


# BMJ Open Understanding the surgeon's behaviour during robot-assisted surgery: protocol for the qualitative Behav'Robot study

Clément Cormi <sup>1,2</sup>, Guillaume Parpex,<sup>3</sup> Camille Julio,<sup>4</sup> Fiona Ecarnot,<sup>5</sup> David Laplanche,<sup>1</sup> Geoffrey Vannieuwenhuysse,<sup>6</sup> Antoine Duclos,<sup>7,8</sup> Stéphane Sanchez<sup>1</sup>

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## ABSTRACT

**Introduction** Robot-assisted surgery is spreading worldwide, accounting for more than 1.2 million procedures in 2019. Data are sparse in the literature regarding the surgeon's mechanisms that mediate risk-taking during a procedure, especially robot-assisted. This study aims to describe and understand the behaviour of the surgeons during robot-assisted surgery and the change in their behaviour with increasing experience in using the robot.

**Methods and analysis** This is a qualitative study using semistructured interviews with surgeons who perform robot-assisted surgery. An interview guide comprising open questions will be used to ensure that the points to be discussed are systematically addressed during each interview (ie, (1) difference in behaviour and preparation of the surgeon between a standard procedure and a robot-assisted procedure; (2) the influence of proprioceptive modifications, gain in stability and cognitive biases, inherent in the use of a surgical robot and (3) the intrinsic effect of the learning curve on the behaviour of the surgeons. After transcription, interviews will be analysed with the help of NVivo software, using thematic analysis.

**Ethics and dissemination** Since this project examines professional practices in the field of social and human sciences, ethics committee was not required in accordance with current French legislation (Decree no 2017-884, 9 May 2017). Consent from the surgeons is implied by the fact that the interviews are voluntary. Surgeons will nonetheless be informed that they are free to interrupt the interview at any time.

Results will be presented in peer-reviewed national and international congresses and submitted to peer-reviewed journals for publication. The communication and publication of the results will be placed under the responsibility of the principal investigator and publications will be prepared in compliance with the ICMJE uniform requirements for manuscripts.

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## INTRODUCTION

Arthrobot, the world's first surgical robot, was developed in Vancouver, Canada in 1983,<sup>1</sup> to manipulate and position the patient's limb on voice commands from the surgeon during orthopaedic surgery. Since this pioneering

## Strengths and limitations of this study

- Using semistructured interviews, we will elicit surgeons' perceptions and viewpoints on their behaviour during robot-assisted procedures.
- Different levels of experience (ie, beginner, intermediate and advanced) will ensure wide representativeness.
- Thematic analysis will be used to describe major and minor themes.
- As a qualitative study conducted in France, input will be influenced by the cultural context and representations about technology among French surgeons.
- The advent of robots in the operating theatre also impacts the other workers (ie, operating nurses, anaesthetist nurses and anaesthetists), but this study will focus only on the surgeons' perspectives.

development, dozens of other surgical robots have been developed to assist surgeons in various ways during diagnostic and therapeutic procedures,<sup>1</sup> making them increasingly safe<sup>2</sup> and less invasive.<sup>2-4</sup>

The different robotic surgery devices can be categorised into three groups according to the degree of surgeon involvement.<sup>5,6</sup> First, active systems are capable of autonomously executing an operating procedure following a preplanned sequence input by the surgeon prior to the procedure.<sup>7</sup> They are mainly used in orthopaedics. Second, semiactive systems make it possible to position and guide the tools and the surgeon then performs the actual intervention.<sup>8,9</sup> They are mainly used in neurosurgery. Finally, passive systems are subordinate to the surgeon's action in real time. The surgeon performs the action. These types of systems are mainly used in urological, gynaecological and digestive surgery.

To complete this classification, a further parameter to consider is the location of the surgeon with regard to the operating field. When the surgeon is at a distance



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For numbered affiliations see end of article.

### Correspondence to

Dr Clément Cormi;  
ccormi.osteo@gmail.com

from the patient or operating theatre, and is following or performing the procedure from a console, then this is called a teleoperated robot.<sup>6</sup> The Da Vinci robot, commercialised by Intuitive Surgical, is the most widespread passive, teleoperated robot.<sup>10</sup> In their annual report for 2019, the company claimed that they had 5582 devices in service around the world (of which 977 are in Europe), accounting for approximately 1 229 000 procedures performed in 2019.<sup>11</sup>

The presence of surgical robots in the operating theatre is now well established. There has been growing interest in this topic among the scientific community over the last few years, and the number of scientific publications in this field has plateaued at around 2000 articles per year since 2016. However, numerous controversies persist, mainly regarding two key points: (1) the efficacy of robotic surgical procedures vs the gold standard<sup>12–18</sup>; (2) the safety and harmlessness of robotic surgical procedures.<sup>19–27</sup> The first of these two issues needs to be studied specifically in each specialty, and in each surgical indication. Conversely, the second point has more general applicability, and is of relevance for all surgeons who may, at one time or another, be called on to interact with a surgical robot.

In a retrospective study of the Food and Drug Administration data for the period from 2000 to 2013, Alemzadeh *et al* estimated the number of adverse events to be 83.4 injury and death events per 100 000 procedures.<sup>19</sup> However, this number could be underestimated due to underreporting of complications and adverse incidents.<sup>27</sup> Two main types of adverse events can be distinguished, according to whether they result from material malfunction or human error.<sup>19 23 24</sup> The latter type of event seems to decline with increasing operator experience, and when the robot is in routine use in the specialty.<sup>19</sup>

Numerous factors can influence the decisions made by the surgeon during a procedure. Hendra *et al* propose a classification of these factors based on whether they are related to the patient, to the surgeon's experience, or to external factors.<sup>28</sup> Leung *et al* propose a different categorisation, according to whether the influential factors are 'avowed' (eg, first, do no harm), 'unavowed' (eg, rushing to finish a case on time to avoid cancellation of the next case), or 'disavowed' by the surgeon (eg, financial motives).<sup>29</sup> The full set of decisions made by the surgeon before and during the operation lead them to stay within, or to venture outside of their comfort zone.<sup>30–33</sup> In every situation, the surgeon has to reassess their own capabilities and adapt the therapeutic option proposed.<sup>30</sup> By working at the boundary of their personal comfort zone, each surgeon is likely to be more or less comfortable with risk-taking during a procedure.<sup>30</sup> Data are sparse in the literature regarding the mechanisms that mediate this behaviour,<sup>29–35</sup> and no study has specifically examined how surgeons manage risk during robot-assisted procedures.

Lastly, the development of robot-assisted surgery has prompted investigation of the learning curves for various

procedures.<sup>36–38</sup> Findings indicate that the surgeon's position on the learning curve seems to be associated with variables such as the length of the procedure, the volume of blood loss during the operation and postoperative complications, etc.<sup>39 40</sup> While experience seems to influence the performance of surgeons using a robot, no study has yet investigated the impact of learning curves on the perception of risk by the surgeon using the robot.

Considering the relevance of these factors, we aim to describe and understand the behaviour of the surgeons during robot-assisted surgery and the change in their behaviour with increasing experience in using the robot.

## METHODS AND ANALYSIS

### Design and setting

We will perform a qualitative study using semistructured interviews with surgeons who perform robot-assisted surgery. Semistructured interviews make it possible to elicit the surgeon's perception and viewpoint on a predefined topic via a guided conversation between the interviewer and the interviewee.<sup>41</sup> An interview guide comprising open questions will be used to ensure that the points to be discussed are systematically addressed during each interview. Considering the literature for conducting qualitative study, more than eight main questions would threaten the richness and the openness of the discussion, while less than five would limit the benefit of follow-up questions.<sup>42 43</sup> In this study, we opted for five main questions and five additional follow-up questions. The first question is related to the moments before the surgery, with the assumption that the behaviour of the surgeon before the surgery is different between robotic and standard procedures. Questions 2–5 specifically ask about the surgeon's behaviour during the robotic-assisted procedures, based on a literature search and findings from preliminary interviews with two hepatobiliary surgeons who commonly perform robot-assisted procedures. The interview guide is provided in online supplemental appendix 1.

### Study population

Multicentre study including surgeons performing robot-assisted surgery in one general (non-academic) hospital and one University Hospital in eastern France, the multisite Paris public hospital system (AP-HP) and one private clinic in Paris.

### Eligibility criteria

The following participants will be eligible: senior abdominal and pelvic cavity surgeons (ie, visceral surgeons, gynaecological surgeons and urologists) having completed their robot-assisted surgery training. Many of the procedures performed by these specialists are laparoscopic surgeries, so they are experienced in using remote tools like graspers, and in performing surgery through a screen, which are attributes shared with robotic-assisted procedures.

An intentional sampling procedure will be used to recruit participants for the study based on their age, sex and experience with robot-assisted surgery. The aim is to access the various levels of experience and promote transferability of the findings.<sup>44</sup> Participation will be voluntary. Surgeons will receive no compensation (financial or gift) for their participation.

### Data collection procedure

Recruitment of surgeons for voluntary participation is currently ongoing. Each surgeon will participate in an individual semistructured interview, which will follow the interview guide. Interviews will be performed until saturation is reached,<sup>45</sup> that is, the point beyond which further interviews fail to bring forth any new information. Interviews will be recorded and transcribed. The threshold for saturation cannot be determined in advance; however, we aim to perform a minimum of 20 interviews.

At the surgeons' convenience, the interviews will be conducted online using videoconferencing software or in-person in their usual place of work.

### Patient and public involvement

No patients will be involved in this study.

### Data analysis

After transcription, interviews will be analysed with the help of NVivo software, using thematic analysis.<sup>46 47</sup> The aim of thematic analysis is to identify and categorise the different themes occurring in a cross-sectional manner across all interviews. Each theme is then considered as a meaningful and independent unit of the discourse. Major themes and secondary themes may be identified. Major themes are relevant points that are spontaneously well developed by all participants. Minor themes are less well developed by participants, seeming of lesser importance in their discourse, and not necessarily mentioned by all participants.

In view of the learning curve inherent to the acquisition of competence in the use of the surgical robot, results will be analysed through the prism of the surgeon's experience. Surgeons' sociodemographic data may be used to complement the profiles that emerge, according to their attitude towards risk.

### Study status

Recruitment is ongoing. The first interview was conducted on 26 May 2021. To date, 14 surgeons have agreed to participate, and 8 interviews have been performed. The study is expected to end on 31 January 2022.

## ETHICS AND DISSEMINATION

Since this project examines professional practices in the field of social and human sciences, ethics committee was not required in accordance with current French legislation (Decree no 2017-884, 9 May 2017). Consent from the surgeons is implied by the fact that the interviews are voluntary. Surgeons will nonetheless be informed that

they are free to interrupt the interview at any time. They will also be informed that citations from their interview may be used (after translation into English) to substantiate results in future scientific publications.

Data will be processed and managed in compliance with the French and European regulations relating to data privacy (Reference Methodology MR-004, Deliberation no 2018-155, 3 May 2018). Data will be rendered anonymous using an alphanumeric coding system that will prevent identification of the participants. Only the lead investigator will have access to the correspondence list, which will be conserved for 2 years after the publication of the results, or a maximum of 20 years. Interview recordings will be conserved until the data have been published and will then be deleted.

### Access to data

All researchers in the Behav'Robot study team will have access to the final data and interview transcripts. Because the interviews are rendered anonymous, interview transcripts may not be shared if they contain identifying information about the surgeon, but data strictly required for monitoring, quality control and audit of the study will be available, in accordance with the statutory and regulatory provisions in force in France.

### Dissemination

Results will be presented in peer-reviewed national and international congresses and submitted to peer-reviewed journals for publication. The communication and publication of the results will be placed under the responsibility of the principal investigator and publications will be prepared in compliance with the ICMJE uniform requirements for manuscripts.

## DISCUSSION

To the best of our knowledge, this will be the first qualitative study to describe how surgical robots impact on surgeons' behaviour in the operating theatre.

Since the 1990s, the adage 'the bigger the incision, the bigger the surgeon' has evolved into 'the smaller the incisions for the laparoscopic procedure, the bigger the surgeon'.<sup>48</sup> As robot-assisted surgery becomes more widespread, the next catchphrase could become 'the more at ease with the robot, the bigger the surgeon'.

However, the use of the robot spatially and socially isolates the surgeon from the rest of the operating room, leading to a loss of non-verbal information.<sup>49</sup> Therefore, maintaining a high level of awareness,<sup>50</sup> that is, an understanding of the activities of others, which provides context for their own activity, will come at the cost of a concerted effort in verbal communication, mobilising non-technical skills that need to be practised.<sup>26 51</sup>

It remains unclear how surgeons apprehend the apportioning of risk between the robot and their own actions, and how they integrate the robot's performance into their own ongoing risk assessment during the procedure.



Some surgeons may find it reassuring to have the support of the robot, which they may judge to be less prone to error than humans, whereas others may feel that they have less control when the robot is participating. These crucial points regarding the attitude towards risk evaluation may be elucidated by our study, and help to identify the limits of maximum robotic involvement that surgeons would find acceptable.

Possible limitations of this qualitative study include the fact that the introduction of robot-assisted surgery affects all the staff in the operating theatre, but our study focuses only on the surgeons' perspective. Second, surgeons from the participating centres may not be representative of the overall population of surgeons in France. Even if they are, the results will nevertheless be coloured by the French context and healthcare system, and may not be representative of the perceptions, behaviours or opinions of surgeons in other countries. Finally, surgeons may be reluctant to admit to feelings or practices that may reflect poorly on their performance or abilities.

In summary, there is a need to understand the behaviour of surgeons during procedures with robotic assistance. This qualitative study will provide new insights that may help improve training programmes in robot-assisted surgery and elucidate risk evaluation by the surgeon during robot assisted procedures.

#### Author affiliations

<sup>1</sup>Pôle Territorial Santé Publique et Performance des Hôpitaux Champagne Sud, Centre Hospitalier de Troyes, Troyes, France

<sup>2</sup>LIST3N/Tech-CICO, Université de Technologie de Troyes, Troyes, France

<sup>3</sup>Department of Gynecology Obstetrics II and Reproductive Medicine, Hôpital Cochin, Paris, France

<sup>4</sup>Department of Digestive Surgery, Hôpital Saint-Louis, Paris, France

<sup>5</sup>EA3920, Burgundy Franche-Comté University, Besançon, France

<sup>6</sup>Département de chirurgie gynécologique, mammaire et carcinologique, Centre Hospitalier de Troyes, Troyes, France

<sup>7</sup>Health Data Department, Hospices Civils de Lyon, Lyon, France

<sup>8</sup>Research on Healthcare Performance (RESHAPE), Université Claude Bernard Lyon 1, Lyon, France

**Contributors** CC, DL, GV and SS conceived the study. CC, GP, CJ, FE, DL, GV, AD and SS contributed to the development of the study design and final protocols for sample selection and interviews. GP, CJ and GV are the local supports for the study. CC, GP, CJ, FE, AD and SS contributed to writing the manuscript. All authors reviewed and approved the final version of the paper.

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#### ORCID iD

Clément Cormi <http://orcid.org/0000-0003-3567-0082>

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