Patient Handoff Among General Surgery Residents in Saudi Arabia: A Cross-Sectional Study

Abdulaziz M. Saleem (✉ Abdulaziz.m.saleem@gmail.com)

Department of Surgery, Faculty of Medicine, King Abdulaziz University, Jeddah

Mai Kadi

Department of Community Medicine, Faculty of Medicine, King Abdulaziz University, Jeddah

Research Article

Keywords: Adverse events, communication, healthcare, healthcare provider, patient care, patient handoff

Posted Date: January 10th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1182102/v1>

License: This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background

Communication failure is a common cause of adverse events. An essential element of communication among healthcare providers is patient handoffs. To explore this practice, we assessed patient handoffs among general surgery residents in Saudi Arabia.

Methods

A cross-sectional survey was conducted with individuals in accredited general surgery residency programs in Saudi Arabia between 2020 to 2021.

Results

Participants comprised 118 general surgery residents—66 (57.3%) were females; 67 (72.8%) did not receive any formal training on patient handoff; 35 (38.8%) reported that they were sometimes interrupted during the patient handoff process. The most common reason for such interruptions was medical personnel paging. Further, 60 (68.1%) general surgery residents stated that such interruptions led to a decreased quality of effective communication, 39 (44.3%) believed it led to decreased quality of patient care, 63 (71.5%) believed it led to the loss of some information related to patient handoff, and 16 (18.1%) believed it led to patient harm. Finally, 31 (34.4%) general surgery residents believed that the existing handoff system at their institutions neither adequately protected the patient's safety nor allowed for continuity of care; and 51 (68%) reported that they did not have a standardized protocol for patients' verbal handoff process at their institution. There were higher proportion of patients with minor harm in residents who did not, rare or some time received verbal or written hand off (67% vs 33%).

Conclusion

The patient handoff process among general surgery residents in Saudi Arabia is subjective, not standardized, and can contribute to patient harm. Standardizing it is paramount to improve patient safety.

1. Background

Patient handoff refers to a practice whereby a healthcare provider transfers patient care information to another healthcare provider to ensure the patient's safety and continuity of care. The public formed negative perceptions of the safety and reliability of the U.S. healthcare system when the Institute of Medicine published a now-famous report in 2000 showing that, on average, 98,000 deaths occur annually in U.S. hospitals as a direct result of medical errors¹. A retrospective review that included 444 closed

malpractice claims from four liability insurers found that communication breakdown was one of the system factors that led to medical errors ². A similar retrospective review of 51 hospitals in the state of New York shows that 26% of systemic errors were due to inadequate reporting and communication ³. A review of 7,926 patient medical records across 21 hospitals in the Netherlands found that the main cause of adverse events was knowledge-based mistakes and information-transfer problems ⁴. In addition to their toll on patients, medical errors also damage the overall healthcare system because of their cascading effects. They ultimately increase the total cost and length of hospitalization as well as reduce trust in the physicians, lead to job loss, and decreased morale among physicians.

Failure to adequately communicate, known as a “communication breakdown,” has been repeatedly shown to be a leading cause of medical error in root cause analyses. Indeed, communication is critical to patient handoffs. When inadequately performed, patient handoffs result in harm to the patient. A cross-sectional study among surgery residents in the U.S. and Canada found that the existing patient handoff contributed to patient harm ⁵. Another survey of general surgery residents and internal medicine residents at Massachusetts General Hospital showed that 59% of residents reported that incomplete handoff had resulted in one or more events of patient harm, of which 12% of the cases led to major harm ⁶.

To the best of our knowledge, no prior studies have assessed patient handoffs practices among general surgery (GS) residents in Saudi Arabia. Thus, we aimed to assess the patient handoff process among GS residents across all general surgery residency programs in Saudi Arabia. We also attempt to identify the common reasons that lead to incomplete patient handoffs resulting in patient harm as well as investigate the factors that improve patient handoffs based on the experience of residents.

2. Method

2.1 Selection criteria

We conducted an anonymous survey that included all GS residents from R1 to R5 in all the accredited general surgery residency programs by the Saudi Commission for Health Specialties (SCFHS). The survey was sent to the SCFHS for approval prior to distributing it among all the GS residents. Individual program directors were approached to send the survey to their residents. The Research Committee of the Unit of Biomedical Ethics at King Abdulaziz University Hospital has approved the study and reviewed the waived informed consents from all participants (Reference number 334-20). All methods were carried out in accordance with relevant guidelines and regulations.

2.2 Survey content

The survey was divided into four sections. The first section contained questions about demographic information, the hospital setting, and the level of residency training. The second section contained questions about verbal handoffs and how they were conducted at their institutions. The third section contained questions about the written handoff, and the fourth about patient harm and how to improve

the existing handoff process at the institutions. A pilot study involving junior and senior GS residents at King Abdulaziz University hospital was conducted to ensure content clarity and clarity of the survey.

2.3 Survey administration

The survey was administered online using SurveyMonkey (www.surveymonkey.com). The URL was sent to the GS residents through the SCFHS. To increase the response rate, the URL was sent directly to the program directors, who then resent it to their GS residents as well.

2.3.1 Definitions of patient handoff

Patient handoff (“sign-out”) is “the transfer of information along with authority and responsibility during transitions in care across the continuum, to include an opportunity to ask questions, clarify, and confirm”⁷.

2.3.2 Definition of patient harm

Minor harm was defined as an event with a limited clinical consequence owing to communication error or incomplete handoff without causing any harm to the patient (e.g., a missed or delayed follow-up on a radiological test or laboratory result or a delay in assessing a new patient)⁵. Major harm was defined as an event with a major clinical consequence such as complication, injury, or even death secondary to communication failure or incomplete handoff⁵.

2.4 Statistical analysis

Data was summarized as mean $\pm$ standard deviation for continuous variables and counts (percentages) for categorical variables. Chi-square test was conducted to test the association between type of handoff received and proportion of patients who suffered from minor harm.

The significance level was at a P-value of <0.05 and a 95% Confidence interval. Collected data were entered and analyzed with **Stata version 13.0** (Stata Corp, College Station, Texas, USA).

3. Results

A total of 118 GS residents responded and their responses were analyzed. Table 1 presents the complete characteristics of the participants. There was equal gender distribution with 66 (57.3%) responses from female residents. Most GS residents (72.8%) did not receive any formal training or attend any workshop on patient handoffs and how to conduct them. Among those who reported that they have received formal training, 11 (11.9%) were GS residents training at the Ministry of Health hospitals (Figure 1). Fifty-eight (63%) GS surgery residents believed that the time they spent during the handoff process was appropriate, while 24 (26%) believed it was too short.

Table 1
Characteristics of the surgery residents who participated in the survey (n = 118)

Characteristic	n (%)
Gender *	
Male	49 (42.6%)
Female	66 (57.3%)
Age (Median in years)	28
Year of finishing internship	
Before 2014	12 (10.7%)
2014	6 (5.4%)
2015	12(10.7%)
2016	16(14.2%)
2017	27(24.1%)
2018	14(12.5%)
2019	25(22.3%)
Region	
Northern region	0 (0%)
Southern region	0(0%)
Central region	13(11.4%)
Eastern region	4(3.51%)
Western region	97 (85%)
Type of hospital	
University hospital	13(11.2%)
Private hospital	26(22.4%)
Ministry of Health hospital	49(42.2%)
National guard / armed forces hospital	20(17.2%)
King Faisal specialist hospital and research Center	4(3.4%)
Other	4(3.4%)

*Some of the participants skipped some of the questions that led to the discrepancy between the total number of cohorts and the total number of their responses.

Characteristic	n (%)
Level of training	
PGY1	28(24.5%)
PGY2	17(14.9%)
PGY3	19(16.6%)
PGY4	19(16.6%)
PGY5	31(27.1%)
Level of satisfaction of the residents about patient's handoff	
Very satisfied	6(6.6%)
Satisfied	37(41.1%)
Neither satisfied nor dissatisfied	30(33.3%)
Dissatisfied	11(12.2%)
Very dissatisfied	6(6.6%)
*Some of the participants skipped some of the questions that led to the discrepancy between the total number of cohorts and the total number of their responses.	

With regards to details related to patient handoff practice among GS residents, details are presented in Table 2. Thirty-five (38.8%) GS residents reported that they were sometimes interrupted during the patient handoff process. The most common reasons for interruptions were medical personnel paging. Other reasons included “side conversations” with other colleges, late arrival of residents causing interruptions and requiring repeating the handoffs, and being needed in the operating room. GS residents perceived that interruption affected the handoffs, 60 (68.1%) believed that interruptions led to a decreased quality of effective communication, 39 (44.3%) believed it decreased quality of patient care, 63 (71.5%) believed that it led to loss of information, and 16 (18.1%) believed it led to patient harm. During on-call time, 34 (37.7%) GS residents attended to an average of 20–39 patients during their call period; 32 (35.5%) attended to an average of 11-19 patients; and only 8 (8.8%) covered more than 40 patients during their shift. Figure 2 shows all characteristics by hospital type.

Table 2
Characteristics of patient handoff among surgery residents in Saudi Arabia.

The handoff process was conducted with opportunity for questions and answers (interactively)					
Always	Most of the time	Sometimes	Rarely	Never	Total
29(31.5%)	23(25%)	28(30.4%)	10(10.8%)	2(2.1%)	92
Handoffs occur at a designated time					
Always	Most of the time	Sometimes	Rarely	Never	Total
26(28.2%)	32(34.7%)	21(22.8%)	9(9.7%)	4(4.3%)	92
Handoffs occur in a designated place					
Always	Most of the time	Sometimes	Rarely	Never	Total
29(31.5%)	26(28.2%)	17(18.4%)	7(7.6%)	13(14.1%)	92
Frequency of interruption during the handoff process					
Always	Most of the time	Sometimes	Rarely	Never	Total
10(11.1%)	16(17.7%)	35(38.8%)	26(28.8%)	3(3.3%)	90

Finally, 31 (34.4%) GS residents believed that the existing handoff system at their institutions neither adequately protected patient safety nor allowed for continuity of care. Of those GS residents who believed that the patient handoff at their institution was not safe, 13 (41.9%) worked at the Ministry of Health hospitals, followed by 8 (25.8%) at private hospitals.

This finding did not reach statistical significance, though figure 3 and 4 shows that there were higher proportion of patients with minor harm in residents who did not, rarely or sometime received verbal or written hand off (67% vs 33%).

3.1 Verbal handoff

In total, 51 (68%) GS residents reported that they did not have a standardized protocol for patients' verbal handoff process at their institution, while 24 (32%) said otherwise. Table 3 and Table 4 present further details on verbal patient handoffs.

Table 3
Characteristics of verbal patient handoff among surgery residents.

Do you receive a verbal handoff about ALL patients whom you need to take care of during the on call?					
Always	Most of the time	Sometimes	Rarely	Never	Total
20(25.9%)	30(38.9%)	18(23.3%)	8(10.3%)	1(1.3%)	77
Do you receive complete verbal handoff, which makes you well-prepared for the shift change?					
Always	Most of the time	Sometimes	Rarely	Never	Total
11(14.4%)	28(36.8%)	24(31.5%)	11(14.4%)	2(2.6%)	76
Is the verbal handoff conducted face to face?					
Always	Most of the time	Sometimes	Rarely	Never	Total
18(23.3%)	28(36.3%)	17(22%)	13(16.8%)	1(1.3%)	77
Is the verbal handoff conducted over the phone?					
Always	Most of the time	Sometimes	Rarely	Never	Total
2(2.6%)	15(19.4%)	36(46.7%)	17(22%)	7(9%)	77
Do you use the read-back technique (repeating back critical information to ensure that it is accurately received)?					
Always	Most of the time	Sometimes	Rarely	Never	Total
11(14.2%)	27(35%)	18(23.3%)	15(19.4%)	6(7.7%)	77

Table 4
Elements of verbal and written handoff reported by the surgery residents during the handoff process.

Characteristics	Verbal n (%)	Written n (%)
Name of each patient	47(61.8%)	39(72.2%)
Age of each patient	52(68.4%)	46 (85.1%)
Date of admission for each patient	27(35.5%)	39 (72.2%)
Primary physician for each patient	69(90.7%)	28 (51.5%)
Type of surgical procedure(s) in the current admission for each patient	66(86.8%)	50(92.5%)
Date of the procedure for each patient	48(63.1%)	39 (72.2%)
Relevant prior surgical procedure(s) for each patient	42(55.2%)	46(85.1%)
Clinical course in the current admission for each patient	48(63.1%)	33 (61.1%)
Complications experienced by each patient	61(80.2%)	31 (57.4%)
Co-morbidities	55(72.3%)	31(57.4%)
Medications for each patient	26(34.2%)	40(74%)
Diet information for each patient	27(35.5%)	19(35.1%)
Code status for each patient (if any recent change)	29(38.1%)	18(33.3%)
Identification of the sickest patient on the list	47(61.8%)	22(40.7%)
Pending laboratory results to follow	59(77.6%)	25(46.3%)
Pending consults to evaluate	60(78.9%)	41(75.9%)
Pending radiological tests to follow	63(82.8%)	42(77.7%)
Anticipated issues or problems	50(65.7%)	44(81.4%)
New consults/admissions	47(61.8%)	33(61.1%)

3.2 Written handoff

GS residents reported different methods of written handoffs at their institutions. Thirty (38.9%) reported using an electronic form (such as Excel or Google sheet). Eighteen (23.3%) reported using instant messaging. Fourteen (18.1%) reported using handwritten forms, and 15 (19.4%) had no written handoff. Only 11 (19.3%) GS residents reported that they had received a complete written handoff about all the patients needing care during on-call time, while 6 (10.5%) reported that they had received a complete written handoff that made them well prepared for the shift. Further details are reported in Table 4 and Table 5.

Table 5
Characteristics of written handoff among surgery residents.

Do you receive a complete written handoff about ALL the patients whom you need to take care of during the on call?					
Always	Most of the time	Some of the time	Rarely	Never	Total
11(19.3%)	20 (35%)	15 (26.3%)	4 (7%)	7 (12.2%)	57
Do you receive complete written handoff, which makes you well prepared for the shift change?					
Always	Most of the time	Some of the time	Rarely	Never	Total
6 (10.5%)	22 (38.6%)	18 (31.5%)	4 (7%)	7 (12.2%)	57
Is the written handoff handed to you physically?					
Always	Most of the time	Some of the time	Rarely	Never	Total
8 (14%)	11 (19.3%)	12 (21%)	10 (17.5%)	16 (28%)	57

3.3 Patient harm

Forty (56.3%) GS residents reported that they had received an incomplete handoff that resulted in minor harm to a patient, and the majority were based in Ministry of Health hospitals (Figure 5). The verbal handoff did not contain the most current information reported by 25 residents (64.1%), which was the most common reason for minor harm. Another reason was interruptions during the patient handoff (Table 6 and Table 7). Furthermore, 14 (19.1%) residents were PGY-5, followed by 7 (12.3%) residents who were PGY-3; 26 (66.6%) discussed incomplete handoffs with the resident responsible in order to prevent such an incident occurring again, while 13 (33.3%) did not discuss such events, often to avoid confrontation with their colleagues (Table 6). Only 6 (8.7%) GS residents reported that they had received an incomplete patient handoff that resulted in major harm to the patient. Table 6 lists the reasons for major harm. Five (83.3%) GS residents who had reported incidents of major harm owing to incomplete handoff discussed the adverse event with the residents at fault. Only one (16.6%) of the GS residents did not discuss an event with colleagues in order to avoid confrontation. Among the incidents of major harm, three (50%) residents reported some changes in the handoff process to prevent such an incident from occurring again. The GS residents also reported on factors that could improve the handoff process at their institutions (Table 8), and their satisfaction (Figure 6)

Table 6

Reasons that led to an incomplete patient handoff that resulted in minor and major harm.

Reasons	Minor harm N (%)	Major harm N (%)
The verbal handoff did not contain the most current information.	25(64.1%)	6(100%)
The written/electronic handoff did not contain the most current information.	18(46.1%)	4(66.6%)
Interruption during the handoff process.	15(38.4%)	2(33.3%)
Language barrier between the residents.	2(5.1%)	1(16.6%)
Knowledge base problem from either one of the residents.	16(41%)	4(66.6%)
Time constraint affecting the outgoing resident	14(35.9%)	2(33.3%)
Time constraint affecting the incoming resident (you).	7(17.9%)	1 (16.6%)
Interpersonal conflict between the incoming and outgoing resident.	6(15.3%)	0(0%)
Lack of interactive handoff process (handoff given without opportunity for questions and answers)	22(56.4%)	1(16.6%)
The handoff was conducted in a distracting environment. (e.g., hospital hallway or emergency department)	11(28.2%)	0(0%)
Reasons why residents did not discuss with their colleagues the incomplete handoff that resulted in minor and major harm.		
Avoid confrontation with their colleagues	4 (30.7%)	1 (100%)
Lack of time	3 (23%)	0
No major harm caused to the patient	2(15.3%)	0
The residents who gave the handoff were more senior than the residents	2(15.3%)	0
Forgot about it	1(7.6%)	0
Overwhelmed with long call hours	1(7.6%)	0

Table 7
Most common reasons for patient handoff interruption among surgery residents.

Causes of interruptions	n (%)
Medical personnel paging (medical students, other residents, consultants)	45(50.5%)
Nurses' paging	42(47.1%)
New consult/admission that needed evaluation	42(47.1%)
Trauma alert or patient coding	26(29.2%)
Other causes	9(10.1%)

Table 8
Ways to improve patient handoff based on the residents' opinions.

Residents' suggestions to improve patient handoff	n (%)
Implementing an educational course about patient handoff to all the residents	49(73.1%)
Performing the handoff under supervision of a senior resident.	40(59.7%)
Performing the handoff under supervision of an attending surgeon.	31(46.2%)
Take extra measures to decrease the non-urgent interruptions during the handoff process.	38(56.7%)
Standardize the written/electronic handoff so that all the residents will follow the same technique to sign out every time.	52(77.6%)
Standardize the verbal handoff so all the residents will follow the same technique to sign out every time.	43(64.1%)
Devote a specific and protected time of the day for the handoff process.	41(61.1%)
Devote a specific place for the handoff process to take place.	31(46.2%)
Improve the electronic/written handoff computer program.	37(55.2%)
Using an electronic tablet (such as an iPad) for the handoff.	25(37.3%)
Using a smartphone application for the handoff.	34(50.7%)

4. Discussion

Patient handoff is essential to ensure continuity of care among healthcare providers. A lack of standardization in that area can make the quality of treatment variable and subjective. Multiple variables such as patient load, location where the handoff has taken place, and interruptions during the handoff play an important role. As the number of residency programs increases in Saudi Arabia across all specialties, higher workload and lack of formal training and standardization are expected to increase incidents of medical errors secondary to communication failure. Effective communication is thus an essential non-technical skill in surgeons' manuals, where communication and team work are defined as

“giving and receiving knowledge and information in a timely manner to aid establishment of a shared understanding among team members”⁸.

Our study showed lack of formal training in patient handoff and it showed a variable quality of patient handoff. Indeed, only 31% of residents reported that the patient handoff was always done interactively, and less than 30% stated that it was done at the same time and place. However, this result is unexpectedly better in reports on surgery residents in the U.S. and Canada⁵. The higher rates of interruptions during handoffs may also point to an environment where patient handoff time is not regulated and protected. Healthcare providers can take cues from professionals in other high-risk environments, where strict measures are followed to ensure clear and adequate communication. For example, in aviation, “sterile cockpit” protocols protect the cockpit crew from unnecessary distractions at different critical times during the flight.

Our study shows that residents believe that major interruptions during the handoff process could have caused subsequent harm to quality of care. The quality of effective communications with the other healthcare providers was also low and residents believed that it often led to information loss. These results differ from those of a prospective observational study by Kitch *et al.* on distraction among surgery residents during patient handoff⁶, where 214 surgery resident handoffs were observed over 18 months. Although 102 (48%) reported distraction during the patient handoff, there was no significant difference in the quality of handoffs. This difference in quality with our results may be explained by the presence of a standardized process for both verbal and written handoffs, which made the surgery residents more resilient against distraction. This type of standardization is mostly absent in the institutions included in our study. However, these contrasting results may also be attributed to the Hawthorne effect, that is, the residents in Kitch *et al.*'s study did not provide accurate feedback on interruptions that decreased handoff quality⁶. Another retrospective study that reviewed the data of mobile phone-based paging systems among PGY1 surgery residents found that these residents received, on average, 48 ± 41 messages per shift⁹. Most of these messages were between 5.00 p.m. and 7.00 p.m., when patient handoff and the transition of care among surgery residents take place, and no interruptions are expected, as this may lead to medical errors^{10–13}.

Interruptions may occur when a healthcare provider is trying to reach out to residents, because of side conversations, or owing to interruptions from other residents. Fixing this problem requires standardizing a time and place for handoffs. Educating all healthcare providers of the “sterile hour” will reduce distractions, except in emergency cases such as during trauma codes. Criteria or a scoring system, can be established to prioritize interruptions and weed out unnecessary ones during the sterile hour. In general, however, all unnecessary conversations should be avoided during patient handoff and transfer of care.

Standardization is paramount for improving the quality of the patient handoff^{14,15}, and respondents in our survey unanimously agreed with this suggestion. In our cohort, there was an obvious lack of standardization of both verbal and written handoffs, followed by incomplete verbal handoffs, which together led to most minor and major harm events.

Up to our knowledge, this is the first detailed cross-sectional study about patient handoff among GS resident in Saudi Arabia, which is an extremely important and yet under-researched topic in this region. Finally, our study had some limitations. Our survey was restricted to only GS residents. Including residents from different specialties will offer richer and more contextualized insights on the causes of and solutions for low-quality patient handoffs. In addition, the number of participants in the survey was limited.

Conclusions

Further research is needed to assess patient handoffs across all residency programs in different specialties and in different hospital settings in Saudi Arabia to assess the true scope of the problem. Mandatory educational modules for patient handoffs are ought to be a requirement for all residents by the SCFHS.

Abbreviations

GS
general surgery
SCFHS
Saudi Commission for Health Specialties
KFSHRC
King Faisal Specialist Hospital and Research Center
MOH
Ministry of Health

Abbreviations

GS: general surgery

SCFHS: Saudi Commission for Health Specialties

KFSHRC: King Faisal Specialist Hospital and Research Center
MOH: Ministry of Health

Declarations

- **Ethics approval and consent to participate:**

The Research Committee of the Unit of Biomedical Ethics at King Abdulaziz University Hospital has approved the study and reviewed the waived informed consents from all participants (Reference number 334-20).All methods were carried out in accordance with relevant guidelines and regulations.

- **Consent for publication:**

The Research Committee of the Unit of Biomedical Ethics at King Abdulaziz University Hospital has approved the use of data for publication (Reference number 334-20).

- **Availability of data and materials:**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

- **Competing interests:**

The authors declare that they have no competing interests.

- **Funding:**

The authors declare that no financial support was received from any organization for the submitted work.

- **Authors' contributions:**

AMS collected the data and wrote major part of the manuscript. MK analyzed the data and wrote major part of the manuscript. All authors read and approved the final manuscript.

- **Acknowledgements:**

Not applicable.

References

1. . In: Kohn LT, Corrigan JM, Donaldson MS, eds. *To Err is Human: Building a Safer Health System*. Washington (DC)2000.
2. Rogers SO, Jr., Gawande AA, Kwaan M, et al. Analysis of surgical errors in closed malpractice claims at 4 liability insurers. *Surgery*. 2006;140:25-33.
3. Leape LL, Brennan TA, Laird N, et al. The nature of adverse events in hospitalized patients. Results of the Harvard Medical Practice Study II. *N Engl J Med*. 1991;324:377-384.
4. Zwaan L, de Bruijne M, Wagner C, et al. Patient record review of the incidence, consequences, and causes of diagnostic adverse events. *Arch Intern Med*. 2010;170:1015-1021.
5. Saleem AM, Paulus JK, Vassiliou MC, Parsons SK. Initial assessment of patient handoff in accredited general surgery residency programs in the United States and Canada: a cross-sectional survey. *Can J Surg*. 2015;58:269-277.
6. Kitch BT, Cooper JB, Zapol WM, et al. Handoffs causing patient harm: a survey of medical and surgical house staff. *Jt Comm J Qual Patient Saf*. 2008;34:563-570.
7. Pocket Guide: TeamSTEPPS. Content last reviewed January 2020. Agency for Healthcare Research and Quality, Rockville, MD. .
8. The Non-Technical Skills for Surgeons (NOTSS) System Handbook v1.2.
9. Elhage SA, Watson MD, Green JM, Sachdev G. Distractions During Patient Handoff: The Application-Based Messaging Volume on General Surgery Interns. *J Surg Educ*. 2020;77:e201-e208.

10. Keers RN, Williams SD, Cooke J, Ashcroft DM. Causes of medication administration errors in hospitals: a systematic review of quantitative and qualitative evidence. *Drug Saf.* 2013;36:1045-1067.
11. Palese A, Sartor A, Costaperaria G, Bresadola V. Interruptions during nurses' drug rounds in surgical wards: observational study. *J Nurs Manag.* 2009;17:185-192.
12. Thomas L, Donohue-Porter P, Stein Fishbein J. Impact of Interruptions, Distractions, and Cognitive Load on Procedure Failures and Medication Administration Errors. *J Nurs Care Qual.* 2017;32:309-317.
13. Wiegmann DA, ElBardissi AW, Dearani JA, Daly RC, Sundt TM, 3rd. Disruptions in surgical flow and their relationship to surgical errors: an exploratory investigation. *Surgery.* 2007;142:658-665.
14. Mukhopadhyay D, Wiggins-Dohlvik KC, MrDutt MM, et al. Implementation of a standardized handoff protocol for post-operative admissions to the surgical intensive care unit. *Am J Surg.* 2018;215:28-36.
15. Agarwal HS, Saville BR, Slayton JM, et al. Standardized postoperative handover process improves outcomes in the intensive care unit: a model for operational sustainability and improved team performance*. *Crit Care Med.* 2012;40:2109-2115.

Figures

Figure 1

Number of surgery residents who received formal training on patient handoff based on the hospital type.

KFSHRC: King Faisal Specialist Hospital and Research Center

MOH: Ministry of Health

Figure 2

Number of patients that are covered during the on-call time by the surgery residents based on the hospital type.

KFSHRC: King Faisal Specialist Hospital and Research Center

MOH: Ministry of Health

Figure 3

Comparison of who received verbal handoff that resulted in a minor harm to a patient

Figure 4

Comparison of who received written handoff that resulted in a minor harm to a patient

Residents who received incomplete handoff that resulted in minor harm to the patients based on hospital type

Figure 5

Number of residents who received incomplete patient handoff that resulted in minor harm to the patients based on hospital type.

KFSHRC: King Faisal Specialist Hospital and Research Center

MOH: Ministry of Health

Figure 6

Surgery residents' satisfaction regarding patient handoff at their institution based on hospital type

KFSHRC: King Faisal Specialist Hospital and Research Center

MOH: Ministry of Health

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [PatientHandoffAmongResidentsinSaudiArabia..ACrossectionalSurveyrawdata.xlsx](#)