

# The Influence of Operating Room Handoffs on Teamwork, Stress, and Work: a 360 degree Evaluation of Team Shared Situation Awareness

Cristan E. ANDERSON MD <sup>a,b</sup> and Lygia STEWART MD <sup>a,b</sup>

<sup>a</sup>*Department of Surgery, University of California, San Francisco  
513 Parnassus Avenue, Room S-321, San Francisco, CA 94143*

<sup>b</sup>*San Francisco VA Medical Center  
Surgery (112), 4150 Clement Street, San Francisco, CA 94121*

## ABSTRACT

Teamwork is important in the operating room. Team members rely on each other's expertise for successful task completion. Because of lunch and change of shift breaks, handoffs occur frequently, but little is known about their effect on team performance, or the team's awareness of these changes. We performed a 360 degree evaluation of the effect of operating room handoffs on teamwork, stress, and work among the members of the operative team (surgeons, anesthesia providers, circulator nurses, scrub technicians). An independent observer also evaluated the effect of handoffs. We specifically examined for evidence of shared team situation awareness. Surgical attendings reported decreased teamwork, increased stress, and increased work due to handoffs in about 30-50% of cases; while nursing personnel reported handoffs to be seamless, and have little effect (5%) on teamwork, stress, or work. This demonstrated a lack of shared team situation awareness, among operating room teams, regarding the influence of handoffs on team performance.

## KEYWORDS

*Surgical teams, Handoffs, Situation Awareness, Patient Safety*

## INTRODUCTION

The operating room (OR) is a complex environment in which effective communication and the coordination of multiple team members is crucial for safe and efficient functioning. Team members rely on one another's expertise for completing tasks successfully. They must share information rapidly when responding to expected and unexpected events. Many have suggested that aviation and surgery share common features, and suggested using aviation safety procedures to provide a framework for quality improvement. (Hugh 2002; Karl 2009; Sexton, Thomas, & Helmreich 2000). And, medical team training (MTT) programs, developed utilizing concepts from aviation crew-resource management, including checklists and briefings; have led to improvements in team communication, team performance, decreased delays, and improved patient safety. (Wolf, Way & Stewart 2010; Neily, Mills, Young-Xu., et al., 2010; Young-Xu, Neily, Mills, et al., 2011). Our group has had a robust MTT program, with >95% participation, present for over 8 years.

There are important differences between surgical teams and aviation teams. Aviation teams remain fixed (no other choice at 30,000 feet), and have a mandatory standardized experience on airplanes they crew. Surgical teams are composed of surgeons, anesthesia providers, a circulating nurse (who is outside the sterile field), and a scrub technician (who is inside the sterile field and works directly with the surgeons). Unlike aviation teams, surgical teams change during the case. Labor and union policies dictate two 15 minute breaks, and one 30 minute lunch break, in an 8 hour working period. Also, depending on staffing, emergencies, absences, etc., circulating nurses and scrub technicians may not have extensive experience (or in some cases, very little experience) with the specific case type they staff. While specialized nursing and anesthesia teams are commonly designated for certain surgical specialties (e.g., cardiac and transplant), this is not the case across the board. There is a general concept of cross-training in nursing; and it is common to work with non-specialized nursing staff, especially later in the day (after change of shift). Studies have shown that working with a fixed, specifically trained, nursing staff results in improved patient outcomes, improved safety climate, improved efficiency, and lower costs (Kenyon, Lenker, Bax, & Swanstrom 1997; Muller, Zalunardo, Hubner, Clavien, & Demartines 2009; Stepaniak, Heij, Buise, Mannaerts, Smulders, & Nienhuijs, 2012). But, even fixed teams require mandatory breaks (as dictated by labor law agreements).

As defined by Endsley (1995), shared situation awareness is the degree to which the team has reached a common state of understanding. There are no studies that have examined the effects of handoffs on team dynamics, or shared team situation awareness during surgical operative cases. We studied this.

## METHODS

We performed a 360 degree evaluation of handoffs during surgical cases (from 4/3/14 – 6/16/14). Detailed evaluation questionnaires were given to all members of the OR team, including: Surgical attendings, Surgical residents, Anesthesiology providers (MDs, nurse anaesthetists), Circulating nurses, and Scrub nurses or technicians. Evaluations were directed toward a specific operative case, and they were completed in real time, immediately following the provider's portion of the case. All medical professionals who participated in the case were given evaluations forms, including surgeons; nursing and anesthesia team members who started the case, provided relief (breaks, lunch), or who completed the case following change of shift. In addition, 20 cases were observed and evaluated by an observer who did not participate in the operative case; this person was a surgeon with a focus in human factors.

Evaluations covered teamwork, specifics of the case, the providers role, stress from handoff, extra work related to handoffs, and the overall process. Evaluation forms were designed so we could correlate responses from the various medical professionals on the same case.

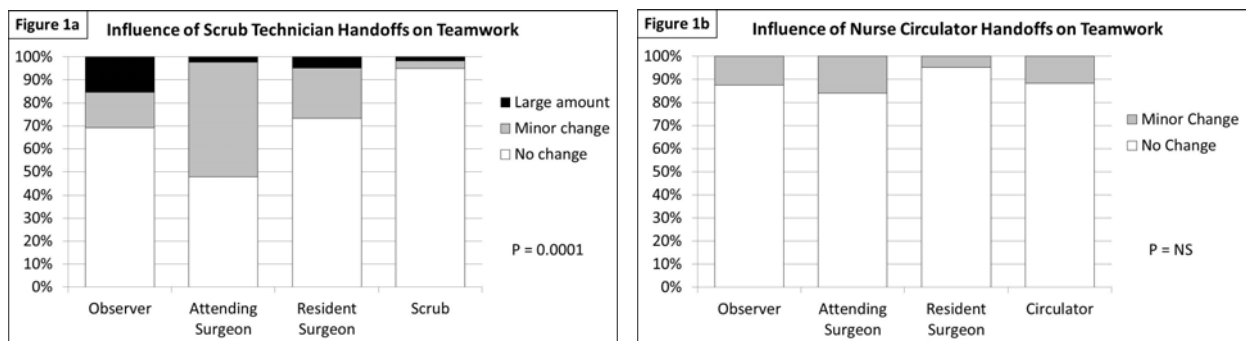
## RESULTS

A total of 359 evaluation forms were completed, covering 89 different operative cases. The number of evaluations completed by each type of medical professional is shown in Table 1. The average number of handoffs / operative case by each medical professional group was as follows: Surgery 0, Anesthesia 1.2 (range 0-4), Circulator Nurse 1.7 (range 0-4), Scrub Technician 1.7 (range 0-5). This means that, during an average case, surgeons worked with a total of 2 Anesthesia providers, 3 circulator nurses, and 3 scrub technicians. There were no nursing handoffs in 12-15% of cases, and no anesthesia handoffs reported in 35% of cases; the maximum number of handoffs reported was: 5 Anesthesia providers, 5 circulator nurses, and 5 scrub technicians during one surgical case. Surgeons reported that the timing of circulator and scrub handoffs were optimal in only 69% and 55% of cases, respectively.

**Table 1.** Medical Professionals Participating in Handoff Evaluations

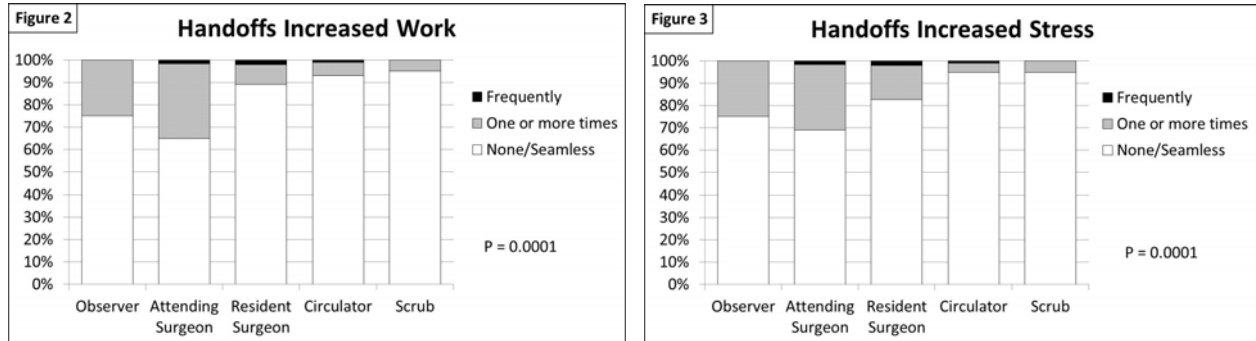
Medical Professional	Subgroup	Number
Surgeon	Attending	63
	Resident	46
	Observer	20
Anesthesia	MD / Nurse Anaesthetist	48
Nursing	Circulator	108
	Scrub Technician	74

Anesthesia handoffs were generally reported to be seamless (96%) and were often (63%) not noticed by surgeons, including the observer. Analysis of Anesthesia handoffs were not part of the nursing evaluation. Anesthesiology providers evaluated their handoffs as 100% seamless, with no change in teamwork, stress, or work. Anesthesia, in all these cases, had a more separate defined role. Given these findings, we did not analyse Anesthesia handoffs in the context of the rest of the surgical team.

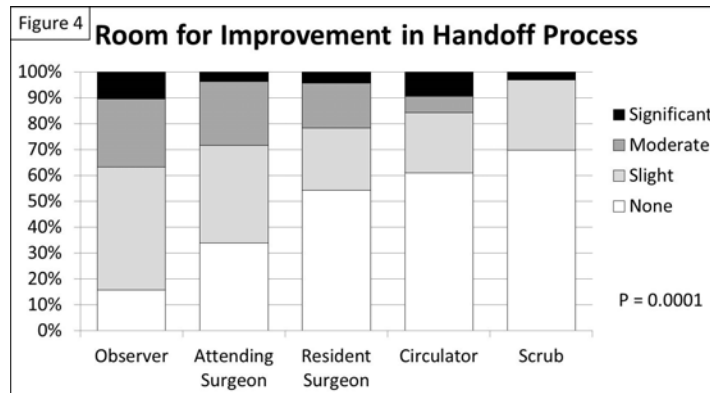


The influence of handoffs on teamwork is shown in Figure 1a and 1b, as reported by the various team members. As shown, attending surgeons reported that scrub technician handoffs changed teamwork more than 50% of the time, while the observer reported a 30% change; in contrast, scrub technicians perceived minimal changes in teamwork (5%);

these differences were significant ( $P < 0.0001$ , Chi-squared). Nurse circulator handoffs, were reported to have a lesser effect on teamwork, and there were no significant differences in perception among the team members



The influence of handoffs on work and stress are shown in Figures 2 and 3, as reported by the various team members. As shown, attending surgeons reported that handoffs increased work, and created stress, in over 30% of cases. The observer was somewhat aware of the increased work and stress due to handoffs, but less than the attending surgeons. In contrast, nurse circulators and scrub technicians generally lacked awareness of the increased stress and work caused by handoffs; differences in awareness were highly significant ( $P < 0.0001$ , Chi-squared).



Evaluation of the overall handoff process by the various team members, regarding room for improvement, is shown in Figure 4. As can be seen, the observer perceived the largest need for improvement in the handoff process (85%), followed by the surgical attending (67%). Once again, nurse circulators and scrub technicians perceived the handoff process to be more flawless than other team members; the differences in awareness were highly significant ( $P < 0.0001$ ).

## DISCUSSION

There has been considerable interest in physician handoffs during normal patient care, including the increased number of resident handoffs due to current limitations in resident work hours. These studies have highlighted possible patient safety issues related handoffs. (Borman, Jones, & Shea, 2012; Lee, Myers, Rehmani, et al., 2012; Kitch, Cooper, Zapol, et al, 2008; Charap 2004). But, there are no studies examining the effects of handoffs in the operating room on patient safety. One reason this is an important issue is that handoff frequency is actually much higher in the operating room than with normal patient care on hospital wards. Most hospital patient-related handoffs occur at the end of an 8-12 hour physician shift; while in the operating room, cases lasting a few hours can be associated with multiple nursing personal handoffs, especially if they occur near the lunch hour or change of shift (usually 3 pm); and only 12-15% of cases, reported no operative nursing staff handoffs. Thus, handoff “density” is much higher in the operating room.

A number of studies have reported that working with designated, or specifically trained, operative nursing staff results in improved patient outcomes, improved safety climate, efficiency, and lower costs (Kenyon, Lenker, Bax, & Swanstrom 1997; Muller, Zalunardo, Hubner, Clavien, & Demartines 2009; Brown, Parker, Quiñonez, et. al., 2011; Stepaniak, Heij, Buise, et al, 2012). Also, an observational study of cardiothoracic surgery cases, reported that teams whose members were familiar with the operating surgeon had significantly fewer events and teamwork failures than teams where the majority of members were unfamiliar with the operating surgeon. But only 4% of failures were

attributed to handoffs. (ElBardissi, Wiegmann, Henrickson, Wadhwa, & Sundt, 2008). These studies highlight the advantages of stable specialized teams. But, many of these studies were in populations where specialized nursing staff (circulator and scrub technicians) are standard (eg, cardiothoracic surgery), this is not the case for many other surgical specialties. But even specialized teams have handoffs for lunch and change of shift breaks.

This study examined the influence of handoffs on teamwork. Teamwork is very important in the surgical arena (Weaver, S.J., Rosen, M.A., Diaz-Granados, D., Lazzara, E.H., Lyons, R., Salas, E., et al, 2010). This study was specifically designed to capture the perceptions of all the members of the surgical team. We noted that OR nursing personnel were generally unaware of the deleterious effects of handoffs on surgeons, especially the attending surgeon. Attending surgeons reported that handoffs decreased teamwork, increased work, increased stress, were not at an optimal time in 31-45% of cases, and had significant room for improvement. Similar observations were made by the independent observer. In contrast, nursing staff reported that handoffs were usually seamless, did not decrease teamwork, and did not increase work or stress. Differences were highly significant. This demonstrates a lack of shared situation awareness. It is perhaps an even more significant finding since this lack of awareness occurred in the setting of a medical center with robust medical team training protocols.

Shared situation awareness is defined as the overlap in individual situation awareness across a population at a given moment in time and space. (Endsley, 1995; Smith 1995; Endsley & Jones, 2001; Gorman 2006; Saner et al., 2009) The overlap of individual situation awareness between team members is important when they have the same task requirements – as is the case with the surgeon and scrub technician. The surgeon and scrub technician work as a tightly-coupled team (like a dancing team). High level shared situation awareness occurs when this overlap is robust, accurate, ongoing, and includes the necessary information for each individual person to perform his/her part in the overall group effort. This is crucial for success for small groups engaged in complex tasks. The nurse circulator also has the same task, but their role is not as tightly linked with the surgeon. The greatest loss in teamwork, due to handoffs, was between the surgeon and scrub technician (who works directly with the surgeon). Thus, following the handoff, the surgeon was now working with a team member who was less able to anticipate what is needed. This (anticipation) is an important non-technical skill for scrub nurses (Mitchell, Flin, Yule, et al, 2011). The surgical attending has the responsibility for the patient, while to some degree anesthesia and nursing personnel are interchangeable (and they did change, as this study documented), the attending surgeon is not interchangeable. It was clear that the attending surgeon, who carries the responsibility for the patient, more acutely felt the impact of issues related to changes in OR personnel; even more than other surgeons (surgical residents, independent observer). The surgical attending, working at the sharp end of the point, carries the brunt of the system issues.

This study highlights the concepts of shared versus distributed situation awareness. Shared situation awareness implies shared requirements and purposes whereas distributed situation awareness implies different, but potentially compatible, requirements and purposes (Stanton et al., 2006; Saner et al., 2009; Nazir et al., 2014). In this context, the Anesthesia team has distributed situation awareness with the rest of the team; they have their own role supporting the patient, but there was no need for a fully shared understanding of all details. But, for optimal function, the surgeon and scrub technician, require tightly-coupled shared situation awareness. The circulator nurse falls somewhat in the middle, she has some roles that are separate and do not need to be fully shared by the surgeon and scrub technician; but she needs to maintain awareness of the progress of the operation to supply equipment, supplies, etc. The degree of distributed vs shared situation awareness seemed to impact the influence of handoffs on stress, work, and teamwork. Anesthesia handoffs (distributed situation awareness) were perceived as seamless by the surgeons, while scrub technician handoffs were more likely to decrease teamwork and increase work and stress.

An increase in stress during operative cases, even 30%, is meaningful. A number of studies have examined the influence of stress on individual and team performance. A large body of research indicates that the individual's breadth of attention narrows, they tend to become more self-focused. Group members adopt a narrower, more individual perspective of task activity, and with this narrowing of perspective, team members' cognitions shift from a broader, team perspective to a more narrow individualistic focus. (Driskell & Salas 1991, 1999). Additionally, stress has been reported to decrease surgeons non-technical skills, including communication and decision-making (Arora, Sevdalis, Nestel et al 2010; Arora, Hull, Sevdalis, et al, 2010). A number of studies have highlighted the importance of non-technical skills for surgeons (Youngson & Flin 2010; Flin, Yule, Paterson-Brown, et al, 2007; Flin, Yule, Paterson-Brown, et al, 2006).

It is important to put this study into the context of other studies employing a survey to determine physician attitudes about patient safety. This study was not a general survey about safety culture attitudes; instead we asked medical providers to evaluate a specific operative case, and describe the effect of the handoff *on that case*, and on the various aspects of team performance. Data was collected in real time, about specific operative cases. Interestingly, studies reporting physician safety culture attitudes reported that surgeons were more optimistic than nurses. These studies

described substantial discrepancies in perceptions of teamwork held by surgeons and nurses; surgeons rated the teamwork of others as good, while nurses perceived teamwork as poor. (Makary, Holzmueller, Sexton, et al, 2006; Makary, Holzmueller, Thompson, et al, 2006; Sexton, Thomas, & Helmreich, 2000). The tendency for surgeons to rate teamwork positively, makes the findings in the current study even more meaningful.

## CONCLUSION

Teamwork is important in the operating room. Team members rely on the specific expertise of other team members for successful operations. This study examined the effect of handoffs on team performance, and looked for evidence of shared team situation awareness of any handoff-induced variations in performance. A 360 degree evaluation of the effect of operating room handoffs on teamwork, stress, and work among the members of the operative team (surgeons, anesthesia providers, circulator nurses, scrub technicians) as well as evaluation by an independent observer was performed. Surgical attendings reported decreased teamwork, increased stress, and increased work due to handoffs in about 30-50% of cases; while nursing personnel reported handoffs to be seamless, and have little effect (5%) on teamwork, stress, or work. This demonstrated a lack of shared team situation awareness, among operating room teams, regarding the influence of handoffs on team performance. This is an important observation, since, in the setting of increased stress and work, surgeons need additional support from their team members. If the team members have no perception of the issues created by handoffs, they will not act to lend the support that is needed. This is the first, and only, study on the effect of handoffs on team performance in the operating room. The findings are significant and warrant an active response. It is hoped that dissemination of this information will increase awareness of this issue, and create opportunities to decrease the effects of handoffs on teamwork.

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