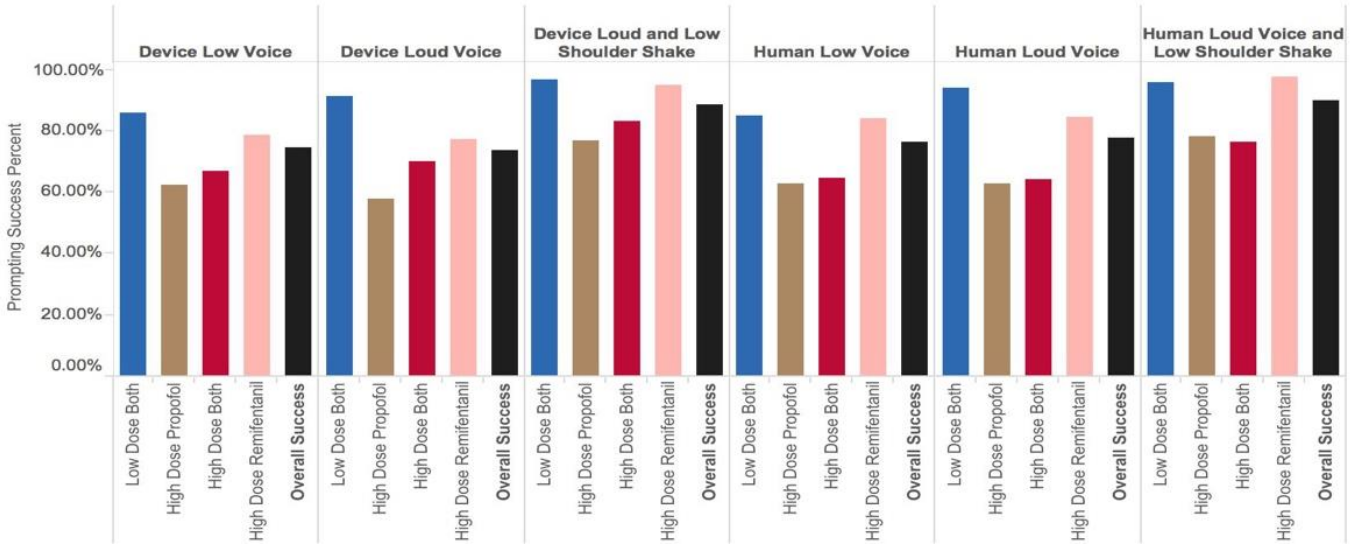


*Figure 1: Prompting Success Percent across all prompting types for both the device (recorded voice) and the nurse. Low dose remifentanil (<1 ng/mL) and propofol (<1 ug/mL) marked in blue, high dose remifentanil (>1 ng/mL) marked in pink, high dose Propofol (>1 ug/mL) marked in brown, high dose both drugs marked in red.*

**Discussion**: Our results confirmed our hypothesis; a device voice prompt was not inferior to a live human voice prompt. Neither the live voice nor the device voice prompt was successful in prompting volunteers to breathe once they achieved a sedation level consistent with general anesthesia. Future work is warranted to explore whether device voice prompts can diminish episodes of postoperative ventilatory depression in settings where clinician availability may be limited (e.g. the hospital floor).
**Reference**: 1) Lee, Lorri A, et al. “Postoperative Opioid-Induced Respiratory Depression: A Closed Claims Analysis.” Anesthesiology, vol. 122, 3 Aug. 2015, pp. 659–665.