Panda: A Smartphone App to Support Management of Postoperative Pain in Children

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Introduction: Effective postoperative pain management reduces deleterious physiological and psychological disturbances in children and therefore promotes optimal recovery. Pain management requires appropriate assessment and it is widely, though not universally, accepted that the best method is based on *self-report*, using tools such as the Faces Pain Scale–Revised (FPS-R) and Colour Analogue Scale (CAS), for which extensive validation data have been published [1].

A 2010 audit of pain management following discharge from day surgery at a tertiary pediatric centre showed that, despite the predictability of post-discharge pain and comprehensive discharge instructions, carers at home often lack the resources to effectively assess pain and adhere to appropriate analgesic guidelines [2]. Preliminary data from a follow-up audit, currently ongoing, suggests that the majority of children recovering from adenoidectomy/tonsillectomy experience moderate or severe pain in the 48 hours following surgery, but that many do not receive regular acetaminophen/ibuprofen as instructed at discharge.

Panda is a smartphone app designed to support decision-making about postoperative pain management in children. It is being built using a robust, modular framework specifically designed for medical applications [3]. A series of studies is guiding this development. The Phase 1 study demonstrated agreement between Panda's electronic versions of the FPS-R and CAS and the original paper- and plastic-based versions [4].

Methods: The aim of this study was to evaluate how data may be collected to build models of anticipated pain. Data from the Phase 1 study has been re-analysed. This dataset contains pain scores, obtained from children aged 4-18 years recovering from a variety of surgical procedures. Pain was assessed on waking and again approximately 30 minutes later and was collected with both the *Panda* and the original FPS-R/CAS tools, with 3-5 minutes between each pair of assessments. Hence, we have self-report pain scores from 4 different time-points over 30-50 minutes following emergence from anesthesia.

Results: The analysis of changes in these pain scores over time revealed procedure-specific characteristics (Figure 1). Pain after tonsillectomy showed wide inter-patient variability, with 5/15 (33%) patients still scoring their pain ≥8 between 15 and 45 mins after waking. Other procedures demonstrated better postoperative pain management.

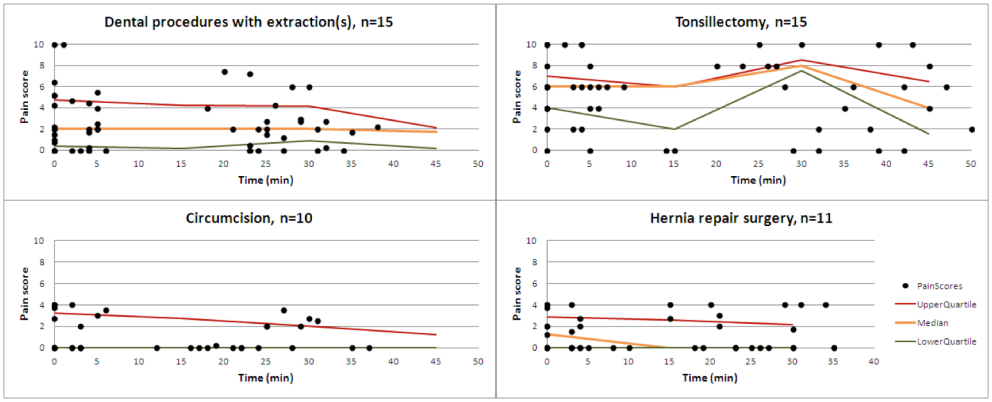

Figure 1 Procedure-specific pain scores collected during the 50 min after emerging from anesthesia, for procedures with ≥10 cases. Pain scores collected with the *Panda* or original FPS-R/CAS tools are plotted against time from first pain score (on waking). Upper quartiles (red), medians (orange) and lower quartiles (green) are plotted for pain scores up to 0, 15, 30 and 45 min.

Conclusion: Collecting regular pain scores using a device such as *Panda*, ideally over a longer time-frame, may provide a mechanism for generating procedure-specific pain models.

In Phase 2, we will incorporate these anticipated pain models along with pain assessment scores and medication tracking into decision rules, which will be clinically evaluated for support of decision-making about postoperative pain management. In Phase 3, we will evaluate usability, compliance and satisfaction characteristics with clinicians, parents and children during in-hospital and at-home use.

Panda has the potential to improve reliability of pain monitoring, to provide intelligent pain management guidance during in-hospital and at-home care, and to streamline communication with clinicians.

References: [1] Pediatrics. 2013;132(4):e971-9. [2] Pain Res Manag. 2012;17(5):328–334. [3] Proc ICFP. 2013; New York:ACM Press, pp.357-62. [4] Proc Am Soc Anesth Ann Mtg. 2013; San Francisco:LBC02