

## Human factors in the OR

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**Objective:** Pediatric cardiac surgery (PCS) has a low error tolerance and demands high levels of cognitive and technical performance. The risk of technical failure during operations is recognised, but there is evidence that further improvements in safety depend on systems factors, in particular, effective team skills. The hypotheses that small intraoperative non-routine events (NRE's) can escalate to more serious situations and that effective teamwork can prevent the development of serious situations, were examined to develop a method to assess these skills and to provide evidence for improvements in training and systems.

**Methods:** This mixed-method design, using both quantitative and qualitative measures, used trained human factors observers that observed and coded NRE's and teamwork elements from the time of patient arrival into the operating room (OR) to the patient handover in the intensive care unit. Real-time teamwork observations were coupled with questionnaires on safety culture, microsystems preparedness measures, operative duration, assessed difficulty of the operation and patient outcome measures. Behaviour was rated whether it hindered or enhanced teamwork.

**Results:** 40 PCS cases were observed. Surgeons displayed better teamwork during complicated procedures, particularly during the surgical bypass/repair epoch. More procedural non-routine events were associated with a more complicated post-operative course ( $M_{\text{uncomplicated}} = 9.08$ ;  $M_{\text{minor complications}} = 11.11$ ;  $M_{\text{major morbidity}} = 14.60$ ,  $F(2,26)=3.46$ ,  $p<.05$ ). A rapid 5 question questionnaire filled out immediately after the operation correlated significantly with the complexity ( $r=.54$ ), duration ( $r=.62$ ), number of non-routine events ( $r=.31$ ) and patient outcome ( $r=.56$ ). The total number of team behaviours was associated with case complexity ( $r=.39$ ), but this association disappeared when duration of the operation was taken into account ( $r=.04$ ). Procedural non-routine events decreased substantially over time ( $M_1 = 13.5$ ;  $M_2 = 7.1$ ,  $F(1,37) = 33.07$ ,  $p<.001$ ).

**Conclusions:** Structured observation of effective teamwork in the operating room can identify substantive deficiencies in the system, even in otherwise successful operation. High performing teams display good teamwork when operations become more difficult. Better teamwork does not directly lead to better patient outcomes.

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