Communication and Contextual Factors in Robotic-Assisted Surgical Teams: Protocol for Developing a Taxonomy

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Table of Contents

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Abstract

Background: Robotic surgery has been rapidly integrated into surgical practice in the past few decades. The operating theatre setup for robotic surgery is different from the setup for open or laparoscopic surgery such that the operating surgeon sits at a console away from the rest of the surgical team and patient. Communication and team dynamics are altered due to this physical separation and visual barriers imposed by the robotic equipment. Thus, the overarching aim of this project is to examine what comprises effective communication by robotic surgical teams and its contextual factors.

Objective: We aim to develop a taxonomy of communication behaviours and contextual factors and apply the taxonomy to observe and train robotic surgical teams. We will also examine patterns of communication behaviours based on gender.

Methods: We will conduct semi-structured interviews with robotic surgical team members including the surgeon, assisting surgeon or trainee, bedside or first assistant, nurses, and anaesthesiologists. Participants will represent different disciplines, including urology, general surgery, gynaecology, and have a range of experiences in robotic surgery. We will use a reflexive thematic analysis to analyse the data and develop a preliminary taxonomy of communication behaviours and contextual factors, their descriptions, and examples. Using the preliminary taxonomy, we will observe live robotic surgeries in the Royal College of Surgeons in Ireland (RCSI) affiliated hospitals using event coding. We will observe varying lengths and conditions of robotic surgical procedures to a capture a wide range of communication behaviours and contextual factors and refine the taxonomy. We will conduct data collection in parallel with data analysis such that if we identify a new behaviour in an interview, we will follow up and ask about it in additional interviews and/or observations.

Results: The taxonomy will include a list of actionable communication behaviours, contextual factors, their descriptions, and examples. The results from this project will be used to observe and train surgical teams in a simulated environment to effectively communicate with each other and prevent communication breakdowns. It will also add to the knowledge base on the role of gender in communication in robotic surgery and produce recommendations that can be incorporated into training.

Conclusions: This project will contribute to the improvement of communication skills of surgical teams and the quality and safety of patient care.

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Communication and Contextual Factors in Robotic-Assisted Surgical Teams: Protocol for Developing a Taxonomy

Abstract

Background: Robotic-assisted surgery (RAS) has been rapidly integrated into surgical practice in the past few decades. The operating theatre setup for RAS is different from the setup for open or laparoscopic surgery such that the operating surgeon sits at a console away from the rest of the surgical team and patient. Communication and team dynamics are altered due to this physical separation and visual barriers imposed by the robotic equipment. Thus, this protocol describes a project that will examine what comprises effective communication by RAS teams and its contextual factors that facilitate or inhibit effective communication in RAS.

Objective: We aim to develop a taxonomy of communication behaviours and contextual factors in RAS teams. We also aim to examine patterns of communication behaviours based on gender.

Methods: We will first conduct a scoping review on communication in RAS to develop a preliminary taxonomy of communication based on the literature. We will then conduct semi-structured interviews with RAS team members including the surgeon, assisting surgeon or trainee, bedside or first assistant, nurses, and anaesthetists. Participants will represent different disciplines, including urology, general surgery, gynaecology, and have a range of experiences in RAS. We will use a reflexive thematic analysis to analyse the data and further refine the taxonomy. We will also observe live robotic surgeries in the Royal College of Surgeons in Ireland (RCSI) affiliated hospitals. We will observe varying lengths and conditions of RAS procedures to a capture a wide range of communication behaviours and contextual factors and finalise the taxonomy. Although we anticipate conducting 30 interviews and 30 observations, we will collect data until we achieve data sufficiency. We will conduct data collection in parallel with data analysis such that if we identify a new behaviour in an interview, we will follow up and ask about it in additional interviews and/or observations.

Results: The taxonomy from this project will include a list of actionable communication behaviours, contextual factors, their descriptions, and examples. As of May 2024, this project has been approved by the RCSI Research and Ethics Committee. We will start collecting data in June 2024 and plan to publish the results as we find meaningful results in our data analysis in 2024 and 2025.

Conclusions: The results from this project will be used to observe and train surgical teams in a simulated environment to effectively communicate with each other and prevent communication breakdowns. It will also add to the knowledge base on the role of gender in communication in RAS and produce recommendations that can be incorporated into training. This project will contribute to the improvement of communication skills of surgical teams and the quality and safety of patient care.

Keywords: communication; teams; robotic surgery; robotic-assisted; simulation

Introduction

There has been an exponential growth in establishing and integrating robotic-assisted surgery (RAS) into surgical practice and training in the last few decades. For example, the use of RAS for all general surgery procedures increases from ~2% to ~15% from 2012 to 2018.[1] Compared with open or laparoscopic surgery, RAS reduces postoperative pain, promotes faster recovery time, and provides better patient outcomes.[2] However, the introduction of the robotic system into the

operating theatre changes the spatial configuration of the surgical team and patient. The surgeon who sits at a console is physically separated from the surgical team and patient who remain in the sterile field. As the surgeon places his/her head inside the console to look at the video feed of the surgical site, he/she no longer has a direct view of physical movements and nonverbal cues from the surgical team. The surgical team also faces the robotic operating equipment, which obstructs their view of each other. Consequently, the surgeon and the rest of the team are dependent on explicit, descriptive communication not only to give and respond to instructions and requests, but also to provide updates on the status of the patient and robotic system. Thus, RAS entirely changes communication and team dynamics in the surgical team, raising the potential for miscommunication and misunderstandings that may threaten the potential for enhanced outcomes.

Non-technical skills, such as communication, are critical for improving surgeons' performance, operative workflow, patient outcomes, and reducing adverse events.[3,4] Although communication has been identified as one of the essential non-technical skills in robotic surgery,[3,5] we know little about how the surgical teams communicate most effectively in RAS. This limited understanding about what constitutes effective communication in RAS is problematic because failed communication is the second most common factor contributing to surgical errors.[6] Thus, this protocol describes a project that aims to develop a taxonomy of communication behaviours and contextual factors that facilitate or inhibit effective communication in RAS.

Previous studies have developed assessment or rating tools for non-technical skills in RAS using behavioural marker methodology.[3,5] Schreyer et al. identified leadership & management, teamwork & cooperation, problem solving & decision making, and situational awareness as essential non-technical skills.[4] However, their rating tool did not focus specifically on communication but on non-technical skills as a whole. In contrast, Manuguerra et al. and Raison et al. identified communication as an essential non-technical skill.[3,5] However, their behavioural markers were not actionable from the perspective of training. Examples of behavioural markers were *"effective verbal communication whilst at the console," "appropriate interaction with beside assistant surgeon,"* and *"presence of feedback."* [3,5] As an example, team members cannot coordinate with each other if they do not effectively communicate their needs. Therefore, this project goes beyond the-state-of-the-art and examines communication specifically as a key non-technical skill in RAS as it is fundamental to other non-technical skills.

Moreover, Manuguerra et al. and Raison et al. developed rating tools only for surgeons.[4,5] However, RAS changes existing roles not only for surgeons but also for other surgical team members. For example, nurses in RAS are expected to have more technical knowledge and coordination.[7] They are also expected to speak up and share information outside of the surgeon's vision that might help improve efficiency in the operating theatre or patient safety.[8] As a result, there are changes in role-based communication needs and expectations. Therefore, this project goes beyond previous studies that examines non-technical skills only for surgeons and examines communication by RAS team members.

Furthermore, gender influences the perceptions, experiences, teamwork, and performance of healthcare professionals in the operating theatre, hence affecting patient care and outcomes. For example, women are less listened to when they speak up and share concerns about the patient in the operating theatre than men.[9] In addition, male and female healthcare professionals perform clinical practices differently which leads to different patient outcomes. Examples of this include evidence that female physicians are more likely to follow clinical guidelines and engage in more patient-centred communication compared to male physicians, and patients treated by female physicians experience lower mortality and readmission rates than those treated by male physicians.[10] Thus, it

is important to understand how gender influences surgical teams' training, learning, teamwork, and performance in RAS. However, the role of gender in robotic surgery has not been studied in previous research. As there are changes in team roles and dynamics in robotic surgery, this project addresses the gap in the-state-of-the-art and examines the role of gender in communication by robotic surgical teams.

This project has two important contributions to RAS. First, the taxonomy from this project will include a list of actionable communication behaviours, contextual factors, their descriptions, and examples. We anticipate that the taxonomy will be used for behavioural observations and training surgical team members to effectively communicate with each other and prevent communication failures. Second, this project will also answer important questions related to gender dimension (e.g., male vs. female surgical team members engaging in a specific communication behaviour) that can be taken into consideration in their training.

Methods

Scoping Review

Literature Search

We will first conduct a scoping review to examine the existing literature on communication in RAS and identify the gaps in the literature. We will follow Peters et al.[11] for methodological guidance in conducting our scoping review and Tricco et al.[12] for reporting the review using Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR).

We will search the following databases:

- PsycINFO
- Cinahl
- Pubmed
- Cochrane
- Embase
- MedLine
- Web of Science

We will also search the grey literature in the following databases:

- Scopus
- Google Scholar

We will use the following search (S) terms:

S#1: Title/Abstract
robotic surg* OR "robotic surgery" OR "robot-assisted surgery" OR "robot assisted surgery" OR "robotic assisted surgery" OR "robotic-assisted surgery" OR robotic surgical procedure* OR robotic surg* team* OR "minimally invasive surgery"

S#2: MeSH Terms or Subject Terms
robotic surgery

S#3

S#1 OR S#2

S#4: Title/Abstract
“non-technical skills” OR “non technical skills” OR “nontechnical skills” OR communicat* OR coordinat* OR cooperat* OR collaborat* OR teamwork OR team process* OR interpersonal skill* OR “information sharing” OR non-technical skill* OR team dynamic*

S#5: MeSH Terms or Subject Terms
communication

S#6
S#4 OR S#5

S#7
S#3 AND S#6

The syntax in S#7 is included below:

("robotic surg*"[Title/Abstract] OR "robotic surgery"[Title/Abstract] OR "robot-assisted surgery"[Title/Abstract] OR "robot-assisted surgery"[Title/Abstract] OR "robotic-assisted surgery"[Title/Abstract] OR "robotic-assisted surgery"[Title/Abstract] OR "robotic surgical procedure*"[Title/Abstract] OR ((("robot"[All Fields] OR "robot s"[All Fields] OR "robotically"[All Fields] OR "robotics"[MeSH Terms] OR "robotics"[All Fields] OR "robotic"[All Fields] OR "robotization"[All Fields] OR "robotized"[All Fields] OR "robots"[All Fields]) AND "surg*"[All Fields]) AND "team*"[Title/Abstract]) OR "minimally invasive surgery"[Title/Abstract] OR "robotic surgical procedures"[MeSH Terms]) AND ("non-technical skills"[Title/Abstract] OR "non-technical skills"[Title/Abstract] OR "nontechnical skills"[Title/Abstract] OR "communicat*"[Title/Abstract] OR "coordinat*"[Title/Abstract] OR "cooperat*"[Title/Abstract] OR "collaborat*"[Title/Abstract] OR "teamwork"[Title/Abstract] OR "team process*"[Title/Abstract] OR "interpersonal skill*"[Title/Abstract] OR "information sharing"[Title/Abstract] OR "non technical skill*"[Title/Abstract] OR "team dynamic*"[Title/Abstract] OR "communication"[MeSH Terms])

Data Extraction

We will select the data based on the following inclusion and exclusion criteria. We will then extract information relevant to our review (i.e., communication in RAS) using a charting table. We will analyse the data using descriptive statistics (e.g., frequency). Finally, we will report the results using PRISMA-ScR as well as in diagrams and/or tables. This scoping review will result in the preliminary taxonomy of communication and contextual factors in RAS teams.

Table 1. List of Inclusion and Exclusion Criteria in Scoping Review

Inclusion Criteria	Exclusion Criteria
Publication date: between January 2010 and December 2023	Publication date: before 2010
Population: healthcare professionals	Target population: medical students
Context: (1) simulation, hospitals, medical centres (2) teaching/learning environment (3) effects of environmental, external, or	Context: community

contextual factors (e.g., stress, audio and video issues) on communication	
Type of surgery: (1) robotic-assisted surgery (2) comparison of robotic surgery to other types of surgery	Type of surgery: laparoscopic, open
Sources: peer-reviewed articles, conference proceedings, theses, and dissertations	Sources: books, periodicals, magazines, policy documents, websites
Language: English	Language: non-English
Study design: (1) quantitative, qualitative, and mixed methods (2) training, assessment, rating tool, checklist, protocol	Study design: All types of review

Conducting Interviews

This project will take place at the Royal College of Surgeons in Ireland (RCSI). We will use purposive and convenience sampling to recruit participants. We will invite participants through the RCSI's surgical networks. We will conduct one-on-one semi-structured interviews with the members of the surgical teams, including the consultant/attending surgeon, assisting surgeon or trainee, bedside or first assistant, nurses, and anaesthetists. Participants will represent different disciplines including urology, general surgery, gynaecology, and have a range of experiences in robotic surgery. The interviews will take place in-person or virtually, and will be audio recorded and transcribed. A sample interview questions is "In robotic-assisted surgery, what does it look like when communication is effective in the team?"

Though we anticipate conducting 30 interviews, we will collect data until we achieve data sufficiency (i.e., enough data to answer research questions capturing both uniqueness of communication experience and its socially constructed meaning)[13] and an equal representation of male and female voices. In qualitative research, sample size depends on a number of factors, such as study purpose, sample specificity, and quality of exchange between researchers and participants. For example, participants give rich accounts of their experiences requiring less sample size. A study with a broad aim and limited theoretical background requires more sample size.

We will analyse the data in parallel to data collection. We will use a reflexive thematic analysis, an iterative process where researchers interpret and analyse patterns of behaviours while being aware of their own assumptions, experiences, and social positions (e.g., with regards to gender).[14] We will identify and develop themes of communication and contextual factors. We will also calculate interrater agreement with an adequate proportion of the data. If we find a new theme, we will clarify or ask further questions in the following interviews. Through this iterative process, we will further refine the taxonomy.

Conducting Observations

We will conduct interviews and observations in parallel to allow them to inform each other as the period of data collection and iterative data analysis proceeds. We will observe live robotic surgical procedures at hospitals affiliated with RCSI. The RCSI Group is comprised of several hospitals, including Beaumont Hospital, which provides a national and regional service to Dublin and the Northeast. We will invite participants through the RCSI's surgical networks. A researcher will be

present in the operating theatre and take notes at an optimal distance to hear communication between the surgeon, assisting surgeon, first assistant, nurses, and anaesthetist. Excel will be used to record the frequency of the behaviours observed. Moreover, we will observe varying lengths of robotic surgical procedures to capture a wide range of communication behaviours as certain parts of a procedure are more challenging and create conditions that require different strategies of management and communication. Although we anticipate observing 30 robotic surgical procedures, we will collect data till we achieve data sufficiency.

We will analyse the data and further refine the taxonomy. We will also calculate interrater agreement with an adequate proportion of observations. If we find a new behaviour or event during an observation, we will follow up with additional interviews and/or observations. We will pursue this iterative process till we achieve data sufficiency. The final outcome of the iterative process is a valid and reliable taxonomy of communication behaviours and contextual factors, their descriptions, and examples that can be used for behavioural observations.

Results

The data collected will include interviews (audio files, transcripts, and codebook) and observational notes (Excel sheet). The taxonomy will include a list of communication behaviours and contextual factors, their descriptions, and examples. This project is funded under the first author's Marie Skłodowska-Curie Actions Fellowship (Grant No. 101107170) by the European Union from September 2023 to September 2025. As of May 2024, it has been approved by the RCSI Research and Ethics Committee. We are preparing to start conducting interviews in June 2024 and conduct data collection and analysis throughout the year. We aim to publish the results as we find meaningful results in our data analysis in 2024 and 2025.

Discussion

Anticipated Results

RAS differs from open or laparoscopic surgery because of the surgeon's separation from the surgical team and patient and the presence of the robotic operating equipment in the operating theatre. As a result, it inherently changes communication and team dynamics in RAS teams. This protocol describes a project that aims to develop a taxonomy of communication and contextual factors that facilitates or inhibits effective communication in RAS. The taxonomy will include a list of communication behaviours and contextual factors in RAS, their descriptions, and examples. We also anticipate results related to gender dimension, such as whether and/or how male and female surgeons engage in similar or different patterns of communication behaviours.

Comparison with Prior Work

Compared with previous studies that examine overall non-technical skills in RAS,[3-5] this project focuses specifically on communication and its contextual factors that facilitate or inhibit effective communication in RAS teams. As communication is fundamental to other non-technical skills, the taxonomy of communication from this project can be used for behavioural observations and training focusing specifically on communication. In addition, previous studies have used behavioural marker methodology to develop rating tools for non-technical skills in RAS. Behavioural marker methodology categories a number of behaviours into broad behavioural classes.[15] While it provides an overall assessment of non-technical skills, some behaviours in a behavioural class may not occur frequently, and it is susceptible to observer bias.[15] For example, one behavior might stand out to an observer who then rates the entire behavioural class favourably. On the other hand, the taxonomy from this project will focus on specific and defined communication behaviours that are

easier to observe and train and less susceptible to observer bias. Thus, this project has unique contributions to improving communication skills in RAS teams.

Limitations

We acknowledge possible limitations in this project. We are collecting data in the da Vinci robotic surgical system by Intuitive as it is currently the most common robotic platform used in Ireland and around the world. There are other robotic systems, such as Hugo RAS system and Versius by CMR Surgical. There might be differences in communication due to different system setups. Moreover, we will only examine core communication behaviours that can be trained across different disciplines or specialties. There might be discipline-specific communication as well as contexts (e.g., emergency situation) that need to be incorporated into training. Therefore, future research should further examine communication in different contexts.

Conclusions

The results from this project will serve as training materials to observe and train surgical teams in a simulated environment to effectively communicate with each other and prevent communication failures. Simulation provides a safe environment that mimics a real hospital for learning and practicing surgical skills and techniques. Thus, the results will be applied in simulation training focusing on communication for surgical teams. We will also answer important questions related to gender dimension. The results will inform behaviours and contexts that need to be emphasized in simulation training and addressing gender gaps. In conclusion, this project aims to improve communication skills of RAS teams so that they are competent and responsible in effectively communicating with each other and using robotics to deliver safe patient care.

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KPN and CC contributed to the development of this project, and KPN wrote the manuscript. This project is funded under KPN's Marie Skłodowska-Curie Actions Fellowship (Grant No. 101107170) by the European Union from September 2023 to September 2025.

Data Availability

The data sets, including raw data, will not be openly available as they contain personal information of participants (e.g., gender) and their personal experiences which are confidential. The taxonomy resulting from this project will serve as the metadata that will include codes used in data analysis, their description, and examples. Researchers can use it to replicate the study or for future research. The taxonomy will be published in Open Access journals and/or made publicly available via appropriate repositories (e.g., Zenodo, RCSI Repository, Open Research Europe). Request for access to the data may be considered if individuals have received trainings on research ethics and General Data Protection Regulation and approvals from appropriate research ethics committees.

Disclosure

We did not use generative AI in any portion of the manuscript writing.

Conflicts of Interest

None declared.

Abbreviations

CMR: CMR Surgical
CC: Claire Condron
KPN: Kyi Phyu Nyein

PRISMA-ScR: Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews
RCSI: Royal College of Surgeons in Ireland
RAS: Robotic-Assisted Surgery
S: Search

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Supplementary Files

Multimedia Appendixes

Peer reviews from the funding agency.
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