The Impact of Operating Room Distractions on Stress, Workload, and Teamwork

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Objective: To investigate whether distractions in the operating room (OR) are associated with higher mental workload and stress, and poorer teamwork among OR personnel.

Background: Engaging in multiple tasks can affect performance. There is little research on the effect of distractions on surgical team members' behavior and cognitive processes.

Methods: Ninety general surgery cases were observed in real time. Cases were assessed by a surgeon and a behavioral scientist using 4 validated tools: OR Distractions Assessment Form, the Observational Teamwork Assessment for Surgery tool, NASA-Task Load Index, and short form of the State Trait Anxiety Inventory. Analysis of variance was performed to evaluate significant differences between teamwork, workload, and stress level among team members. Correlations (Pearson r) were computed to evaluate associations between variables.

Results: The most prevalent distractions were those initiated by external staff, followed by case-irrelevant conversations. Case-irrelevant conversations were associated with poorer team performance. Irrelevant conversations initiated by surgeons were associated with lower teamwork in surgeons (across team skills: $r = -0.44$ to -0.58, $P < 0.05$ to 0.01) and anesthesiologists ($r = -0.38$ and $r = -0.40$, for coordination and leadership; $P < 0.05$). Equipment-related distractions correlated with higher stress ($r = 0.48$, $P < 0.05$) and lower teamwork (across team skills: $r = -0.42$ to -0.50, $P < 0.05$) in nurses. Acoustic distractions correlated with higher stress in surgeons ($r = 0.32$, $P < 0.05$) and higher workload in anesthesiologists ($r = 0.30$, $P < 0.05$).

Conclusions: Although some distractions may be inevitable in the OR, they can also be detrimental to the team. A deeper understanding of the effect of distractions on teams and their outcomes can lead to targeted quality improvement.

Keywords: distractions, OR, stress, teamwork, workload

Patients admitted to hospital may suffer a significant amount of injury because of medical management.[1,2] Within acute care settings, the operating room (OR) is a frequent source of adverse events, mainly due to its inherently complex structure.[3] Such errors can be catastrophic for patients, personnel at the sharp end, and health care institutions alike.[4] In the OR, adverse events are often triggered by a combination of factors such as demanding caseloads, pressure to perform complex tasks, and conflicting priorities,[5] which can lead to increased mental strain, stress, and poor teamwork.[6–8] This holds particularly true in a context of constrained resources.[9,10] It is also likely that these factors are linked in a cascade effect: increased workload can result in higher mental demand, which can outweigh the OR team's resources to cope. This in turn leads to excessive stress, which is detrimental to the technical, cognitive, and team-working facets of surgical performance.[11]

Our current understanding of the impact of environmental factors on surgeons' performance and cognitive processes or on OR teams is limited.[12] Previous studies in other high-reliability organizations have demonstrated that multitasking can have a detrimental effect on performance, particularly in pressurized environments, as it entails a degree of distraction from the primary task.[13–15] In these non–health care settings, distractions are studied in detail and intentionally minimized. For example, distractions are recognized as one of the most common causes of pilot error[16] and the "sterile cockpit" practice (no unnecessary conversations) has been introduced to ensure focused attention without distracters at safety-critical phases of a flight.

Within surgery, however, most studies to date have only described the prevalence of environmental distractions in the OR, with little exploration of their consequence upon surgeons, anesthesiologists, and nurses.[17–21] This is of concern, given evidence to suggest that increased distractions can lead to a higher rate of errors in the OR.[22] This is reflected by the Agency for Healthcare Research and Quality that has mandated a "high-level priority" to reduce distractions in the OR to improve patient safety.[23]

The psychology literature suggests that distractions can lead to a greater strain on working memory, reduce spare attention capacity, and increase both cognitive demand and stress. However, most studies linking distractions with surgeons' performance, although well-conducted, have been carried out in simulated settings with little extrapolation to the real OR environment.[24] An exception is a recent trial testing a noise-reduction intervention in a pediatric OR, which found that excessive noise was associated with both surgeons' stress responses (physiological and self-reported) and postoperative complications.[25] A more detailed understanding of the source and impact of different types of distractions on OR team-members would permit development of targeted interventions to prevent or mitigate their effects thereby leading to safer surgical practice.

This study aimed to investigate whether distractions in the OR are associated with impaired teamwork, higher mental workload, and higher stress in OR teams.

METHODS

Study Design, Setting, and Sample

This was a prospective, cross-sectional observational study. Ninety General Surgery cases were randomly sampled using computer-generated lists in a large London (UK) community hospital over a period of 10 consecutive months to overcome any seasonal biases. In line with the principles of qualitative research, the aim was to be as inclusive as possible of the various types of cases performed in an OR—rather than restricting the study (and its findings) to a single procedure. As the outcome variable was team-members' cognitive

and behavioral processes (not clinical results), this approach enabled a much richer data set to be obtained through inclusion of multiple team-members across multiple procedures. Open operations therefore included appendectomy, inguinal hernia repair, thyroidectomy, varicose vein surgery, and mastectomy. Laparoscopic operations included cholecystectomy, appendectomy, inguinal hernia repair, and small bowel resections. The study was approved by the hospital's local ethics committee as a quality improvement project. Informed consent was obtained from all participants before data collection and anonymity assured.

Study Procedure

For each case, 2 researchers were present in the OR—1 surgeon and 1 behavioral scientist. Before commencing the observations, the latter was trained to proficiency in Observational Teamwork Assessment for Surgery (OTAS) usage by an expert (ie, reliability reached intraclass correlation coefficient of 0.70, which indicates acceptable rating proficiency[26]). To minimize bias due to the Hawthorne effect, the researchers spent some time in the ORs without conducting observations before the study commenced so as to acclimatize OR staff to their presence. During the intraoperative phase of every case, distractions and teamwork were recorded and rated in real-time.[27] In addition, activities and events were recorded using standard ethnographic field note techniques[28] to ensure data reliability. At the end of each case, the NASA-Task Load Index (NASA-TLX) and the short form of the State Trait Anxiety Inventory (STAI) scales were administered to the core team members (primary operating surgeon, scrub nurse, and anesthesiologist in charge) to measure their workload and stress, respectively.

Outcome Measures

Distractions

Distractions in the OR were recorded in real time by a trained observer using a previously validated instrument.[19] The frequency and intensity of the following distractions was recorded: (1) external staff—entering, exiting, or initiating case-irrelevant conversations; (2) case-irrelevant conversations within the OR team; (3) acoustic—telephone, mobile phones, pagers, radio, and external noises; (4) equipment—unavailable or faulty; (5) procedural—intrinsic to surgical work (eg, surgeon slows down to teach observing students); and (6) work environment—related to the OR environment (eg, diathermy pedals left in the wrong place). The intensity of distractions was measured on a scale of 1 to 9: lower scores 1 to 3 are related to salient stimuli that may affect the team, which are either ignored or dealt with by circulating personnel; scale points 4 to 6 relate to individual core team members (surgeons, scrub nurse, and anesthesiologist) being distracted by an event. Highest scale points 7 to 9 relate to 2 or more members of the core surgical team being distracted, leading to workflow interruption.

Teamwork

This was assessed using the extensively validated OTAS.[29] OTAS assesses 5 aspects of teamwork in the OR: communication, coordination, cooperation or backup behavior, leadership and team monitoring or situational awareness, each on a scale of 0 to 6 with higher scores indicating better team performance. Each subgroup in the OR (anesthetic, nursing, and surgical) is assessed separately by averaging the ratings of each of the 5 behavior scales. Global OR team scores are derived via averaging the scores of the 3 subgroups.

Workload

Workload was measured using the validated NASA-TLX.[30] This tool is widely used in aviation and other high-risk environments to obtain workload estimates. It captures 6 aspects of workload: mental, physical and temporal demands, frustration, effort, and performance. Each of these 6 items is self-rated on a 21-point visual analog scale (total score ranges from 6 to 126) with higher scores indicating higher workload.

Stress

The short version of the STAI was used to capture stress,[31] which has been validated for use in the OR.[32] STAI measures stress using 6 items: 3 positive ("I feel calm," "I feel content," and "I feel relaxed") and 3 negative ("I feel tense," "I feel upset," and "I feel worried"), all self-rated on a 4-point scale, thus yielding a total score from 6 to 24. Higher scores indicate higher stress. The positive items are reverse-coded for analysis.

Data Analyses

Data were analyzed using SPSS 19 statistical software (SPSS, Chicago, IL). Descriptive statistics (means and standard deviations) were computed for all outcome measures. Analysis of variance (ANOVA) was performed to explore the presence of significant differences in teamwork; workload; and stress levels between surgeons, anesthesiologists, and scrub nurses. Correlational analyses (Pearson r correlation coefficients) were computed to statistically evaluate associations between distractions, teamwork, workload, and stress, and to ascertain whether these measures were correlated with patient American Society of Anesthesiologists (ASA) classification and case length. For all analyses, statistical significance was set at $P < 0.05$.

RESULTS

Case Sample and Participants

Ninety cases were included in the study—producing 69 hours 40 minutes of real-time observation in ORs. The mean operative time for the observed cases was 46 minutes (SD = 35.16). Patients' ASA classifications ranged from I to IV (I = 51% of cases, II = 35%, III = 13%, and IV = 1%). Measures were collected from 85 team members: 23 surgeons (9 attendings and 14 senior residents), 28 anesthesiologists (19 attendings and 9 residents), and 34 nurses (21 senior nurses and 13 trainee nurses).

Descriptive Analyses: Levels of Distractions, Teamwork, Workload, and Stress in the OR

Distractions

Distractions were observed in 98% of the cases (88/90) (Table 1). The mean number of intraoperative distractions was 10.94 (SD = 7.11) per case. Taking into account case duration, the mean rate of distractions was 6.69 (SD = 4.73) per hour—or 1 every 10 minutes on average. The mean intensity of distractions was 4.72 (SD = 1.36). The most prevalent types of distractions were those initiated by external staff entering the OR (81% of which were unnecessary), followed by case-irrelevant conversation within the OR team. The most intense distractions were equipment-related (83% due to wrong or missing equipment and 17% due to faulty equipment), followed by procedural distractions. Table 2 provides illustrative examples of distractions drawn from the researchers' ethnographic notes.

Teamwork

The mean global teamwork score was 3.64 (SD = 0.42) on the OTAS 0 to 6 scale (Table 3, *top panel*). Surgeons received significantly higher scores on leadership than either anesthesiologists or nurses. Surgeons' cooperation skills were also significantly higher than those of the anesthesiologists. Nurses scored significantly higher at communication and cooperation than anesthesiologists,

TABLE 1. Mean Frequency, Rate, and Intensity of Distractions

Distraction Type	Frequency/Case, Mean (SD)	Rate/Hour, Mean (SD)	Intensity/(0–9), Mean (SD)
External staff (entering/exiting and case-irrelevant conversation initiated by external staff)	5.32 (3.73)	7.52 (5.33)	4.50 (1.39)
Global case-irrelevant conversations (any conversation not directly related to the patient on the table initiated by a member of the team)	4.38 (2.90)	7.60 (6.85)	4.71 (1.39)
● Case-irrelevant conversation initiated by surgeons	2.55 (1.89)	4.28 (3.78)	6.17 (1.13)
● Case-irrelevant conversation initiated by anesthesiologists	2.22 (1.38)	4.34 (4.10)	4.63 (1.75)
● Case-irrelevant conversation initiated by nurses	2.24 (1.44)	3.50 (2.43)	4.30 (1.34)
Acoustic (OR telephone, mobile phones, pagers, radio and external noises)	2.33 (1.73)	3.24 (2.75)	3.29 (1.86)
Equipment (unavailable or faulty equipment)	1.79 (1.35)	2.32 (1.48)	7.40 (1.75)
Procedural (intrinsic to surgical work)	1.50 (0.84)	2.23 (1.60)	6.69 (1.94)
Work environment (related to OR environment)	1.67 (0.71)	1.75 (1.05)	5.43 (2.60)
Total	10.94 (7.11)	6.69 (4.73)	4.72 (1.36)

TABLE 2. Selected Ethnographic Notes

Distraction Type	Ethnographic Notes
Equipment	The circulating nurse leaves the OR and the scrub nurse has to ask one of the researchers to fetch equipment from the scrub room. The scrub nurse has to leave the table to show the researcher where to find the equipment. (Cases 27 and 72)
Acoustic	The surgeon's cell phone rings loudly. The circulating nurse asks the surgeon whether she should answer. The surgeon briefly stops and asks the nurse to answer. The nurse acts as the intermediary between the caller and the surgeon. The surgeon continues to operate while simultaneously dealing with the caller's requests. (Case 52)
OR environment	The diathermy pedal is hidden and the surgeon stops to ask one of the circulating nurses to find it. He is visibly exasperated. (Cases 65, 72, and 81)
OR environment	The surgeon inappropriately adjusts both OR lamp handles and one falls on the patient. (Case 1)
Case-irrelevant conversations and equipment	Several overlapping conversations are distracting the team: the assistant surgeon admonishes a circulating nurse for misplacing a previous patient's file, while the scrub nurse talks to another circulating nurse about lunch and, at the same time, the attending surgeon complains after realizing one of the OR lights is not working: "*how am I supposed to do vascular surgery in the dark!*" (Case 23)
External staff	An administrator enters the OR and asks the surgeon: "*do you have a minute?*" The surgeon leaves the OR for a few minutes to talk to the administrator about a recent meeting. (Case 24)

TABLE 3. Descriptive Statistics and ANOVA of Teamwork, Workload, and Stress Scores

Outcome/Assessment Measure	Dimensions	Surgeons, Mean (SD)	Anesthesiologists, Mean (SD)	Nurses, Mean (SD)	F value
Teamwork/OTAS	Communication	3.68 (0.92)	3.42 (0.61)	3.81 (0.70)	6.05*
	Coordination	3.67 (0.78)	3.86 (0.58)	3.56 (0.88)	3.64†
	Cooperation	3.80 (0.75)	3.53 (0.61)	3.92 (0.66)	7.37*
	Leadership	3.87 (0.86)	3.34 (0.55)	3.28 (0.56)	17.82*
	Monitoring	3.41 (0.83)	3.78 (0.70)	3.66 (0.74)	5.57*
	Global teamwork	3.68 (0.72)	3.59 (0.45)	3.64 (0.59)	2.19
Workload/NASA-TLX	Workload	45.09 (22.06)	37.38 (21.81)	38.25 (18.20)	13.52*
Stress/STAI	Stress	8.92 (3.73)	8.07 (2.83)	8.08 (2.71)	7.29*

*Significant at $P < 0.01$.
†Significant at $P < 0.05$.

whereas anesthesiologists scored higher on coordination. Finally, anesthesiologists were significantly better at team monitoring than surgeons.

Workload

The mean workload score (Table 3, *middle panel*) for surgeons was 45.09 (SD = 22.06) on the NASA-TLX, for anesthesiologists was 37.38 (SD = 21.81), and for scrub nurses was 38.25 (SD = 18.20). ANOVA showed that surgeons experienced significantly higher work-load than both anesthesiologists and scrub nurses. Scrub nurses and anesthesiologists' workload did not differ significantly from each other.

Stress

Mean stress score (Table 3, *bottom panel*) for surgeons was 8.92 (SD = 3.73), for anesthesiologists 8.07 (SD = 2.83), and for scrub nurses 8.08 (SD = 2.71). Surgeons were significantly more stressed than anesthesiologists and scrub nurses.

TABLE 4. Associations Between Rate of Distractions and Teamwork, Workload, and Stress

	Distractions			
	Case-irrelevant Conversation Initiated by Surgeons	**Case-irrelevant Conversation Initiated by Anesthesiologists**	**Case-irrelevant Conversation Initiated by Nurses**	**Equipment Distractions**
Teamwork				
Surgeons				
Communication	− 0.46*	− 0.20	− 0.18	− 0.41†
Coordination	− 0.58*	0.11	− 0.10	− 0.15
Cooperation	− 0.28	− 0.07	− 0.07	− 0.22
Leadership	− 0.52*	− 0.25	− 0.15	− 0.17
Monitoring	− 0.44†	− 0.09	− 0.01	− 0.08
Anesthesiologists				
Communication	− 0.14	0.09	− 0.12	− 0.07
Coordination	− 0.38†	0.01	− 0.27†	− 0.19
Cooperation	− 0.14	0.17	− 0.12	0.03
Leadership	− 0.40†	− 0.15	− 0.29†	− 0.10
Monitoring	0.03	− 0.05	− 0.03	− 0.15
Nurses				
Communication	− 0.17	0.15	− 0.08	− 0.46†
Coordination	− 0.18	− 0.05	− 0.11	− 0.50†
Cooperation	− 0.30	− 0.01	− 0.10	− 0.42†
Leadership	− 0.27	0.12	− 0.12	− 0.42†
Monitoring	− 0.22	0.03	− 0.09	− 0.45†
Workload				
Surgeons	− 0.31	− 0.23	− 0.28†	0.14
Anesthesiologists	− 0.22	− 0.18	− 0.14	0.06
Scrub nurses	− 0.18	− 0.39*	− 0.20	− 0.11
Stress				
Surgeons	− 0.26	− 0.19	− 0.22	0.06
Anesthesiologists	− 0.28	− 0.01	− 0.08	0.21
Scrub nurses	0.00	− 0.19	− 0.05	0.21

*Correlation significant at $P < 0.01$.
†Correlation significant at $P < 0.05$.

Correlational Analyses of Distractions, Teamwork, Workload, and Stress in the OR

Distractions and Teamwork

Distractions were generally associated with impaired teamwork (Table 4, top panel). More specifically, the amount of irrelevant conversations initiated by surgeons correlated negatively with their communication score, as well as their coordination, leadership, and team monitoring scores (across team skills: $r = −0.44$ to $−0.58$, P <0.05 to 0.01). Likewise, anesthesiologists' scores on coordination and leadership were negatively linked to the rate of irrelevant conversations initiated by surgeons ($r = −0.38$ and $r = −0.40$ for coordination and leadership, respectively; $P < 0.05$), and also by OR nurses ($r = −0.27$ and $r = −0.29$ for coordination and leadership, respectively; $P < 0.05$).

Furthermore, nurses' scores in all aspects of teamwork (communication, coordination, cooperation, leadership and team monitoring) were lower when the rate of equipment-related distractions was high (across team skills: $r = −0.42$ to $r = −0.50$, $P < 0.05$). Higher rate of procedural distractions was also linked to poorer communication by OR nurses ($r = −0.44$, $P < 0.05$).

An increased rate of equipment-related distractions was associated with poorer communication by the surgeons ($r = −0.41$, $P < 0.05$), whereas anesthesiologists' cooperation with the rest of the OR team was lower when more distractions occurred related to the OR environment, such as the operating table set at the wrong angle ($r = −0.72$, $P < 0.05$). There was no significant correlation between external or acoustic distractions and teamwork for any of the team members.

Distractions and Workload

The overall pattern that emerged here was that case-irrelevant conversations occurred when workload was low (Table 4, middle panel). More specifically, irrelevant conversations initiated by OR nurses correlated with lower workload reported by surgeons ($r = −0.28$, $P < 0.05$). Similarly, irrelevant conversations initiated by anesthesiologists correlated with lower workload reported by scrub nurses ($r = −0.39$, $P < 0.01$). Conversely, anesthesiologists reported higher workload in the presence of more intense acoustic distractions ($r = 0.30$, $P < 0.05$). There was no significant correlation between external distractions and workload for any of the team-members.

Distractions and Stress

More intense acoustic distractions were associated with higher stress levels among surgeons ($r = 0.32$, $P < 0.05$) (Table 4, bottom panel). Likewise, intense equipment distractions were positively correlated with higher stress levels among scrub nurses ($r = 0.48$, $P < 0.05$).

A final set of correlational analyses showed that case length was positively correlated with ASA classification ($r = 0.30$, $P < 0.01$) as should be expected; in turn, higher ASA classification was positively correlated with more intense work-related distractions ($r = 0.74$, $P < 0.05$) and higher stress levels among anesthesiologists

($r = 0.26$, $P < 0.05$). Case length was also negatively correlated with overall rate of distractions ($r = -0.49$, $P < 0.00$)—in other words, distractions were less frequent in longer cases.

DISCUSSION

This study investigated associations between distractions and OR personnel's teamwork, workload, and stress. Our findings confirmed that distractions are ubiquitous—occurring in 98% of cases—and comparable with those of earlier studies, which have reported similar rates and types of distractions in the OR.[17–21,33]

Overall, teamwork scores and team members' levels of workload and stress were moderate. Surgeons, however, reported higher workload and stress than other team members, yet they also exhibited the highest levels of leadership, suggesting resilience and coping strategies commensurate with the high levels of experience of the study participants. When workload was low, teams were more likely to engage in case-irrelevant conversation. Because of the correlational nature of the study, we cannot infer causality—but these results do suggest that informal conversations may have been used as a strategy to "release pressure" in the OR. Alternatively, it is also possible that the teams were more likely to engage in informal conversation during routine, non-stressful cases when they had spare attention capacity.[34] Nonetheless, case-irrelevant conversation was also associated with poorer team performance. Without further cognitive testing, we cannot infer a mechanism for this effect—however, a possible explanation is that a lapse of concentration during moments of distracting conversation may have led to a decreased awareness of the needs of the wider team. This highlights the importance of remaining vigilant throughout a case so as to maintain a high functioning team.

Distractions related to equipment problems were associated with poor overall teamwork among nurses and higher stress levels. This finding is not surprising, given that equipment preparation and management falls directly within the OR nurses' professional role and responsibilities. The rate of equipment distractions during the observed procedures, most of which were missing or wrong equipment, was not negligible—approximately 1 equipment-related distraction every 90 minutes of a procedure. Although this may not be particularly high, when they occur, equipment problems can be frustrating and a significant source of delay. They are also an example of a problem, which could be addressed with adequate preoperative planning and communication, including a preoperative briefing. Furthermore, acoustic distractions were linked to higher stress experienced by surgeons and higher workload reported by anesthesiologists. This may be explained by the prevalence of highly distracting phone calls and pager communications, which both professional groups often had to attend to, sometimes to the detriment of the surgical flow. A higher rate of procedural distractions, notably teaching of surgical residents, was linked to poorer communication among nurses. This finding is interesting and requires further investigation: it may indicate that nurses suppress or delay their interaction with the team when training is taking place, which could result in harmful omissions.

Encouragingly, a lower rate of distractions was observed in longer cases and in those with patients with higher morbidity. However, the intensity of distractions was statistically similar across cases and higher in the case of work-related distractions. Worryingly, the latter were more intense in cases with higher ASA classification. Finally, although there were no associations between external distractions and our outcome measures, the sheer number of unnecessary external visitors to the ORs that we observed should be a cause for concern, as high personnel flow through ORs has been significantly associated with hospital acquired infections.[35]

Our results should be considered within the context of this study's limitations. The generalizability of these finding to pre- and postoperative stages, and to other procedures and settings should be demonstrated. The average case length was relatively short and patient ASAs were low, indicating low risk—longer and more complex cases may yield lower team performance in the presence of distractions. Furthermore, only global scores were obtained on all measures. This precluded more fine-grained analyses across different parts of the procedures, which may trigger different levels of workload or stress in OR team-members. For example, nurses' workload may increase during the preoperative stage while preparing for a case, anesthesiologists may feel higher stress levels at induction and extubation, and surgeons are more likely to report higher workload during the cases. Such analyses would be beneficial, but they require significant additional work from both OR observers and also OR practitioners, which was not feasible within this study without jeopardizing the quality of the data. Moreover, surgical outcomes (such as adverse events) were not assessed—hence, the link between them and the observed distractions remains to be tested. Although efforts were made to minimize a potential Hawthorne effect by allowing a familiarization period during which observers did not assess team members, their presence in the OR may have altered team behavior resulting in a degree of bias. Attempts were also made to reduce other potential biases: validated instruments for all outcomes were used to reduce measurement bias; cases were randomly selected to minimize sampling bias; finally, team members were asked to complete NASA-TLX and STAI immediately after each case to reduce recall bias. However, given the tendency of medical staff to play down the effects of stress and fatigue,[8] stress and workload levels may have been underestimated.

The results of this study have implications for surgical performance and team well-being. Although some distractions may be inevitable, others, particularly during tasks that require undivided attention, should be proactively limited as they can induce human error and have negative consequences on patient safety.[25] We would also argue that although most of the cases we observed were relatively simple and "routine," a culture of distractions within the OR may spill over to more complex cases. Cases where significant errors have been made, as voluntarily reported and analyzed by surgeons on the UK's Confidential Reporting System for Surgery (eg, wrong anastomosis being carried out or surgeon altogether forgetting to carry out an anastomosis—see www.coress.org.uk), reveal surgeons and OR teams being distracted and ORs feeling chaotic as factors contributing to the errors. To some extent, distractions in the OR may be managed through "systemic" interventions, such as the establishment of regular preoperative briefings,[36] the appropriate use of the World Health Organization Checklist,[37] or the introduction of Standard Operating Protocols (including, for example the concept of the "sterile OR," where no unnecessary conversations occur at safety-critical points of a procedure). At other times, the successful management of these distractions may rely upon strong surgical leadership and team-members buy-in. In fact, the ability to effectively manage errors and unexpected events is a "marker of surgical excellence."[22] Ultimately, enhancing surgical performance and outcomes requires a systems approach, which encompasses improving procedures and skills. A clearer understanding of the interaction between the team and the OR environment is imperative if we are to truly recognize and mitigate all the factors that impact upon team performance and error.[17]

CONCLUSIONS

This study highlights the prevalence of distractions and explores the relationship between these and stress, workload, and teamwork in the OR. We found that distractions occur on a regular basis (1 every 10 minutes of a procedure) and that the teams are particularly vulnerable when stress and workload is low, highlighting the need to remain ever-vigilant throughout a procedure. The finding that certain distractions may impair team performance can contribute to the

development of evidence-based interventions aimed at ameliorating such distractions, and improving patient safety in surgery.

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