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Interruptions and distractions in the gynaecological operating theatre: irritating or dangerous?

Wai Yoong*, Ayemon Khin, Navin Ramlal, Bogadi Loabile and Stephen Forman

Department of Obstetrics and Gynaecology, North Middlesex University Hospital, London, UK

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Distractions and interference can include visual (e.g. staff obscuring monitors), audio (e.g. noise, irrelevant communication) and equipment problems. Level of distraction is usually defined as I: relatively inconsequential; II: > one member of the surgical team affected; III: the entire surgical team affected. The aim of this study was to observe the frequency and impact of distracting events and interruptions on elective gynaecology cases. Data from 35 cases were collected from 10 consecutive operating sessions. Mean number of interruptions was 26 episodes/case, while mean number of level II/III distractions was 17 episodes/case. Ninety per cent of interruptions occur in the first 30 minutes of the procedure and 80.9% lead to level II/III distraction. Although no complications were directly attributable to the observed distractions, the mean prolongation of operating time was 18.46 minutes/case. Understanding their effects on theatre environment enables appropriate measures to be taken so that theatre productivity and patient safety are optimised.

Practitioner Summary: This observational study of 35 elective cases shows a mean interruption rate of 26 episodes/case with 80.9% affecting > one member of operating team, leading to mean prolongation of 18.46 minutes/case. Theatre staff should be aware of these findings and appropriate measures taken to optimise theatre productivity and patient safety.

Keywords: distractions; interruptions; gynaecology

Introduction

Distractions and interruptions have been shown to interfere with performance and safety in aviation industry and contribute to accidents (Chou and Funk 1990; Latorella 1996). The impact of mobile phone use and texting on the unsafe behaviour of drivers have also been demonstrated in recent simulated experiments (Yannis et al. 2014; Macy et al. 2014). In medicine, earlier observational studies on medical and nursing staff have also noted that continuous interruptions led to loss of concentration, thus increasing the likelihood of making error (Chisholm et al. 2001). Based on task analysis, Chisholm et al. (2001) established that physicians from Accident and Emergency as well as primary care departments spent on average one-sixth of their working time managing interruptions to their clinical tasks. Similarly, in a study conducted in an intensive care unit in Australia (Alvarez and Coiera 2005), it was noted that distracting communication occurred almost a third of the time, with colleagues interrupting each other 14 times/hour. Brixley et al. (2008) also noted approximately 10 interruptions/minute when five physicians and nine nurses were observed over 29.5 hours and 40 hours respectively in a tertiary trauma centre.

Similar factors in the theatre environment that can affect productivity and patient safety and studies have highlighted the negative effects of distractions (such as noise, irrelevant communications, bleeps, mobile phones and equipment failures) in surgical (Primus, Healey, and Undre 2007) as well as urological (Healey, Primus, and Koutanji 2007) operating theatres. Healey, Primus, and Koutanji (2007) reported a mean of 20.47 distracting events/case with a mean rate of 0.45 events/minute in an observational study of 30 urological day cases; later, the same team from a London teaching hospital suggested broadly rating distracting events into a nine-level behaviourally anchored scale (Sevdalis et al. 2009) depending on how these lead to interruptions and breaks in task activity.

Previously, in a prospective study investigating the surgical journey of patients during elective gynaecology theatre lists (which highlighted that only 60% of theatre occupancy was actually spent operating), Lewis et al. (2012) identified numerous 'bottlenecks' and inefficiencies which prevented rapid throughput of cases. At that time, the senior author of the study had anecdotally noted that theatre micro-environment as well as irrelevant communications and poor equipment preparation contributed to suboptimal usage of theatre time but did not specifically analyse the effect of these factors on safety or efficiency. The aim of the current study was to objectively quantify the frequency and impact of interruptions and distractions on clinical performance and patient safety during elective gynaecology theatre lists.

*Corresponding author. Email: waiyoong@nhs.net

Methods

A distraction was defined as an event that diverted the attention of the primary surgeon (or members of the surgical team) from the set tasks while an interruption constituted a break in task activity (Healey, Sevdalis, and Vincent 2006). Three levels were used to categorise the extent to which the operation team was affected by each disruption and interruption based on a scale simplified from data previously validated by Sevdalis et al. (2009) from a London teaching hospital:

Level I: Minimal level of distraction. There was a disturbance (usually dealt with by a 'floating' member of staff) but operating team did not show any observable sign of being affected.

Level II: At least one member of the surgical team was visibly distracted from their task.

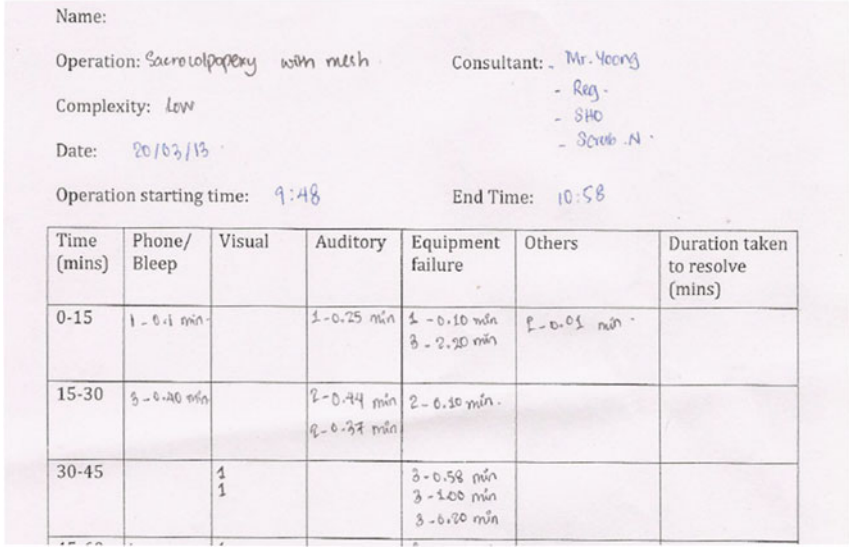
Level III: More than one member of the team, including the operating consultant, is affected and visibly distracted from task.

The sources of distractions in the operating theatre environment included visual (e.g. staff obscuring monitors), auditory (e.g. phones, bleeps and noise), irrelevant communication (e.g. discussions and queries not directly relevant to index surgical case, such as theatre manager asking about bed availability or occupancy), equipment problems, non-theatre staff movement through theatre, communication difficulties (e.g. doctors or nurses not responding to questions) and others as previously described by Healey, Sevdalis, and Vincent (2006). The duration of task interruption (in minutes) as a result of individual distracting event was recorded prospectively on a proforma and the effect on theatre team productivity and task completion was noted as previously categorised by Sevdalis et al. (2009). Potential patient compromise, length of stay (in hours) and any Serious Untoward Incident (SUI) (as defined by National Patient Safety Agency) attributable to the above events during the theatre sessions were also recorded.

All cases were performed by the senior author or experienced senior trainee (who had to have performed at least 10 such cases) to reduce any inherent interruptions due to teaching bias.

Data were collected from real time observations (Figure 1) by three supernumerary independent observers (two observers were always present at each session) and were compared and triangulated after each case with the primary surgeon/s. Triangulation refers to the process of collecting data from two or more sources, which were later cross checked and validated against each other (Smith et al. 2006; Campbell, Arfanis, and Smith 2012). In this study, the observers and surgeons debriefed each other and compared findings at the end of each case so that there is agreement on what constituted distractions and when these occurred. The three observers underwent training by the senior author in order to reduce inter-observer differences as follows: first, all three thoroughly read the available literature especially the relevant chapter by Sevdalis et al. (2009); they then collected pilot data for three operating sessions to familiarise themselves (these data were not used as part of study).

Theatre staff sometimes varied during the 10 sessions due to staff rotation but preoperative team briefings were always conducted and the World Health Organisation Surgical Checklist consistently used.



Name:

Operation: Sacrocolpopexy with mesh Consultant: - Mr. Yeong
- Reg.
- SHO
- Scrub N.

Complexity: Low

Date: 20/03/13

Operation starting time: 9:48 End Time: 10:58

Time (mins)	Phone/ Bleep	Visual	Auditory	Equipment failure	Others	Duration taken to resolve (mins)
0-15	1 - 0.1 min		1 - 0.25 min	1 - 0.10 min 3 - 2.30 min	1 - 0.05 min	
15-30	3 - 0.30 min		2 - 0.44 min 2 - 0.37 min	2 - 0.10 min.		
30-45		1 1		3 - 0.58 min 3 - 1.00 min 3 - 0.30 min		

Figure 1. Facsimile of proforma used to collect data on distracting events in 15-minute segments.

Results

Data from 35 cases were collected from 10 operating sessions, totalling 80 hours of theatre occupancy time (defined as the time the patient enters the anaesthetic room until the time she leaves the operating theatre). The total operating time (i.e. time recorded from knife to skin until completion of surgery) for the 35 cases was 29.95 hours, which constituted 40% of actual theatre occupancy. Senior trainees were the primary surgeons in 15 cases (supervised by the senior author) while 16 cases were performed by the consultant himself. Cases were predominantly vaginal hysterectomy (VH)/pelvic floor reconstructions, surgical urinary incontinence cases and operative hysteroscopy or laparoscopy (Table 1). The authors documented 650 individual distracting events based on criteria previously described by Healey et al. (5). The mean number of distractions or interruptions per patient was 26, while the mean number of level II and III distractions per patient was 17; interestingly, there appeared to be no statistically significant difference whether the consultant or senior trainee was the primary surgeon (mean number of interruptions per case was 25.2 vs 26.6 and mean number of level II/III distractions16 vs 17.8 respectively; $p > 0.05$ in both). Ninety per cent of interruptions occur in the first 30 minutes of the procedure and interruptions were more likely if the procedure become complicated or longer. In total, 80.9% of distractions affect more than one member of operating team (i.e. level II/III), leading to a break in task activity.

While no intraoperative complications were documented from the 35 cases which could be directly attributable to the observed distractions or interruptions, theatre efficiency was compromised, with mean prolongation of operating time being 18.46 minutes/case.

The operations were listed in Table 1. In minimal access cases (operative laparoscopy and hysteroscopy cases), equipment problems contributed most to level II/III interruptions, accounting for up 66% of the interruption time, while irrelevant communications (20.3%) were the most common cause of unnecessary prolongation of cases in vaginal surgery. Overall, equipment failure (49.96%), irrelevant communications (25.61%) and auditory distractions (8.95%) had most negative impact on interrupting the theatre lists (level III) (Table 2).

The mean length of stay ($\pm$ SD) was 18.6 ($\pm$ 3.4) hours for vaginal cases, 6.2 ($\pm$ 1.33) hours for sacral nerve implants, 12.4 ($\pm$ 2.4) hours for laparoscopic cases and 10.1 ($\pm$ 1.3) hours for hysteroscopic cases, respectively, while the commonest postoperative complication was urinary tract infection which occurred following VH ($n = 1$) and transobturator tape ($n = 1$).

Discussion

Attention refers to the limited control an operator has over sensory stimuli that he/she chooses to process: this is usually the stimuli the operator considers to be relevant to the task in hand (Pooley and Robson 2011). During a surgical procedure, selective attention is employed by the surgeon to focus on the primary task, at the exclusion of others. Distractions, which could be defined as visual (e.g. view of monitor being blocked), auditory (phones and bleeps), equipment failures, irrelevant communication and others, can force an operator to switch attention from the primary task, in order to process the new stimuli. This not only reduces the efficiency of the surgical process (Healey, Primus, and Koutanji 2007) but has been implicated in the development of anaesthetic critical events (Smith et al. 2006; Campbell, Arfanis, and Smith 2012) and pose a threat of making potential errors in trauma surgery (Tavares Pereira et al. 2011).

The authors acknowledge that their study is limited by the relatively small number cases ($n = 35$) but must point out that published studies on the subject have mostly used data from case series of less than 50 individual cases.

Current aggressive theatre efficiency drives, together with the recent adoption of Enhanced Recovery pathways (Relph et al. 2013) and the use of minimally invasive endoscopic and vaginal surgery has led to an environment that relies on the surgeon working under considerable pressure to perform. Thus, while distractions and interruptions did not culminate in intra or post-operative complications in this study, they do disrupt surgeon's attention and task activity; furthermore, factors such as equipment failure and irrelevant communications (especially relating to bed availability) has been shown exacerbate surgeons' stress levels (Arora et al. 2010). Prior to current study, the senior surgeon (WY), at times, has had to deal with administrative queries *during* a surgical procedure itself from theatre staff and managers pertaining to bed status and possibility of having to cancel the next patient; he or a member of his surgical team was then tasked to speak to the cancelled patients. While this may form part of expected good patient care, there was an increasing cognitive demand on the surgical team to multitask and this real time study was an attempt to assess the effect of distracting events on performance and safety in elective gynaecology lists.

A significant number of unnecessary distractive and interruptive episodes occurred during elective gynaecology lists, with the majority ($>$90%) being categorised as level II and III. For each gynaecology case, the authors observed a mean of 17 episodes which negatively affects at least one member of the operating team, leading to a mean delay in length of surgery of 18.46 minutes. Interestingly, data collected in this study indicated that distractions and interruptions seem to affect both senior trainees and consultants equally and did not support claims that experience itself had a role in coping with

Table 1. Distracting events stratified according to type of cases and their effects on duration of surgery.

Cases	*n*	No. of distracting events/case (mean)	No. of type II events/case (mean)	Mean delay/case due to type II events (minutes)	No. of type III events/case (mean)	Mean delay/case due to type III events (minutes)	Mean operating time (KTS to final suture) (minutes)
Vaginal cases, i.e. VH, mesh pelvic floor repairs, vaginal oophorectomy	14	16.6	4.3	2.01	6.5	7.72 minutes (causes: irrelevant comm 1.56 minutes; equip failure 0.88 minutes)	68.2
Sacral nerve implants	4	6.5	1	0.37	2.5	1.53 minutes (causes: equip failure 1.01 minutes; communication, e.g. scrub nurse left to get instruments 0.4 minutes)	25.5
Transobturator tapes	2	11.5	3	1.3	4	6.12 minutes (causes: equip failure 1.83 minutes)	31
Operative laparoscopic cases	6	25.33	6	2.69	12.2	18.2 minutes (causes: equip failure 12.07 minutes; auditory 1.6 minutes)	86.33
Operative hysteroscopic cases	4	16.75	5	1.77	3.75	9.9 minutes (main cause: equip failure 3.29 minutes)	42.5
Others, i.e. intravesical botulinum A, open myomectomy	5 (2 open procedures) plus botox and cystsocpy	20	4	1.15	8.4	9.4 minutes (main causes: equip failure 6.67 minutes; irrelevant comm 1.37 minutes)	52.6

Table 2. Level, duration and sources of distracting events.

Distractions	Equipment	Visual	Irrelevant communication	Auditory	Others	Total distraction time (s)	%
Level I	32	81	3539	1807	66	5525	21.8
Level II	579	222	1597	251	507	3156	12.45
Level III	12,051	39	1355	210	3007	16,662	65.75
Total distraction time (s)	18,662	342	6491	2268	3580	25,343	
%	49.96	1.35	25.61	8.95	14.13		

distractions. Previous authors (Hsu et al. 2008) have found that more experienced participants were less affected by distractions during simulated laparoscopic tasks, attributing this to the unconscious competence and automaticity developed in executing tasks when performed by an expert surgeon. One likely explanation for the current data is that senior trainees involved had done at least 10 previous cases (which also reduced the confounding variable of teaching) and thus may have sufficient multitasking ability to handle the distracting events. Second, the most common distracting events of equipment failure (49.96%) and irrelevant communication (25.61%) probably affected the entire team irrespective of whether the procedures were performed by the senior trainees or consultant.

High noise levels can affect concentration but unlike levels which exceed 130 dB recorded in trauma operating rooms (Tavares Pereira et al. 2011), thus interfering with speech intelligibility, the average noise level in our elective gynaecology lists is relatively low (during our two pilot observation sessions prior to commencement of study, a mean noise level of 62 dB was recorded on the audiometer). As such, the noise level was not considered as an important distracting factor in this study.

The authors find the aviation concept of the 'sterile cockpit' germane to the discussion here: the Aviation Safety Agency of the United States (US FAR part 121, 542) mandates that

> No command pilot or flight crew may allow any other activity during a critical phase of flight which may confuse crew member from the performance of his/her duties or to interfere in any way in the performance of their duties

Adherence to this rule help crew members avoid the need to manage unnecessary concurrent tasks that may compromise safety during flying (US Aviation and Action Safety Program 2013) and while this cannot be extrapolated directly to the operating theatres, there is sufficient data in this study to indicate that work interrupted during elective lists can lead to deviations in planned activities.

Unless mitigated by appropriate prevention strategies, distractions and impaired ability to focus on primary tasks can lead to potential error and inefficiencies in theatre. Thus, preoperative briefings and theatre staff training on how to reduce the numbers of distracting events during surgery is important. Recognising the sources of distractions and understanding their effects on theatre environment enable appropriate proactive measures to be taken so that both theatre productivity and patient safety are optimised.

References

Alvarez, G., and E. Coiera. 2005. "Interruptive Communication Patterns in the Intensive Care Unit Ward Rounds." *International Journal of Medical Informatics* 74: 791–796.

Arora, S., L. Hunt, N. Sevdalis, T. Tierney, D. Nestel, M. Woloshynowych, A. Darzi, and R. Kneebone. 2010. "Factors Compromising Safety in Surgery: Stressful Events in the Operating Room." *The American Journal of Surgery* 199: 60–65.

Brixley, J. J., Z. Tang, D. J. Robinson, C. W. Johnson, T. R. Johnson, J. P. Turley, V. L. Patel, and J. Zhang. 2008. "Interruption in One Trauma Centre: A Case Study." *International Journal of Medical Informatics* 77: 235–241.

Campbell, G., K. Arfanis, and A. F. Smith. 2012. "Distraction and Interruption in Anaesthetic Practice." *British Journal of Anaesthesia* 109 (5): 707–715.

Chisholm, C. D., A. M. Dornfield, D. R. Nelson, and W. H. Cordell. 2001. "Work Interrupted: A Comparison of Workplace Interruptions in Emergency Department and Primary Care Offices." *Annals of Emergency Medicine* 38: 146–514.

Chou, C. D., and K. Funk. 1990. "Management of Multiple Tasks: Cockpit Management Task Errors." pp. 470–442. *Proceedings of IEEE International Conference on Systems, Man and Cyber*netics, November 4–7.

Healey, A. N., N. Sevdalis, and C. A. Vincent. 2006. "Measuring Intraoperative Interference from Distraction and Interruption Observed in the Operating Theatre." *Ergonomics;* 49: 589–604.

Healey, A. N., C. P. Primus, and M. Koutanji. 2007. "Quantifying Distraction and Interruption in Urological Surgery." *Quality and Safety in Health Care* 16: 135–139.

Hsu, K. E., F. Y. Man, R. A. Gizicki, L. S. Feldman, and G. M. Fried. 2008. "Experienced Surgeons Can do More Than One Thing at a Time: Effect of Distraction on Performance of a Simple Laparoscopic and Cognitive Task by Experienced and Novice Surgeons." *Surgical Endoscopy* 22 (1): 196–201.

Latorella, K. A. 1996. "Investigating Interruptions: An Example from the Flightdeck." *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 40, pp. 249–253.

Lewis, M. A., R. D. Hall, S. O. Okolo, and W. Yoong. 2012. "How Time Flies: A Prospective Analysis of Theatre Efficiency During Elective Gynaecology Lists." *Gynecological Surgery* 9 (2): 213–217.

Macy, M. L., P. M. Carter, C. R. Bingham, R. M. Cunningham, and G. L. Freed. 2014. "Potential Distractions and Unsafe Driving Behaviors Among Drivers of 1- to 12-Year-Old Children." *Academic Pediatric* 14 (3): 279–286.

Pooley, D., and D. Robson. 2011. "Information Processing." In *Human Factors and Pilot Performance*, 97–119. The Air Pilots' Manual Vol. 6. 4th ed. Shoreham Airport, West Sussex, England: Pooley's Air Pilot Publishing.

Primus, C. P., A. N. Healey, and S. Undre. 2007. "Distraction in Urology Operating Theatre." *BJU International* 99: 493–494.

Relph, S., A. Bell, V. Sivashanmugarajan, K. Munro, K. Chigwidden, S. Lloyd, A. F. Fakokunde, and W. Yoong. 2013. "Cost Effectiveness of Enhanced Recovery After Surgery Programme for Vaginal Hysterectomy: A Comparison of Pre and Post-Implementation Expenditures." *International Journal of Health Planning and Management*. doi:10.1002/hpm.2182. [Epub ahead of print].

Sevdalis, N., S. Arora, S. Undre, and C. Vincent. 2009. "Distraction and Interruptions in the Operating Room." In *Safer Surgery. Analysing Behavior in the Operating Theatre*, edited by R. Flin and L. Mitchell, 205–243. Farnham: Ashgate.

Smith, A. F., C. Pope, D. Goodwin, and M. Mort. 2006. "What Defines Expertise in Regional Anaesthesia." *British Journal of Anaesthesia* 97: 401–407.

Tavares Pereira, B., A. Tavares Pereira, C. Santos Correia, A. C. Marttos Jr, R. K. A. Fiorelli, and G. P. Fraga. 2011. "Interruptions and Distractions in the Trauma Operating Room: Understanding the Threat of Human Error." *Revista do Colégio Brasileiro de Cirurgiões* 38 (5): 292–297.

US Aviation and Action Safety Program. 2013. "Accident and Incident Data."

Yannis, G., A. Laiou, P. Papantoniou, and C. Christoforou. 2014. "Impact of Texting on Young Drivers' Behavior and Safety on Urban and Rural Roads Through a Simulation Experiment." *The Journal of Safety Research* 49: 25–31.