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ORIGINAL ARTICLE

Staff perceptions of the effects of an integrated laparoscopic theatre environment on teamwork

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Abstract Laparoscopic surgery has now replaced traditional open surgery as the preferred method of intervention for many procedures. Although there are advantages of laparoscopic surgery to the patient, the technology puts additional strain on the surgical team. There are three aspects to the theatre environment that need to be considered: staff safety, patient safety and cost efficiency. We have previously published on the effect of the laparoscopic theatre environment on staff safety. To our knowledge, there are no data on the effect of integrated theatres on surgical teamwork. We therefore wished to determine staff perception of the effect that the integrated theatre environment had on their working interactions and behaviour in the operating room. This was a cross-sectional questionnaire survey. Twenty-seven theatre staff (nurses, consultants and trainees) working in a laparoscopic theatre were asked to complete a questionnaire. This included general demographics and their perception regards the theatre environment and team interaction. Visual analogue scores were used to compare the integrated and non-integrated theatres. Non-parametric statistical analysis was used. Overall the theatre team members had a strong preference for working in an integrated theatre environment. They felt that it resulted in greater efficiency, better teamwork and reduced stress levels. Differences were highly significant ($p<0.0001$). This is the first paper ever to look at the impact of the theatre environment on comfort and behaviour of medical and nursing staff involved in carrying out laparoscopic surgery. It is only by assessing these factors and the quality of the operating theatre environment that the true benefits of integrated theatres will be appreciated. This investment not only protects staff and patients but these data suggest that the improved behaviours may further enhance safety and also create greater efficiency resulting in cost savings.

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Background

Laparoscopy was first described by Kelling in 1901 [1]. The introduction of laparoscopic appendectomy in 1983 transformed it from a diagnostic tool to a therapeutic intervention [2]. Further development has seen laparoscopic surgery replacing traditional open surgery as the preferred method of intervention in many clinical situations [3–5]. More recent technological advances have led to improved visualisation and greater precision and accuracy [6].

The avoidance of an abdominal incision is associated with reduced post-operative pain and wound complications and a more acceptable cosmetic result. Early mobilisation has sped up recovery and reduced the length of hospital stay [5, 7, 8] with attendant advantages for cost control [9]. On the other hand, the technology could put additional strain on the surgical team. Open surgery has a high degree of freedom and surgeons work in line with their visual axis. There is a three-dimensional direct vision and direct tactile feedback. There is no need for monitors, accessory equipment like gas insufflators or extra wiring. During laparoscopic surgery, there are two-dimensional vision and a loss of depth perception to some extent as well as a fulcrum effect with tremor enhancement. There are only 4 degrees of freedom and the major limitation is that the view is not the under control of the surgeon. The increased technological complexity and sometimes poorly adapted equipment for the laparoscopic theatre environment have increased the potential risks to the surgical team [10].

The laparoscopic integrated theatre is a superior operating environment in which the laparoscopic equipment and multiple flat-screen monitors are permanently installed to be operational on demand inside the theatre. The equipment is

installed in columns attached to a ceiling-mounted suspension system that facilitates versatile positioning away from the monitors. All the wiring is concealed inside the suspension system and led out through the ceiling. The laparoscopic equipment can be remotely controlled by the operating surgeon or by the circulating nurse using a touch panel at a control station. It links together, via an interface, all surgical equipment including the room and camera lights, gas insufflator and diathermy machine.

There are three aspects to the theatre environment that need to be considered: staff safety, patient safety and cost efficiency. We have previously published on the effect of the laparoscopic theatre environment on staff safety [10].

The airline industry has demonstrated that teamwork can have a positive effect on safety outcomes [11]. There is also strong evidence coming from industry and commerce that the physical work environment can affect staff motivation and ability to effectively carry out their jobs [12].

There is increasing interest within the health care sector in the relationships between teamwork and patient safety. The audit commission carried out a review of operating theatres in the UK in 2003 and emphasised the importance of teamwork rather than just individual expertise [13]. The entire team must work in harmony towards a safe and cost-effective system. Integrated operating theatres are expensive to install and the question of the impact of integrated theatres on teamwork and safety is of interest to stakeholders and service users. Such an assessment would inevitably be complex and require ongoing research. One way to begin a line of inquiry in the topic is to evaluate staff perceptions of the effect that the integrated theatre environment had on interactions and behaviour in the operating room. This was the focus of our pilot study.

Methods

This is a cross-sectional survey, in which an opportunistic sample of theatre staff of different disciplines at a tertiary referral hospital completed a brief questionnaire that asked about their experience of integrated and non-integrated operating theatres. The inclusion criteria were work experiences in both types of theatres. The study sample comprised nine theatre nurses, nine consultants and nine trainees.

Table 1 Demographics

	Median age (IQR)	Males (%)
Nurses	41 (34, 48.5)	44.4
Trainees	38 (32.5, 39.5)	77.8
Consultants	44 (42, 50)	66.7

Table 2 Preference for working in an integrated theatre

	Integrated theatre, median (IQR) for all three groups together	Non-integrated theatre, median (IQR) for all three groups together
Satisfaction/preference overall	9 (9, 10)	4 (3, 6)
Overall efficiency/theatre efficiency	9 (8, 10)	5 (3, 6)
Positive theatre team behaviour/ teamwork	9 (7, 10)	5 (5, 7)
Stress level	2 (1, 2)	7 (6, 8)

The questionnaire included demographic information: age, gender, years of theatre work experience, years and current percentage of work in an integrated theatre, level of laparoscopic surgery (minor, intermediate and advance) and level of assistance (main surgeon or assistant).

The participants were asked to rate on a number of items from 1 (poor) to 10 (excellent). The nurses were asked questions to compare their experience in working in an integrated versus non-integrated theatre. These included their everyday tasks as well their interaction with the medical team, their perception of teamwork, stress and overall satisfaction.

The consultants were asked to compare their experience in both theatre settings. The questions were addressing their attitude towards the rest of the team members, their stress, their satisfaction as well as their overall performance and efficiency.

For the trainees, in addition to the above, they were asked to comment on the support and therefore the training they had in the two theatre settings.

Statistical methods (data analysis)

The main perception questions that the participants were asked consisted of responses that ranged from 1 (poor) to 10 (excellent) satisfaction levels. The numerical ratings were treated as interval data. Pairwise comparisons were made for each group's responses between integrated and not integrated theatre with the use of the non-parametric Wilcoxon-Sign test.

Table 3 Nurses' answers

	p value	Integrated theatre, median (IQR)	Non-integrated theatre, median (IQR)
Efficiency at start of day	0.018	10 (8, 10)	6 (3. 5,7)
Efficiency at end of day	0.018	9 (8, 10)	6 (4, 7)
Interaction with medics	0.017	9 (8, 10)	6 (5, 8.5)
Interaction with nurses	0.017	10 (8.5, 10)	7 (6, 9)

Table 4 Trainees' answers

	p value	Integrated theatre, median (IQR)	Non-integrated theatre, median (IQR)
Positive scrub nurse behaviour	0.020	8 (5.5, 9.5)	5 (4.5, 5.5)
Positive circulating staff behaviour	0.018	8 (7, 9)	5 (4, 6)
Positive consultant behaviour	0.049	8 (7.5, 9.5)	5 (3.5, 8.5)
Ability to perform tasks well	0.008	9 (8, 9.5)	6 (3, 7)

A non-parametric test was chosen over a parametric one due to the very small number of participants, i.e. nine pairs for each group. Due to this same reason, medians and IQRs (interquartile ranges) were used to summarise the data. Percentages were used for categorical variables. For those questions that were applicable to all three groups the responses for all 27 subjects were combined. Within group differences for these variables were also checked for significance.

Findings

The demographic characteristics of the staff are shown in Table 1. The complexity of laparoscopic surgery that the consultants were involved in were graded by them as minor (10 %), moderate (20 %) and major (70 %).

Overall the theatre team members indicated an overriding preference for working in an integrated theatre environment. They reported that it had resulted in greater efficiency, better teamwork and reduced stress levels. The median values and interquartile ranges are shown in Table 2. Differences were highly significant ($p<0.0001$). Within group differences were also significant for each of these variables.

The nurses were also asked about efficiency at the start and the end of each working day as this reflects the effort required to prepare and shut down the theatre environment when it is to be used for laparoscopic surgery. Interactions with medical and nursing staff in both theatre environments were also assessed. Results are shown in Table 3. All differences were significant.

The trainees were asked additional questions regarding the behaviour of specific team members in both of the theatre environments and regarding their ability to perform their own tasks adequately. All their responses were significantly in favour of the integrated theatre (Table 4).

The consultants felt that behaviour and performance was enhanced by the integrated theatre (Table 5). The only variable on which there was no significant difference was consultants' impression of the degree of helpfulness of the person manipulating the lower end during the operation.

Table 5 Consultants' answers

	p value	Integrated theatre, median (IQR)	Non-integrated theatre, median (IQR)
Positive scrub nurse behaviour	0.011	9 (8, 10)	4 (3.5, 6.5)
Positive circulating staff behaviour	0.024	8 (7, 9.5)	4 (3.5, 6.5)
Surgical performance	0.012	9 (8.5, 9.5)	7 (3, 7.5)
Helpfulness of main assistant	0.041	8 (6.5, 9.5)	6 (5, 8)
Helpfulness of bottom assistant	0.334	7 (5.5, 8)	6 (5, 7)

Conclusion

This is an exploratory study that aimed to gather information about the perceptions of theatre staff of the impact of the theatre environment on the work experiences of themselves and their colleagues involved in laparoscopic surgery. It is the first paper addressing the impact of integrated theatres.

A number of weaknesses limit the capacity to conclude from the pilot data. The number in each staff group was small. However, the small numbers differences were highly significant. A further weakness lies in the use of unvalidated visual analogue scales although these are widely used in medical research. There are also potentially confounding variables, e.g. the levels of difficulty of surgery carried out in the two theatre environments, and technical errors during surgery that could have influenced staff perceptions about the two theatre environments being compared.

However, the results fell into a consistent pattern of discriminatory responses in staff perceptions of the two physical work settings. This overriding pattern strongly suggests the need for further research in the impact of theatre environments on staff experiences and the attendant consequences on performance, safety and satisfaction. Further research should involve larger samples from multi centres.

It is only by assessing these factors and the quality of the operating theatre environment that the true benefits of integrated theatres will be appreciated. This investment not only protects staff and patients but these data suggest that the improved behaviours may further enhance safety and also create greater efficiency resulting in cost savings.

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