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Developing a Quality Standard for Verbal Communication During CABG Procedures

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Verbal communication during coronary artery bypass graft (CABG) procedures is essential for safe and efficient cardiac surgery, yet sensitive to failure due to a current lack of standardization. The goal of this study was to improve communication during CABG by identifying critical items in verbal interaction between surgeons, anesthetists, and perfusionists. Based on 6 video recordings, a list was assembled containing items of communication in CABG procedures. Personal interviews and a consecutive focus group meeting with surgeons, anesthetists, and perfusionists revealed which of these items were considered critical. Afterward, the recordings were systematically analyzed on the communication of these critical items. Practitioners considered 64 items to be critical to verbally communicate for safe CABG surgery. On average, these critical items were verbalized in 4.4 out of 6 recorded CABGs. Observations also show that the surgical subteam is the most verbally active subteam and the initiator of the majority of all exchanges. The exchange type involved was mainly "direction" and "status." The majority of communication during critical events is between 2 subteams and occurs in the form of call-back loops. Over half of the call-backs are substantive and communication is rarely directed at a specific team member by name. In this study, a list was developed containing 64 items that practitioners unanimously considered critical to verbalize during a CABG procedure. It forms the foundation of a quality standard for verbal communication during cardiopulmonary bypass (CPB) and can increase safety and efficiency of cardiac surgery.

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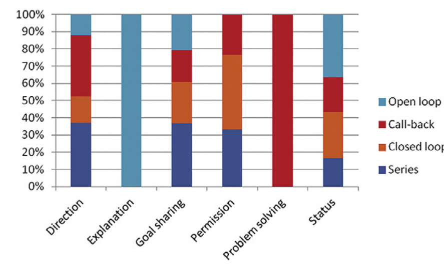
Keywords: CABG, Communication, Quality standard



Distribution of loop types, categorized by exchange type.

Central Message

Using a list of carefully selected critical events and quality criteria, a structural assessment of communication during CABG surgery was performed. This quality standard is unique in cardiac surgery.

Perspective Statement

Standardization of verbal communication between team members during CABG surgery is lacking. This is the first study which systematically analyzed communication during CABG, resulting in the conception of a list of 64 critical items to communicate. The approach of combining video recordings, personal interviews, and focus group meetings is of great importance to reach consensus.

Abbreviations: ACC, aortic cross clamp; ACT, activated clotting time; CABG, coronary artery bypass graft; CP, cardioplegia; CPB, cardiopulmonary bypass; HLM, heart-lung machine; ECC, extracorporeal circulation; OR, operating room

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INTRODUCTION

Proper and clear communication is essential in any medical specialty to avoid error, but especially in cardiac surgery, where room for error is very small and communication is challenged by the introduction of a third party. Next to the surgeon and anesthesiologist, the perfusionist is also a vital player in team communication.

Coordination of activities between all 3 main team members is essential. Since they receive different information from different sources, most communication is shared verbally and is therefore susceptible to failure. It has been appreciated that verbal communication is responsible for most minor failures and major adverse events during cardiac surgery.[1,2] One of the mechanisms allowing communication failure is

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communication inconsistency, which has been shown to be widely present during general and cardiac surgery.[3,4] Standardization of communication in the operating room (OR) could reduce communication failures and several efforts have been made to develop communication protocols,[5] preoperative briefings,[6] assistive devices,[7] as well as team trainings.[8–10] However, a definition of communication quality to support the development of standardization is currently lacking. To date, there is no standardization for communication during cardiopulmonary bypass surgery.

The goal of this study was to contribute to the standardization of communication practices by developing a quality standard for the critical verbal exchanges between surgeons, anesthetists, and perfusionists during cardiopulmonary bypass procedures.

METHODS

The study was conducted at Leiden University Medical Centre from August 2016 to December 2016. This study served as a qualitative exploratory study to develop a quality standard for the critical verbal exchanges during cardiac surgery. Video recordings were made of 6 coronary artery bypass graft (CABG) surgeries. Three video cameras were positioned at different angles for optimal view of the surgical procedure and 1 microphone was positioned at the location of each subteam to ensure optimal audio recording of each subteam (perfusionists, cardiac surgeons, and anesthesiologists). The video recordings were analyzed by a single observer. The observer had a background in biomedical engineering and communication sciences.

Relevant verbal sequences were documented and transcribed. Sequences were defined as verbal interaction from one subteam to another, relevant to the procedure. Verbal sequences were then grouped into verbal exchanges (sequences concerning the same topic) and classified according to an adapted classification from Hazlehurst et al[11] (Table 1).

Table 1. Adapted Classification of Exchange Types Used in the Video Analysis Based on the Classification Made by Hazlehurst et al.[11]

Exchange Type	
Direction	"Command an action that seeks to transition the activity system to a new state"
Goal sharing	"Create expectation of a desired future state"
Status	"Create shared understandings about the current state"
Alert	"Convey abnormal or surprising information about the current state "
Explanation	"Create a rationale for the current state"
Problem solving	Steer toward a more complete understanding of the current state*
Permission	Request approval to further transition the activity system to a new state†

*altered definition from Hazlehurst et al classification
†added to Hazlehurst et al classification

Permission to record the surgeries was obtained from the institutional review board, works council, and board of directors. Furthermore, consent was obtained from all team members present at the time of recording and from the patient. All data were analyzed anonymously.

Video Observations

Within each procedure, 5 surgical stages were identified: preparation, initiation, clamp time, weaning, and finish. To allow for a more detailed analysis, 12 tasks were identified: check activated clotting time (ACT), connect heart-lung machine (HLM), start extracorporeal circulation (ECC), flush cardioplegia (CP), place aortic cross clamp (ACC), administer CP, remove ACC, measure vein, place side clamp, remove side clamp, stop ECC, and disconnect HLM. For each verbal sequence, time, subteams involved, surgical stage, task, and the quality criteria were assessed.

Quality Criteria

Verbal exchange quality criteria were created based on current literature.[4,5,7,12–14] Quality criteria encompass 3 different aspects: breakdown resilience, consistency, and purposefulness (Fig. 1, Table 2).

BREAKDOWN RESILIENCE

Breakdown resilience included 3 different aspects of the verbal exchange that could lead to breakdown of communication: loop type, call-back type, and exchange direction.

There are 4 different loop types: open loop, call-back loop, closed loop, and series.[4,5,7,12–14] Open loops are exchanges without call-back and only involve 1 subteam (the initiators). Call-backs are exchanges with call-back from 1 or 2 subteams (receiver) and in closed loops, the initiator fully "closes" the exchange loop with a final call after the receiver gave a call-back, as shown in Figure 2. Series involve more sequences between 2 or 3 subteams than in any of the other loops.

Focussing on call-backs in particular, these can be categorized as either substantive or insubstantive. Substantive call-backs contain information about what information was received (eg, "heparin is in" in response to "administer heparin"), whereas insubstantive call-backs contain at most affirmative information (eg, "yes" or "OK" in response to "administer heparin").

Last, communication can be directed toward a specific team member by name, or undirected (exchange direction). Directed communication is considered to be more resilient against breakdown.[7]

CONSISTENCY

The second quality criteria, consistency of communication, refer to what extent a specific event is verbalized in the same manner across surgeries. In this study, consistency was evaluated in 3 domains: timing of exhange, the initiating subteam, and the exchange type.[4]

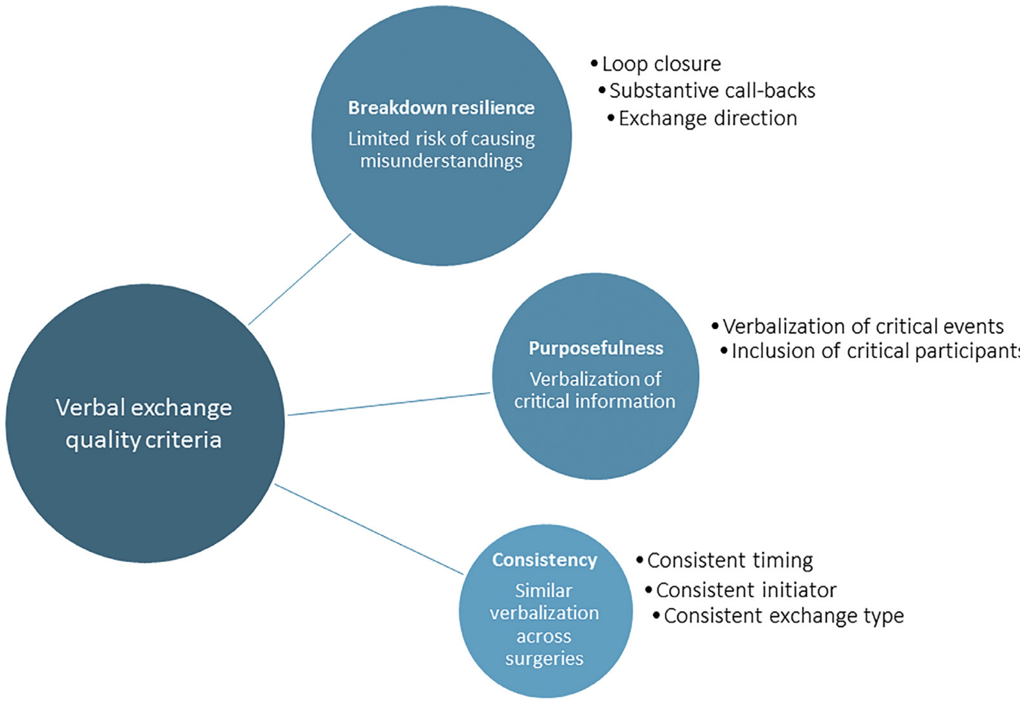


Figure 1. Verbal exchange quality criteria based on current literature.[4,5,7,12–14] Three aspects are considered: resilience to breakdown, consistency, and purposefulness. Further details are provided in Table 2.

PURPOSEFULNESS

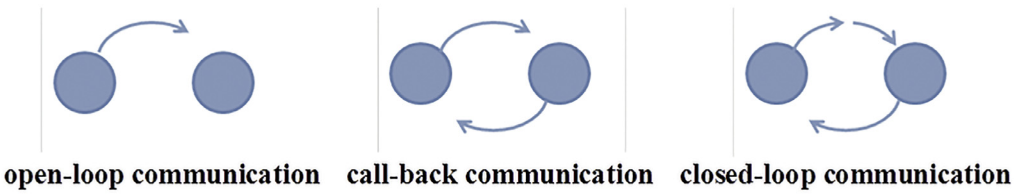
The third quality criteria, purposefulness, apply to which extent critical events are verbalized and the inclusion of critical participants.[5] The first is expressed in the number of exchanges uttered per critical event and the second in the sum of exchanges per critical event, for each subteam.

Interview and Focus Group

Verbal exchanges were grouped into events.[7] If an event occurred at 2 or more surgeries, it was defined as a recurring event. Structured interviews took place with 2 members of each subteam in which they were asked to rate all events on the list as either critical or noncritical. Each second interviewee

Table 2. List of Communication Qualities and Their Corresponding Measured Aspects

Communication Quality	Quality Aspect	Measured Aspect	Measurement Range	Source
Resilience to breakdown	Closed loop exchanges	Loop type	(Open loop, call-back, or closed loop)	12,13,7,4,5,14
	Substantive call-backs	Call-back type	(Insubstantive or substantive)	
	Directed exchanges	Whether an exchange is directed toward a specific team member with name	(Undirected or directed)	7
Consistency	Consistent timing	Number of different surgical phases a critical event was verbalized in	(1–5)	4
	Consistent initiators	Number of different subteams that initiated an exchange about a critical event	(1–3)	4
	Consistent exchange types	Number of different exchange types used to verbalize a critical event	(1–6)	
Purposefulness	Verbalization of critical events	Number of cases a critical event was verbalized in	(1–6)	5
	Involvement of critical participants	Number of critical participants verbally present (as sender or receiver) per event	(1–3)	



		2 subteams		3 subteams
Open loop	A	Protamine is at one third		
Call-back	S	Heparin may be administered	P	And the pump is empty
	A	Heparin administered	A	Yes
			S	Good
Closed loop	S	How much do you have [perfusionists]?	P	Breathing is also (...)?
			S	Yes sure
	P	About 100	A	Yes
	S	Oh, ok	P	Ok
Series	S	[Anesthetist], should I stay here, because the pressure is 75	P	Off bypass
			A	Yes, I heard you
	A	Stay there?	S	Off bypass?
	S	At half a liter, or… Do you agree that it's going to fast?	A	Yes
			S	Wonderful
	A	No, fine, let's go off bypass (…)		
	S	Yes		

Figure 2. Loop types and examples per number of subteams involved. Open loops are exchanges without call-back and only involve one subteam. Call-backs are exchanges with call-back from 1 or 2 subteams and in closed loops the initiator fully "closes" the exchange loop with a final call after the receiver gave a call-back. Series involve more sequences between 2 or 3 subteams. A, anesthetist; P, perfusionist; S, surgeon.

within the same specialism was confronted with any differences between answers, so as to establish a preliminary consensus between raters.

A structured focus group meeting was held with all 6 members of the subteams that had been interviewed. During the focus group meeting, the results from interviews were discussed and consensus was reached on the criticalness of an event.

RESULTS

Verbal Sequences and Exchanges

During the 6 operations recorded, 1314 sequences were transcribed, resulting in an average of 219 ± 41 sequences per surgery. The surgical subteam uttered most sequences, on average 99 ± 25 per surgery, followed by the perfusionist (72 ± 20) and the anesthetist (47 ± 25). In total, 9 sequences could not be attributed to any of the 3 subteams.

The sequences were grouped into a total of 674 exchanges, resulting in an average of 112 ± 26 exchanges per surgery and 1.95 sequences per exchange. The majority of exchanges were initiated by the surgical subteam (58% of all exchanges), followed by the perfusionists (19% of all exchanges) and the anesthetist (11% of all exchanges). The most popular exchange types were "status" (50 ± 10 per surgery) and "direction" (33 ± 9). "Status" exchanges were initiated by all subteams, whereas "direction" exchanges were initiated mostly by the surgical subteam, as shown in Figure 3.

Critical Events

Sixty-eight recurring events were identified during the 6 cases. During the interview stage of the focus group members, another 11 events were identified as potentially critical. During the focus group consensus was reached that 64 events were critical, of which 21 were critical to all 3 subteams, 43 to 2 subteams (Table 3). Of all critical events, 13 were only critical when applicable (eg, turning on artificial breathing when it was turned off, use of right internal mammary artery, recurrent administration of cardioplegia).

APPLYING QUALITY CRITERIA

Breakdown Resilience

Three aspects of verbal exchanges were assessed with regard to breakdown resilience: exchange loop type, call-back type, and direction. Referring to the first aspect, open loop comprised 27%, call-back 60%, closed loop 7.7%, and series 5.4% of all exchanges (Fig. 4). Focussing on all exchange loop types where call-back was used, 55% of the answers were substantive (Fig. 4). Communication was directed at a specific team member by name in 6.5% of all 336 critical exchanges.

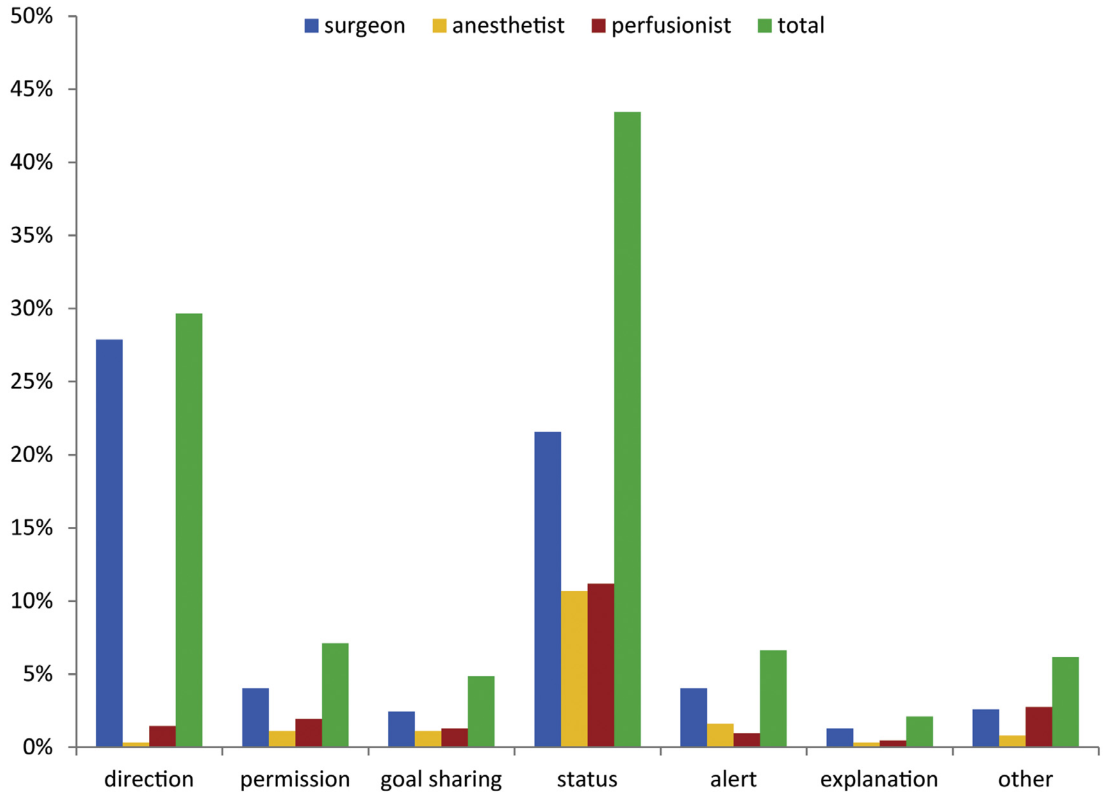


Figure 3. Distribution of exchange types in total and per initiating subteam. The most popular exchange types were "status" and "direction." "Status" exchanges were initiated by all subteams, whereas "direction" exchanges were initiated mostly by the surgical subteam.

Consistency

Consistency of communication was assessed in terms of timing, initiator, and exchange type consistency.

Of the 64 critical events 60 (94%) were consistently verbalized in the same phase of surgery. Three critical events could occur throughout the procedure, thus no consistency of timing can be expected (eg, hemodynamically compromising manipulation of the heart). Also, verbalization of the critical event occurred both before and after the event took place (eg, cross clamping of the aorta). Regarding the consistency of the initiating subteam, 30 out of 64 (47%) events were initiated by alternating subteams throughout the 6 cases. With regard to the consistency in exchange type, 42 of 64 (66%) events were consistently verbalized with the same exchange type.

Purposefulness

Purposefulness was measured in terms of verbalization of critical events, as well as the inclusion of critical participants. Unconditional critical events were verbalized on average 4.4 out of 6 cases. Focussing on events critical for 2 subteams, these were verbalized in 4.7 out of 6 cases. If the events were critical for all 3 subteams, they were verbalized in 4.2/6 cases.

In 9% of all critical events (35 out of 336 critical exchanges in 6 cases), 1 of the critical subteams was not verbally active during the exchange. This mostly involved the anesthesia subteam (26 of the 35 events). Thirty-two of these events were critical to all 3 subteams.

DISCUSSION

The goal of this study was to develop a quality standard for the critical verbal exchanges between surgeons, anesthetists, and perfusionists during CABG procedures. Interviews and structured focus groups with cardiac surgeons, perfusionists, and anesthetists resulted in consensus on which events throughout the procedure were critical to verbalize. Six surgical cases were recorded on video and systematically analyzed on predefined quality criteria applied on the verbal communication around these critical events.

The main result of this study is the conception of a list of 64 items that are critical to communicate during CABG procedures, which facilitates a thorough description of the current status of communication during cardiopulmonary bypass procedures. This list of items in combination with the quality criteria provides a quality standard which can be used to assess the current status of communication, identify areas for improvement, and construct targeted quality improvement programs.

The analysis showed that the surgical subteam is the most verbally active subteam and the initiator of the majority of exchanges. The exchange type involved was mainly "direction" and "status." The other 2 subteams, perfusionist and

Table 3. List of Critical Events and Critical Subteam Involved

Critical Event	Critical Subteams
Regulate anticoagulation	
Administer heparin	S + A
Heparin circulating	S + A
Heparin circulating 2 min*	S + A
Activated clotting time (ACT) started	A + P
ACT is sufficient for cannulation (>300)/ blue suction is on	S + P
ACT is sufficient for extracorporeal circulation (>400)	S + A + P
Cannulation	
Test suction	S + P
Suction is adequate	S + P
Divide the arterial and venous line	S + P
Prepare for cannulation	S + A + P
Arterial canule has been inserted	S + A + P
Clamp removed from arterial canule	S + P
Sufficient pulsation and line pressure	S + A + P
Permission to start retrograde autologous priming (RAP)	S + A + P
Start RAP*	S + A + P
RAP is complete*	A + P
Clamp removed from venous canule	S + P
Start extracorporeal circulation (ECC)	
Start ECC	S + A + P
Indicate ECC temperature	S + P
Full flow achieved	S + A + P
(Do not) adjust artificial breathing	S + A
Flush cardioplegia	
Flush cardioplegia	S + P
Stop flushing	S + P
Place aortic cross clamp	
Low flow*	S + A + P
Aortic cross clamp placed	S + A + P
Normal flow*	S + A + P
Administer cardioplegia	
Start cardioplegia	S + A + P
Pressure in root is adequate	S + P
Flow is adequate	S + P
Heart is still	S + A + P
Cardioplegia circulating for 2 minutes	S + P
Stop cardioplegia	S + P
Suck yellow	S + P
Last cardioplegia administered 15 minutes ago	S + A + P
Last cardioplegia administered 20 minutes ago	S + A + P
Remove aortic cross clamp	
Low flow*	S + A + P
Aortic cross clamp removed	S + A + P
Normal flow*	S + A + P
Stop ECC	
Continue artificial breathing*	S + A + P
Make output	S + A + P
Permission to reduce flow	S + A + P
Artificial breathing is on	S + A + P
Heart rhythm is adequate	S + A + P
Heart function is adequate	S + A + P
Heart filling is adequate	S + A + P
Patient body temperature is adequate	S + A + P
Reduce flow/stop ECC	S + A + P
ECC at 1 L index	S + A + P
ECC at 1/2 L index	S + A + P
Stop ECC	S + A + P
Decannulation	
Administer protamine	S + A + P
Root needle removed	S + A + P
Venous canule removed	S + A + P
Withdraw blood from venous line	S + A + P
Protamine at 1/3	S + A + P
Stop blue suction	A + P
Blood volume left in pump	S + A + P
Empty pump	S + A + P
Pomp is completely empty	S + A + P
Arterial canule removed	S + A + P
Protamine complete	S + A + P
Other events	
Table movements*	S + A + P
Hemodynamically compromising manipulation of the heart*	S + A + P
Sample taken from anesthetic line during ECC*	S + A + P

A, anesthetic subteam, P, perfusion subteam; S, surgical subteam.
*Only if applicable.

anesthetist, expressed less verbal communication and were more likely to use the "status" exchange type. Conceptually, these findings meet expectations, as the surgical team is the one to determine the pace of the procedure. The majority of communication during critical events is between 2 subteams and occurs in the form of call-back loops. Over half of the call-backs are substantive, and communication is rarely directed at a specific team member by name. In a fair number of situations, critical events are not verbalized or one of the subteams does not participate in the communication during the event.

Conception of a Quality Standard

The largest challenge with regard to the development of a list of critical events is the complexity of a surgical procedure. A list of critical events facilitates the reproducibility of studies concerning communication during cardiac surgery. Previous studies have attempted to rate criticalness of events. One study defined 52 events based on observations of cardiopulmonary bypass procedures.[7] The authors asked surgeons, anesthesiologists, and perfusionists to rate the criticalness of each of these items on a scale from 1 to 7. It found a high agreement between all raters, which caused them to average the scores and differentiate between 3 priority groups (high, medium, and low). Our study also included events that were found unanimously critical by all subteams.

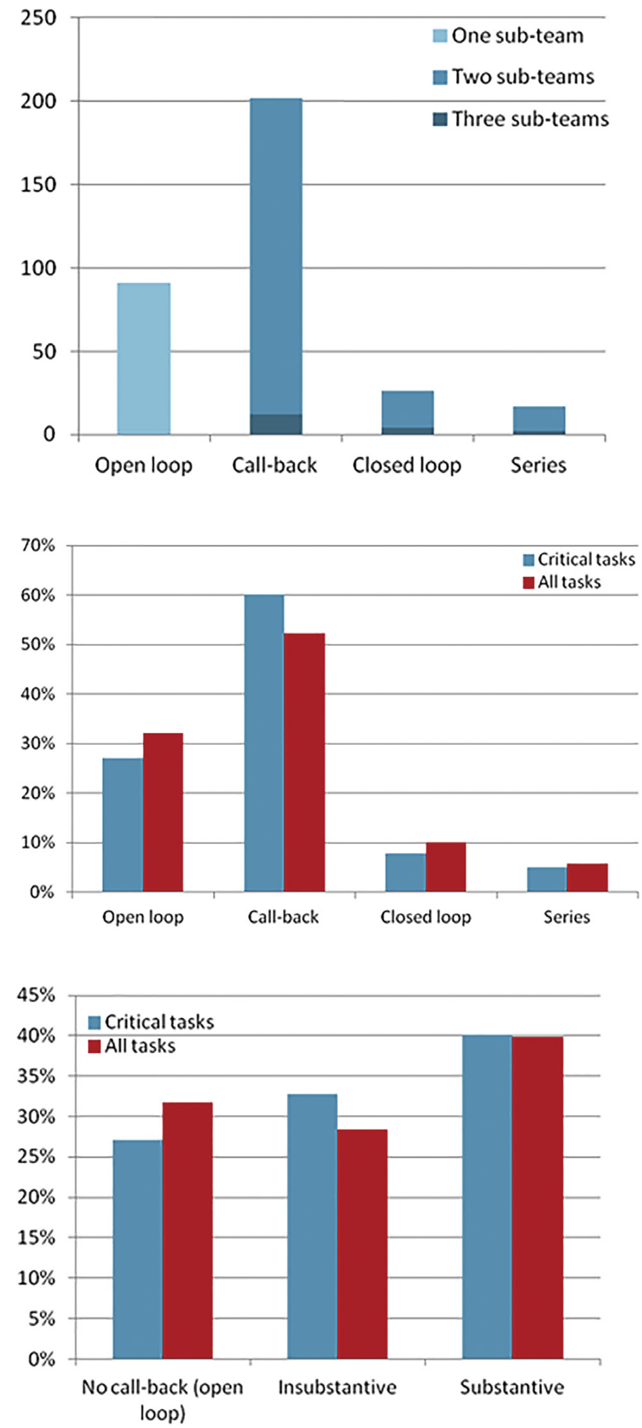


Figure 4. Number and distribution of critical exchanges per loop type and substantiveness of call-backs. The most frequently used loop type was call-back and in the majority of exchanges the call-back was substantive.

However, about one-third of all events showed great differences in terms of perceived criticalness. Instead of averaging scores, a focus group was created to settle conflicts and to reach a consensus. This gives the opportunity for dialogue concerning critical events, and leads to mutual understanding about what defines a critical event. Furthermore, it created an understanding of why events were considered critical by different subteams.

There is substantial literature indicating that the involvement of practitioners in video observations can increase the validity of the data and provide clinicians with direct feedback on their practice.[2,5,11,15–18] In this way, video-based research could directly contribute to patient safety. Thus, the focus group meetings proved to be of eminent importance in the conception of quality standards.

Quality Criteria

Structured analyses of the videos using the list of critical events showed occasional discordance with the quality criteria. Further investigation exposed several reasons for this. Critical events were particularly not verbalized or inconsistently verbalized when there was inter- or intradisciplinary disagreement over the criticalness of the event during the focus group meetings. These disagreements were often driven by a lack of knowledge with regards to the informational needs of other subteams. Therefore, in addition to agreement on criticalness of events, it is also important to have a dialogue between the subteams on why events are critical. Similarly, it is important to analyze why open loop was used in specific cases, when this form of communication is most vulnerable to breakdown.[7] Two events were consistently communicated with an open loop: preparation for arterial cannulation (*goal sharing*) and start of ACT measurement (*status*). The purpose of the first exchange is to request the anesthesia subteam to control the blood pressure and to alert all team members that a surgical action with a potential risk is about to be performed. However, some team members lack the need for this information and much rather be informed of the moment after which the cannula is inserted in the aorta. This could explain why the receiver did not provide a call-back or provided insubstantive call-backs. In addition, during some open loop communication, feedback is received in a nonverbal form, such as the audio-visual feedback of suction.

Another reason for insubstantive call-backs might be that a substantive call-back would cause confusion. For example, if it involved an instruction ("administer heparin"), the receiving party wants to acknowledge that it received the instruction ("yes"), but not that it has executed the instruction ("heparin is administered").

Verbal absence of a subteam during a critical event could be explained by the fact that events were unanimously found to be critical, but do not involve all subteams. As a considerable part of the communication involves the flow of suctions, cardioplegia and other practical issues around the heart-lung machine, it may be expected that the anesthetist is not active in these exchanges.

Few exchanges were directed by name. Directing exchanges can enforce a call-back in critical exchanges, a communication tool that surgeons seem to use more often than others. The request for call-back might be more distinct for the surgical subteam than other subteams, as surgeons are often fixated on the operating field and have no visual feedback, thus solely rely on verbal communication.

Limitations

A possible limitation of the study is the small sample size. Although only 6 cases were recorded, abundant data were collected as the cases yielded over 1300 communication sequences. Second, the videos were analyzed by 1 observer. However, the observer only transcribed the video recordings, while further interpretation was performed during personal interviews and the focus group meeting.

Future Research

This study provides a framework for further study of communication during cardiac surgery. Future research may focus on validating the quality standard, by analyzing and applying it on more CABG cases. In addition, the quality criteria should be formulated per item, for example, loop type, type of call-back (substantive vs insubstantive) and the use of standardized phrases. A good way to do this is the use of focus group meetings.

Little has been published on methods to analyze teamwork, communication, and other nontechnical skills. This study is an example of a structured approach to quantify the current level of communication. It shows that the combined use of interviews and focus group meetings is a successful way to reach consensus in the selection of critical events. The resulting list of critical events and the quality criteria may be applied in other institutions, which would facilitate the reproducibility of future studies. The methods and results of this study may be utilized by others undertaking research into communication during cardiac surgery or for local quality improvement initiatives. Furthermore, the method can be applied on other cardiac surgeries, such as valve repair and replacement. This will lead to the development of different lists of critical events, each tailored to a specific procedure. Once a quality standard is developed, it could be used to initiate the development of tools to improve communication and compare pre- and postintervention results in team communication during cardiac surgery.

CONCLUSION

Although verbal communication between cardiac surgeon, perfusionist, and anesthetist is essential during cardiopulmonary bypass, standardization for communication during cardiopulmonary bypass surgery is lacking. Using video observations, structured interviews of involved specialists, and focus group meetings, this study resulted in the conception of a quality standard. The list consisting of 64 items encompasses all critical events that are considered indispensable for safe and efficient communication during surgery. Systematic analyses of these critical events lead to a thorough understanding of the quality of communication and allow for the identification of areas for improvement.

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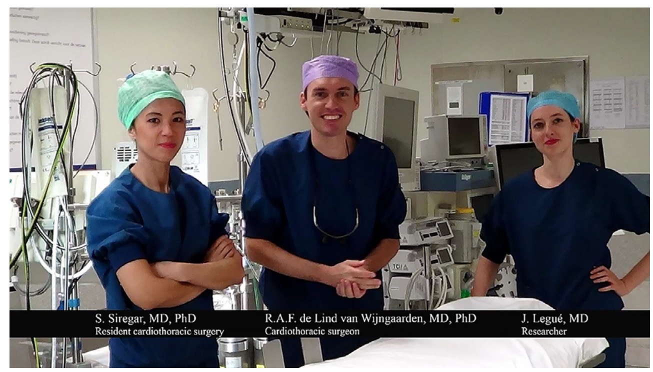
This paper was presented at the AATS Patient Safety Course 2018 in Boston, Massachusetts.

SUPPLEMENTARY MATERIAL

The following is the supplementary data to this article:



Video 1. Three authors explain the importance of the study with examples of the quality criteria.

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