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Quality of change-of-shift handoffs between surgical teams during surgery

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ABSTRACT

Background: Patient handoff is considered a critical measure for patient safety and continuity of care, particularly in the operating room where the patient fails to provide sufficient or appropriate information. This study aimed to assess the quality of change of shift handoffs between surgical teams during surgery.
Methods: This cross-sectional descriptive study evaluated the quality of scrub and circular handoffs regarding duration, process, information deletion, and satisfaction with handoffs. The quality of handoff process was further assessed in six main dimensions, namely environment, process organization, communication skill, content, clinical judgment, and professionalism using CEX instrument. The information omission items of handoffs were evaluated using a guideline proposed by Association of Surgical Technologists (AST) and the SWITCH Shift Change Checklist. The surgical team's satisfaction was measured using a revised version of the clinical change-of-shift survey used in Petrovic's study.
Results: In this study, 66 handoffs were observed and assessed. Information omission in surgical reports was 16.81% (SD = 15.31, Min = 0, Max = 76.5) between two circular persons and 19.55% (SD = 12.32, Min = 0, Max = 65) between two scrub persons. According to a nine-point scoring scale, the mean score of handoff process quality was 5.40 between two circular and 6.17 between two scrubs. The mean duration of shift change was 62 (SD =15) seconds between two circular persons and 93 (SD=21) seconds between two scrubs. The surgical team's satisfaction with handoffs was 67.5%.
Conclusion: This study revealed the necessity of a structured method for handoffs among the surgical team at the change-of-shift time during surgery. The data presented in this study would contribute to developing such a framework.

1. Introduction

Handoffs refer to exchange of patient information and caring responsibility from one healthcare provider to another during the care transition process[1, 2]. Handoffs are applied in different occasions in a health system, including when transferring a patient from one center to another, from one ward to another ward in the same hospital, or even in a ward as a process of communicating information and responsibility among the staff[3].

The errors committed by healthcare providers during the exchange of information account for about 80% of negative consequences in healthcare environments[4], including devastating medical events, delays in patient treatment, increased hospital stay, psychological stress on medical staff and community members, as well as enhanced financial costs[1, 5, 6]. About 200,000 to 400,000 patients annually die from preventable medical errors in the USA. Communication defects are a factor leading to such mistakes, and low-quality information exchange is associated with adverse consequences[7].

The transfer of essential and sensitive information from a caregiver to another during handoff is crucial to patient safety and continuity of care. In this regard, communication defects are a major cause of irreversible events[8, 9]. A majority of complications are posed by the lack of effective communication, incorrect information, misinterpretation, and omitted or misleading information[10-12].

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The operating room is a stressful, high-speed, and complex environment where team members frequently experience interruptions and problems during communications. The noise from equipment, music playback, and multiple conversations could even make the exchange of simple information complicated[13].

Communication errors frequently occur at seven-to-eight minute intervals in operating rooms. In 90% of cases, these errors have an adverse effect on surgery in several ways, including delays, procedural errors, waste of resources, team tension, omission of information, or other undesirable events[14-16].

One of the critical scenarios in the operating room is to have handoffs during the surgery process among the surgical staff. This process could be conducted from one circular to another or from a scrub technician to another. Although the surgeons are continuously present during a surgery, the operating room technologists in scrub and circular roles traditionally work on a shift schedule. Accordingly, change-of-shift between scrubs and circular persons might occur during surgery[17]. Communication during personnel transition is vulnerable because incorrect information could be exchanged, or important information could be missed resulting in consequent mistakes[18]. Studies have revealed that change-of-shift complications occur three times more frequently than the usual patient care[19].

The involvement of new staff in the surgical procedure during surgery and the presence of communication gaps may be other factors raising the likelihood of adverse effects. Moreover, the variability of handoff approaches between scrubs and circular persons may also lead to misunderstandings and errors[20].

Numerous standard systems and techniques are available for handoff, and there are various formats such as SBAR, I-PASS, SHARQ, Five Ps, and NURSE PASS[21]. The advantages of these standardization tools are reduced information error, increased quality of exchanged information, and decreased risks to patient safety. In general, each of these tools is associated with some advantages and disadvantages. For example, SBAR tool is highly effective when time is limited and quick decisions are needed, but one of the limitations of this tool is in situations involving transmission of information about complex patients who require broader information and context[22]. I-PASS tool has overcome this limitation and is more compatible in medical and pediatric wards. However, in a surgical suite, there is not enough time to do a formal I-PASS handover on anyone[23].

Due to the lack of sufficient information about the handoff process in Iran, the research question was whether the existing unstructured and traditional change-of-shift reports could properly transfer care and job responsibilities in frequent care deliveries, particularly in the operating rooms where the complexity of patient's condition and work environment makes it more difficult to read and traditionally exchange information. Accordingly, this study aimed to evaluate the quality of handoff at the time of shift delivery, i.e. the quality of process and amount of information omission and satisfaction of the operating room staff.

2. Materials and methods

2.1. Ethical considerations

Ethical approval was obtained from Ethics Committee Directorate for Clinical Researches, (Approval ID: IR.MAZUMS.REC.1398.1224). In addition, the study subjects signed informed consent before taking part in the study.

2.2. Setting

This cross-sectional descriptive study was extracted from a research project, and followed the recommendations of Strengthening the Reporting of Observational Studies in Epidemiology (STROBE). This research aimed to evaluate the quality of handoff at the change-of-shift time among surgical team members (scrub and circular roles) from January 29 to July 17, 2020 in the operating rooms of Sina and Imam Reza (AS) Teaching Hospitals affiliated to Tabriz University of Medical Sciences, Iran.

2.3. Inclusion and exclusion criteria and sampling method

In Iran, the role of scrub and circular is taught together in a two-year course or a four-year undergraduate course for an operating room technologist, and in the operating room, they play a rotating role in both scrubbing and circular.

Forty operating room technologists with at least one a year of work experience in the relevant field participated in this study, and delivery of morning surgery shifts to the evening was considered in the present research. The subjects who were unwilling to continue the study and those who had change-of-shift because of emergency were excluded from the study.

The sample size in this study was calculated to be 75 handoffs with 95% confidence and 80% study power. Following a pilot study in the research setting and review of previous studies[24], we selected the samples proportionally with regard to the surgical procedures, including gynecological surgery, orthopedics, general surgery, neurosurgery, urology, and the role of personnel (circular or scrub). The surgeries were selected for handoff evaluation during change-of-shift and the consent forms were received from all team members, according to which they were accepted to be observed.

2.4. Data collection

To conduct the study, the researcher attended the operating suit after obtaining ethical permission from the University Ethics Committee, as well as receiving a letter of introduction and reference and presenting the letters to authorities of Sina and Imam Reza (AS) Hospitals to have their consent. In both hospitals, the written consent forms were filled in by the personnel to participate in the study. Then, the demographic form addressing the research participants, including gender, level of education, work experience, type of employment and the satisfaction questionnaire were filled in by the participants.

A week interval was considered to normalize the researcher's presence as a group member and eliminate the adverse-effects it may have on personnel's behaviors. During this period, no data was collected despite the researcher's presence as part of the group using the shift change checklist. To evaluate handoff quality, the researcher attended the operating suite every day before shift delivery and assessed the manner of handoff during the surgery at the change-of-shift time using the relevant tools. Moreover, the participants were not informed of the concerned criteria under review.

2.5. Quality assessment of handoff process

To evaluate the quality of handoff process, the CEX-instrument was used, which has been used in many studies[24, 25]. This checklist has been designed to evaluate the process of information exchange in six main dimensions, including environment, process organization, communication skills, content, clinical judgment, and professionalism. This tool is scored based on a scale ranging from 1 to 9. Modifications were made to use this tool to assess the change of shift handoff during surgery. Also, for a more accurate evaluation in each domain, for each item in the standard tool, it was possible to score 1–9, and the mean score of the items was considered as the total score of that domain. Given that handoff is highly sensitive for patient safety in surgery, the surgical team must provide high-quality handoffs; therefore, handoffs with scores <5 were regarded as unsatisfactory.

2.6. Handoff content quality evaluation

To assess the quality of handoff content and the amount of

information omitted, we used the basic and standard information form of change-of-shift during surgery, which was extracted from 17 guidelines provided by the Association of Surgical Technologists for standard change-of-shift and SWITCH shift delivery checklist in Johnson's et al. study[8, 26]. The form encompassed 20 items, and each item was scored from zero (i.e., the information content of the item is not related to change-of-shift) to 9 (i.e., the information content of the item is fully related to change-of-shift).

2.7. Surgical team's satisfaction with handoffs

The modified version of the personnel satisfaction with handoff questionnaire by Petrovic was used to assess the surgical team's satisfaction with handoff[27]. In this questionnaire, the level of satisfaction was classified in the form of 10 items using a five-point Likert scale ranging from one ("strongly disagree") to five ("strongly agree)."

2.8. Statistical analysis

Data were analyzed using SPSS software version 22. Descriptive statistics included mean and standard deviation, and Kolmogorov-Smirnov test was used to determine the type of data distribution. One-way ANOVA parametric test was used for data with normal distribution; otherwise, Mann-Whitney and Kruskal-Wallis non-parametric tests were used. The level of significance in all the tests was set at $P<0.05$.

3. Results

In this study, 75 change-of-shift handoffs on surgery between scrub and circular persons of the surgical team were observed. The data obtained for one or more change-of-shifts from the quality evaluation checklists was omitted in nine cases, which were excluded from the study. Finally, 66 handoffs were analyzed. There were 40 operating room technologists in these handoffs, with a range of 2–5 handoffs for each technologist. The participants' mean age (and standard deviation) was 31.41 ± 5.6 years. Table 1 shows other demographic information of the personnel in the two hospitals. The average change-of-shift time was 62 s (SD = 15) between two circular persons and 93 s (SD = 21) between two scrubs. The longest and the shortest delivery time were observed in general and orthopedic surgeries, respectively. The duration of handoff based on the type of surgery and the role of circular and scrub is presented in Table 2.

3.1. Handoff process quality

Table 3 presents the evaluation of handoff process using CEX instrument for six dimensions, namely environment, procedure organization, communication skills, content, clinical judgment, and professionalism. The average score of handoff procedure was 5.40 between two circular persons and 6.17 between two scrubs. A significant difference was observed in organizing handoff between scrubs and circular handoff (p <0.00).

Table 1
Demographic information in the two hospitals surveyed.

Characteristic		Hospital-1 (n = 22)	Hospital-2 (n = 18)	P-value
Age (years)		32.8 (SD=7.31)	30.02 (SD=4.96)	T test: 0.36
Sex				Chi square: 0.32
	Male	8	6	
	Female	13	12	
Work history (years)		10 (SD=6.85)	9.2 (SD=7.22)	T test: 0.77
Education level			5	Chi square: 0.89
	Associate degree	4	13	
	Bachelor's degree	17		
Type of employment	Training course	6	5	Chi square: 0.76
	Contractual	0	3	
	Permanent	15	10	

Hospital-1: Sina, Hospital-2: Imam Reza(AS).

Table 2
Details of handoff duration and information omissions in different surgeries.

Type of surgery(n = 66)	Duration of hand off(Seconds)	Information omission %
Gynecology (N = 23)		
C to C(n = 10)	64±21	16.1± 9.8
S to S(n = 13)	110±24	30.8±14.2
Neurosurgery (N = 19)		
C to C(n = 8)	45±12	28.5±14.6
S to S(n = 11)	114±21	25.9±13.5
General (N = 12)		
C to C(n = 5)	105±24	12.1±7.4
S to S(n = 7)	142±35	20±9.1
Orthopedic (N = 6)		
C to C(n = 2)	35±12	13.0±5.5
S to S(n = 4)	46±13	25±12.4
Urology (N = 6)		
C to C(n = 3)	62±9	13.3±6.4
S to S(n = 3)	54±14	10±3.2

C: Circular person, S: Scrub.

Table 3
Measurement of handoff quality via observations using the Handoff CEX instrument tool.

Domain	Scrubs Handoff		Circular persons Handoffs		P-value
	Mean	%<5	Mean	%<5	
Setting	6.2(SD=1.6)	16.7	6.0(SD=1.6)	20	0.62
Organization	4.6(SD=0.9)	42	3.4(SD=1.7)	56	0.00
Communication Skill	6.9(SD=0.8)	0	6.3(SD=1.7)	6.7	0.10
Content	6.4(SD=0.8)	10	5.8(SD=1.9)	26.7	0.11
Clinical Judgment	6.4(SD=0.9)	3.3	5.7(SD=1.7)	20	0.06
Professionalism	6.3(SD=0.9)	10	5.1(SD=1.7)	13.3	0.59

Hand-off CEX rates domains on a scale of 1–9 (unsatisfactory to superior)%< 5: Indicates the percentage of hand-offs that have scored less than 5 and are considered unsatisfactory.

3.2. Handoff content quality

On average, the percentage of omitted information in change-of-shift phase during surgery is reported to be 16.81% (SD = 15.31, Min = 0, Max = 76.5) between two circular persons and 19.55% (SD = 12.32, Min = 0, Max = 65) between two scrubs. Moreover, the information omission rate in handoffs regarding "patient profile, type of surgery, and anesthesia" was 76.5% between two circulars and 65% between two scrubs. Furthermore, the rate of information omission concerning the presence of urinary catheter and the amount of urine ranked second with 45% between two circular persons and 41% between two scrubs. The items associated with the percentage of information omissions during handoffs are presented in Fig. 1, which are related to information subgroups of surgical procedures, drugs and fluids, tools and equipment, samples, and counts. The highest and lowest percentages of information omission were observed in neurosurgery and urological surgery, respectively. Table 2 presents the details of information omissions in different surgeries.

3.4. Surgical team's satisfaction with handoffs

Thirty handoff satisfaction questionnaires were filled by 40 personnel participating in this study, and the average handoff

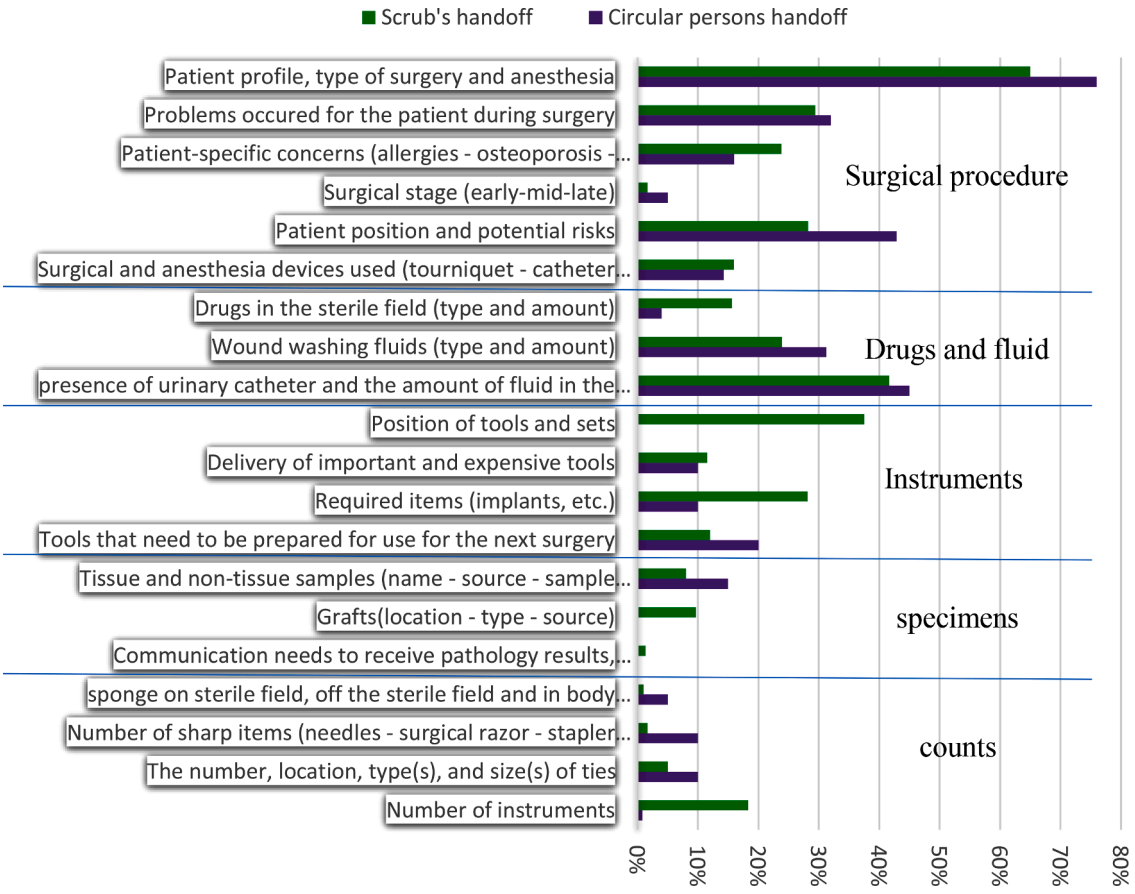

Fig. 1. The mean percentage of information omissions.

satisfaction rate was 67.5% (Table 4).

4. Discussion

The exchange of critical and sensitive information in handoffs from a caregiver to another is vital for patient safety and continuity of care, particularly in operating rooms where the patient cannot provide enough information[8, 9]. However there is no specific research in this regard.

The present results indicated that handoff during surgery is usually inadequate and incomplete among scrubs and circular persons. This study examined several items at the delivery time, which could be considered in four areas: duration of handoffs, handoff process errors, the content of exchanged information errors and the surgical team's satisfaction.

Table 4
Surgical team satisfaction from handoff.

Items	N	agree and strongly agree%
1. I was satisfied with the handoff for this patient	17	65%
2. I could hear all of the report	21	85%
3. I received information about potential problems that could arise in this patient	21	58%
4. I received information on things that I need to follow up	19	75%
5. The patient's condition matches what I get in report.	17	65%
6. I was clear as to when the handoff actually started and ended	22	90%
7. Shift delivery reports allow me to prioritize my tasks.	15	55%
8. Immediately after nurse-to-nurse shift report, I am able to communicate with physicians regarding patient care.	17	65%
9. The length of report is an effective use of my time	12	40%
10. Mistakes in patient care and equipment rarely occur in the current shift delivery process	14	50%
Total mean		67.5%

The average change-of-shift time was 62 s (SD = 15) between two circular persons and 93 s (SD = 21) between two scrubs. However, due to the lack of relevant research, these results cannot be interpreted. The studies aimed at standardizing and improving handoff quality in other specialties have considered a long handoff time to be either positive or negative. Catchpole et al. showed that using a checklist and defining procedures and responsibilities for patient delivery significantly decreased delivery time[28]. However, Salzwedel et al. assessed the effects of checklists on handoff quality from anesthesia to recovery. They observed an increase in time after the intervention and regarded it as a sign of higher information exchange rates and improved patient care[29].

The quality of handoff process is associated with an effective communication process for information exchange and patient care. The communication process is a sustainable and dynamic interaction that can be affected by several factors in operating rooms.

In this study, the environmental evaluation of handoffs, which deals with communicating interruptions and noises in the operating room environment and barriers during the change-of-shift process, showed a non-favorable status. The average score of handoff process was 5.40 between two circular persons and 6.17 between two scrubs.

In their study, Lo et al.[30] reported the patient's environment delivery score using CEX instrument among medical attendants to be equal to 7.97. Moreover, Horwitz et al.[25] estimated the nurses' handoff score during change-of-shift equal to 7.3, indicating a moderately favorable status. Many communication barriers in operating rooms can interfere with the effective exchange of patient information, of which the surgical team should be aware. The barriers to effective communication can

interfere with the exchange of patient care. Noises in operating rooms (e.g., music, unrelated conversations, and noise of electrical equipment) can lead to unnecessary interruptions in the exchange process among the surgical team members[26].

The loud noises in the operating rooms are produced by technical equipment[31]. Equipment noises up to 120 dB are caused by moving equipment, sticking and moving metal tools, and using electrical or air-powered surgical instruments, hammers, suction devices, and anesthesia monitors[32].

Noises disrupt the listener's understanding in communication, thereby making the complete and accurate exchange of information from speakers to listeners difficult. Given that removing all the noises in operating rooms is not practical, there might be interventions to improve the situation by modifying communication behaviors in the operating rooms to ensure appropriate information sharing and comprehension. Communication training could guarantee information sharing even under the effect of loud noises. Interventions may aim at improving communication by teaching the required skills such as step-back and closed-loop communication[31].

The handoff was in a poor condition due to the absence of special training on structuring handoff connections between scrubs and circular persons using various methods such as SBAR, I PASS, etc. The order of handoff communications between the scrubs was slightly better than that between circular persons. This may be because the two scrubs come together after scrubbing and wearing gloves during the shift change; however, circular persons are constantly on the move due to the nature of their duties, which causes interruptions and disorders in handoff. In contrast, Hunter et al. conducted a study to evaluate the use of SBAR structure for handoff among the surgical team members six years after performing a study in an on-campus higher education center. They eventually concluded that the scrubs used the previously-learned SBAR structures less frequently than circular persons. To explain this issue, they referred to the involvement of scrubs during surgery (e.g., holding the retractor to prevent interruptions in surgery)[33].

Regarding the problems associated with information exchange content in this study, the average of information omission in each handoff was 19.55% between the two scrubs and 16.81% between the two circular persons. In the study of Negpal on the rate of information omission in handoffs after surgery, nine items were lost in each handoff on average[34]. Similarly, Joy reported that the ratio of information omission in each operating room-to-ICU patient handoff was 6.33[35].

There are three potential reasons for an ineffective exchange of information: interruptions during handoff, the lack of a standard reporting process, and uncertainty about what important information should be exchanged to avoid interruptions[36].

The effect of using the standard model of handoff between neurological intensive care unit to neurology department in the study of Ding (2012) showed that handoff-related errors decreased from 18.89% to 5.70%[37].The surgical team must use standardized measures such as checklists to be consistent in adopting information exchange strategies. After implementing a standardized tool, the results revealed an increase in staff's satisfaction with the manner and content of communication messages[38]. Moreover, training health care professionals using routine procedures and handoff protocols would improve the patients' safety level in health organizations[39].

According to the guidelines provided by AST, the following information must be exchanged at the change-of-shift time between surgical team members: confirming the correct patient, patient position including positioning devices, and surgical procedure such as any incidental occurrences or variations that may affect the usual progression of procedure; ensuring anesthesia; determining patient allergies; specifying name/type of tissue specimen, region/side of the body it was obtained, and location of the specimen, which are still on the sterile field or off the sterile field; communicating if waiting for pathology results; checking if intraoperative x-rays have been taken and if waiting for results; confirming specific patient precautions; seeing if advanced directives are documented in the patient's medical record; measuring the amount of irrigation fluid administered during the surgical procedure; looking for the presence of an indwelling catheter; checking whether thermal devices or DVT devices are being used; taking a brief overview of the location of surgical instrumentation, equipment, supplies, and implants; counting sponges, sharps, and instruments; checking the location, type(s), and size(s) of ties; and finally examining the medication(s) and solution(s), including irrigating solution to be on the sterile field[26].

In the present study, the surgical team's satisfaction with handoff was 67.5%, which was smaller than similar assessments in nurse handoffs. In a study by Johnson et al.[40], nurses' satisfaction score with the patient handoffs was 4.36 out of 5. Kazemi et al. also reported the satisfaction score of 5.10 out of 6[38]. Cooper stated that handoffs could provide an important safety review, thereby paving the way for healthcare providers to assess their care services and correct potential errors[41]. However, the surgical team reported the least satisfaction in items related to task prioritization and efficient use of time during the change-of-shift report in this study.

5. Limitations

The handoff quality might be assessed in terms of content, methods, and delivery outcome. The patient delivery outcome usually includes satisfaction with patient delivery and patient's safety outcomes following the handoff. One of the limitations in this study was that no result was obtained for the effects of incomplete handoff during surgery at the change-of-shift time on the patient safety outcomes. Another limitation of this study was collecting data during the COVID-19 epidemic, which could affect the results.

6. Conclusion

The results showed that the quality of handoff process in the field of organization was worse than in other areas, especially among circular persons who are constantly rotating in the operating room due to their role. Important information is lost in the shift changed during surgery, the most common of which is "patient profile, type of surgery and anesthesia." Due to the lack of information on traditional change-of-shift handoffs, some information required by the surgical team during the care process is not included. This makes the team members fail to respond to surgeon's and even the anesthesiologist's requests, ultimately leading to low-quality patient care due to communication errors. Iranian hospitals do not use a standard structure for shift delivery handoff for operating room technologists during surgery. The results of this study revealed the necessity of a structured method for handoffs among the surgical teams at the change-of-shift time, which would provide a framework to guide the exchange process in favor of the surgical teams and the patient. The data presented in this study would contribute to developing such a framework.

Authors' contribution

M. H. R. and E. N. did overall supervision, material provision, and study conception. M. H. R. collected the required data. E. N. statistically analyzed the data and helped in data provision. M. H. R. provided the required data and prepared the manuscript. M. L. and H. A. prepared the manuscript, had final editing, and put forth the study conception.

Declaration of Competing Interests

No, there are no competing interests for any author.

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Availability of data and materials

All data generated or analyzed during this study are included in this article. The datasets are available from the corresponding author by reasonable request.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.pcorm.2021.100192.

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