

Use of a Standardized Mnemonic, Formal Training, and Experience Improves Situation Awareness during Surgical Resident Handoffs

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ABSTRACT

Introduction: Surgical training regulations in the United States limit physician daily work hours and this creates frequent transfers of care (patient handoffs) between physicians. This observational study assessed factors associated with effective surgical resident handoffs. **Method:** A single investigator observed 141 surgical resident handoffs (junior residents, senior resident, moonlighter handoffs; evaluated on a Likert scale 1-5, 5=best). Observation occurred before and after formal handoff training. **Results:** Formal handoff training and increased resident experience (i.e. senior residents) was associated with improved situation awareness during handoffs. Training significantly improved junior resident's handoffs, moonlighter's ability to receive handoffs, and minimized the effect of distractions during handoffs. **Discussion:** The use of formal training increased the proficiency of junior resident patient handoffs to that of senior residents many years more advanced in their training. Formal education accelerates the natural course at which junior surgical residents and moonlighters acquire proficiency in conducting efficient patient handoffs.

KEYWORDS

Practical Application; Cognitive Field Research and Cognitive Task Analysis; Situation Awareness / Situation Assessment; Patient Safety; Handoffs; Surgical Resident Training

INTRODUCTION

Prior to 2003, a single surgical resident team managed the care of patients on their service (with attending surgeons). All surgical residents on the team knew the patients and alternated taking in-hospital call. This meant that there was always a member of the team in the hospital, so handoffs were unnecessary. This required surgical residents to be on call frequently (every 2-3 nights) and work long hours. In 2003, the Accreditation Council for Graduate Medical Education (ACGME) limited resident work hours to 80 hours/week, and mandated that residents go home within 6 hours of 24 hour call and receive one day off a week. This change required surgical residents to cross-cover other surgical services; and led to the use of moonlighters (physicians paid to work overnight or weekends). This increased the number of handoffs from one physician to another, and also meant that the physician managing the patient was more frequently not a member of the primary surgical team. In subsequent years, the ACGME further limited first year surgical residents work hours to <16 hours/day (Antonoff, Berdan, Kirchner, Krosch, Holley, Maddaus, D'Cunha 2013); this further increased the number of patient handoffs among residents. It has been estimated that in one month a first year surgical resident will perform >300 patient handoffs, and patients hospitalized for 3 days will have their care signed out from one provider to another >15 times (Antonoff et. al 2013).

Effective communication is essential in effectively transferring critical patient information between providers. Poor communication has been shown to be a contributing factor in malpractice claims, poor health care outcomes, sentinel events, and medical errors (Riesenberg, Leitzsch, Massucci, Jaeger, Rosenfeld, Patow, Padmore, Karpovich 2009). Effective patient handoffs require an understanding of the reason for patient hospitalization and anticipation of potential problems. Situational awareness is critical to this process defined as 'the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future' (Endsley & Garland 2000; Flin, Yule, Paterson-Brown, Maran, Rowley, & Youngson 2007). It is not sufficient to just retrieve data; surgical residents need to be able to comprehend the information and "story" given to them, and anticipate future problems. Often, situational awareness is achieved after many years of training and learned through extensive clinical experience.



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Residents have reported inconsistent training on performing patient handoffs and formal assessments have shown serious deficiencies in completeness, accuracy, and lack of situational awareness (Antonoff, et al 2007). The ACGME now requires residency programs to monitor patient handoffs to facilitate continuity of care and improve patient safety. Surgical residency training has responded to the challenge of reduced work hours with increased educational training to enhance safety and organizational efficiency of trainee's work. We conducted an observational study on the effectiveness of patient handoffs before and after implementing a patient handoff mnemonic and conducting formal patient handoff education on efficient handoffs in our surgical residency.

METHODS

A single investigator observed 141 surgical patient handoffs, evaluating physicians giving and receiving handoffs. The observer was a surgeon (GAN), who had recently completed training. The observer was a non-participant in the handoff process. The observer did give feedback after the handoff when directly solicited for feedback by residents or moonlighters.

Handoffs consisted of a face to face discussion of each patient on the service, with the ability for the handoff recipient to ask questions. Physicians utilized a detailed handoff instrument that included the reason for hospitalization, medical problems, surgical procedures, important events during hospitalization, laboratory data, pathology, and radiology results. Physicians involved in the handoff discussed the patient's status, active medical problems, surgical procedures, the plan of care, critical medications, important events during hospitalization, things that need to be done after the handoff, and any additional information the physician coming on needed to be aware of.

Handoffs were observed for factors influencing situational awareness. Three surgical resident groups were compared: junior residents (post-graduate year 1 and 2 from medical school), senior residents (post-graduate year 3, 4, and 5 from medical school), and moonlighters (paid physicians that care for patients overnight or weekends). Most moonlighters are residents working per diem evenings and weekends while doing 1-3 years of research. Many surgical training programs require 1-2 years of research between the 2nd to 4th year of surgical residency during which time these residents will "moonlight". The observer evaluated factors associated with situation awareness during handoffs and used a survey to track factors influencing situation awareness during handoffs including: the time of day, day of the week, the handoff participants, year of training of the surgical residents and/or moonlighters, whether a situational overview was provided by the individual(s) giving signout, facilitating and distracting features that occurred during handoffs, miscommunication, effective aspects of handoffs, and whether the participants had received formal handoff training. Handoffs with prominent situation awareness for one or more patients were also noted as a separate entry.

We compared levels of situation awareness among providers who had or had not received formal didactic education on conducting a patient handoff (Table 1). Only junior residents and moonlighters received the formal didactic training; senior residents did not receive formal handoff training. Many first year surgical residents received handoff training prior to starting residency (6/21/12) and were observed for a total of 7 months. Some first year surgical residents did not receive handoff training prior to their first day of work; these residents were trained in their second year. Second year residents, third year residents, and moonlighters were trained from Sept-Nov 2012; this allowed for observation 4 months prior to training and 3 months after training (Table 1).

Table 1. Number of Residents and Moonlighters Observed Before and After Training

Giving A Handoff	Junior Resident	Moonlighter	Senior Resident
Before Training	31	11	30
After Training	57	12	
Receiving A Handoff			
Before Training	22	25	46
After Training	25	23	

The formal didactic training included use of a handoff mnemonic (IPASS). The mnemonic elements included: I=illness (is the patient stable or critically ill), P=patient summary (reason for admission, events during hospitalization), A=action list (things to do, timeline for completion), S=situation awareness (understanding what is going on with the patient, perception of important information, comprehension, and interpretation of issues, anticipation, and planning for potential problems), and S=synthesis. The training contained lectures and group discussions on handoff rationale, appropriate handoff structure/content, and how to implement the handoff mnemonic.

We used a Likert scale (1-5, 5=best) to score situation awareness during handoffs (Table 2) The individual(s) giving the handoff was also graded on actively engaging the individual(s) receiving the handoff, ensuring mutual understanding of critical information, and appropriately addressing concerns. Situation awareness was evaluated on resident's and moonlighter's ability to fully understand a patient's illness and current status with comprehending and communicating concerns for the patient in the near future and what potential steps may need to be taken in caring for the patient.

Table 2. Situation Awareness Scoring

SA Level	Likert Scale	Manifestation of Situation Awareness
Level 1 Perception	1	Poor understanding of the patient’s illness, unaware of the significance of critical information that may change the course of events for a patient.
	2	Understands the nuances of the patient’s illness and current condition and therefore possible problems that may arise in caring for a patient but unfamiliar with treatments and appropriate actions to take if these problems were to arise
Level 2 Comprehension	3	Understands the nuances of the patient’s illness and current condition, comprehension of how it may affect them, and appropriately anticipates these problems/outcomes.
Level 3 Projection	4	Understands the significance of a patient’s illness and condition, grasps the possible outcomes of what could happen given their condition, anticipates these problems/outcomes, knows the appropriate treatment, and sometimes has a plan to address them.
	5	Understands the significance of a patient’s illness and condition, grasps the possible outcomes of what could happen given their condition, anticipates these problems/outcomes, proficient in the treatment of these problems, and clearly communicates the plan to address them if they were to arise

Data analysis included descriptive statistics and group mean calculations of situation awareness scoring. Fisher’s exact test was used to define significance between the groups. SPSS Version 12/0 (Windows) was used for all statistical analyses, $P < 0.05$ was considered significant. This study was approved by the IRB (IRB # 12-09953 University of California, San Francisco and San Francisco Veterans Affairs Medical Center).

RESULTS

Formal Handoff Training improved many aspects of the signout process. Junior residents more frequently provided a situation overview during handoffs after training (6.5% vs. 37.5%, $p < 0.005$) as did moonlighters after training (18.2% vs. 50%); while senior residents gave a situation overview 50% of the time (Figure 1).

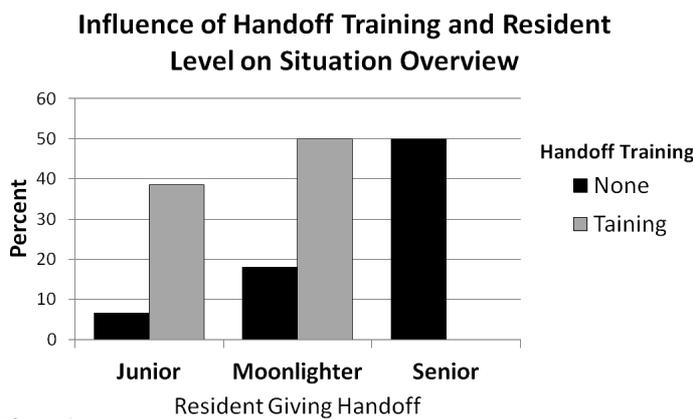


Figure 1

training, situation awareness scores with distractions were the same as those without distractions (Figure 3). The number of omissions during handoffs decreased after training for junior residents (77.5% to 48%) and moonlighters (45% to 25%). Miscommunication was less frequent after training of junior residents (61% to 39%) and moonlighters (46% to 17%); while it occurred in 7% of handoffs by senior residents.

Training showed a profound impact on junior resident’s situation awareness in giving a patient handoff (3.39 vs 3.8, $p < 0.03$, Figure 2). Moonlighters also showed improvement, albeit not significant, in their situation awareness after training (3.27 vs 3.83). Senior residents demonstrated a high level of situation awareness (score 4.63 out of possible score 5) during handoffs without formal training.

Distractions during signout were lower in mornings than evenings (0.71 vs 1.83, $P = 0.009$). Prior to handoff training, residents demonstrated less situation awareness when distractions (pages, calls, consults, etc.) were present (3.65 vs 3.95, $P = 0.182$); after handoff

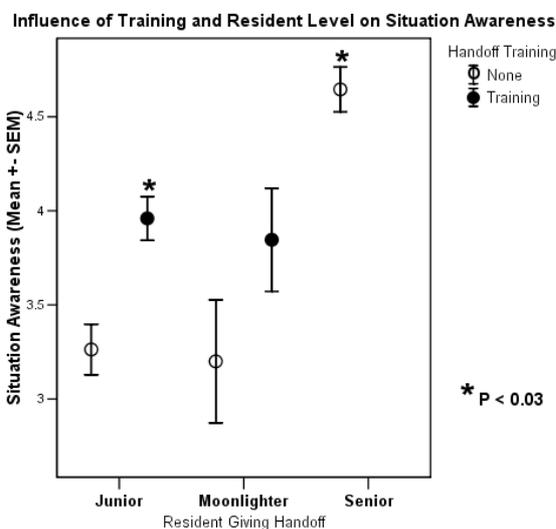


Figure 2

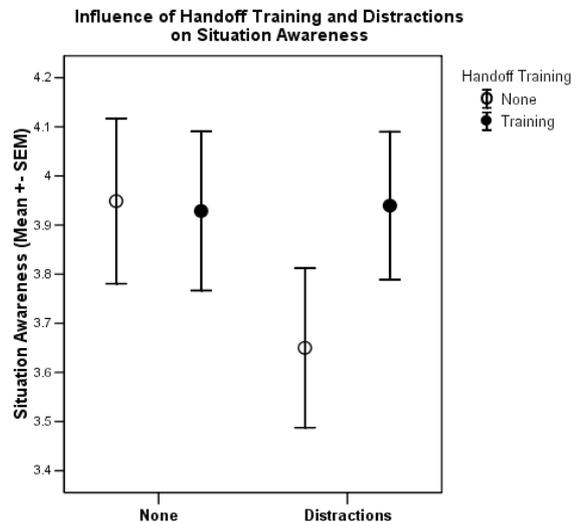


Figure 3

Situation awareness when plotted over time showed improvement for all groups (Figure 4). Junior residents had an exponential increase in situation awareness from November to January correlating with completion of handoff training and clinical experience. Moonlighters demonstrated increased situation awareness after completing handoff training in October. Senior residents started off with a moderate level of situation awareness that exponentially increased after their first month of residency, and then maintained a high level.

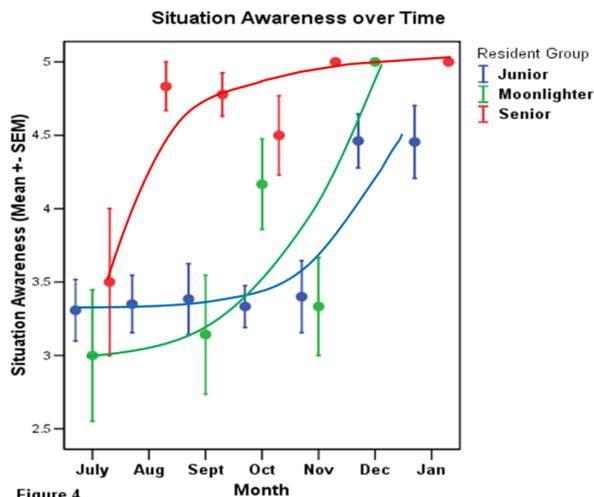


Figure 4

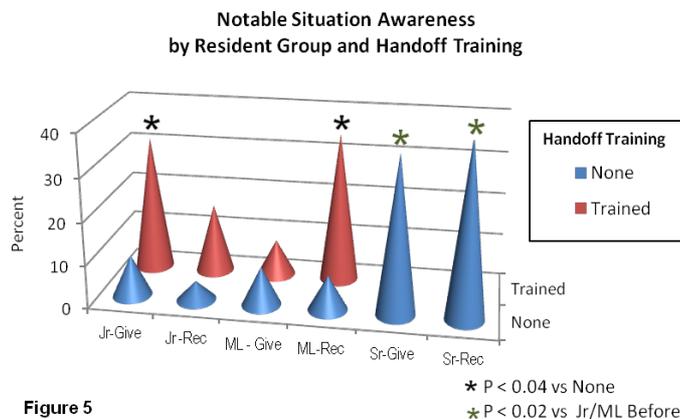


Figure 5

The observer looked for instances of particularly effective situation awareness (for one or more patients) during handoffs, and these were noted as a separate entry. These instances of exceptional situation awareness were more common among handoffs given by Junior residents (J-Give) after handoff training and among handoffs received by moonlighters (ML-Rec) after handoff training (Figure 5). Senior residents displayed a high level of situation awareness in both giving and receiving handoffs without formal training (Figure 5).

CONCLUSION

In the current era of limited resident work hours, physician handoffs have increased exponentially. This makes handoffs a key part of patient safety (Borman, Jones, Shea, 2012). Studies of handoffs have reported decreased patient safety due to increased number of handoffs and problematic handoffs (Lee DY, Myers EA, Rehmani SS, Wexelman BA, Ross RE, Belsley SS, McGinty JJ, Bhora FY, 2012; Kitch, Cooper, Zapol, Marder, Karson, Hutter, Campbell, 2008; Charap 2004). In one study, 59% of residents reported that patients had been harmed due to problematic handoffs, and 12% reported this as major harm (Kitch, Cooper, Zapol, et al. 2008). Another study estimated that the most important piece of patient information was not communicated 60% of the time, and that residents overestimated their handoff effectiveness (Chang, Arora, Lev-Ari, D’Arcy, Keysar 2010). These studies highlight the need for graduate medical education to focus on improving resident’s situation awareness during handoffs. The medical literature describes three key tenets of handoffs: face-to-face uninterrupted communication, communication of data that is factual and unambiguous, and the need for formal didactic and interactive training in handoffs (DeRienzo, Frush, Barfield, Gopani, Griffith, Jian, Mehta, Papvassiliou, Rialon, Stephany, Zhang, Andolsek, 2012). Others, have documented key strategies for successful handoffs (Patterson ES, Roth EM, Woods DD, Chow R, Gomes JO, 2004); many of these strategies have been incorporated into the handoff process. The focus on safe transitions of care stress the importance of implementing innovative models in surgical curricula to enhance trainees’ situation awareness. The current study showed that formal handoff training resulted in improved situation awareness. Surgical residents and moonlighters demonstrated more effective communication, greater focus on key elements, decreased omissions, and more successful handoffs following training.

Handoff training also seemed to provide resilience during distractions. Before training, distractions were associated with decreased situation awareness; but after training, residents were able to maintain the same level of situation awareness despite distractions. This is a critical skill as physicians are frequently distracted by pages, nurses, other physicians, and phone calls during handoffs. Training facilitated resident’s ability to focus on critical issues. The mnemonic provided a script and mental image of critical information, allowing residents to proactively direct handoffs.

Handoffs are different in mornings vs evenings. The evening handoff is a lengthy process between a junior resident and moonlighter lasting 1.5-2 hours. This involves discussing the days events, operations, active and evolving problems, and care that needs to be completed overnight. The morning handoff takes about 30 minutes, and usually involves moonlighters signing out overnight events with a summary of things completed. This delegation of duties may explain why handoff training led to more notable handoff situation awareness among junior residents when giving handoffs, while training led to more notable situation awareness among moonlighters when receiving handoffs (Figure 4).

A limitation of this study is that there was only one observer of the handoffs. This may have led to some bias in the results as another observer's results were not used to validate the results obtained. There may have been a Hawthorne effect as well; the observer noted an increase uses of the mnemonic and focus in giving the signout when her observation of the handoff was known to the residents/moonlighters. This limitation was modified by observing handoffs without the participant's awareness.

Residents were keen to improve their handoffs and frequently solicited feedback from the observer. This periodic feedback reinforced resident's handoff skills. This feedback has been described as an important 'cue→strategy' association (Zsombok, Klein 1997). This meant that residents and moonlighters were getting additional "coaching" on handoffs and may explain some of the improved situation awareness over the course of the study. It could also be that over time residents and moonlighters gained more clinical experience, which improved handoff ability. But experience alone cannot explain the increase in situation awareness, because moonlighters have 1-3 years more clinical experience than junior residents, yet they started at a level of situation awareness similar to junior residents, and improved following training.

Senior residents started with lower situation awareness in July corresponding to the transition from junior to senior resident. They then quickly transitioned (within a month), without handoff training, to achieve proficiency; this likely resulted from years of clinical experience. Their years of clinical experience facilitated development of Level 3 Situation Awareness; the ability to project future events from current events (Endsley, Garland 2000; Patterson, Roth, Woods, Chow, Orlando 2005). Situation awareness is an essential skill that surgical residents obtain over time, enhancing their decision making; but this study demonstrated that formal training can expedite this process.

In health care, we use critical cues and intuition to direct the care of patients. This intuition comes from pattern matching and recognition (Klein 1998). Situation awareness requires time and is gained with increasing experience. Senior surgeons might describe it as an inclination, gestalt, or impression of what might happen given the information provided; much of the knowledge is tacit rather than explicit. Resident's ability to assess clinical conditions quickly and accurately is mostly learned through clinical experience, not instruction. But, training and providing a framework for handoffs (with situation awareness as a frames) led to improved handoffs. Our data demonstrates the value of didactic handoff training and mnemonic use to improve surgical handoffs and suggests this approach can accelerate proficiency in situation awareness.

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