Do Safety Checklists Improve Teamwork and Communication in the Operating Room?

A Systematic Review

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Objectives: The aim of this systematic review was to assess the impact of surgical safety checklists on the quality of teamwork and communication in the operating room (OR).

Background: Safety checklists have been shown to impact positively on patient morbidity and mortality following surgery, but it is unclear whether this clinical improvement is related to an improvement in OR teamwork and communication.

Methods: A systematic search strategy of MEDLINE, EMBASE, PsycINFO, Google Scholar, and the Cochrane Database for Systematic Reviews was undertaken to obtain relevant articles. After de-duplication and the addition of limits, 315 articles were screened for inclusion by 2 researchers and all articles meeting a set of prespecified inclusion criteria were retained. Information regarding the type of checklist, study design, assessment tools used, outcomes, and study limitations was extracted.

Results: Twenty articles formed the basis of this systematic review. All articles described an empirical study relating to a case-specific safety checklist for surgery as the primary intervention, with some measure of change/improvement in teamwork and/or communication relating to its use. The methods for assessing teamwork and communication varied greatly, including surveys, observations, interviews, and 360° assessments. The evidence suggests that safety checklists improve the perceived quality of OR teamwork and communication and reduce observable errors relating to poor team skills. This is likely to function through establishing an open platform for communication at the start of a procedure: encouraging the sharing of critical case-related information, promoting team coordination and decision making, flagging knowledge gaps, and enhancing team cohesion. However, the evidence would also suggest that when used suboptimally or when individuals have not bought in to the process, checklists may conversely have a negative impact on the function of the team.

Conclusions: Safety checklists are beneficial for OR teamwork and communication and this may be one mechanism through which patient outcomes are improved. Future research should aim to further elucidate the relationship between *how* safety checklists are used and team skills in the OR using more consistent methodological approaches and utilizing validated measures of teamwork such that best practice guidelines can be established.

Keywords: briefing, communication, operating room, operating theatre, safety checklist, surgery, teamwork

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Safety checklists have been routinely used in aviation and other high-risk industries that require complex human interaction to prevent accidents occurring as a result of human error since as far back as the 1930s.[1] Their introduction to surgery occurred much more recently, in the last decade, and was prompted by an increased awareness of the significant number of deaths that occur each year as a result of avoidable surgical error—which are estimated to be around half a million worldwide.[2,3] Safety checklists have now been produced for use in the operating room (OR) in a number of different iterations and have been mandated according to national policy in several countries.[4] A high-profile example is the World Health Organization's (WHO's) Surgical Safety Checklist, developed as part of their 2006 "Safe Surgery Saves Lives" campaign.[2,5]

The Surgical Safety Checklist and others like it comprise a set of core safety checks to be verbally performed by the OR team at specified times during a surgical procedure (eg, preincision). These checks are designed to minimize the risk of complication and death by reinforcing and standardizing accepted safety procedures (which can be overlooked by busy teams) and by creating redundancy in the system to allow for human error to be captured.[4,6,7] A growing surgical evidence base supports that safety checklists substantially improve adherence to appropriate clinical practices (eg, antibiotic administration, DVT prophylaxis), which in turn reduce avoidable morbidity and mortality.[8–15]

As well as improving adherence to clinical practices, safety checklists are designed to improve surgical safety by influencing wider aspects of performance in the OR, that is, fostering better interprofessional teamwork and communication. Breakdowns in multidisciplinary teamwork in the OR are reported as one of the most common contributory factors towards the occurrence of wrong site surgeries and other surgical adverse events.[16–21] By promoting direct verbal communication and interaction, checklists aim to open the lines of communication between OR team members, to ensure a common understanding or "shared mental model" of the patient, procedure, and risks, and to empower individuals to voice safety concerns who may not otherwise feel able to do so, thus increasing the probability of surgical error being captured or mitigated before it is too late. Furthermore, safety checklists act to familiarize team members with one another (and some of them, like the WHO Checklist, stipulate that team members introduce themselves before a case). Research has shown that sharing the names and roles of individuals in the OR is one of the most effective methods for promoting an individual's sense of participation and responsibility in the case, again increasing the probability that individuals will speak up if they anticipate or detect a problem. This is especially relevant given that team membership is often not consistent from 1 day to the next.[1,4,22,23]

The aim of this review was to systematically evaluate the available literature relating to the impact of surgical safety checklists on teamwork and communication in the OR. The objective was to establish whether there is robust evidence to suggest that the use of safety checklists improves these team skills.

METHODS

Databases searched included Embase (1980 to February 2012 week 7), MEDLINE (1946 to February 2012), and PsycINFO (1967 to February 2012). Additional searches were also carried out on Google Scholar and the Cochrane Database of Systematic Reviews. The last search was conducted on July 24, 2012. The following search terms were used:

- *Category A (Population)*: Surgery* OR surgical* OR operating theatre* OR operating room* OR obstetric* OR gyn(a)e*
- *Category B (Intervention)*: Checklist* OR check-list* OR briefing* OR world health organi*
- *Category C (Outcome)*: Teamwork* OR non-technical* OR nontechnical* OR notec* OR communication*

After combining all 3 search categories, the following additional limits were imposed: English language articles, articles between 1980 and present, and those involving human subjects only. Titles and abstracts of all articles retrieved from the initial search were reviewed by 2 of the authors (Russ: psychologist; Rout: surgeon) to select those that were relevant to the aims of the review. All selected articles were subjected to full-text review by the same 2 authors, and those that satisfied the inclusion criteria were retained (Fig. 1).

To triangulate the search strategy, all reference lists of retained articles were checked for additional papers that may have been missed by the initial search. The studies varied widely in terms of study design and methodology which prevented data pooling and meta-analysis. Therefore, a qualitative synthesis and critical evaluation of the evidence was carried out.

RESULTS

Selected Articles

A flow diagram of the search strategy is presented in Figure 2. The initial search generated a total of 639 citations, of which 324 articles were excluded after the additional search limits were applied. Forty-four articles were selected for full-text review after evaluating all titles and abstracts. Of these, 27 articles were excluded because they did not meet the inclusion criteria. Three additional relevant articles were identified from a reference search of the selected articles, resulting in a total of 20 articles for inclusion in the current review.

1. Original empirical studies only: review articles, commentaries, editorials, conference abstracts, and articles presenting data previously reported elsewhere were excluded.
2. Surgical checklists only: checklists developed for use in other settings (e.g. intensive care units, medical wards) were excluded.
3. Safety checklists applied to individual cases only: articles reporting checklists unrelated to safety or team 'briefings' without patient-specific checklists were excluded.
4. Included studies should describe the impact of the checklist on measures of teamwork and/or communication in the OR i.e. some measure of change/improvement in these skills has been undertaken.
5. The checklist was the primary intervention and not part of a safety bundle such as a team training program.

FIGURE 1. Inclusion criteria.

Study Characteristics

Table 1 presents an overview of the characteristics of the 20 articles reviewed (ie, type of checklist used, communication/teamwork measure(s), study methodology, study site, surgical specialty). Studies spanned across 12 different countries in total, including both developed and developing countries-–1 article[38] presented a global study spanning 8 different countries. Nine of the studies focused on a single surgical specialty, all others assessed the impact of the checklist across multiple specialties. The following surgical specialties were listed: general, cardiothoracic, vascular orthopedic, trauma, ear-nose-throat (ENT), and obstetrics. One study was conducted in a simulated OR[28]; all others report data collected in relation to the use of the checklist in real OR procedures. Fourteen of the studies undertook a pre-/postintervention design, allowing for teamwork/communication postchecklist to be compared to baseline performance without a checklist.[24,26–29,31,33,34,38–43] One randomized controlled trial (RCT) was included.[37] The remaining studies assessed the impact of the checklist on performance retrospectively.[25,30,32,35,36]

Type of Checklist

Seven of the 20 articles reported on the use of the WHO's Surgical Safety Checklist or a specialty-specific modification of it.[35,38–43] The WHO Surgical Safety Checklist is designed such that safety checks are carried out at 3 operative phases: "Sign-in" (before anesthesia induction), "Time-out" (before incision), and "Sign-out" (following the procedure before team members leave the OR). Checks at "Sign-in" are completed between the anesthetic staff (at a minimum) and the patient and include confirmation of ID, consent, procedure, allergies, expected blood loss, and checking of the anesthetic equipment. The entire OR team is present for "Time-out" for team introductions and a final check of patient ID/procedure, surgical issues (expected blood loss, special equipment, potential risks), anesthetic issues (patient history, ASA grade, and monitoring equipment check), nursing issues (sterility of instruments, equipment problems), antibiotics, DVT prophylaxis, essential imaging, patient warming, hair removal, and glycemic control. Finally, at "Sign-out" the entire team confirms the name of the procedure, specimens, final counts, equipment problems, and concerns for recovery.

The remaining 13 articles[24–34,36,37] reported on safety checklists that had been either undertaken in accordance with national recommendations (eg, that of the Joint Commission on Accreditation of Healthcare Organizations, which produced guidelines for a "time-out" prior to incision for all surgical procedures, named the "Universal Protocol"),[23,26,27,31] or developed locally in response to a perceived need for improvement in surgical safety. Locally developed tools were either designed from scratch or based around an existing tool already developed to aid communication/teamwork in the OR by the authors or their collaborators. The precise development process varied but all checklists were developed by multidisciplinary groups and based on prior research, literature reviews, and/or expert opinion, and had engagement from OR members in prototype content, refinement, and piloting. They all contained very similar items to that of the WHO checklist. Nine of these 13 articles described checklists that consisted of preoperative ("Time-out" equivalent) safety checks only[24–27,29–37,40,42] 2 consisted of pre- and postoperative checks,[32,36] and 2 consisted of pre-, intra-, and postoperative checks.[28,37] Like the WHO checklist, 4 of these articles presented checklists that separated items according to the OR subteam responsible for carrying out the checks (ie, surgical team, anesthetic team, nursing team)[24,33,34,37] and team introductions formed part of the safety checks in 6 of the articles.[24,26,27,31,36,37] Furthermore, in all 13 instances, the entire OR

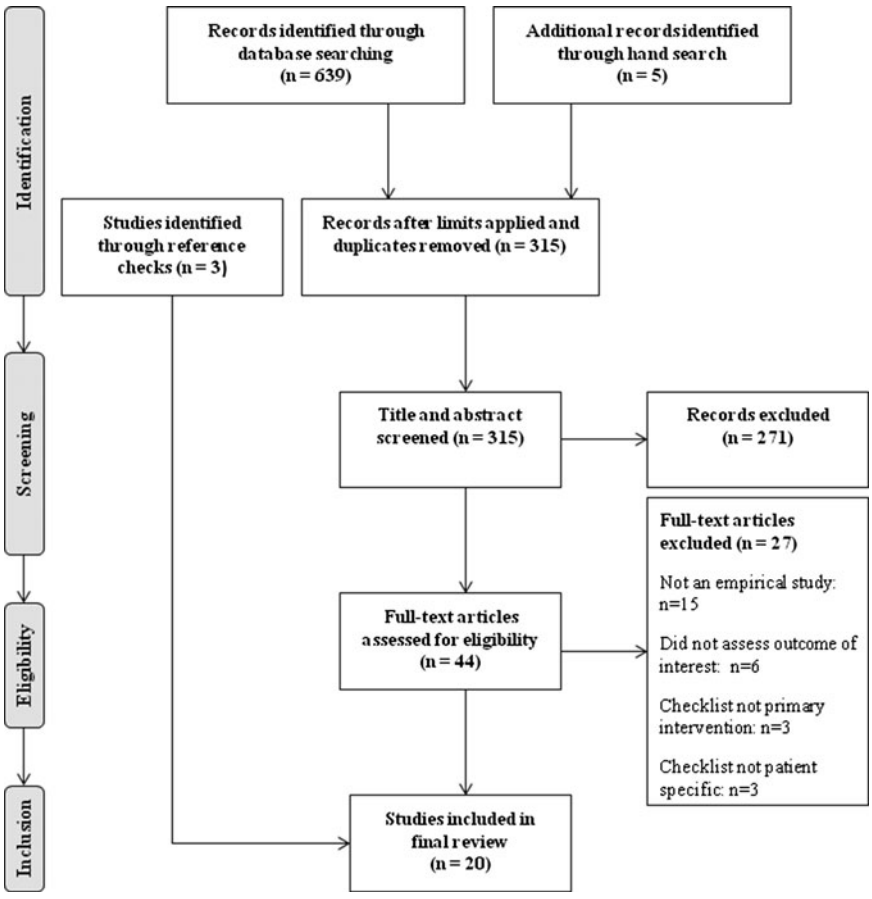

FIGURE 2. PRISMA flow diagram: Search strategy.

team (or at least one senior member of each OR subteam) was required to be present when the checks were carried out.

A paper checklist was used to prompt discussions in all 20 of the articles selected. In one article, the checklist was also presented in poster format on the OR wall.[34]

Teamwork/Communication Measures

Teamwork and communication measures varied greatly across the reviewed articles (Table 2). Broadly, 1 (or a combination) of 3 different methodological approaches was undertaken to assess the impact of the checklist on teamwork/communication: self-report, observations, or 360° ratings. Self-report was utilized in 15 of the 20 reviewed articles using questionnaires in 13 studies[24,26–28,32,35,37–43] and interviews in 2 studies[25,36] to capture OR professionals' perceptions of teamwork/communication. The number of respondents ranged from 11 (Lingard et al[25]) to 1748 per study.[42] Typically, all disciplines within the OR were represented in the sample. Seven articles used observational methods to capture the quality of teamwork/communication across the OR team.[25,28–30,33,34,37] Observations were carried out by trained observers either in real-time or from videos, and the total number of observations conducted ranged from 16 (Henrickson et al[33]) to 232.[34] One article used 360° ratings of self and peers' teamwork.[31] Finally, 3 studies mixed self-report and observational approaches to assess checklist impact.[25,28,37] Of note, whereas the observational and 360° measures largely had validation evidence, self-report measures were variable in this respect, with only 4 of the 13 retrieved assessment instruments having some supportive psychometric evidence.

Impact of Checklist on Teamwork and Communication

Table 3 presents a detailed summary of data relating to the impact of safety checklists on teamwork and communication in the OR and the study limitations for all articles reviewed. The impact of the checklist on teamwork/communication has been summarized below according to the methodological approach undertaken.

Self-reported Teamwork/Communication

Of the 13 articles that utilized surveys, 10 reported a positive impact of the checklist on teamwork, including strengthened "team feeling" in the OR,[35] improved communication (relating to both preoperative and postoperative checks), for example, increased discussion of critical events,[24,32,40–42] better familiarity and knowledge of team members' names,[39–41,43] improved decision making,[26] better interprofessional coordination and assignment of tasks,[43] and fewer delays caused by miscommunications.[27]

The remaining 3 articles reported mixed results. One study found no pre-/postimprovement in scores on the teamwork climate of the SAQ; however, 85% of OR staff agreed that the checklist had improved OR communication when asked after checklist implementation.[38] Koutantji et al[28] found a pre-/postimprovement in 2 of their 4 survey items relating to the impact of the checklist on teamwork/communication; these 2 items referred to the impact of preoperative checks on teamwork, no difference was found on the items relating to postoperative checks. Finally, in an RCT, no difference in self-reported situational awareness was found between the control (no checklist) group and the intervention (checklist) group,

TABLE 1. Study Characteristics

Authors	Year	Type of Checklist	Outcome Assessed*	Study Methodology†	Country	Setting	Surgical Specialty
DeFontes and Surbida[24]	2004	Patient-specific preoperative briefing checklist	Teamwork climate	Survey—Pre/post (6 months before checklist implementation and 6 months after).	USA, Orange County	1 medical center at an integrated managed care consortium	Multispecialty
Lingard et al[25]	2005	Patient-specific checklist designed to prompt preoperative discussion	Team building and exchange of information	Interviews and observations (real ORs)—Post (Checklist implementation took place over 7 weeks during which observations were conducted)	Canada	1 quaternary academic center	Vascular surgery
Makary et al[26]	2007	Patient-specific preoperative briefing checklist	Team coordination and quality of decision making	Surveys—pre/post (Pre–data collection lasted 5 months, checklist was implemented for 3 months, post–data collection lasted 2 months)	USA	1 tertiary academic center	General surgery, plastic surgery, neurosurgery
Nundy et al (same group as above)[27]	2008	Patient-specific preoperative briefing checklist	Communication breakdowns resulting in delays in starting surgical procedures	Surveys—Pre/post (pre–data collection lasted 2 months, checklist was implemented for 3 months, post–data collection lasted 2 months)	USA	1 tertiary academic center	General surgery, plastic surgery, neurosurgery
Koutantji et al[28]	2008	Patient-specific safety checklist with pre, intra- and postoperative components	Quality of teamwork (decision making, communication, leadership, and overall teamwork) and perceived impact of checklist on teamwork and communication	Surveys and observations (in simulated OR)—pre/post (Simulation session lasted 4–5 h in total. One scenario was completed without the checklist at the start of the session, another was completed with the checklist at the end of the session)	UK, London	1 large university hospital	Simulations of general and vascular surgery procedures
Lingard et al[29]	2008	Patient-specific checklist designed to prompt preoperative discussion	Communication failures and perceived impact of checklist on proactive team communication	Observations (real ORs)—pre/post (Pre–data collection lasted 5 months, the checklist was then implemented over 3 months, post–data collection then commenced over 5 months. The study lasted 13 months in total.)	Canada	1 tertiary academic center	General surgery
Whyte et al (same group as above)[30]	2008	Patient-specific checklist designed to prompt preoperative discussion	Negative teamwork events specifically linked to checklist usage	Observation (real ORs)—Post (Checklist implementation took place over 7 weeks during which observations were conducted.)	Canada	1 tertiary academic center	General surgery

(*continued*)

TABLE 1. (*Continued*)

Authors	Year	Type of Checklist	Outcome Assessed*	Study Methodology†	Country	Setting	Surgical Specialty
Paige et al[31]	2008	Patient-specific preoperative briefing checklist	Quality of teamwork (eg, team orientation, accountability, communication)	360° ratings of self and peers (real ORs)—pre/post (The study lasted 7 months in total. No additional information regarding timings provided.)	USA, Alaska	1 rural community hospital	General surgery
Berenholtz[32]	2009	1-page, patient-specific, preoperative briefing and postoperative de-briefing checklist	Interdisciplinary communication and teamwork	Surveys—post (Data collection commenced 15 months after checklist implementation)	USA, Baltimore	1 tertiary academic center	Multispecialty
Henrickson et al[33]	2009	Patient-specific preoperative briefing checklist	Surgical flow disruptions related to miscommunication	Observations (real ORs)—pre/post (Postobservations were carried out 7 days after briefing implementation)	USA	1 tertiary academic center	Cardiovascular
Einav et al[34]	2010	Patient-specific preoperative briefing checklist (presented in poster format in all ORs)	Near-misses associated with problematic teamwork	Observations (real ORs)—pre/post (preobservations lasted 3 months, postobservations in gynecology took place 5 months later and lasted 3 months, observations in orthopedics took place 10 months later and lasted 3 months)	Israel, Jerusalem	1 tertiary care hospital	Gynecology and orthopedics
Nilsson et al[35]	2010	WHO Surgical Safety Checklist	"Team feeling" in the OR	Surveys—post (Data collection lasted for 3 weeks 1 yr after the checklist had been implemented)	Sweden, Ostergotland	2 Swedish hospitals	Multispecialty
Papaspyros et al[36]	2010	Patient-specific preoperative briefing and postoperative de-briefing checklist	Quality of communication	Interviews—Post (No information was provided regarding timings)	UK, Leeds	1 university hospital	Cardiac surgery
Calland et al[37]	2011	Patient-specific safety checklist with pre-, intra-, and postoperative components	Team coordination and communication.	Surveys and observations (from video recordings of real ORs)—RCT (The study lasted 15 months in total.)	USA, Virginia	1 university hospital	General surgery—laparoscopic cholecystectomy procedures only

(*continued*)

TABLE 1. (*Continued*)

Authors	Year	Type of Checklist	Outcome Assessed*	Study Methodology†	Country	Setting	Surgical Specialty
Haynes et al[38]	2011	WHO Surgical Safety Checklist	Teamwork climate	Survey—pre/post (Pre- and post–data collection lasted for 2 weeks. Checklist implementation lasted between 1 week and 1 month. The study ran for 1 yr in total.)	Jordan, India, Tanzania, Philippines, the United Kingdom, the United States, New Zealand, Canada	6 public hospitals, 1 district rural hospital, 1 charity hospital	Multispecialty excluding cardiac surgery
Helmio et al[39]	2011	WHO Surgical Safety Checklist	Communication between OR team members, discussion of critical events, and awareness of OR team members' names	Surveys—pre/post (Pre–data collection lasted for 1 month and commenced 4 months before the checklist was introduced, post–data collection lasted for 1 month as soon as the checklist was introduced)	Finland, Helsinki	1 university hospital	Otorhinolaryngology
Takala et al (same group as above)[40]	2011	WHO Surgical Safety Checklist	Quality of communication in the OR	Surveys—pre/post (Pre–data collection lasted 4–6 weeks, checklist was then implemented over 4 weeks, post–data collection then commenced and lasted 4–6 weeks)	Finland	4 university hospitals	Multispecialty
Kearns et al[41]	2011	Modified WHO Surgical Safety Checklist	Quality of OR communication and familiarity with team members	Surveys—pre/post (Pre–data collection lasted 1 month, post–data collection commenced 3 months after the checklist was implemented.)	UK	1 obstetric tertiary referral center	Obstetrics
Sewell et al[42]	2011	WHO Surgical Safety Checklist	Communication and teamwork	Surveys—pre/post (Pre–data collection lasted 4 months, checklist was then implemented over 1 month, postchecklist data collection then commenced and lasted 4 months)	UK, London	1 university hospital	Trauma and orthopedics
Bohmer et al[43]	2012	Modified WHO Surgical Safety Checklist	Interprofessional coordination, team communication, and familiarity with other staff members	Surveys—pre/post (Post–data collection took place 3 months after checklist implementation. No information regarding timing of pre–data collection provided)	Germany, Cologne	1 university hospital	Anesthesiology and trauma care

*For outcome assessed, the terminology of the original study has been used where possible (ie, wherever a consistent descriptor of the outcome variable was provided).
†Study methodology includes the timing of the introduction/implementation of the checklist—as this could have contributed to the impact on the outcome measures.
OR indicates operating room; WHO, Word Health Organization.

TABLE 2. Summary of Teamwork/Communication Measures

Assessment Instrument	Studies Utilizing the Instrument	Instrument Description	Validity/ Reliability Evidence Available?
Self-report instruments			
Safety Attitudes Questionnaire (SAQ)-Teamwork climate subscale	[24,38]	Self-report instrument for measuring attitudes and perceptions in safety-related domains in health care. Has several subscales (including a teamwork climate) and available in different formats (including one specific to the operating room environment). Teamwork climate consists of 14 items relating to the quality of teamwork in the department of interest, all rated on a 5-point Likert scale.	Yes[44]
OR Briefing Assessment Tool	[26,27]	A 17-item case-based version of the SAQ with 4 items relating to teamwork/ communication listed in the manuscripts (full questionnaire not provided). Items rated on a 5-point Likert scale. (*Team discussions are common in the ORs. Decision making used input from relevant personnel. Surgery anesthesia worked together as a well-coordinated team. Communication breakdowns that lead to delays in starting surgical procedures are common.)*	Yes[26]
Briefing Attitudes Questionnaire Short Version	[28]	A questionnaire for assessing staffs' views of briefing using a checklist. 14 items provided in the manuscript of which 4 were related to teamwork/communication (*To what extent do you think briefings can enhance teamwork in the operating theatre (OT)? To what extent do you think briefings can enhance communication of team members working in the OT? To what extent do you think debriefings can enhance teamwork in the OT? To what extent do you think debriefings can enhance communication of team members working in the OT?)* Scoring system not described.	No
Study-specific questionnaire	[32]	A questionnaire with both structured and free-text responses relating to the effect of the checklist on interdisciplinary communication and teamwork and the burden and average time taken to complete the tool. The authors provide the full questionnaire in the Appendix. 2 teamwork/communication-related items rated on a 5-point Likert scale (*Briefing is an effective strategy to improve interdisciplinary communication. Debriefing is an effective strategy to improve interdisciplinary communication.)*	No
Study-specific questionnaire	[35]	An 8-item questionnaire with answers provided either on a 4-point Likert scale or in binary format. The authors provide the full questionnaire in the Appendix. One item related to teamwork/communication (*Timeout strengthens the team feeling in the operating theatre. YES/NO*)	No
Study-specific questionnaire	[37]	A 24-item postcase questionnaire captured team members' subjective measures on a 5-point Likert scale. Full scale not provided but 3 items relating to teamwork/ communication were referred to in the manuscript: satisfaction with team efficiency, satisfaction with team communication, and situational awareness of team events.	No
Study-specific questionnaire	[38]	A 6-item questionnaire designed to measure the impact of the checklist. All items provided in the manuscript. One teamwork/communication related item (*Communication was improved through the use of the checklist*), answered on a 5-point Likert scale.	No
Study-specific questionnaire	[39,40]	A multiple-choice (yes, no, I don't know, not relevant) questionnaire relating to performance of safety checks and communication. The authors provide the full questionnaire in the Appendix. Three teamwork/communication related items were included (*Were critical events discussed between anesthesiologist and surgeon? Was communication successful between the team member? Was everybody aware of the name and role of each team member?*)	Yes[40]
Study-specific questionnaire	[41]	No details of the questionnaire provided. Two teamwork/communication related items were listed in the "Results" section (*I felt familiar with others in theatre, I felt communication in theatre had improved*).	No
Study-specific questionnaire	[42]	A 4-item questionnaire designed for evaluating the impact of the checklist. All items were provided in the manuscript and answered yes, not sure, or no. One item related to teamwork/communication (*The checklist improved team communication and teamwork*).	No
Study-specific questionnaire	[43]	A 19-item questionnaire using a 5-point Likert scale response system-full questionnaire provided in the manuscript. Questions covered safety-relevant aspects of the perioperative period, work process, and interprofessional cooperation. Multiple items related to communication/teamwork (eg, *I know all co-workers in the OR team, I believe the teamwork in the OR is excellent*).	No
Study-specific interviews	[25]	Interview participants were asked to describe the benefits and drawbacks of the checklist. Interviews were informal—no description of the interview schedule/approach was provided. Interviews were analyzed using a grounded theory approach to pick out emergent themes regarding how the checklist complemented/conflicted existing processes, how it was received by team members, and what effects the discussion had.	Yes[25]
Study-specific interviews	[36]	No description of interview schedule/approach provided. Interviewees were asked for their opinion of the checklist. Interviews were then subjected to a simple qualitative analysis that counted the adjectives used and how many related to communication.	No

(*continued*)

TABLE 2. (*Continued*)

Assessment Instrument	Studies Utilizing the Instrument	Instrument Description	Validity/ Reliability Evidence Available?
Observational instruments			
A theory-based instrument to evaluate team communication in the operating room	29	A checklist-type tool to capture the frequency and nature of communication failures in the OR, and any immediate consequences of these failures. Failures were categorized as content, occasion, purpose, or audience related, and were complemented by contextually relevant observation notes. Used by trained observers in real-time.	Yes[45]
Ethnographic field notes	25,30	Trained/experienced observers documented the content and process of team briefings. Procedurally relevant communication before and after the checklist discussion was documented. An emergent theme analysis was used to analyze the ethnographic field notes. In one study,[30] field notes were reviewed/analyzed to specifically identify "negative events" relating to the use of the checklist. Negative events were classified according to 5 themes: masking knowledge gaps, disrupting positive communication, reinforcing professional divisions, creating tension, and perpetuating problematic culture.	Yes[30]
The NOn-TECHnical Skills (NOTECHS) scale	28	Items assessing 5 teamwork dimensions (range of scores 1–6): communication and interaction (4 items); vigilance/situational awareness (3 items); team skills (4 items); leadership and management skills (5 items); decision-making crisis (5 items). Used by trained observers to rate behavior in simulated scenarios in real-time.	Yes[46]
Study-specific observations	33	One trained observer conducted real-time observations of surgical procedures in real and rated all disruptions in surgical flow according to 1 of 4 causal categories: patient-related, equipment or resource related, procedural knowledge issues, or miscommunication events. Miscommunication events included verbal commands failing to be conveyed, being conveyed incorrectly, or being incorrectly interpreted.	Yes[33]
Study-specific observation notes	34	One of 4 trained observers noted all activities, verbal exchanges, the use of equipment, and the times at which they occurred. Observation notes were retrospectively analyzed to pick out and classify nonroutine events into 1 of 7 categories. One category related to teamwork/communication (problems with teamwork).	Yes[34]
Study-specific observations	37	Evaluation of team communication and coordination from video recordings of surgical procedures by nonblinded assessors using a 3-point scale (not done, partially completed, completed successfully) for 5 different elements: role introductions, case presentations, roles and responsibilities review, contingency planning, and equipment check.	No
360° rating instruments			
360° OR Teamwork Assessment Scale	31	13 teamwork-related items (eg, leadership, mutual trust, backup behavior, situational awareness) rated on 6-point Likert scales following a procedure—individuals rate themselves first and then each of their OR colleagues.	Yes[31]

OR indicates operating room.

and perceptions of team efficiency and communication were actually poorer in the intervention group. However, observed team performance was rated higher in the intervention group (reported later).[37]

Three articles reported interdisciplinary differences regarding the impact of the checklist. Two studies found that anesthesiologists and nurses, but not surgeons, reported improved communication after checklist implementation.[39,40] Similarly, another study reported that nonmedical staff were more likely to perceive an improvement in communication than medical staff.[41] Finally, Helmio and colleagues[39] found that surgeons and anesthesiologists, but not nurses, reported increased knowledge of OR team members' names.

The 2 interview studies supported a positive impact of safety checklists on communication in the OR, with quotes relating to improved familiarity with team members, better understanding of fellow team members' concerns, feeling better valued as a team member, and being more willing to "speak up" about safety concerns.[25,36]

Observed Teamwork/Communication

Of the 7 articles that undertook an observational methodology, 5 reported a positive impact of the safety checklist on teamwork/communication. In 1 study, Lingard and colleagues[25] highlighted 6 positive functions of the checklist from their ethnographic field notes, 4 of which were related to team skills. These were promoting provision of case-related information (allowing more efficient and proactive planning by the team), encouraging articulation of concern, supporting interdisciplinary decision making, and enhancing team building/camaraderie.[25] In another study, the same group reported a significant reduction in OR communication failures after checklist implementation (dropping from an average of 3.95 to 1.31 failures per case), particularly for those failures with visible adverse consequences.[29] These results were mirrored by Henrickson and colleagues,[33] who reported significantly fewer miscommunication events after checklist implementation (dropping from 2.5 to 1.17 per case). Another article reported fewer nonroutine events (or near misses) associated with poor teamwork when the checklist was used.[34] Finally, in their RCT, Calland and colleagues[37] found that the quality of team communication and coordination was rated as higher in the intervention (checklist) versus the control (no checklist) group.

One simulation study reported mixed results. Whereas surgeons' decision making was rated significantly better by experts after checklist implementation, anesthesiologists' decision making was rated significantly worse. Furthermore, checklist implementation had no impact on the observed quality of communication, leadership, or overall teamwork.[28]

A single study highlighted negative impacts that safety checklists may pose on teamwork (while acknowledging that positive

TABLE 3. Impact of Safety Checklists on Teamwork and Communication in the Operating Room

Authors	Type of Checklist	Outcome and Tool	Design and Sample	Findings	Limitations*
DeFontes and Surbida[24]	Patient-specific preoperative briefing checklist	Outcome: Perceived teamwork climate Tool: SAQ—teamwork climate	Pre/postsurvey study 119 OR staff and 60 surgeons responded in total	% agreement that teamwork climate and communication were good substantially increased after initiation of briefings.	*Statistical significance of results not reported.*
Lingard et al[25]	Patient-specific checklist designed to prompt preoperative discussion	Outcome: Team building and exchange of information Tool: Interviews and ethnographic field notes from observations	Qualitative observational study Ethnographic field notes during 18 observations of real-time checklist usage post introduction Interviews after introduction of checklist 11 interviewees 3 surgeons, 1 surgical fellow, 3 nurses, 1 anesthesiology resident	Team building and camaraderie were identified as one of the functions of the checklist in interviews and observations. Increased team cohesion was noted as an outcome by surgeons.	Researchers both observed and participated in checklist intervention—creates potential bias *No control (lack of prechecklist assessments)*
Makary et al[26]	Patient-specific preoperative briefing checklist (OR Briefing 5)	Outcome: Perceived coordination of care and quality of decision making Tool: 3 "team"-related items on ORBAT: a case-based version of the SAQ	Pre/postsurvey study Pre = 306 respondents Post = 116 respondents Surgical attending physicians, surgical residents, anesthesia attending physicians, anesthesia residents, scrub nurses, circulating nurses, medical students, nurse assistants.	Agreement that surgery and anesthesia worked together as a well-coordinated team that team discussion were common in the OR and that decision making utilized input from relevant personnel increased significantly postimplementation of the checklist.	Unsure of generalizability of results to other centers *Only 2 questionnaire items related to impact of checklist on teamwork*
Nundy et al (same group as above)[27]	Patient-specific preoperative briefing checklist	Outcome: Perceived communication breakdowns resulting in delays in starting surgical procedures Tool: 1 "Team"-based item on ORBAT: a case-based version of the SAQ	Same as above	Agreement that communication problems had resulted in a delay to starting a surgical procedure significantly reduced after checklist implementation (from 80% to 65%).	Surgeons self-selected to participate—unsure of generalizability of results *Only 1 questionnaire item related to impact of checklist on teamwork*
Koutantji et al[28]	Patient-specific safety checklist with pre-, intra-, and postoperative components	Outcome: Observed quality of teamwork (decision making, communication, leadership, and overall teamwork) and perceived impact of checklist on teamwork and communication Tool: A modified version of the nontechnical Skills Human Factors Rating Scales (HFRS-M)—based on experts' observations. Briefing attitudes questionnaire—4 items relating to teamwork/	Pre/postmixed design in simulated OR environment Pre = 9 full OR teams conducted one simulated crisis scenario Post = same 9 full OR teams conducted different (but matched) simulated crisis scenario Surgeon, surgical assistant, scrub nurse, circulating nurse, anesthesiologist, anesthetic nurse/assistant	There was a significant improvement in scores for the 2 items on the briefing attitudes questionnaire that related to the impact of preoperative checks (briefings). No difference was found for the items relating to postoperative checks (de-briefings) Surgeons' decision making was rated significantly better by experts after checklist implementation, but anesthesiologists' decision making was significantly worse after the checklist implementation.	Small sample size Observers were not blinded to the use of the checklist *Evaluation of briefing based on its use in just 1 simulated scenario* *No validity/reliability data available for questionnaire*

(*continued*)

TABLE 3. (*Continued*)

Authors	Type of Checklist	Outcome and Tool	Design and Sample	Findings	Limitations*
		communication; 2 of which referred to preoperative checks (briefings), 2 referred to postoperative checks (de-briefings).		Checklist implementation had no impact on experts' ratings of communication, leadership, or overall teamwork	
Lingard et al[29]	Patient-specific checklist designed to prompt preoperative discussion	Outcome: Observed communication failures and perceived impact of checklist on team Tool: Real-time OR observations by experts rating communication failures using a validated tool	Pre/postobservational study Pre = 86 observations Post = 86 observations	The mean number of communication failures per procedure declined from 3.95 to 1.31 after the intervention—a statistically significant reduction The number of communication failures with at least 1 visible consequence declined from 207 pre to 75 post Increase in proactive and collaborative team communication	Cannot isolate the active component of the checklist
Whyte et al (same group as above)[30]	Patient-specific checklist designed to prompt preoperative discussion	Outcome: Observed negative teamwork events specifically linked to Checklist usage Tool: Ethnographic field notes from observations	Qualitative observational study Ethnographic field notes in 302 cases after checklist implementation	In 45 of the 302 briefings observed, the entire briefing was unconstructive. 5 types of negative team events relating to the checklist/briefings were recorded: masking knowledge gaps, disrupting positive communication, reinforcing professional divisions, creating tension, and perpetuating a problematic culture.	*This study only focuses on the negative effects of the checklist; however, it acknowledges that overall the checklist had a positive impact.* *No control (lack of prechecklist assessments)*
Paige et al[31]	Patient-specific preoperative briefing checklist	Outcome: Perceived quality of teamwork (eg, team orientation, accountability, communication) Tool: ORTAS (OR Teamwork Assessment Scale). 360° ratings of self and peers on 13 teamwork dimensions on 6-point scale.	Pre/postdesign Pre = 20 cases Post = 16 cases 17 OT team members participated in total	Peer-assessed scores of teamwork significantly increased after introduction of the checklist but self-assessed teamwork scores did not.	Completing the 360° assessment may have been educative in itself and led to improved teamwork scores. No improvement in self-assessed teamwork. Limited number of participants
Berenholtz et al[32]	A 1-page, patient-specific, preoperative briefing and postoperative de-briefing checklist	Outcome: Perceived interdisciplinary communication and teamwork	Surveys 1 yr after checklist implementation 40 respondents 10 surgeons, 10 anesthesiologists, 10 nurse anesthetists, and 10 circulating nurses	90% of respondents agreed that briefing is an effective strategy to improve interdisciplinary communication and teamwork 69% agreed that de-briefing was an effective strategy to improve interdisciplinary communication, whereas 72% agreed that de-briefings improve teamwork.	Survey was not validated. Survey sample was limited (N = 40) Results need to be generalized to other institutions. *No control (lack of prechecklist assessments)* *Only 2 questionnaire items related to impact of checklist on teamwork*

(*continued*)

TABLE 3. (*Continued*)

Authors	Type of Checklist	Outcome and Tool	Design and Sample	Findings	Limitations*
Henrickson et al[33]	Patient-specific preoperative briefing checklist	Outcome: Observed surgical flow disruptions related to miscommunication Tool: Real-time OR observations	Pre/postobservational study Pre = 10 observations Post = 6 observations	After implementation of briefings there were significantly (53%) fewer miscommunication events per case (1.17 post vs 2.5 pre)	Small sample size The observer was a medical student with limited clinical experience. Observer was not blinded to whether the teams had been briefed or not
Einav et al[34]	Patient-specific preoperative briefing checklist (presented in poster format in all ORs)	Outcome: Observed near-misses associated with problematic teamwork Tool: Real-time OR observations of nonroutine events associated with problems in teamwork	Pre/postobservational study Pre = 130 observations Post = 102 observations	A significant reduction in the mean number of nonroutine events associated with poor teamwork after implementation of the checklist.	
Nilsson et al[35]	WHO Surgical Safety Checklist	Outcome: Perceived "team feeling" in the OR Tool: 1 "Team"-related item on study-specific questionnaire	Surveys 1 yr after checklist implementation 331 respondents 147 surgeons, 30 anesthesiologists, 63 anesthetic nurses, 44 OR nurses, and 47 nurse assistants	65% agreed that the "Time-out" strengthens the team feeling in the OR	Lack of "pre" intervention questionnaire—no control *No mention of origin of questionnaire items and no validity/reliability data available* *Only 1 questionnaire item related to impact of checklist on teamwork*
Papaspyros et al[36]	Patient-specific preoperative briefing and postoperative de-briefing checklist	Outcome: Perceived quality of communication Tool: Interviews	Qualitative interview study postintroduction of briefings/checklist 15 interviewees Anesthesiologists, perfusionists, scrub nurses, and technicians	The checklist/briefings were perceived to have improved communication in the OR	Small sample size No control (lack of prechecklist assessments) Qualitative analysis of attitudes only—no significance testing *No validity/reliability data available for interview approach*
Calland et al[37]	Patient-specific safety checklist with pre-, intra-, and postoperative components	Outcome: Observed team coordination and communication. Perceived team communication and situational awareness. Tool: Observations of team coordination and communication by experts using the RATE tool from video recordings. Multiple items on study-specific questionnaire	RCT—control group and checklist/intervention group. Observations conducted retrospectively. Surveys conducted postprocedure Control group = no checklist—23 cases observed, 142 survey respondents Intervention group = checklist—24 cases observed, 139 survey respondents	Observations: Favorable team communication and coordination behaviors were rated higher in the intervention group. Surveys: Perceptions of team efficiency and communication were poorer in the intervention group. Perceptions of situational awareness did not significantly differ between groups.	Some residents and other staff may have contributed in both intervention and control cases—possible contamination of results (the attending surgeon was the only team member who was clearly assigned to either control or intervention group). The checklist was not always performed as intended *No mention of origin of questionnaire item and no psychometric data presented* *Researchers who scored video observations were not blinded to experimental group* *Only 1 questionnaire item related to impact of checklist on team communication*

(*continued*)

TABLE 3. (*Continued*)

Authors	Type of Checklist	Outcome and Tool	Design and Sample	Findings	Limitations*
Haynes et al[38]	WHO Surgical Safety Checklist	Outcome: Perceived teamwork climate Tool: Shortened version of the Safety Attitudes Questionnaire (SAQ) + study specific questionnaire—in total 2 "team"-related items	Pre/postsurvey study. (SAQ administered pre and post, study-specific questionnaire administered post only) Pre: 281 respondents Post: 257 respondents All clinical disciplines participated (surgeons, nurses, and anesthesiologists)	No significant difference between pre/postscores for SAQ item relating to teamwork in the OR ("The physicians and nurses here work together as a well-coordinated team"). Majority (84.8%) agreed checklist improved OR communication on study-specific questionnaire.	Did not track survey response rate so unsure if data representative Sites volunteered so results may not be generalizable Potential bias in survey responses because clinicians aware of project. *Only 2 questionnaire items related to impact of checklist on teamwork* *No validity/reliability data available for questionnaire*
Helmio et al[39]	WHO Surgical Safety Checklist	Outcome: Perceived communication between OR team members, discussion of critical events, and awareness of OR team members' names Tool: 3 "team"-related items on a study-specific questionnaire	Pre/postsurvey study Pre = 288 respondents Post = 412 respondents All OR staff	Surgeons and anesthesiologists were significantly more likely to report that they knew OR team members' names and that critical events had been discussed after checklist implementation. Anesthesiologists and nurses were significantly more likely to agree that there was successful communication after checklist implementation.	*Only 2 questionnaire items related to impact of checklist on teamwork*
Takala et al (same group as above)[40]	WHO Surgical Safety Checklist	Outcome: Perceived communication between OR team members, and awareness of OR team members' names Tool: 3 "team" items on a study-specific questionnaire	Pre/postsurvey study Pre = 901 respondents Post = 847 respondents Circulating nurses, anesthesiologists, and surgeons	Circulating nurses and anesthesiologists (but not surgeons) reported significantly improved communication after checklist implementation. There was a significant improvement for all subteams in perceived knowledge of team members' names and roles postchecklist. Anesthesiologists and surgeons reported a significant improvement in the number of cases in which critical events were discussed after checklist implementation. Operations in which failed communication was deemed to have occurred significantly reduced after checklist implementation Congruence between subteams (surgeons, anesthesiologists, and nurses) in terms of perceived communication failures was low	The heterogeneity of the participating specialties may be considered a weakness

(*continued*)

TABLE 3. (*Continued*)

Authors	Type of Checklist	Outcome and Tool	Design and Sample	Findings	Limitations*
Kearns et al[41]	Modified WHO Surgical Safety Checklist	Outcome: Perceived quality of OR communication and familiarity with team members Tool: 2 "team" items on a study-specific questionnaire	Pre/postsurvey study Pre = 53 respondents Post = 46 respondents Midwives, auxiliaries, obstetric trainees, anesthesiology residents, anesthetic nurses, attending anesthesiologists, attending obstetricians	Significantly more OR staff agreed that they felt familiar with others after checklist implementation 69.6% of staff agreed that the checklist had improved OR communication Nonmedical staff were significantly more likely than medical staff to believe that the checklist had improved communication	*Statistical difference between pre- and postquestionnaire answers not presented for communication item—only for familiarity item* *Only 2 questionnaire items related to impact of checklist on teamwork* *No mention of origin of questionnaire items and no validity/reliability data available*
Sewell et al[42]	WHO Surgical Safety Checklist	Outcome: Perceived team communication and teamwork Tool: 1 "team"-related item on a study-specific questionnaire	Pre/postsurvey study Pre = 100 respondents Post = same 100 respondents Surgeons, anesthesiologists, nurses, and allied health professionals	Agreement that the checklist improves communication and teamwork increased from 47% pre to 77% post.	*No mention of origin of questionnaire items and no validity/reliability data available* *Only 1 questionnaire item related to impact of checklist on teamwork* *Statistical significance of findings not presented*
Bohmer et al[43]	Modified WHO Surgical Safety Checklist	Outcome: Perceived interprofessional coordination, team communication, and familiarity with other staff members Tool: Multiple "team" items on a study-specific questionnaire	Pre/postsurvey study 71 respondents altogether Medical staff and other personnel involved in surgery	Anesthesiology department: Physicians reported significantly better familiarity with team members (team members' names/functions), interprofessional coordination, and communication regarding intraoperative complications, after introduction of the checklist. Department of Traumatology: Physicians reported significantly better assignment of tasks within the operating room after introduction of the checklist.	*No mention of origin of questionnaire items and no validity/reliability data available*

OR indicates operating room; ORBAT, OR Briefing Assessment Tool; ORTAS, OR Teamwork Assessment Scale; RCT, randomized controlled trial; SAQ, Safety Attitudes Questionnaire; WHO, World Health Organization.
*The text not in italics is reported by the author; the text in italic is our critical appraisal.

impacts were also observed). These included disrupting positive communication (eg, by the checklist itself becoming the focus and detracting from the sense of exchange between the team members, or by disrupting the natural flow of information in the OR), reinforcing professional divisions (eg, by leaving certain individuals or professional groups out of the checking process), and creating tension (eg, in coordinating unwilling team members, interrupting work routines, and exposing individuals' knowledge gaps).[30]

360° Ratings of Teamwork/Communication

Paige and colleagues[31] found that peer-assessed teamwork scores significantly increased following introduction of the checklist but self-assessed teamwork scores did not.

DISCUSSION

Checklists are increasingly becoming part of routine practice for ensuring safety in ORs, and their use has been linked to improved rates of mortality and morbidity.[15–22] A key mechanism through which safety checklists are intended to bring improvements to surgical care is by promoting better teamwork and communication in the OR. This is a point often argued by checklist developers and implementers[22,23,47] yet not scientifically reviewed to date. The current review aimed to examine the existing evidence base and to evaluate the claim that checklists do indeed foster such team skills.

The 20 articles included in the review were heterogeneous in terms of the methodology used to assess the impact of the checklist on teamwork/communication, largely because team skills were not always the primary outcome assessed. Nonetheless, there was a good degree of concordance between the results of individual studies. The following findings emerged:

- Self-perceptions of teamwork and communication improved following the implementation of safety checklists.[24–27,32,35,36,39–43]
- There was a reduction in visible consequences of poor communication and near-misses associated with communication errors after the checklist implementation.[29,33,34]
- The observed mechanisms through which checklists improved teamwork centered around establishing an open dialogue at the start of the case, promoting provision of case-related information, revealing knowledge gaps, encouraging articulation of concerns, provoking a change in the care plan, supporting interdisciplinary decision making and coordination, and enhancing team "feeling."[25,26,35,43]
- Where there were interdisciplinary differences in the impact of the checklist, the evidence tends to show that OR nursing personnel perceive maximum benefit to team working as a result of checklists, surgeons perceive least positive impact, and anesthesiologists fall in between.[39–41]

Although the evidence on the whole supports a highly functional impact of safety checklists on teamwork in the OR, not all of the findings were positive. Four studies reported mixed results, noting some beneficial impacts on the team when using certain measures, but no benefits when using others.[28,30,37,38] One study reported worse situational awareness for anesthesiologists when a checklist was used; however, this was based on using the checklist in just 1 simulated scenario and thus the generalizability of the findings is limited.[28] Another study outlined some of the paradoxically adverse effects a safety checklist can have on communication.[30] Whyte et al[30] describe how positive communication might actually be disrupted by the "staged" nature of the interaction that sometimes occurs during checking. In other instances, if teams choose to maintain their positive communications at the point in time they have always done so, rather than waiting for the "Time-out" or checking process, the checklist can become a redundant and even "boring" repetition of information. This puts it at risk of becoming nothing more than a tick-box exercise, promoting a degree of complacency in the system. Checklists might also create a false sense of security that critical information has been communicated, when in fact a lack of real engagement in the checking process means that things may not have been checked as rigorously as they would have been otherwise. In addition, if team members differ in the degree to which they have bought into the system, a checklist might antagonize team relationships/interactions and accentuate hierarchy gradients. Lingard and colleagues[29] emphasized that although they observed a positive impact of their safety checklist in reducing communication failures, they also encountered several cultural and team barriers that had challenged successful implementation of the tool. These included a reluctance of staff to alter their habitual workflow, a perceived threat to individual excellence, prioritization of other tasks, staff shortages, and educational duties. Such barriers, they advised, should be anticipated and strategically mitigated prior to implementation of checklists.[29]

Limitations and Implications for Future Research

The heterogeneity of research design, methodology, and study quality of the included articles (sample size, inclusion of methodological controls, etc) was recognized as a significant limitation of the research available in this area and it meant that a formal meta-analysis was not possible. This limitation has been recognized elsewhere in a review of safety checklists.[48] Many of the articles assessed multiple end-points in addition to teamwork/communication, for example, process measures (eg, delays, equipment issues, compliance with procedures) and/or patient outcome measures (eg, complication rates, mortality rates). At times this made it difficult to tease apart the various effects being reported and to identify the impact the checklist had on teamwork/communication skills specifically, indicating that the number of end-points assessed at one time should be limited. In particular, the lack of standardized, valid assessment of the quality of teamwork/communication stood out as a weakness. Nine of the 13 survey studies reported on the use of study-specific ad hoc developed questionnaires, 7 of which had not been validated, and many of which contained just 1 or 2 items relating to teamwork and/or communication. Similarly, the observational tools varied considerably with regard to the quality of the data available to support their validity/reliability. Valid, reliable, and consistent assessment of team performance is essential for making full-bodied reliable conclusions regarding the impact of safety checklists. This would suggest that it is necessary to take caution in interpreting the results from some of these studies and that more focused studies are required where the scope of the impact of checklists is limited to measuring clearly defined outcomes relating to teamwork and communication dimensions alone, and using validated, reliable scales. Several such tools are now available for measuring the quality of teamwork, via either self-report or observation in the OR in a scientific, reliable, and valid manner, for example, the Teamwork Climate Sub-scale of the Safety Attitudes Questionnaire[44,49] and the Observational Teamwork Assessment for Surgery instruments,[6,50,51] respectively. By adopting these validated tools and steering away from the use of ad hoc developed assessment tools, standardized terminology for describing the specific team performance elements being assessed can also emerge. In this review, we found great variation in the terminology used between the studies, which made it difficult to make cross-study comparisons and to draw out patterns in the evidence base.

In addition to the choice of assessment tool/instrument, the study design also varied greatly. Five of the 20 studies reviewed included no baseline/control assessment of teamwork/communication and thus only assessed the improvement in team skills retrospectively, which has limitations. We would recommend that to make reliable conclusions regarding the impact of checklists, future studies

should include baseline assessments of teamwork/communication, should take into account the need for an implementation phase (ie, an allowance of time for the checklist to be incorporated into practice and to iron out any initial teething problems), and then assess the same team skills postimplementation in a longitudinal fashion such that both initial and sustained impacts can be determined.

A final limitation of the available literature was a failure to adequately associate *how well* a checklist was used (ie, the quality of its implementation) with the impact it had on teamwork/communication. Although 2 of the articles reported an overall association between increased compliance with using the checklist and an improvement in teamwork[40,42] none of the articles related specific characteristics of checklist usage (eg, who led the checks, who was present, who paused, who contributed, how much/what information was exchanged, how long it took) to the quality of teamwork. This will be important to address in future research for developing an understanding of "best practice" in using checklists in surgery. Tools for systematically assessing variation in the quality of checklist usage are, therefore, necessary and should be developed as part of future research in this area.

Implications for Surgical Practice

Despite the limitations mentioned earlier, this review highlights a positive association between the use of safety checklists and the quality of teamwork in the OR. This may represent one mechanism through which safety checklists result in improvements to clinical outcomes and compliance with clinical processes.[8–15] However, the potential adverse effects of checklists and barriers surrounding their successful implementation that were also highlighted indicate that incorporating these structured tools into the busy, interdisciplinary OR environment is unlikely to be without challenge and that the strategy undertaken during their introduction may moderate the extent of the impact they bring about.[29,30,48,52] Although checklists have clear face validity as communication and safety tools, it is important to emphasize that just making them available in the OR or requiring OR personnel to start using them does not necessarily equate to better patient outcomes and better team working.[53] Indeed, poor usage of a checklist can have *dysfunctional* effects for the team. Given these findings, team training and education focused on instilling effective/optimal use of checklists, embedded into the OR work routine should be provided. In addition to training, a strategic and inclusive approach should be taken during their introduction to clinical practice. Enlisting all stakeholders' (ie, including OR professionals or potentially also the patients) input into checklist design and customization will likely be important in promoting buy-in and ensuring that the tool ascribes to the frontline and end user's logic of communication. Once a checklist has been produced, its introduction should be planned in advance and complemented by training and education where necessary (eg, checklists can be introduced as part of wider team training or surgical quality improvement programs, as has been reported by some institutions).[54,55] Some flexibility and accessibility to modification (for local circumstances or for a specialty) will also be important, and regular systematic feedback on the impact of the checklist on local surgical performance (including process and outcome measures) should be integrated in the implementation approach.[14,48]

Auditing of the use of checklists is also likely to be an area that requires careful consideration. The audits presented in the articles reviewed[32,40,42] were very much centered around binary compliance with checklist usage, that is, whether the checklist was completed or not, whether the form was signed, or whether certain items of the checklist were completed. This pattern resembles our own experience of the audit approach commonly undertaken in hospitals in the United Kingdom. While such audits give a broad impression of checklist uptake, they tell us little about the degree to which the checklist stimulates safety-related conversations between team members or acts as a platform for interdisciplinary communication. We take the view that more meaningful audits will emerge when we start using tools that are able to capture how exactly checklists are actually used within the busy OR setting on a daily basis and the implications this has for teamwork. Such data will likely tell us much more about whether and how checklists are becoming truly embedded within surgical practice and also what works well/not so well when such checklists are used (so they can be reviewed and modified as necessary). The currently prevalent "tickbox" approach to auditing checklist usage is not adequate.

On a wider scale, a focus on fostering a strong culture for safety within a hospital is also important for the implementation of checklists and other safety interventions. We hypothesize that a strong safety culture will increase the chance of checklists being used in the "true spirit" rather than simply being seen as a bureaucratic irritation. When completed poorly or when lacking engagement (particularly at a senior level), not only will checklists have the potential to disrupt team function, but this also likely sends out a negative message that it is not a priority to improve communication in an organization.[30] This is an important by-product of checklist implementation and we propose that it should be acknowledged and monitored at an early stage of the implementation strategy. Finally, when implementing checklists, it will be important to take into account the limitations of such interventions. Checklists can act as an inexpensive and potentially effective means to promote safety and communication in a team, but they certainly cannot address underlying systemic problems—like, for example, very low staffing levels that result in very unstable teams.[53,56] It will, therefore, be important to integrate the use of safety checklists into more comprehensive safety and quality improvement packages that take into account such systemic problems and contextual factors (eg, skills mix, task demands, infrastructure, technological resources, work environment, organizational reward systems) and have the support of social networks with a shared "safety vision" that is reinforced across the system. Well-implemented checklists are effective, but not a panacea that can solve all problems.[9,53]

CONCLUSIONS

This systematic review reveals that safety checklists improve both perceived and observed teamwork and communication in the OR. Given the close association between teamwork and patient safety, these results suggest that the optimization of safety checklists in surgery should be a priority for the prevention of surgical error. Surgeons should remain aware of the potential negative impacts a checklist might have on communication and team function when not used well. How a checklist is designed and implemented requires a strategic approach, with significant input and leadership from surgeons and other OR professionals.

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