Interruptions and miscommunications in surgery: An observational study

#### ABSTRACT

Suboptimal communication within surgical teams is the leading contributor to adverse patient outcomes across all healthcare settings. In surgery, up to 30% of procedure-specific information may be lost as a result of miscommunication. The aim of this observational study was to describe the relations between interruptions, team familiarity, and the number of miscommunications in surgery. A purposive sample of 160 surgical procedures across 10 specialties over a six month period was undertaken. The number of interruptions, length of time teams had worked together, and the number and type of miscommunications per case were recorded. Descriptive analysis was used to quantify interruptions in respect to the source (conversational, procedural) and type of miscommunication (content, occasion, audience, purpose, experience). Kendall's tau- $\tau$  correlation was used to assess the relationship between interruptions, team familiarity, and miscommunications. Results revealed an inverse correlation between the length of time that teams worked together and the number of miscommunications in surgery ( $\tau$ =-.33, p<.01). There was a positive correlation between the number of intra-operative interruptions and the number of miscommunications ( $\tau$ =.30, p<.01). These results may help to inform the development of evidence-based interventions designed to mitigate the effects of miscommunications in surgery.

Key words: operating room; intra-operative distraction; communication; dedicated team; correlation.

# Plain Language Statement

We observed 160 surgical cases across 10 specialties of both planned and unplanned surgeries to describe the relationship between intra-operative interruptions, team familiarity, and miscommunication in surgery. Across 107 cases, 243 intra-operative interruptions occurred. In 91 cases, there were 175 miscommunication events. There were significant statistical relationships between interruptions, the length of time teams had worked together, and the number of miscommunications in surgery. These results suggest that the longer teams had worked together, the fewer miscommunication events occurred; and, that as the number of intra-operative interruptions increased, so did the number of miscommunications.

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## Background

Since the Institute of Medicine (IOM) published its report, *To Err is Human*, <sup>1</sup> patient safety has received burgeoning attention in healthcare literature and the popular press. Yet despite the increasing recognition of the issues that contribute to miscommunications in surgery, and the shift from focusing on the individual practitioner to the organizational context as source of error, <sup>2</sup> improvements in the communication practices of surgical teams have been incremental at best. A systems perspective recognizes that clinical skills alone are not sufficient to determine team effectiveness <sup>3</sup> – in surgery there are many other interdependent demands that are not under one's control. <sup>4</sup> Workload, the reliability and effectiveness of equipment, the impromptu manner in which surgical teams are often assembled in the operating room (OR), and the variable experience levels of staff may impact on the performance of anesthesiologists, surgeons, nurses and technicians. The aim of this observational study was to describe the relations between interruptions, team familiarity, and the number of miscommunications that occur in surgery.

### LITERATURE REVIEW

There is a growing body of evidence linking the critical relationship between teamwork and patient safety in healthcare<sup>5</sup>6, yet alarmingly, miscommunication has been uncovered as the root cause of over 60% of sentinel events reported by the Joint Commission on Accreditation of Health

Organizations.<sup>7</sup> In surgery, the profound and lasting impact of miscommunication has been poignantly manifest in events such as wrong site surgery.<sup>8 9</sup>

Researchers from the United States have described effective communication in surgery as being a crucial non-technical skill that defines overall performance. 10 11 Researchers from Australia and the United Kingdom have identified constraints in team communication in the context of the culture of medicine, 12-15 and described the impact of organizational and departmental constraints. 4 16-18 Explicitly, historical and contextual conditions such as increased workloads, competing priorities, silo mentality and medical heroism, limited the effectiveness of communication practices among teams. 13, 14, 16, 17 In their suite of Canadian observational studies, Lingard and colleagues<sup>19-22</sup> identified patterns of communication failures in surgery according to their effects and subsequently developed a team checklist to improve team communications. In one study, they found that up to 30% of procedure-specific information was lost during team exchanges, and one third of these jeopardized patient safety by increasing cognitive load, disrupting routine, and exacerbating team tension.<sup>19</sup> In most instances, the communication was often too late to be effective, the content was not consistent, accurate or complete, issues were left unresolved to the point of urgency, or key individuals were not included in the discussions and decisions.<sup>19</sup> While many of the studies reviewed here have described the nature of and types of miscommunications that occur in surgery; few have measured the origins of miscommunication in relation to environmental influences, namely interruptions.

Over the last decade, *interruptions* have been described as conditions that reduce efficiency and productivity, and contribute to errors in health care

environments.<sup>12</sup> Weigmann et al's.<sup>23</sup> observational study examined surgical flow interruptions (i.e., pager/telephone, equipment/resources, teamwork) and their relationship to errors in 31 cardiac procedures. Results indicated that 17% of surgical flow disruptions occurred as a consequence of surgeons' pagers going off in the room and the circulating nurse answering the call, while equipment and technical difficulties contributed to another 11% of disruptions. A number of studies conducted in the United Kingdom have described the sources of interruptions and their frequency of occurrence on team performance during surgery. <sup>3 24 25</sup> Sources of interruptions included telephone, beeper, conversation, equipment and procedure. Healey et al's 25 observational study focused on case irrelevant conversations across 50 general surgery procedures, and reported an average of 3.5 case irrelevant conversations per procedure. In the same study, these researchers also identified that equipment unavailability and breakdown culminated in procedural interruptions that required circulating nurses leave the operating room.<sup>25</sup> In an earlier cross-sectional study, Sevadalis et al. <sup>3</sup> found that interdisciplinary team members judged all disruptions to occur more frequently to their colleagues than to themselves, and when interruptions occur, they contribute to error for their colleagues than themselves. In this same study, surgeons reported significantly fewer disruptions than anesthesiologists or nurses.<sup>3</sup> These abovementioned studies have been prominent in informing the development of measures that identify the nature and types of interruptions that occur in surgery; nonetheless, little progress has been made in describing the relationship between team miscommunication and the length of time that teams have worked together in surgery (i.e., team familiarity).

Team familiarity is built on mutual understanding gained through working with members of a surgical team on a regular basis as a dedicated team. Such a connection incorporates an implicit appreciation of individuals' roles within the team, and the ways in which those roles interface with the overall goals of the team. A recent Australian study found that for surgeons and nurses, a lack of continuity in team membership limited opportunities to create and sustain regimens of shared knowledge. For the nurses in this qualitative study, the fluidity of team membership was perceived as problematic because they lacked the familiarity with surgeons' preferences while surgeons perceived this discontinuity as contributing to interdisciplinary conflict. Earlier observational research suggests that the team discontinuity manifest through random assignment of members, has culminated in disruptions, particularly at the operating table. Therefore, it appears that team familiarity may facilitate effective team communication; however, currently there is little research to support this assertion.

## **METHODS**

Aim

The overall aim of this observational study was to describe intra-operative interruptions, and team communication in surgery. Subsumed within this aim were two related purposes: first, to quantify the types of interruptions and miscommunications that occurred in surgery; and second, to describe the relationships between the length of time that surgical teams had worked together, the number of interruptions, and the number of miscommunications in

surgery across 160 surgeries. This study represents a small portion of a larger research program whose goal is to inform the identification and development of appropriate evidence-based interventions designed to enhance team communication in surgery.

## **Conceptual Definitions**

During the design phase of this study, we developed *a priori* definitions of concepts based on an extensive literature review, <sup>19</sup> <sup>28</sup> <sup>29</sup> and our previous work. <sup>12</sup> <sup>16</sup> <sup>30</sup> Specifically, the concepts of interest in this study were the nature and types of intra-operative *interruptions* (i.e., procedural and conversational), and *miscommunication* events (i.e., experience, audience, content, and occasion) that occur in surgery. Previous researchers have identified that interruptions hinder work performance and concentration in surgery, and impose added workload for team members. <sup>23</sup> <sup>24</sup> As our ultimate goal was to quantify the concepts used in this study, the following terms were also included; *duration of surgery, after-hours surgery, established team,* and *prebriefing*. Table 1 details the conceptual definitions and provides exemplars of situations where these definitions applied. These *a priori* definitions subsequently informed development of these concepts as measurable constructs (i.e., variables).

<Insert Table 1>

## Sample of Surgical Procedures

The setting for this study was a large tertiary referral hospital in Queensland, Australia. The operating suite has 22 commissioned ORs, performs about 18,000 surgeries annually, and caters for all surgical specialties except pediatrics, obstetrics and gynecology. A purposive sample of 160 surgical procedures across 10 specialties of both planned and unplanned surgeries was obtained to achieve maximum variation. During a six month period, structured observations were recorded on over 80 surgical teams. In this study, a surgical team was typically comprised of an anaesthetic consultant and/or resident, a surgical consultant and/or resident, circulating nurse, scrub nurse, and an anesthetic nurse.

For this study, a sample size of 84 with 80% power was required to achieve a correlation of 0.30 with a *p*-value of .05 (*Power Analysis and Sample Size*® software, Kaysville, UT, 2008).

### **Data Collection and Measures**

Structured observations were used. Observational methodology has been effectively applied in many high risk domains such as the OR to describe communication, 31 32 and is useful in conducting prospective research describing miscommunications and interruptions. 24 The integrity of an observational study depends on the experience and expertise of the observer. The first author, who has practiced extensively as an OR nurse and was trained in human factors, performed all of the 160 observations. To establish consistency in interpretation and recording of observations, an experienced OR nurse performed observations

with the first author for 10 surgeries. Observational data were collected from March to September, 2009, and reflected approximately 500 hours of observation. Thirty-eight routinely scheduled lists (apart from emergent and emergency surgery) were included in the 160 surgeries. During each surgical procedure, the observer was positioned away from the operating room table, with each member of the surgical team and all of the doors in view, ensuring an optimal viewing position. If the team member ceased their current task to respond to either a visual or an auditory cue, it was coded as an interruption. Field notes were taken to describe all interruption and miscommunication events for each surgical procedure during observations.

A standardized observation form was constructed in a table format with separate columns to record data on predefined variables. The form was piloted and regular group discussions held with the co-investigators in relation to clarification of recorded events in order to refine coding. Categorical data using dummy coding (0 = no, 1 = yes) were collected in relation to; out of hours surgery, established team, use of prebriefings, and the team member interrupted (surgeon/anesthetist, scrub/instrument nurse, anesthetic nurse/technician). The duration of each surgical procedure was measured from skin preparation to application of surgical wound dressings (measured in minutes). Upon gaining participants' consent to be observed, the senior nurse in the room was asked about regularity, stability and the length of time they had worked together. This information was subsequently recorded on the data collection tool (measured in months).

Miscommunications (content, audience, purpose, occasion, and experience) and interruptions (procedure, conversation) were recorded

according to their category. The total number of miscommunication events and interruptions per procedure were summed collectively, and in the aforementioned data categories. In some instances it was possible for a single interruption and/or miscommunication event to be placed into more than one category. Therefore, the primary prompt of the interruption and miscommunication was judged to categorize the event initiating them. During observations, the first author recorded a brief description of each miscommunication and interruption.

Approval to conduct the study was obtained by the institutional ethics boards at the hospital and university. Participants were given written information explaining the study in relation to its aims, procedures, risks and benefits, and informed consent obtained for all observations was renegotiated throughout the data collection period.

### Data Analysis

Data were analyzed using the statistical program *Predictive Analysis*Software (PASW Statistics® Version 18.0; Inc., Chicago, IL) for Windows

(previously known as SPSS). Both descriptive and inferential analyses were used.

For descriptive results, absolute (n) and relative frequencies (%) were used to describe the type of interruption, number of interruptions per surgery, team members interrupted, the number and type of miscommunications, and use of prebriefings and personnel involved. Observed incidences of intra-operative interruptions and miscommunications were summed to obtain a total for each procedure. For length of surgery (measured in minutes), median and

interquartile range (IQR) were used. Inferential analysis using Kendall's tau- $\tau$  correlation was employed to assess bivariate relationships between the number of interruptions, the length of time the team has worked together, and the outcome, the number of miscommunications. The decision to use this non-parametric correlation coefficient was based on the distribution of the data and the sample size.<sup>33</sup> A p-value of <.05 was considered significant.

#### RESULTS

The 160 surgeries were observed across 10 specialties, 129 procedures (80.6%) were planned (i.e., elective), with the mean length of time for surgery taking 85.1 minutes (±111.8 minutes; range 15.0-990.0 minutes). In terms of length of time taken to perform procedures across specialties; cardiac surgeries lasted up to 570 minutes (i.e., 4.45 hours); whereas ophthalmologic and faciomaxillary surgeries lasted an average of 60 minutes, a considerably shorter period of time. Table 2 displays the number of procedures observed across the 10 surgical specialties and the median, IQR and range relative to length of time (in minutes) for surgery.

### <Insert Table 2>

Of the 160 surgeries observed, 50 (31.3%) surgeries were performed by dedicated teams (i.e., surgeons, anesthesiologists and nurses who regularly worked together on a weekly basis in particular lists). The average length of time that teams had worked together was 13 months (±2.3 months, range 0-10 years). Figure 1 graphically displays the number of teams who worked together on a regular basis (as a dedicated team).

## <Insert Figure 1>

Pre-operative prebriefings involving a surgeon, anesthesiologist and nurse were observed in 20 (12.5%) of the 160 surgeries. Miscommunications occurred at least once in 91 (57%) of cases observed, and a total of 175 miscommunication events were observed with a mean of 1.9 per case (±1.2; range = 1-6). Across the 175 miscommunication events observed, the highest number of miscommunications related to experience, with 54 events (30.9%). Table 3 displays these results.

#### <Insert Table 3>

Of the 160 surgeries observed, 107 cases (66.9%) were characterized by interruptions with a total of 243 interruptions occurring across these procedures. Of the 107 cases where interruptions occurred, *conversational* interruptions occurred at least once in 74 cases (69.1%) while *procedural* interruptions occurred at least once in 71 surgeries (66.3%). Across all 107 cases, the mean number of interruptions per case was 2.3 ( $\pm$ 1.6; range = 1-9). Table 4 details the number of surgical cases with the corresponding number of interruptions. Of the 107 surgeries, just under half (n = 47) experienced one interruption; however, during one case, 9 interruptions occurred.

Figure 2 features the number of interruptions that occurred within each surgical specialty. The highest number of interruptions occurred in orthopedic surgery, with 48 (19.7%), while the fewest were observed in ophthalmology, with 11 (4.5%).

## <Insert Table 4 & Figure 2>

Across the 107 surgeries where an interruption occurred, team members were collectively interrupted on 148 occasions, while on an individual basis

surgeons were by far, the most frequently interrupted (n = 98 cases). Figure 3 displays the number of occasions where interruptions were observed for surgeons, anesthesiologists, circulating and scrub nurses across each of the 10 surgical specialties.

<Insert Figure 3>

## **Relationships Analyses**

Kendall's tau- $\tau$  correlation revealed a weak inverse correlation between the length of time that teams worked together and the number of miscommunications in surgery ( $\tau$ =-.33, p<.01). Thus, the longer teams had worked together over time, the fewer miscommunication events occurred. There was a weak positive correlation between the number of intra-operative interruptions and the number of miscommunications ( $\tau$ =.30, p<.01). Essentially, as the number of intra-operative interruptions increased, so did the number of miscommunications.

### **DISCUSSION**

The overall aim of this study was to describe the relations between intraoperative interruptions, team familiarity, and team communication in 160 surgeries. Earlier research has described interruptions as systemic issues that contribute to errors in surgical teams.<sup>3</sup> <sup>23</sup> <sup>34</sup> <sup>35</sup> Yet, few studies have described the relationship between team familiarity and miscommunications. The sample for this study represented a range of specialties, diverse teams and a mix of planned and unplanned surgeries of the OR department observed over a six-month period. To our reckoning, this study represents one of the largest single observational studies conducted in this area.

In our study, miscommunications were observed in nearly 60% of surgeries in relation to experience, content, purpose, occasion and audience. Of some concern is the fact that 30% of miscommunications stemmed from a lack of experience. It appears that lesser experienced team members tend to focus on the task at hand rather than on the broader environmental factors that may limit their situation awareness<sup>36</sup>, and thus leads to fragmented communications with other team members. Notably, fewer than 15% of teams observed performed a prebriefing prior to commencing surgery. Of the few prebriefings we witnessed, the majority were initiated by nursing team members. However, there were other occasions when prebriefings were performed by nurses at a time not suited to other team members and this often culminated in these being performed intermittently or without other members being present. Thus, the opportunity to clarify and amend team understandings (or misconceptions) was, in most instances, an opportunity lost. Previous research has described advantages of surgical prebriefings in relation to enhanced team communications, <sup>21 37</sup> yet the challenges associated with adopting prebriefings in surgery persist. 14 16

In our study, around 30% of the teams observed worked together on a regular basis. Of the 10 surgical specialties observed, cardiac and ophthalmology teams were the most stable and the surgery performed was highly specialized and routine. For instance in ophthalmic lists, the scrub, circulating and anesthetic nurses each remained in those roles for the entire list. In these lists, barely a word was uttered between any of the nurses and the surgeon during the entire

operation; the surgeon did not have to ask the scrub nurse for anything - he just held out his hand while gazing into the binocular eyepieces of the microscope. Notably, our results, supported by the abovementioned field notes, suggest that dedicated teams (that had worked together for a longer period of time) experienced fewer miscommunication events in surgery, and confirms previous research.<sup>23</sup> Undoubtedly, when teams work together on a regular basis they have greater opportunity to develop a 'shared mental model' as they are better able to modify their behaviours in accordance with their expectations of their colleagues' actions across a variety of situations.<sup>26</sup> Consequently, team communication is likely to be more effective. It follows that when teams are assembled randomly; there may be limitations to the extent that members can rely on pre-existing knowledge. Numerous aspects of teamwork may be affected and during crises these teams may be more predisposed to error because of poor communication.<sup>29</sup> <sup>38</sup> However, some believe that with the use of good communication practices even teams drawn together haphazardly can function as cohesive units.<sup>36</sup> Human factors experts advocate the need for developing skills in communication and teamwork as they are essential in improving patient outcomes in surgery. 5 35 Poignantly, education in non-technical skills in surgery is somewhat limited and its role in developing effective communication practices appears to be underestimated.13

Our results suggest that an increase in the number of interruptions has a concomitant effect on the number of miscommunication in surgery. Interestingly, this study found that surgeons were most often interrupted, and concurs with previous research.<sup>3 24 39</sup> During the observation period, it appeared that surgeons and anesthesiologists were able to refocus on their primary activity or multi-task,

depending on the stage of the operation. For instance, during the operative procedure, we witnessed frequent occasions where the circulating nurse answered the surgeon's cell phone and relayed the message to the surgeon with the surgeon verbally responding to the inquiry while simultaneously continuing to close a body cavity. Conceivably, there is a tacit expectation that team members' deal with these competing priorities – yet they are seemingly able to multi-task. Nevertheless, it may be unreasonable to expect OR teams to manage whatever variable work conditions they encounter; and clearly there is a limit to what individuals and teams may adapt to. In their study on interruptions in the emergency department, Chisolm et al. 39 concluded that interruptions were necessary to meet the multiple demands of changing situations, but excessive interruptions may impede clinical performance. Of concern is the potential for diminished situation awareness when key team members are distracted - thus making it difficult for a team to sustain an accurate mental model of the status of the operation, the anesthetic and the patient. <sup>36 40 41</sup> Consequently, gaining an understanding of the **broader** systems issues that contribute to interruptions is imperative. A greater awareness of the various subgroups of interruption and their potential to culminate in miscommunications may guide improvements in surgical processes and standardize work conditions.<sup>24</sup> This is especially important for driving continual change in surgical training, surgical procedures, and the introduction and use of new technologies.

In our study, procedural interruptions stemmed from equipment problems, which were observed more frequently with laparoscopic procedures as compared with open procedures, which necessitated circulating nurses to make more journeys outside the room. This is unsurprising given the complexity

of laparoscopic procedures as compared to open procedures. The growing complexity and use of minimally invasive surgical technologies have consequently increased the demand for attention and skill, especially on the part of the nursing and ancillary staff. We also observed moments when a piece of equipment failed, and the surgery halted until it was fixed or replaced.

Occasionally this occurred during a critical point in the surgery – and became a distraction for the lesser experienced junior surgeons and scrub nurses, hampering their ability to maintain concentration and remain focused.

Undoubtedly, new technology, while it affords minimal access surgery – imposes

the greater need for diligence in the maintenance and servicing of such equipment. Plausibly, equipment failure and its lack of availability are able to be controlled and planned for during case preparation – and are therefore avoidable. Our results lend some support to previous work that found equipment issues contributed to increased work interruption for the sterile team waiting for resolutions for missing equipment or replacement of faulty equipment, which ultimately leads to a break in the flow of the surgery. Passed that procedural interruptions caused by availability of equipment and/or equipment failure may also contribute to miscommunications in surgery. Clearly, a regular maintenance program and preoperative checking of surgical and anesthetic equipment prior to use is essential in order to minimize the risk of this type of interruption.

#### Limitations

We acknowledge there are several limitations to this study. First, the measures may be considered somewhat subjective as they are dependent on an observer's ability to interpret events – and this may vary from person to person. However, the first named author performed all of the 160 observations, was trained in observational research and human factors, had extensive experience as an OR nurse, so was familiar with the subtle nuances of the environment, and was checked with another observer. Additionally, in developing and measuring the constructs used in this study, we used definitions that were underpinned by previous research and were observable. <sup>20</sup> <sup>24</sup> Second, although correlation analyses conveys information about the magnitude and direction of the relationships between the variables under study, causality cannot be assumed.<sup>43</sup> Therefore, these results need to be interpreted with some caution. In spite of this, we used Kendall's value which is considered a more accurate gauge than Spearman's correlation of the correlation in the population.<sup>33</sup> Third, our sample of 160 surgeries, while considered large for an observational study of this nature, was drawn from a single hospital site that may differ to other public hospitals. In spite of this, the sample was sufficient be representative of the OR department observed over a six-month period. Finally, there was no attempt to relate measures reported to patient care directly - for this we would have needed a much larger sample size. Notwithstanding these limitations, the results are promising from the perspective of broadening our understanding of the issues that impede communication in surgical teams.

#### **Future Research**

Observational research may inform OR personnel of the broader aspects of their systems of work, the origin of interruption, and their potential effects. The results of such research could subsequently inform the development of interventions aimed at reducing the number of intra-operative interruption events. Further, multisite research designed to correlate with data from critical incident reporting to demonstrate that interruptions associated with equipment issues may pose risks to patient care would be useful. Finally, research using interviews to probe more deeply into the effects of interruptions and the additional workloads which they impose on individual team members would be timely.

### **CONCLUSION**

The results of this study support the need for dedicated surgical teams where ever possible. Interruptions, albeit that they may not appear ostensibly detrimental, are in themselves, a source of distraction that reduces team members' ability to remain focused, may unnecessarily prolong surgery, and endangers team members' ability to maintain situation awareness and a shared mental model. Observational measures such as those used in this study may help OR teams to glean important insights into the broader aspects of their systems of work. Greater predictability and standardization of work conditions in surgery can reduce workload and stress, and ultimately enhance safety in surgery toward high reliability.

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Table 1: Study concepts, their definitions and exemplars

Concept	Definition	Exemplar from Literature and/or Observations
Duration of Surgery	Defined in relation to behavioural markers of team performance and used as a surrogate measure of technical the complexity of the particular surgery (e.g., cardiac, hepatobilary). <sup>12</sup>	<ul> <li>Longer surgeries experience more interruption events, and potentially result in teamwork failures related to communication.</li> <li>Duration measured from skin preparation to application of surgical wound dressings.</li> </ul>
	In this study, duration measured from application of skin preparation to application of final surgical wound dressing.	
Out of Hours surgery	Emergent or emergency (unplanned) surgery that is not booked within the routine office hours.	<ul> <li>Tend to experiences more intra-operative events such as interruptions, work-arounds, and delays <sup>2-</sup></li> <li>5 – all of which have the potential to erode team</li> </ul>
	In this study, this surgery often occurred during evenings and overnight, and on weekends when there were fewer staff.	communications.
Familiar / Dedicated Team	A group of individuals who share a similar mental model. <sup>6</sup> In surgery, a team is comprised of four core groups; anesthesiologists, surgeons, nurses (circulating/scrub) and technicians who work together for a common goal. <sup>7</sup>	During a difficult case, the bidirectional exchange of the information that is communicated is clear, comprehensible and of an appropriate tone and volume. In order to achieve the intended goals of effective patient care the needs to be synergy between the surgeon and the scrub nurse.
	In this study, membership in a familiar team was characterized as being relatively static and members worked together on a weekly basis in an allocated list.	<ul> <li>Surgeon, anesthesiologist, circulating nurse, instrument nurse, and anaesthetic nurse/technician, who know each other's limitations because they work regularly together.</li> </ul>

Prebriefings	A deliberate and concise discussion performed by surgeons, anesthesiologists, nurses and technicians to facilitate person-to-person transfer of relevant information in real time. <sup>8</sup>	During the team prebriefing, the instrument nurse clarifies whether a certain piece of equipment is required for the case with the surgeon.
	In this study, prebrefings were performed prior to knife-to-skin.	
Interruption	A human experience, discontinuity in task performance, an intrusion of a secondary, unplanned and unexpected task, and externally or internally initiated. <sup>9</sup>	<ul> <li>Classified according to its origin: procedural or conversational.<sup>10</sup></li> <li>Interruptions hinder work performance and concentration in surgery, and impose added workload for team members.<sup>3 4</sup></li> </ul>
Procedural Interruption	Where an item of equipment was unavailable or not working, and the sub-team waiting for assistance from the circulating nurse were classified as procedural interruptions. <sup>11</sup>	<ul> <li>Radiographer not present when required.</li> <li>Failure of laser.</li> <li>Circulating nurse teaching instrument nurse.</li> <li>Equipment not available in the room.</li> </ul>
Conversational Interruption	An occurrences that involved communication using mobile phones or the OR phone (located within the room), beepers, or conversation that was not related to the case being undertaken (case irrelevant conversation). <sup>4</sup>	<ul> <li>Mobile phone ringing during surgery, surgeon request to verbally respond to call.</li> <li>Surgeon from an adjoining theatre discussing another patient with the surgeon who is operating.</li> </ul>
Communication	The transfer of information and understanding from one person to another. <sup>12</sup>	<ul> <li>Surgical prebriefings and post briefings.<sup>7</sup></li> </ul>

Miscommunication	An exchange where information was either incomplete, inconsistent, or key personnel were not included. $^{13}$	•	Miscommunications are classified according to taxonomy of communication episodes related to audience, purpose, occasion, content, and experience. <sup>14-17</sup>
Audience	The participants are present during the communication. <sup>17</sup>	•	Nurses and anesthesiologist discuss patient positioning in the absence of the surgeon.
Purpose	The goals of the exchange are not met, they are unclear, or inappropriate. 17	•	During a liver transplant two nurses discuss whether ice is required, but neither knows, and no further discussion ensues
Occasion	The timing of the communication is inappropriate. <sup>17</sup>	•	Surgeon asking the anesthesiologist post-incision about antibiotic administration – enquiry too late as antibiotics should have been given pre-incision.
Content	The information exchanged is lacking in completeness and accuracy. 17	•	Inaccurate information given to other team members about a patient's Hepatitis B status.
Experience	An understanding of the nomenclature and/or language, and verbal and non-verbal communication used in surgery. 14 18	•	During surgery, the surgeon requests a "sprinkler system" to be taken on the table. The instrument nurse shrugged her shoulders and asked the circulating nurse to clarify. 18

Table 2: Breakdown of Surgeries and their duration (in minutes) observed across the 10 Specialties (N = 160)

					Length of surgery Range (Minutes)	
Specialty	n	%	Md	IQR	Minimum	Maximum
Ophthalmology	20	12.5	30.0	30.0	15.0	75.0
General surgery	20	12.5	52.5	66.0	15.0	180.0
Orthopedic	18	11.2	75.0	109.0	15.0	270.0
Urology	18	11.2	30.0	23.0	15.0	330.0
Plastics	18	11.2	52.5	47.0	15.0	270.0
ENT	18	11.2	45.0	30.0	15.0	990.0
Facio-maxillary	14	8.7	45.0	45.0	15.0	75.0
Neuro-surgery	12	7.6	120.0	68.0	15.0	270.0
Vascular	12	7.6	90.0	69.0	30.0	450.0
Cardiac	10	6.3	196.0	131.0	150.0	570.0

Table 3: Types of miscommunications and their frequency of occurrence (n=175) across 91 surgeries

Miscommunication Category	n	%
Experience	54	30.9
Occasion	46	26.3
Content	35	20.0
Purpose	23	13.1
Audience	17	9.7
Total	175	100

Table 4: Number of surgical cases with corresponding number of interruptions

Surgical Cases	Interruptions	Total Interruptions	
n	n	n (%)	
47	1	47 (19.3)	
27	2	54 (22.2)	
12	3	36 (14.8)	
10	4	40 (16.5)	
6	5	30 (12.3)	
1	6	6 (2.5)	
3	7	21 (8.6)	
1	9	9 (3.7)	
Total 107		243 (100)	

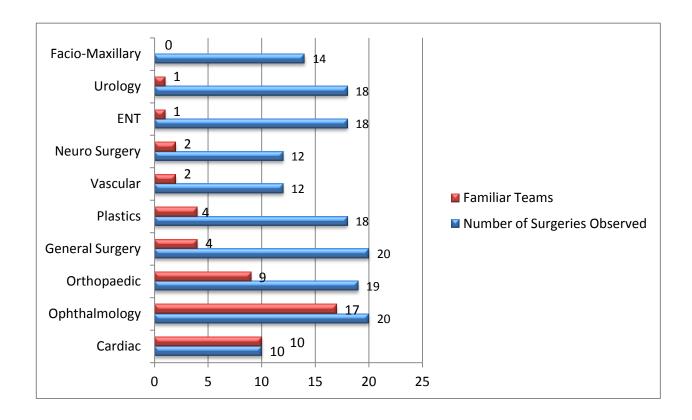


Figure 1: Number of Familiar Teams across each Specialty in relation to the number of Surgeries Observed (N=160)

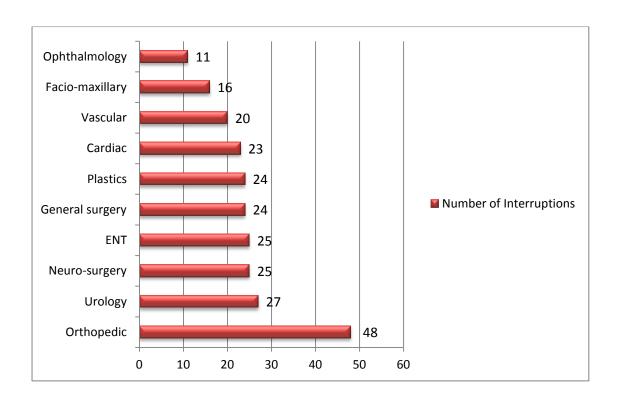


Figure 2: Number of Interruptions across each Specialty (N=243)

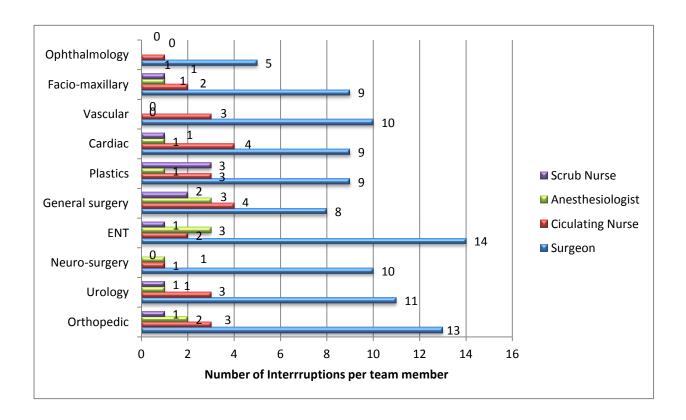


Figure 3: Frequency of Interruptions for each team member across surgical specialty