

# Communication in the operating theatre

S.-M. Weldon<sup>1</sup>, T. Korkiakangas<sup>1</sup>, J. Bezemer<sup>2</sup> and R. Kneebone<sup>1</sup>

<sup>1</sup>Department of Surgery and Cancer, Imperial College London, and <sup>2</sup>Department of Culture, Communication and Media, Institute of Education, University of London, London, UK

*Correspondence to:* Ms S.-M. Weldon, Division of Surgery, Department of Surgery and Cancer, Faculty of Medicine, Imperial College London, QEOM, St Mary's Hospital, 10th Floor, South Wharf Road, London W2 1NY, UK (e-mail: [s.weldon@imperial.ac.uk](mailto:s.weldon@imperial.ac.uk))

**Background:** Communication is extremely important to ensure safe and effective clinical practice. A systematic literature review of observational studies addressing communication in the operating theatre was conducted. The focus was on observational studies alone in order to gain an understanding of actual communication practices, rather than what was reported through recollections and interviews.

**Methods:** A systematic review of the literature for accessible published and grey literature was performed in July 2012. The following information was extracted: year, country, objectives, methods, study design, sample size, healthcare professional focus and main findings. Quality appraisal was conducted using the Critical Appraisal Skills Programme. A meta-ethnographic approach was used to categorize further the main findings under key concepts.

**Results:** Some 1174 citations were retrieved through an electronic database search, reference lists and known literature. Of these, 26 were included for review after application of full-text inclusion and exclusion criteria. The overall quality of the studies was rated as average to good, with 77 per cent of the methodological quality assessment criteria being met. Six key concepts were identified: signs of effective communication, signs of communication problems, effects on teamwork, conditions for communication, effects on patient safety and understanding collaborative work.

**Conclusion:** Communication was shown to affect operating theatre practices in all of the studies reviewed. Further detailed observational research is needed to gain a better understanding of how to improve the working environment and patient safety in theatre.

## Introduction

It is estimated that 234 million surgical procedures are performed globally each year<sup>1</sup>. In developed countries, where 73.6 per cent of procedures occur, 3–16 per cent end in morbidity, and of these 0.4–0.8 per cent are fatal<sup>1</sup>. The majority of surgical errors that contribute to morbidity and mortality can be attributed to communication breakdown<sup>2,3</sup>. The World Health Organization<sup>4</sup> states: 'Problems associated with surgical safety in developed countries account for half of the avoidable adverse events that result in death or disability. The economic benefits of improving patient safety are compelling. Studies show that additional hospitalization, litigation costs, infections acquired in hospitals, lost income, disability and medical expenses have cost some countries between US\$ 6 billion and US\$ 29 billion a year'.

Interprofessional communication plays an essential role in information transfer during operations and has relevance to patient safety<sup>5–8</sup>. The professionals working on operations include surgeons, anaesthetists, operating

department practitioners and nurses, as well as surgical trainees, medical and nurse students. Increasingly, team members represent diverse backgrounds and have different levels of experience and expertise with regard to working in the operating theatre. Although a surgical operation depends on the technical skills of the operating surgeon, the operation itself is a social situation where many tasks are accomplished through communication between team members. Some health research has examined team communication between medical professionals through self-report methods such as interviews<sup>9,10</sup> and documentation<sup>11</sup>. Where direct observation has been used to describe the patterns of communication<sup>12,13</sup>, the communication has generally not been transcribed and analysed in any great detail.

The aim of the present paper is to review systematically the studies that have addressed communication in the operating theatre. The objectives were: to identify current knowledge with regard to communication between healthcare professionals in an operating theatre; to assess

observational studies and explore the analytical methods used for this approach; to map the key communication barriers that have been identified and how these may affect the safety of a procedure; and to identify gaps in knowledge and understanding.

## Methods

A systematic review of the literature was performed for accessible published and grey literature. Quality appraisal was conducted using the Critical Appraisal Skills Programme<sup>14</sup> as a guide.

### Data sources

The following databases were searched in July 2012 using keywords and subject/medical subject heading (MeSH) terms: MEDLINE, Embase, PsycINFO® (American Psychological Association, Washington, DC, USA), ProQuest, Web of Knowledge, International Bibliography of the Social Sciences (IBSS) and Eldis. Grey literature was searched using Eldis, including conference proceedings and governmental publications. A hand reference search of the available literature was performed, as well as the authors' own knowledge of the available literature and use of personal contacts. This was achieved by sending a list of the retrieved references to surgeons and nurses with the request to check whether any relevant literature was missing.

### Study selection

All citations from database searches were exported to EndNote® version X5 (Thomson Reuters, New York, USA)<sup>15</sup>. Duplicates were removed. Two authors scanned all article titles and abstracts using an initial screening inclusion flow chart. The first screening inclusion was developed in order to select only studies that addressed the operating theatre environment, excluding other clinical environments such as hospital wards and clinics. Second, the selected studies had to address communication between healthcare professionals, thus excluding studies that focused on interactions between clinicians and patients, for example. Third, the selected studies had to report observational data, thus excluding studies based on self-reporting, documentation or interviews only. All languages were included and translations sought where necessary by either contacting the author directly or seeking a translator.

A second set of eligibility criteria was then used to screen the full texts of the articles in more detail. Inclusion

criteria were: assesses communication between healthcare professionals within the operating theatre; reports observational research (with qualitative or quantitative analysis). Exclusion criteria were: addresses communication between patient and healthcare professionals; communication issues that arose but were not the focus of the study; surveys, documentation, interviews and focus group studies; studies focusing on communication on wards and other clinical sites separate from the operating theatre; studies of surgical simulation and education.

Each author's final set of included articles was then compared and discrepancies were resolved through discussion and clarification.

### Data extraction

A data extraction form was created and piloted to ensure a systematic and fair retrieval of relevant information from the included studies. The form took into account the study year, country of origin, objectives, methods, study design, sample size, healthcare professional focus and main findings.

Two authors extracted data using the specified format. A consensus on discrepancies was reached through discussion. Authors of the studies were contacted for further information, if not present in the paper.

### Quality assessment

The Critical Appraisal Skills Programme<sup>14</sup> was used to assess the quality of the studies. Two authors assessed each study against the criteria, including rigour, methods, credibility and relevance. Discrepancies in the authors' assessments were discussed and mitigated. Owing to the subjectivity of assessing qualitative studies, the tool should be regarded only as indicative. Assessments were made using the information provided in the published paper only. Assessment criteria for qualitative studies were not included in quantitative study appraisals and this was reflected in the scoring.

### Data synthesis

A meta-ethnography approach<sup>16</sup> was used to synthesize the study data. This approach was chosen as it is designed to generate new theories and explain the outcomes of a range of different methodological approaches. It is particularly useful when there is an emphasis on qualitative studies as it uses induction and interpretation.

Noblit and Hare<sup>16</sup> provide a stepped approach to synthesizing study outcomes. These include: deciding what

is relevant to the initial interest; reading the studies; determining how the studies are related; translating the studies into one another; synthesizing translations; and expressing the synthesis. From reading the included studies, key concepts were identified and second-order interpretations were taken directly from the studies themselves and associated with the relevant concept. By combining all of the interpretations under each key concept, third-order interpretations were turned into a form of hypothesis.

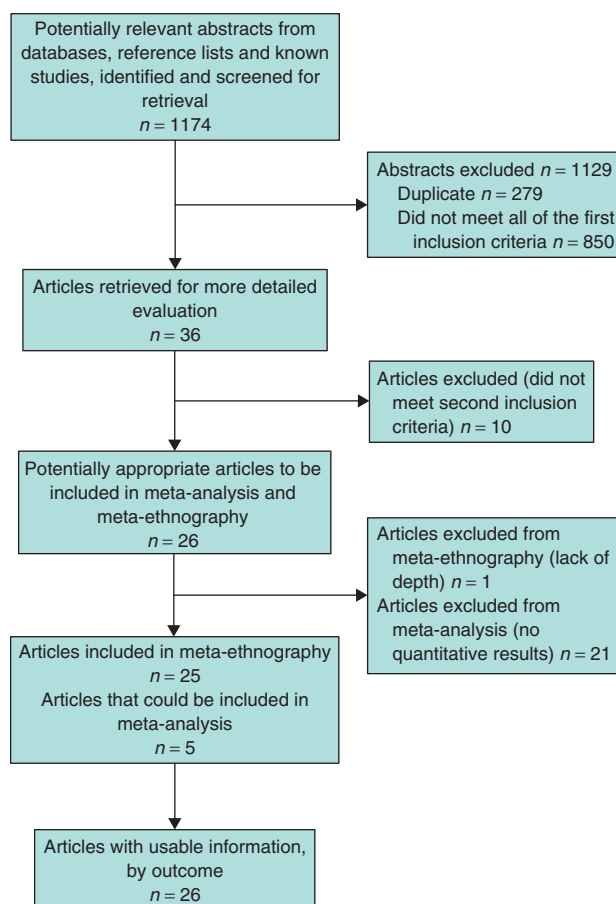
As a result of variation between the quantitative results obtained (some did counts of communication failures whereas others measured time under different conditions), no synthesis or meta-analysis of the quantitative data could be performed, and therefore a descriptive table and short narrative of the results are presented.

## Results

A total of 1174 citations were retrieved, 1165 citations from the electronic search and nine from the reference list hand-search. After removal of duplicates and papers that did not meet the initial inclusion criteria, 36 articles remained (*Fig. 1*). Application of the second screening criteria resulted in the inclusion of 26 studies and the exclusion of ten. Based on the information provided, the 26 studies<sup>13,17-41</sup> included a minimum of 584 research participants, 1094 cases and 2200 observational hours (*Table 1*). Of the 26 studies, 19 were qualitative, two were quantitative and five mixed. Twenty were prospective observational studies; of these, ten used audio/video recordings, seven interview methods, six field notes, two photographs, one questionnaire and one assessment tool. Most studies used a mix of approaches. A variety of theatre staff healthcare professionals were observed across studies, with nurses and surgeons dominating. All of the studies were undertaken in high-income countries, with the majority being from the UK, followed by Australia and the USA. Fourteen of the included studies had been published in a health-related journal<sup>13,18-22,25,27-31,33,34</sup>, and five were in surgical journals<sup>18,25,29,30,34</sup>. Of the ten excluded studies<sup>42-51</sup>, most were excluded on the basis of focus on educational information transfer or organizational structure rather than communication and interactions between individuals. One was excluded because it focused on overlapping job roles to cut costs<sup>42</sup>.

## Quality appraisal results

Overall the quality of the studies was judged to be average to good, with 77 per cent of the methodological



**Fig. 1** PRISMA diagram of articles selected for review

quality assessments being met (*Fig. 2*). A large proportion of studies did not meet the quality appraisal criteria with regard to addressing the researcher/participant relationship, declaring any commercial funding and ethical considerations. This would have ensured there was no commercial or participant/observer bias and that the research had been carried out ethically. This aspect needs to be addressed more often in observational studies. Only three studies<sup>17,18,41</sup> met all of the quality appraisal criteria.

## Meta-synthesis

Six key themes were identified throughout the results sections of the included papers: signs of effective communication; signs of communication problems; effects on teamwork; conditions for communication; effect on patient safety; and understanding collaborative work (*Table 2*).

**Table 1** Methods, size, participants and main findings of included papers

Reference	Year	Country	Objectives	Methods/design	Sample size, time, no. of cases	Healthcare professional focus	Main findings/ author conclusions
Hindmarsh and Pilnick <sup>17</sup>	2002	UK	To explore the interactional organization of collaborative work in the field of anaesthesia	Qualitative: prospective observational audio and video recorded and informal interviews. Ethnographic and conversation analysis approach	Size: n.s. Time: 14 days Cases: n.s.	Anaesthetists, ODAs	Colleagues interactionally constitute back stages for their work to camouflage their communication with one another when a patient is present in order to conceal sensitive information. Communication between healthcare workers is sensitive to talk and bodily conduct and therefore enables a sense of organizational 'knowing' culture
Lingard <i>et al.</i> <sup>13</sup>	2004	Canada	To describe the characteristics of communication failures in the operating theatre	Mixed methods: prospective observational video recorded and field notes	Size: 94 Time: 90 h Cases: 48	Anaesthesia staff, surgical staff, clinical clerks, nurses	Communication failures contributed to jeopardizing patient safety and occurred at least 30% of the time
Christian <i>et al.</i> <sup>18</sup>	2006	USA	To understand better the operating room as a system and identify system features	Mixed methods: prospective observational field notes	Size: n.s. Time: n.s. Cases: 10	All theatre staff	Communication loss and information breakdown cause the greatest threat to patient safety
Riley and Manias <sup>19</sup>	2006	Australia	To examine how time is controlled and governed through interpersonal communication between nurses and doctors	Qualitative: prospective observational study with ethnographic approach; field notes, group and individual interviews	Size: 11 Time: 230 h Cases: n.s.	Nurses, surgeons	Knowledge of individual surgeons' habits was a source of power for nurses that was used in subtle ways
Riley and Manias <sup>20</sup>	2006	Australia	To explore governance and control in operating room nurses' clinical practice	Qualitative: prospective observational study with ethnographic approach; field notes, group and individual interviews. Photographic material used	Size: 11 Time: 230 h Cases: n.s.	Nurses, surgeons	As a form of governance, nurses' knowledge of surgeons is a subjugated form of knowledge, located low down on a hierarchy of knowledge
Riley <i>et al.</i> <sup>21</sup>	2006	Australia	To explore the power relationships in the communications between nurses and surgeons that affect the conduct of the surgical count	Qualitative: prospective observational study with ethnographic approach; field notes, group and individual interviews	Size: 11 Time: 230 h Cases: n.s.	Nurses, surgeons, anaesthetists	Power relationships were highlighted, leading to poor communication when conducting the surgical count
Riley <i>et al.</i> <sup>22</sup>	2007	Australia	Whiteboards in clinical settings play a hybrid role	Qualitative: retrospective observational study with ethnographic approach; field notes, group and individual interviews. Photographic material used and photovoice	Size: n.s. Time: ≥ 230 h Cases: n.s.	Nurses, surgeons	Whiteboards enable communication at a distance – can be beneficial but also detrimental

Table 1 Continued

Reference	Year	Country	Objectives	Methods/design	Sample size, time, no. of cases	Healthcare professional focus	Main findings/ author conclusions
Sanchez Svensson <i>et al.</i> <sup>23</sup>	2007	Sweden /UK	How the arrangement of passing instruments can be reconfigured in the light of problems and circumstances that arise during an operation	Qualitative: prospective observational ethnographic study	Size: n.s. Time: n.s. Cases: n.s.	Nurses, surgeons	An analysis of seemingly simple activities can have implications for an understanding of collaborative work
Sevdalis <i>et al.</i> <sup>24</sup>	2007	UK	To describe the content, initiators and recipients of communications that intrude or interfere with individual surgical cases	Mixed methods: prospective observational study	Size: n.s. Time: n.s. Cases: 48	Surgeons, assistant surgeons, nurses, anaesthetists	Small-talk between team members accounts for more than half of case-irrelevant communication
Undre <i>et al.</i> <sup>25</sup>	2007	UK	To assess teamwork and communication using an assessment tool	Mixed methods: prospective observational study	Size: n.s. Time: n.s. Cases: 50	Surgeons, assistant surgeons, nurses, anaesthetists, ODPs	Anaesthetists and nurses obtained the lowest scores on communication. In addition to low scores on communication, surgeons' teamwork behaviours appeared to deteriorate as the procedures were finished
Finn <sup>26</sup>	2008	UK	To explore operating theatre teamwork discourse	Qualitative: retrospective observational study with ethnographic approach; field notes and interviews	Size: 24 Time: 250 h Cases: n.s.	Surgeons, assistant surgeons, nurses, anaesthetists, ODPs	The privileged position of anaesthetists and surgeons over nurses and ODPs is legitimated and maintained
Gardezi <i>et al.</i> <sup>27</sup>	2009	Canada	To explore whether the use of a structured checklist for a preoperative briefing was an effective way to support communication in the operating theatre	Qualitative: retrospective observational ethnographic study using field notes	Size: 201 Time: n.s. Cases: $\geq 700$	Surgeons, nurses, anaesthetists	There are multiple and complex ways that constrain, and silent communication is produced within the operating theatre; being aware of them may help health professionals to interpret the multiple modalities and strategies of communication at play, in particular with regard to silence
Riley and Manias <sup>28</sup>	2009	Australia	To provide an in-depth understanding about gatekeeping practices by nurses to highlight power relationships	Qualitative: prospective observational ethnographic study using single and group interviews, photographs and diaries	Size: $\geq 11$ Time: 230 h Cases: n.s.	Nurses, surgeons, anaesthetists	Gatekeeping acts can influence and shape clinical practice and, more importantly, can impact on patient care
Zheng and Swanström <sup>29</sup>	2009	USA	To examine team cooperation among surgeons in a surgical team built up with different time lengths	Quantitative: prospective observational study; video recorded	Size: 27 Time: n.s. Cases: 59	Surgeons, assistant surgeons, nurses, anaesthetists	Working in a team allows surgeons to develop sophisticated cognition to anticipate an upcoming task and provide assistance without verbal communication

Table 1 Continued

Reference	Year	Country	Objectives	Methods/design	Sample size, time, no. of cases	Healthcare professional focus	Main findings/ author conclusions
Zheng <i>et al.</i> <sup>30</sup>	2009	USA	To record surgical related activities performed by the scrub nurse with different levels of experience	Quantitative: prospective observational study; video recorded	Size: 27 Time: n.s. Cases: 28	Nurses	Experienced nurses develop sophisticated cognition, with anticipatory movement and eye gaze being two valuable behavioural markers for assessing team performance
Bahl <i>et al.</i> <sup>31</sup>	2010	UK	To define the non-technical social skills of operative vaginal delivery to facilitate transfer of skills from obstetrician to trainee obstetrician	Qualitative: prospective observational study; interview and video recorded	Size: 18 Time: n.s. Cases: 30	Midwives, obstetricians	Explicitly defined skills taxonomy could aid trainees' understanding of the non-technical skills to be considered when conducting an operative delivery
Collin <i>et al.</i> <sup>32</sup>	2010	Finland	To examine surgical operations as participatory practices from the perspective of interprofessional learning and practice	Qualitative: prospective ethnographic interview and field notes observational study; video recorded	Size: 23 Time: n.s. Cases: n.s.	Nurses, surgeons, physicians	Interprofessional teamwork can be implemented by collegial support, transgressing professional roles and sustaining an inclusive atmosphere
Finn <i>et al.</i> <sup>33</sup>	2010	UK	To examine how teamwork phenomenon plays out in practice	Qualitative: retrospective observational ethnographic approach; field notes	Size: n.s. Time: 570 h Cases: n.s.	Surgeons, assistant surgeons, nurses, anaesthetists, ODPs	Teamwork discourse can be instrumentally co-opted in the reproduction of the very occupational divisions it is designed to ameliorate, or simply ignored when compared with other forms of collective identity
Moore <i>et al.</i> <sup>34</sup>	2010	Australia	The role of body orientation as a tool for communication in the operating theatre	Qualitative: prospective observational ethnographic approach; audio and video recordings	Size: n.s. Time: n.s. Cases: n.s.	Surgeons, assistant surgeons, nurses, anaesthetists	Over time, individual teams learn what is intended by particular movements or bodily orientations
Bezemer <i>et al.</i> <sup>35</sup>	2011	UK	Explores language use within the operating theatre in a context of instability and diversity	Qualitative: prospective observational linguistic-ethnographic approach; audio and video recordings and field notes	Size: 55 Time: 70 h Cases: 40	Surgeons, assistant surgeons, nurses, anaesthetists	Meaning needs to be negotiated <i>in situ</i> , with a shift towards more open, participatory power structures
Bezemer <i>et al.</i> <sup>36</sup>	2011	UK	Exploration of how surgeons and nurses organize their activities, how social interactions are used to help structure and define situations, and how differences in knowledge are constructed and oriented	Qualitative: prospective observational symbolic interactionism, ethnomethodology and conversational analysis approach; audio and video recordings	Size: 55 Time: 70 h Cases: 40	Surgeons, assistant surgeons, nurses, anaesthetists	Social interactions between surgeons and nurses are analytically inseparable from the technical demands of their work

**Table 1** Continued

Reference	Year	Country	Objectives	Methods/design	Sample size, time, no. of cases	Healthcare professional focus	Main findings/ author conclusions
Koschmann and Zemel <sup>37</sup>	2011	USA	To give an account of 'informal logic' of relationship discovery practices	Qualitative: n.s.	Size: 4 Time: n.s. Cases: n.s.	Surgeons, scrub nurse, medical student	Scientific practice is permeated with ordinary forms of reasoning and action
Koschmann <i>et al.</i> <sup>38</sup>	2011	USA	Examine how understandings of objects are talked and worked into being within concerted action	Qualitative: n.s.	Size: 3 Time: 35 min Cases: n.s.	Surgeons, assistant surgeons, nurses, anaesthetists	Procedure both determines and is determined by its object
Mondada <sup>39</sup>	2011	France	To observe how participation space is shaped by the way in which participants organize their talk-in-interaction	Qualitative: prospective observational conversational analysis approach; video recordings	Size: n.s. Time: n.s. Cases: n.s.	Surgeons, assistant surgeons, nurses, anaesthetists	In order for teamwork-distributed activities to be managed, the coordination of people, technologies and objects is required
Mondada <sup>40</sup>	2011	France	To investigate the systematic organization of multiactivity	Qualitative: prospective observational conversational analysis and multimodal analysis approach; video recordings	Size: n.s. Time: n.s. Cases: 1	Surgeons, assistant surgeons, nurses	In multiactivity, talk and other actions can project parallel sequential constraints that can be responded to simultaneously or successively
Schraagen <sup>41</sup>	2011	The Netherlands	To explore how a highly competent surgical team deals with unforeseen complexity arising during surgery	Mixed methods: prospective observational ethnographic approach; questionnaires and assessment tools	Size: 9 Time: n.s. Cases: 40	Surgeons, anaesthesiology providers, nurses, perfusionists	Explicit coordination processes were relied on in order to deal with non-routine events during teamwork

n.s., Not specified; ODA, operating department assistant; ODP, operating department practitioner.

### Signs of effective communication

Several of the studies reported an underlying 'knowing' between established staff members within the operating theatre<sup>17</sup>. This form of knowing is described as the team member's ability to interpret what is happening, or about to happen, with very little information being provided. It was recognized in most studies that this area was often overlooked owing to the difficulties in measuring such instances<sup>34</sup>. Where studies did try to identify and interpret this form of communication, non-verbal communication was identified as the dominant factor. For instance, anticipatory movements enable the scrub nurse to interpret the next movements of the surgeon and pass the requested instruments in a timely manner. Non-technical skills such as anticipatory movements, eye gaze and bodily orientations were recognized as being more developed within established teams<sup>29-31</sup>.

This synthesis recognized the need for studies to look at non-verbal communication and pinpoint which of these resources are most dominant and reliable in the contribution to effective communication.

### Signs of communication problems

The synthesized studies addressed not only what contributed to communication failures but also what enhanced communication within the operating theatre environment. Communication failures were identified in many of the studies, from power relationships between healthcare professionals to the use of second-hand communication tools, such as whiteboards<sup>22,24,27,31</sup>. Communication problems were attributed to a mixture of role identities (lack of clarity with regard to role), power relationships and conflicting ideas of appropriateness in communication. Communication appeared to be more effective when non-technical skills such as meaning, negotiating and reasoning were used<sup>18,35</sup>.

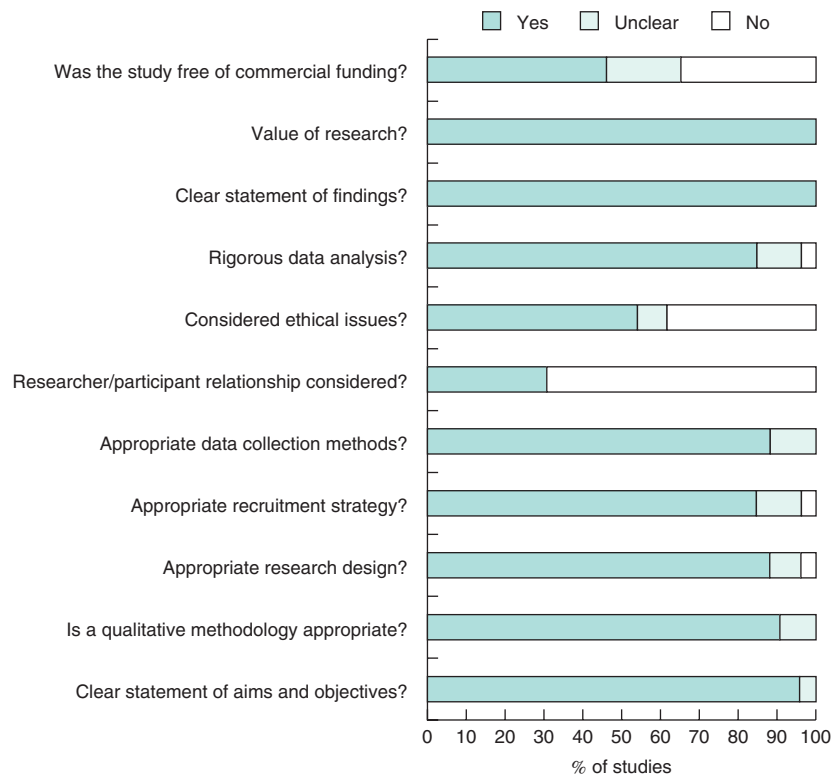


Fig. 2 Critical Appraisal Skills Programme quality appraisal of included studies

Thus the studies recognized the importance of measuring communication successes and failures, and the importance of adjusting the environment and personal conduct to recognize them.

### Effects on teamwork

Teamwork occurred in many different ways and was recognized as often failing within operating theatres<sup>25</sup>. It was identified that teamwork is often hindered or complicated by other forms of collective identity, such as role identities, thus jeopardizing an inclusive atmosphere<sup>28,33</sup>. Teamwork coordination was seen as paramount in order for it to be effective<sup>39,41</sup>. Interprofessional communication is a prerequisite of teamwork; without (effective) communication the team cannot function.

Hierarchical structures and separate healthcare professional identities can prohibit successful teamwork. Further research should explore how these forms of organizational structure have been dealt with in similar organizations, such as the military and aviation.

### Conditions for communication

Power relationships within the operating theatres were recognized as an important factor underlying communication<sup>21,27,35</sup>. These forms of power include the nurses' control over surgeons<sup>19</sup>, and the privileged positions of surgeons and anaesthetists over the rest of the team<sup>26</sup>. It was recognized that on occasions these forms of power contributed to team members feeling unable to speak up when necessary, thus leading to unsafe practice and reduced team effort<sup>26</sup>. One example where this happened in particular was with regard to the surgical count. One of a nurse's responsibilities is to ensure nothing is left inside a patient; however, if an environment is created where nurses do not feel they can ask the surgeon to stop what they are doing during a count, unsafe practice ensues<sup>21</sup>. Safe atmospheres, in which people feel they have the right and duty to speak up regardless of job role, were identified as a prominent aspect in need of change<sup>20</sup>.

This interpretation challenges the hierarchical environment that exists in theatres, and highlights the need for change in communication between professions.



**Table 2** Meta-ethnography concepts and interpretations

Concept	Second-order interpretations	Third-order interpretations
Signs of effective communication	Established teams allow more non-verbal communication <sup>29</sup> ; anticipatory movement and eye gaze increase with experience <sup>30</sup> ; non-technical skills <sup>31</sup> ; intentions identified by particular movements or bodily orientations <sup>34</sup> ; organizational 'knowing' culture <sup>17</sup>	Teams that are well established communicate on an increased level, using less verbal communication and more anticipatory movements such as eye gaze and positioning
Signs of communication problems	Communication loss, information breakdown <sup>18</sup> ; poor communication <sup>27</sup> ; communication through whiteboards <sup>22</sup> ; case-irrelevant communication, small talk <sup>24</sup> ; silence <sup>27</sup> ; non-technical skills <sup>31</sup> ; meaning to be negotiated <i>in situ</i> <sup>35</sup> ; practice is permeated with ordinary forms of reasoning and action <sup>37</sup>	Communication failure, loss and breakdowns can be exemplified by irrelevant talk, silences, power relationships and second-hand communication methods. By understanding the operating theatre's culture of reasoning and action through understanding verbal and non-verbal communication, practitioners can fine-tune their communication skills to suit the environment
Effects on teamwork	Surgeons' teamwork deteriorates near end of procedure, and nurses and anaesthetists score low for teamwork <sup>25</sup> ; need to sustain an inclusive atmosphere <sup>32</sup> ; teamwork can be ignored when compared with other forms of collective identity <sup>33</sup> ; in order for teamwork-distributed activities to be managed, the coordination of people, technologies and objects is required <sup>39</sup> ; explicit coordination processes were relied on in order to deal with non-routine events during teamwork <sup>41</sup>	Communication within teamwork needs to be maintained to ensure successful procedures and patient safety. Teamwork is recognized as often unsatisfactory within operating theatres and deteriorates as time goes on. Banishing separate professional identities and encouraging inclusive atmospheres can improve teamwork. This can be achieved through coordination and training
Conditions for communication	Nurses' power over surgeons <sup>19</sup> ; power relationships <sup>21</sup> ; hierarchy of knowledge <sup>20</sup> ; surgeons' and anaesthetists' privileged positions over nurses and ODPs <sup>26</sup> ; silence <sup>27</sup> ; open, participatory power structures needed <sup>35</sup>	Power relationships are prominent within the operating theatre. Power relationships are seen across all disciplines of the operating theatre and generally relate to a hierarchy of knowledge. Power relationships cause fear and silences, which can in turn relate to unsafe practice. In relation to a changing society, structures need to be challenged
Effects on patient safety	Communication failure a threat to safety <sup>13</sup> ; poorly conducted surgical counts owing to power relationships <sup>21</sup> ; gatekeeping practices impact on patient care <sup>28</sup> ; understanding non-technical skills could potentially prevent morbidity and improve patient experience <sup>31</sup>	Communication failures through power relationships, gatekeeping practices and hierarchy issues all impact on patient safety. Learning to understand the non-technical skills of the operating theatre has the potential to improve patient safety
Understanding collaborative work	Seemingly simple tasks <sup>23</sup> ; anticipatory movement and eye gaze <sup>30</sup> ; non-technical skills <sup>31</sup> ; intentions identified by particular movements or bodily orientations <sup>34</sup> ; social interactions between surgeons and nurses are analytically inseparable from the technical demands of their work <sup>36</sup> ; procedure both determines and is determined by its object <sup>38</sup> ; in multiactivity, talk and other actions can project parallel sequential constraints that can be responded to simultaneously or successively <sup>40</sup>	Non-technical skills between healthcare professionals in the operating theatre are inseparable from the technical demands of the task and therefore the need to understand these interactions is just as important. By observing not just talk but other bodily actions and behaviours, a more complete picture of operating theatre culture can be created

ODP, operating department practitioner.

### Effects on patient safety

Most studies suggested that patient safety is partly contingent on communication<sup>13,28,31</sup>. Seemingly simple tasks such as the surgical count can become compromised if the task is not communicated effectively<sup>21</sup>. Patient safety should be at the forefront of any procedure, and even the simple and mundane practices should be taken seriously if they compromise this.

### Understanding collaborative work

Although it is important to gather information about the outcomes of work in the operating theatre for patients and staff, the studies reviewed also recognized the need to understand in detail the processes, including the complex communication patterns, that lead to those outcomes. In almost all of the studies, it was recognized that communication skills play just as important a

**Table 3** Basic description of quantified study measurements and outcomes

Metric	Outcome
Communication failure Verbal exchanges	Occurred at least 30% of the time <sup>13</sup> Anaesthetists and nurses obtained lowest scores on communication <sup>25</sup>
Anticipatory movements (surgeons)	More anticipatory movements were performed in dedicated teams than in developing teams; however, this had no significant effect on procedure duration <sup>29</sup>
Anticipatory movements (nurses)	Experienced nurses spent less time watching the procedures but performed more anticipatory movements <sup>30</sup>
Case-irrelevant communication	Small-talk accounted for more than half of case-irrelevant communication <sup>24</sup>

role with regard to a clinical task as do technical skills<sup>30,34,36,41</sup>. However, although this is recognized, it is often overlooked, and technical skills are the focus of improvement or training needs<sup>30</sup>. Intentions and misunderstandings can be understood best when looking at collaborative work through an observational lens<sup>23</sup>. Seemingly mundane actions such as eye gaze, anticipatory movements and gestures can often be overlooked<sup>30</sup>, although they can give better insight into how clinicians actually organize and accomplish collaborative work in the operating theatre<sup>40</sup>.

### Quantified narrative

Table 3 provides a description of the quantitative results obtained from the observational studies. The results are few, and use different measures; therefore a meta-analysis could not be performed. Although they indicate the frequency of communication issues within the operating theatre, they provide limited detail of the actual contexts in which these practices occur, and how they might be changed. However, they do highlight that communication failures can have important implications for effective and safe surgical outcomes. Case-irrelevant communication was also seen as dominant within the types of communication; this can have particular implications for communication during surgical operations.

### Discussion

Communication plays a crucially important and complex role in the operating theatre. It is shaped by organizational culture, and non-verbal resources are just as relevant for effective communication. The tacit knowledge/skills

underlying the use of non-verbal communication could be examined by observing practitioners at work. Once made explicit, they can inform important debates about ways to improve clinical practice and feed into training and education.

Considering the volume of communication failures reported, communication ought to be investigated and recognized as an important area for training and professional development. Addressing communication between healthcare professionals complements growing attention to doctor–patient communication, for instance in the undergraduate medical curriculum. Without effective communication to create inclusive environments, and coordinate the multiplicity of tasks involved in surgery, teamwork cannot be successful.

The themes that have emerged from the synthesized studies could determine further research by testing the following hypothesis: by understanding the operating theatre’s culture of reasoning and action through understanding verbal and non-verbal cues, practitioners can fine-tune their communication skills to suit the environment and colleagues’ conduct within it; discouraging separate professional identities and encouraging inclusive atmospheres can improve teamwork. This can be achieved through coordination and training. Communication impacts on patient safety, which can be improved by developing inter-professional communication skills; non-technical skills are inseparable from the technical skills demanded by the task and therefore the need to understand these interactions is just as important. By observing, not just talk, but other bodily actions and behaviours, a more complete picture of operating theatre culture is created. Power relationships affect communication in the operating theatre; power relationships can prevent junior staff from speaking up, in turn relating to unsafe practice.

In spite of growing acknowledgement of its implications for patient safety, communication in the operating theatre is under-researched: only 26 studies were found that addressed communication through observation of work practices in the operating theatre. These studies, although all observational, differed in approach and methods, making it difficult to draw comparisons and conclusions. Video analysis of observed communication could be used to identify what communication behaviours are likely to be effective or ineffective, as video enables a repeated access to the occurring practices and captures in detail the range of ways in which professionals communicate. Those details cannot be recorded in note-taking on-the-spot and are rarely articulated by healthcare professionals in interviews. Many of the generated interpretations resonate with non-observational studies, such as that of a study

by Belyansky and colleagues<sup>52</sup>: ‘Our findings indicate that resident attending intraoperative communication can prevent adverse patient events. Trainees often feel impaired in voicing their concerns to their attendings. Strategies that improve resident attending communication intraoperatively are needed as they are likely to enhance patient safety’.

Communication in the operating theatre is not only under-researched, it also receives disproportionately little attention in the academic surgical community; of the 26 studies reviewed, only five were published in a surgical journal, with only one of these being qualitative. Thus, the small body of research does not currently reach one of its key audiences through one of their major information channels. A particular focus should be placed on the types of method adopted for this kind of research in order to allow better synthesis of results and therefore stronger inferences, which could lead to the development of education and training in this undervalued area of surgical performance. By understanding this subject in greater detail, further research and training based on data-grounded evidence-based research could be developed that would improve both the working environment and patient safety.

## Acknowledgements

This review was funded by the Economic and Social Research Council (grant reference: RES-062-23-3219) as part of an ongoing research project on communication in the operating theatre.

*Disclosure:* The authors declare no conflict of interest.

## References

- Weiser TG, Regenbogen SE, Thompson KD, Haynes AB, Lipsitz SR, Berry WR *et al.* An estimation of the global volume of surgery: a modelling strategy based on available data. *Lancet* 2008; **372**: 139–144.
- Makary MA, Mukherjee A, Sexton JB, Syin D, Goodrich E, Hartmann E *et al.* Operating room briefings and wrong-site surgery. *J Am Coll Surg* 2007; **204**: 236–243.
- Lingard L, Regehr G, Espin S, Whyte S. A theory-based instrument to evaluate team communication in the operating room: balancing measurement authenticity and reliability. *Qual Saf Health Care* 2006; **15**: 422–426.
- World Health Organization. *10 Facts on Patient Safety*; 2012. [http://www.who.int/features/factfiles/patient\\_safety/en/index.html](http://www.who.int/features/factfiles/patient_safety/en/index.html) [accessed 5 September 2012].
- Adams JG, Bohan JS. System contributions to error. *Acad Emerg Med* 2000; **7**: 1189–1193.
- Donchin Y, Gopher D, Olin M, Badihi Y, Biesky M, Sprung CL *et al.* A look into the nature and causes of human errors in the intensive care unit. *Crit Care Med* 1995; **23**: 294–300.
- Schaefer HG, Helmreich RL. The importance of human factors in the operating room. *Anesthesiology* 1994; **80**: 479.
- Wilson RM, Runciman WB, Gibberd RW, Harrison BT, Newby L, Hamilton JD. The Quality in Australian Health Care Study. *Med J Aust* 1995; **163**: 458–471.
- Spafford MM, Lingard L, Schryer CF, Hrynychak PK. Tensions in the field: teaching standards of practice in optometry case presentations. *Optom Vis Sci* 2004; **81**: 800–806.
- Knifed E, Goyal A, Bernstein M. Moral angst for surgical residents: a qualitative study. *Am J Surg* 2010; **199**: 571–576.
- Greenberg CC, Regenbogen SE, Studdert DM, Lipsitz SR, Rogers SO, Zinner MJ *et al.* Patterns of communication breakdowns resulting in injury to surgical patients. *J Am Coll Surg* 2007; **204**: 533–540.
- Lingard L, Reznick R, Espin S, Regehr G, DeVito I. Team communications in the operating room: talk patterns, sites of tension, and implications for novices. *Acad Med* 2002; **77**: 232–237.
- Lingard L, Espin S, Whyte S, Regehr G, Baker GR, Reznick R *et al.* Communication failures in the operating room: an observational classification of recurrent types and effects. *Qual Saf Health Care* 2004; **13**: 330–334.
- Critical Appraisals Skills Programme. *Qualitative Research: Appraisal Tool. 10 Questions to Help You Make Sense of Qualitative Research*. Public Health Resource Unit: Oxford, 2006.
- Thomson Reuters. *EndNote® X5*; 2011. <http://endnote.com/> [accessed 21 September 2013]
- Noblit GW, Hare RD. *Meta-Ethnography: Synthesizing Qualitative Studies*. SAGE Publications: Newbury Park, 1988.
- Hindmarsh J, Pilnick A. The tacit order of teamwork: collaboration and embodied conduct in anesthesia. *The Sociological Quarterly* 2002; **43**: 139–164.
- Christian CK, Gustafson ML, Roth EM, Sheridan TB, Gandhi TK, Dwyer K *et al.* A prospective study of patient safety in the operating room. *Surgery* 2006; **139**: 159–173.
- Riley R, Manias E. Governing time in operating rooms. *J Clin Nurs* 2006; **15**: 546–553.
- Riley RG, Manias E. Governance in operating room nursing: nurses’ knowledge of individual surgeons. *Soc Sci Med* 2006; **62**: 1541–1551.
- Riley R, Manias E, Polglase A. Governing the surgical count through communication interactions: implications for patient safety. *Qual Saf Health Care* 2006; **15**: 369–374.
- Riley R, Forsyth R, Manias E, Iedema R. Whiteboards: mediating professional tensions in clinical practice. *Commun Med* 2007; **4**: 165–175.
- Sanchez Svensson M, Heath C, Luff P. Instrumental action: the timely exchange of implements during surgical operations. In *ECSCW 2007: Proceedings of the 10th European Conference on Computer-Supported Cooperative Work, Limerick, Ireland, 24–28 September 2007*, Bannon LJ, Wagner I,

- Gutwin C, Harper THR, Schmidt K (eds). Springer: London, 2007; 41–60.
- 24 Sevdalis N, Healey AN, Vincent CA. Distracting communications in the operating theatre. *J Eval Clin Pract* 2007; **13**: 390–394.
  - 25 Undre S, Sevdalis N, Healey AN, Darzi A, Vincent CA. Observational teamwork assessment for surgery (OTAS): refinement and application in urological surgery. *World J Surg* 2007; **31**: 1373–1381.
  - 26 Finn R. The language of teamwork: reproducing professional divisions in the operating theatre. *Human Relations* 2008; **61**: 103–130.
  - 27 Gardezi F, Lingard L, Espin S, Whyte S, Orser B, Baker GR. Silence, power and communication in the operating room. *J Adv Nurs* 2009; **65**: 1390–1399.
  - 28 Riley R, Manias E. Gatekeeping practices of nurses in operating rooms. *Soc Sci Med* 2009; **69**: 215–222.
  - 29 Zheng B, Swanström LL. Video analysis of anticipatory movements performed by surgeons during laparoscopic procedures. *Surg Endosc* 2009; **23**: 1494–1498.
  - 30 Zheng B, Taylor MD, Swanström LL. An observational study of surgery-related activities between nurses and surgeons during laparoscopic surgery. *Am J Surg* 2009; **197**: 497–502.
  - 31 Bahl R, Murphy DJ, Strachan B. Non-technical skills for obstetricians conducting forceps and vacuum deliveries: qualitative analysis by interviews and video recordings. *Eur J Obstet Gynecol Reprod Biol* 2010; **150**: 147–151.
  - 32 Collin K, Paloniemi S, Mecklin J-P. Promoting inter-professional teamwork and learning – the case of a surgical operating theatre. *Journal of Education and Work* 2010; **23**: 43–63.
  - 33 Finn R, Learmonth M, Reedy P. Some unintended effects of teamwork in healthcare. *Soc Sci Med* 2010; **70**: 1148–1154.
  - 34 Moore A, Butt D, Ellis-Clarke J, Cartmill J. Linguistic analysis of verbal and non-verbal communication in the operating room. *ANZ J Surg* 2010; **80**: 925–929.
  - 35 Bezemer J, Cope A, Kress G, Kneebone R. ‘Do you have another Johan?’ Negotiating meaning in the operating theatre. *Applied Linguistics Review* 2011; **2**: 313–334.
  - 36 Bezemer J, Murtagh G, Cope A, Kress G, Kneebone R. ‘Scissors, please’: the practical accomplishment of surgical work in the operating theater. *Symbolic Interaction* 2011; **34**: 398–414.
  - 37 Koschmann T, Zemel A. ‘So that’s the ureter.’ The informal logic of discovering work. *Ethnographic Studies* 2011; **12**: 31–46.
  - 38 Koschmann T, LeBaron C, Goodwin C, Feltovich P. ‘Can you see the cystic artery yet?’ A simple matter of trust. *Journal of Pragmatics* 2011; **43**: 521–541.
  - 39 Mondada L. [Coordinating actions in the operating theatre. The creation of a common space of vision, action and participation in the interaction.] *Etnografia e Ricerca Qualitativa* 2011; **4**: 9–38.
  - 40 Mondada L. Operating together through videoconference: members’ procedures for accomplishing a common space of action. In *Orders of Ordinary Action: REspecting Sociological Knowledge*, Hester A, Francis D (eds). Ashgate: Aldershot, 2011; 51–67.
  - 41 Schraagen JM. Dealing with unforeseen complexity in the OR: the role of heedful interrelating in medical teams. *Theoretical Issues in Ergonomics Science* 2011; **12**: 256–272.
  - 42 Koschmann T, LeBaron C, Goodwin C, Zemel A, Dunnington G. Formulating the Triangle of Doom: Le Geste dans son Contexte. *2nd Conference of the International Society for Gesture Studies (ISGS)*, Lyons, 2004.
  - 43 Timmons S, Tanner J. A disputed occupational boundary: operating theatre nurses and operating department practitioners. *Sociol Health Illn* 2004; **26**: 645–666.
  - 44 Hazlehurst B, McMullen CK, Gorman PN. Distributed cognition in the heart room: how situation awareness arises from coordinated communications during cardiac surgery. *J Biomed Inform* 2007; **40**: 539–551.
  - 45 Hindmarsh J, Pilnick A. Knowing bodies at work: embodiment and ephemeral teamwork in anaesthesia. *Organization Studies* 2007; **28**: 1395–1416.
  - 46 ElBardissi AW, Wiegmann DA, Henrickson S, Wadhwa R, Sundt TM III. Identifying methods to improve heart surgery: an operative approach and strategy for implementation on an organizational level. *Eur J Cardiothorac Surg* 2008; **34**: 1027–1033.
  - 47 Manser T, Howard SK, Gaba DM. Adaptive coordination in cardiac anaesthesia: a study of situational changes in coordination patterns using a new observation system. *Ergonomics* 2008; **51**: 1153–1178.
  - 48 Zheng B, Martinec DV, Cassera MA, Swanström LL. A quantitative study of disruption in the operating room during laparoscopic antireflux surgery. *Surg Endosc* 2008; **22**: 2171–2177.
  - 49 Undre S, Sevdalis N, McDermott J, Giddie J, Dinner L, Smith G. Interruptions, teamwork, and safety in the operating room: a prospective quantitative study in urological surgery. *Eur Urol Suppl* 2011; **10**: 60.
  - 50 Zemel A, Koschmann T, LeBaron C. Pursuing a response: prodding recognition and expertise within a surgical team. In *Embodied Interaction: Language and Body in the Material World*, Streeck J, Goodwin C, LeBaron C (eds). Cambridge University Press: Cambridge, 2011; 227–242.
  - 51 Svensson MS, Luff P, Heath C. Embedding instruction in practice: contingency and collaboration during surgical training. *Sociol Health Illn* 2009; **31**: 889–906.
  - 52 Belyansky I, Martin TR, Prabhu AS, Tsriline VB, Howley LD, Phillips R *et al*. Poor resident-attending intraoperative communication may compromise patient safety. *J Surg Res* 2011; **171**: 386–394.