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Team interaction during surgery: a systematic review of communication coding schemes

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ABSTRACT

Background: Communication problems have been systematically linked to human errors in surgery and a deep understanding of the underlying processes is essential. Although a number of tools exist to assess nontechnical skills, methods to study communication and other team-related processes are far from being standardized, making comparisons challenging. We conducted a systematic review to analyze methods used to study events in the operating room (OR) and to develop a synthesized coding scheme for OR team communication.

Materials and methods: Six electronic databases were accessed to search for articles that collected individual events during surgery and included detailed coding schemes. Additional articles were added based on cross-referencing. That collection was then classified based on type of events collected, environment type (real or simulated), number of procedures, type of surgical task, team characteristics, method of data collection, and coding scheme characteristics. All dimensions within each coding scheme were grouped based on emergent content similarity. Categories drawn from articles, which focused on communication events, were further analyzed and synthesized into one common coding scheme.

Results: A total of 34 of 949 articles met the inclusion criteria. The methodological characteristics and coding dimensions of the articles were summarized. *A priori* coding was used in nine studies. The synthesized coding scheme for OR communication included six dimensions as follows: information flow, period, statement type, topic, communication breakdown, and effects of communication breakdown.

Conclusions: The coding scheme provides a standardized coding method for OR communication, which can be used to develop *a priori* codes for future studies especially in comparative effectiveness research.

1. Introduction

1.1. *Importance of the problem*

Communication gaps have been linked to human error in surgery and healthcare [1–6]. Effective communication is vital to reduce errors and improve surgical safety and performance [4]. Successful transfer of information between team members facilitates nontechnical skills such as decision-making, situation awareness, teamwork, leadership, and stress management [4]. Similarly, deficits in information transfer and communication have resulted in adverse events during

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surgery [5]. Breakdowns in communication and teamwork lead to surgical flow disruptions, which have been associated with an increase in errors [6]. Wahr *et al.* [6] concluded that despite different definitions in several studies, "surgical flow disruptions are correlated with adverse events." Consequently, it is not surprising that communication was identified as a root cause in 63% of all the sentinel events reviewed by The Joint Commission between 2004 and 2013 [7].

Interventions such as team training, time-outs, checklists, briefings, simulation-based, and structured communication protocols have helped in improving patient care [6]. To design better interventions, it is critical not only to know their effectiveness but the underlying communication processes that influence how and why they work. Effective communication in any sociotechnical system is indispensable to a safe, efficient, and effective work environment [8]. The healthcare domain presents special challenges to communication because it deals with (a) varied levels of team familiarity (experience of team members from working together), (b) overlapping but different expertise and roles among team members, (c) time constraints, and (d) hierarchical structures [1,8,9].

In summary, it is vital to better understand communication failures and teamwork breakdowns [6] (when, how, and under what context these communication problems happen) so that interventions can be designed.

1.2. Methodological challenges in studying operating room communication

Despite this clear need, methods to study communication problems and other team-related processes in the operating room (OR) are far from being standardized, making comparisons and conclusions challenging. The study of nontechnical aspects and communication in the OR is recent and not well established. Research terms and methods are far from being standardized. For example, in a review about the role of communication in surgery [4], communication problems were referred to in fourteen different ways (ineffective communication, communication errors, miscommunication, failure of communication, communication failures, failure of transmission, lack of communication, communication problems, communication breakdowns, compromised communication, unsatisfactory communication, low levels of communication openness, communication lapses, and information omission).

Methods to assess OR team effectiveness have also varied in terms of their coverage of communication. Tools such as OTAS or NOTECHS are designed to measure team behaviors and skills [6]. Observers use these tools to assess nontechnical skills during an entire surgery, or portions thereof. Although these tools can be used to test the efficacy of interventions [6], such measures do not explain the origin of communication and coordination problems.

The lack of standardization among methods, which study surgical communication, is not surprising given the wide variety of methods used to study communication more broadly. For example, both participative methods (to gather information from healthcare professionals) and observational studies in the OR have been used. Participative assessments provide invaluable information through surveys, interviews, and focus groups, using individuals involved in the process as the "measuring device" [10]. Alternatively, direct observations are used to verify the difference between what people say and what actually happens. This is performed through structured observations (i.e., when observers complete forms as events happen), semistructured or unstructured observations (such as when observers take "free notes"), and video recordings. All these methods can capture team interactions that may provide details about the circumstances surrounding communication breakdowns.

Communication events have also been analyzed in qualitatively different ways, including (i) static or sequential or (ii) flow or content [11,12]. Static analyses count the total number of specific communication events. This is practical when no audio or video recording is available and data collection needs to be performed *in situ*. Sequential analyses preserve the order of events, which allow for better contextual examination. Flow analyses capture who talks to whom, when, and for how long. The advantage of this method is that coding may be performed online or at a rate of 1 h of coding to 1 h of interaction time. Content analyses provide information regarding the meaning of communications, but it is particularly time-consuming [11,12]. Flow communication analyses are used to develop a basic communication map of a situation. Frequency and duration of communication events by participant can be used to study patterns of dominance during team interactions.

Finally, a wide range of methods have been used to code communication events, with specific codes dependent on the research question under investigation. Coding schemes typically have one or multiple (often mutually exclusive) dimensions representing different functions or levels [13]. Coding dimensions may also be categorical or ordinal. For example, Fischer *et al.* [14] video recorded six scenarios of a simulation-based search and rescue mission. All communications of four teams (two high and two low-performing) were coded based on to three categorical dimensions as follows: (a) task-related communications (information sharing, problem solving, meta-cognition, team coordination, and nontask related), (b) interpersonal affect (positive, neutral, or negative), and (c) responses to previous contributions (acknowledgments, disagreements, elaboration, answers to questions, and missing responses). In contrast, Parker *et al.* [15] used a four-point scale to rate the quality of leadership.

There are two main approaches for creating coding schemes such as *a priori* and *a posteriori* [16–19]. The *a priori* technique (i.e., deductive coding) relies on the scientific method [20]. Coding rules are defined before the observations begin, based on theory, previous work, research questions, and hypotheses [16,18]. Thus, deductive coding forces investigators to link their research questions directly to the data [16]. The final *a priori* coding scheme can be adapted or modified after pilots are run to fit the specific population or field characteristics [16,18,20]. This approach allows "online coding," especially useful when no audio or video recording is allowed. Also, if a specific coding scheme is used multiple times, it would allow comparisons between research studies. Alternatively, *a posteriori* coding (i.e., inductive coding) is used during exploratory stages or when there is not enough extant theory to anticipate the content categories [18]. For instance, in the grounded theory methodology, categories emerge through an ongoing process of comparing sections of data