Influence of Hierarchy During Robot-Assisted Surgery

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Introduction

- Hierarchical organization of operating room personnel leads to risk communication breakdowns which result in poor surgical outcomes.
- This study aimed to discover:
  - How do the surgical team's hierarchical relationships affect the frequency of risk utterances between status levels?
  - How does this hierarchy influence the timing (proactive vs. reactive) of these utterances?
  - How do the hierarchical relationships and timing influence situational awareness in the operating room?

Risk Utterance Definition

Table 1. Risk Utterance Examples by Definitions

| Risk Definition	Example of Utterance
Seeks to prevent a behavior or action that could result in a poor patient outcome from occurring.	You're a little too close to the prostate; when you're cutting that come towards me.
	Now remember his tumor is right up here in this region so anything that's funny we need to be worried about.
	Get down more proximally; you're too close to the apex.
	You're going to cut into the bladder if you keep doing that.
Seeks to provide information about a behavior or action that could result in a poor patient outcome.	You've got to be careful, because this is a needle. You can tear the iliacs or something like that.
	Watch your hook. [hook is in the way of the laparoscopic grasper]
	That's a little artery that carries over to the nerve. That's why the nerve was popping. That's the only thing I saw.
	See where you have your bladder neck at the midline... you're making a new bladder neck.
Seeks to provide information about the work environment that could lead to a behavior or action that could result in a poor patient outcome.	Am I hitting something on the outside? [outside the body cavity]
	It got stuck in the port.
	Is it focused? Or is it not clear? I think it is not clean. Can you focus and then see if it clears out? If it doesn't then we need to clean. [in reference to the camera]

Methods

- Three cameras were set up to provide an overhead view of the activities within the operating room (Figure 1).
- Participants wore a lapel-microphone connected to an audio interface.
- Recordings were synchronized using Adobe Premiere Pro CS6 and imported into Noldus Observer XT 12 for transcription.

Figure 1. Operating Room Camera Layout
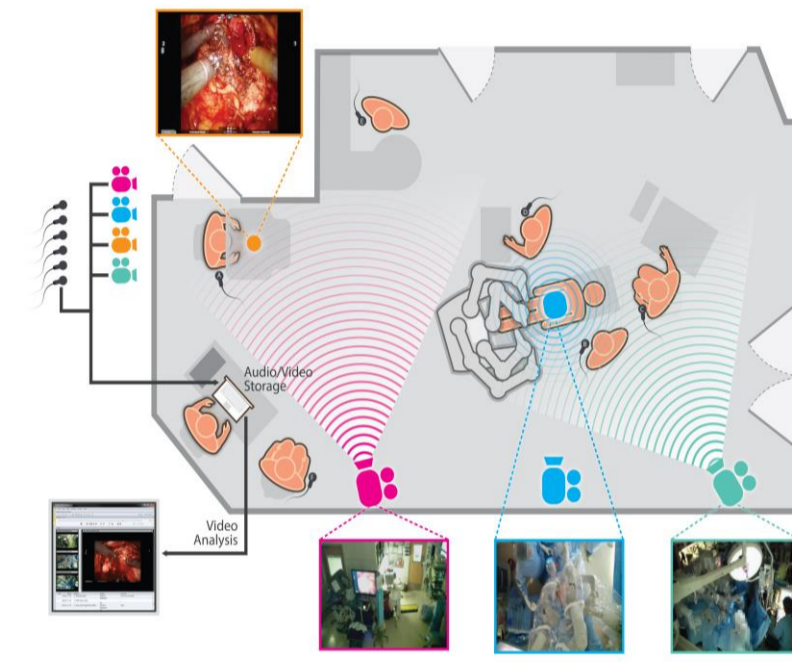
- Audio-visual recordings and transcriptions of 10 robot-assisted radical prostatectomies by three surgeons were examined.
- Utterances were classified by two independent raters based on the sender-recipient exchange, timing (proactive vs. reactive), and the Oxford Non-Technical Skills (NOTECHS) situational awareness score
- Sender-recipient pairs were designated from an individual of assumed higher status to lower status or vice versa (Figure 2).
  - The Oxford NOTECHS is a tool adapted from aviation to be used in the operating room for evaluating the non-technical skills of a surgical team scored categorically: 1 (Below Standard), 2 (Basic Standard), 3 (Standard), or 4 (Excellent).
  - Utterances made by the surgeon or trainee surgeon were classified based on their on-console status.
- Chi-square tests and ANOVAs were used to determine associations between the hierarchical status, utterance timing, on-console status, and NOTECHS situational awareness scores.

Figure 2. Hierarchical Structure
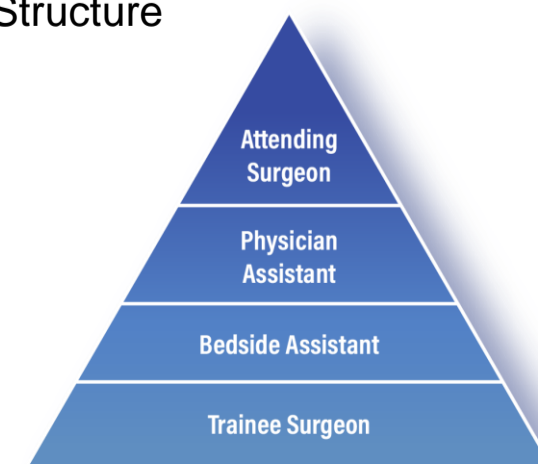
Results

- Acceptable inter-rater reliability was considered to be ≥70%; this study found an agreement level of 72%.
- There was a good level of agreement between raters with a kappa rating of 0.61.
- 4,583 total utterances.
  - 329 utterances (7%) related to risk. Of the risk related utterances, 64% were from individuals of higher status to individuals of lower status.
  - There was no statistical significance of utterance frequency based on hierarchical status ($p = 0.65$).
  - 52% of the surgeon and trainee surgeon's utterances were made on-the-console.
  - There was no significant interaction of hierarchical status, utterance timing, and on-console status on situational awareness scores ($p = 0.25$).
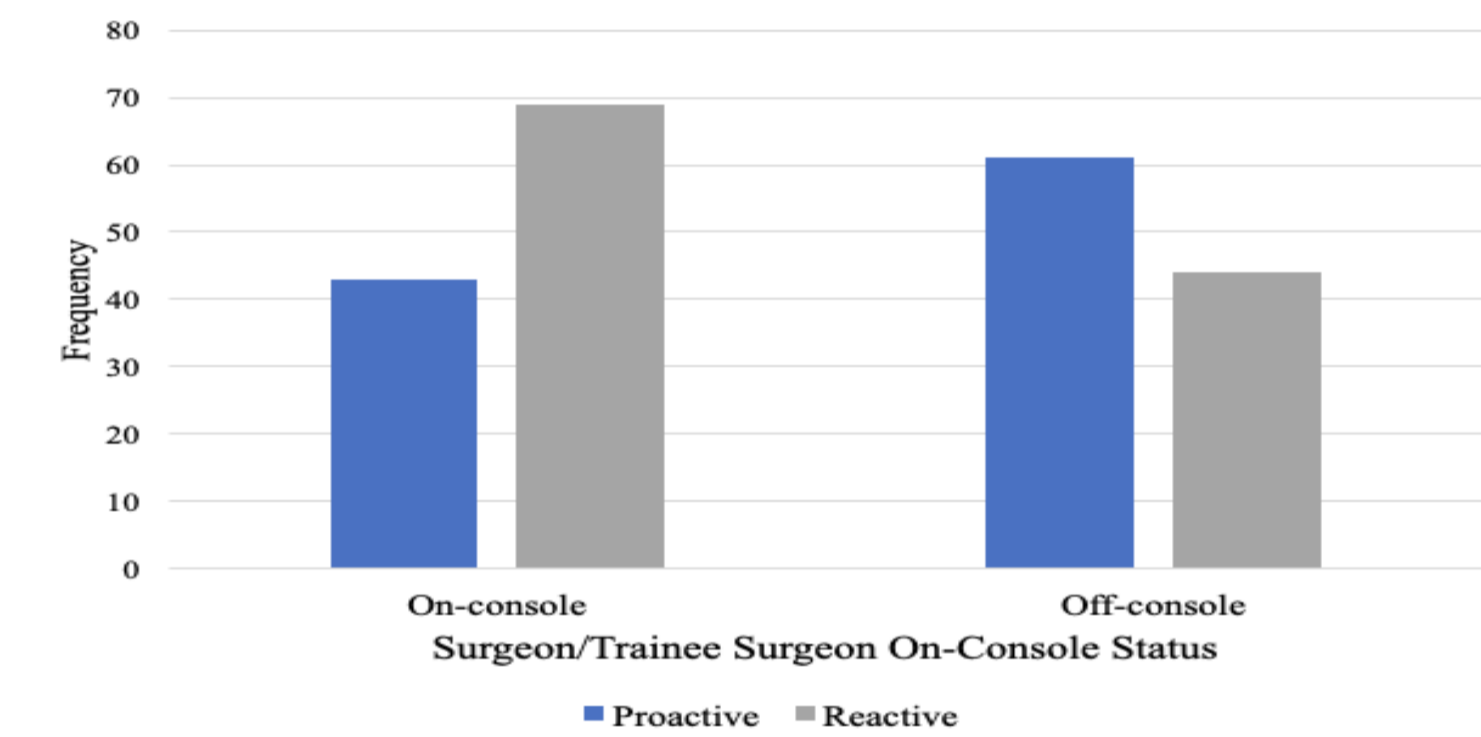
Figure 3. Hierarchical Status on Utterance Timing
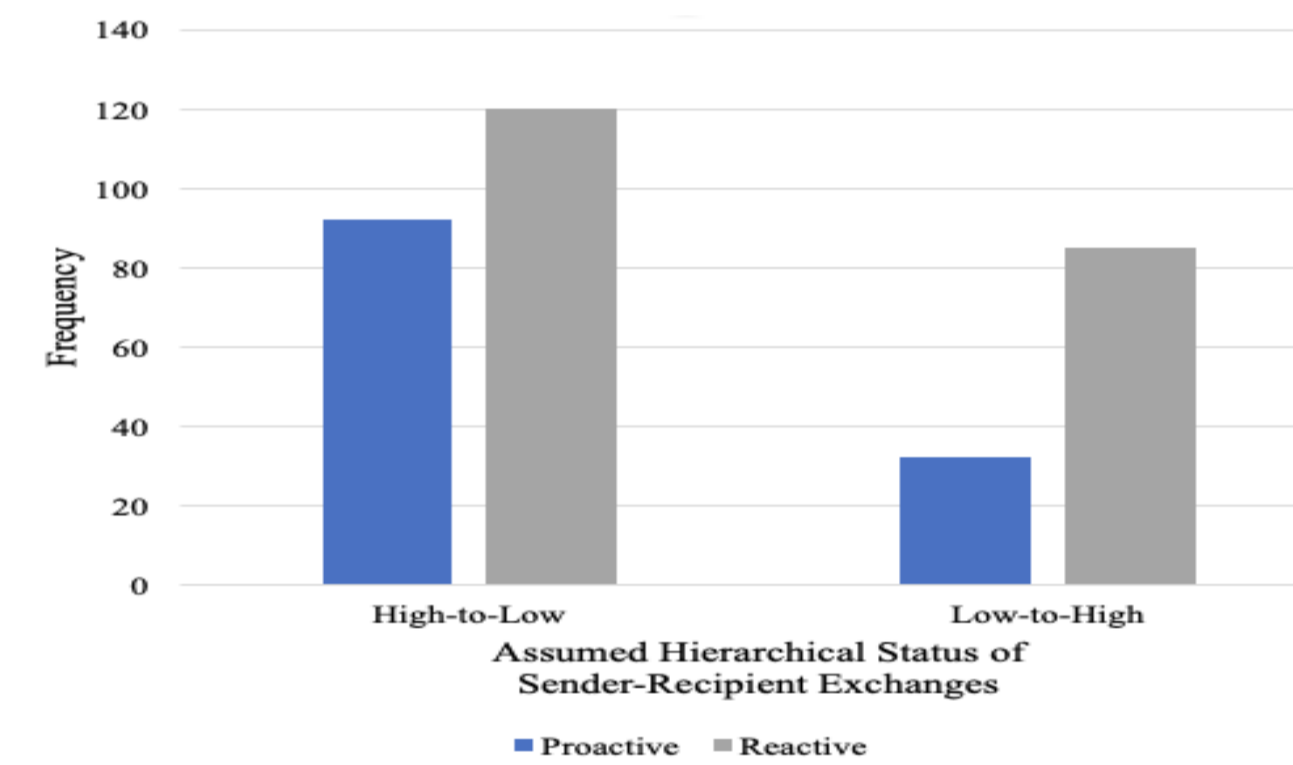
Note. Utterances were significantly more reactive than proactive ($p < 0.01$).

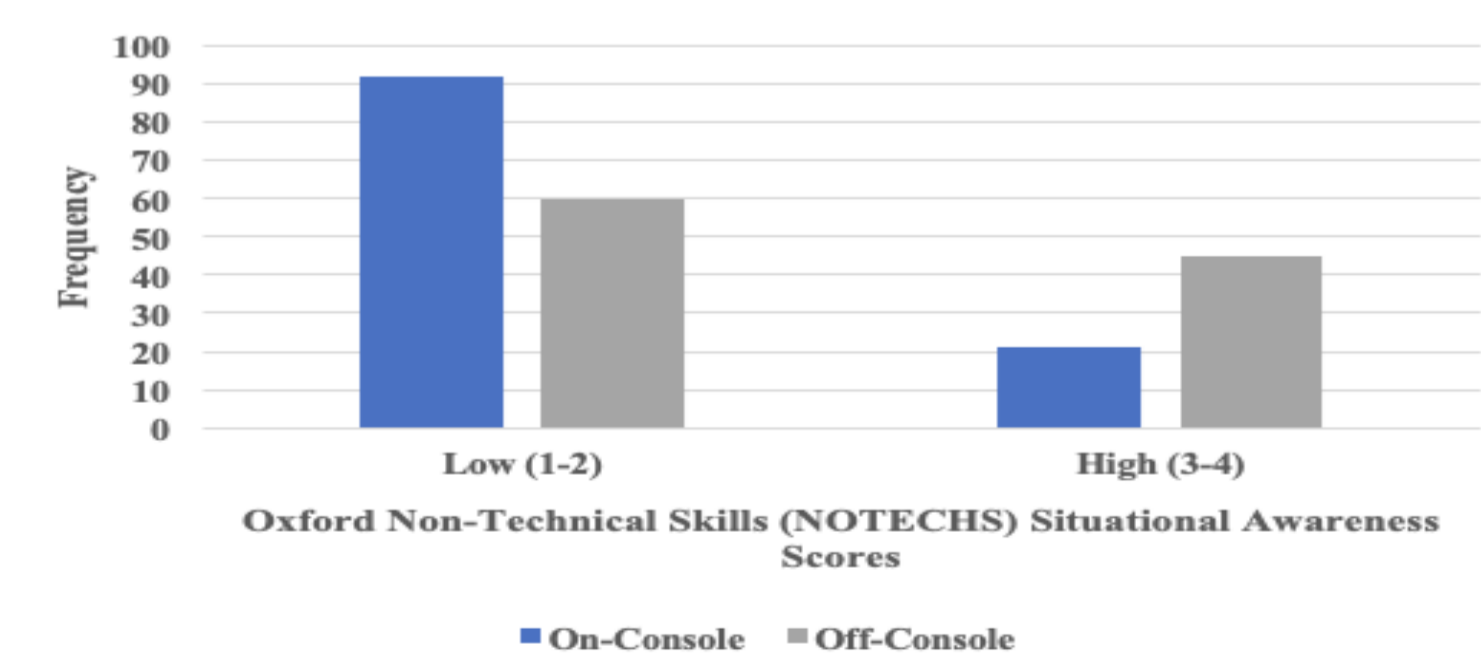Figure 4. Hierarchical Status on NOTECHS Ratings
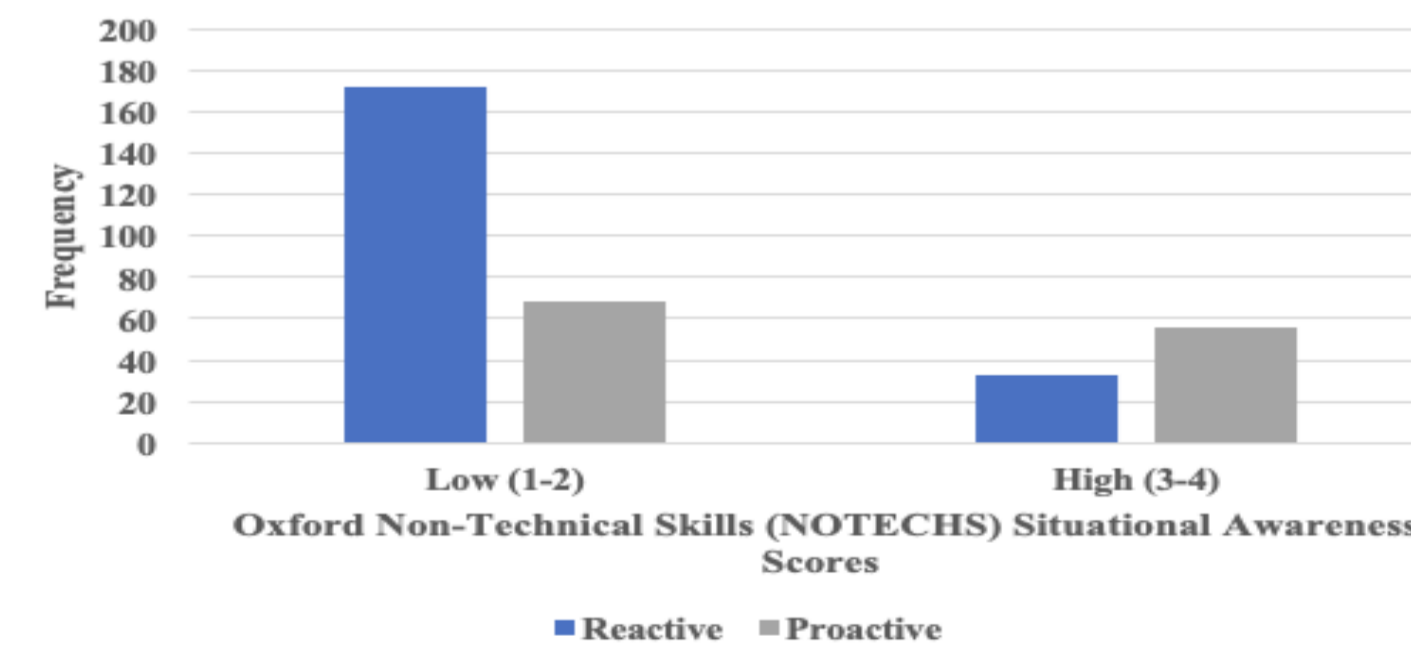
Note. Proactive utterances ($M = 2.48$) had significantly higher NOTECHS scores than reactive utterances ($M = 1.76$) ($p < 0.01$).

Figure 5. On-Console Status on Utterance Timing

Note. Utterances were more reactive when on the console and more proactive off the console ($p < 0.05$).

Figure 6. On-Console Status on NOTECHS Ratings

Note. Utterances made by the surgeon or trainee surgeon had significantly higher NOTECHS situational awareness scores when they were off-the-console ($M = 2.42$) rather than on ($M = 1.78$).

Conclusion

On-console status, rather than the assumed hierarchical status, has the greatest influence on frequency, timing, and rating of risk utterances during robot-assisted surgery. Thus, the hierarchy lead is determined by the performing surgeon, regardless of that individual's status within the hierarchy chain.

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