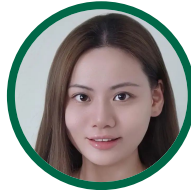


Understanding Dentists' and Patients' Perspectives on Dentistry Robots: An Exploratory Study in Dentist-Patient-Robot Interaction



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RARE LAB

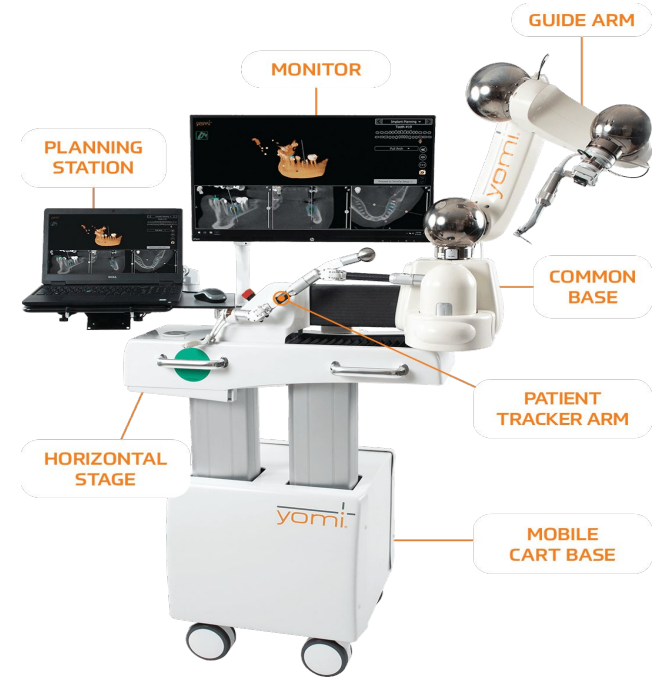
Background

Dental robots can assist with:

- Implant surgery
- Diagnosis
- Intraoral scanning
- Treatment planning



Yomi-assisted dental implant procedure in a clinical setting



Yomi robotic-assisted dental implant system

Research Question

**How do dentists and
patients actually feel
about using robots in
dental care?**

Research Gap

Previous Research

- Technical performance
- Accuracy
- Surgical outcomes

What Is Missing?

- Dentists' perspectives
- Patients' perspectives
- Trust & acceptance in dental care

Research gap: Limited understanding of dentists' and patients' perspectives on dental robots.

Our Study Goals

Benefits

What benefits do people see in dental robots?

Concerns

What are their main concerns?

Future Role

What role should robots play in future dental care?

6 Dentists
86 years combined
practicing experience
+
12 Patients

Surveys + Interviews in real dental offices

Patients Survey and Introduction

Likert-scale questions on

- **Willingness to undergo a procedure**
- **Trust** to improve the quality of care
- Level of robot **autonomy**
- **Comfort**
- **Patient education**
- **Patient-dentist interaction**

(each followed by open response)

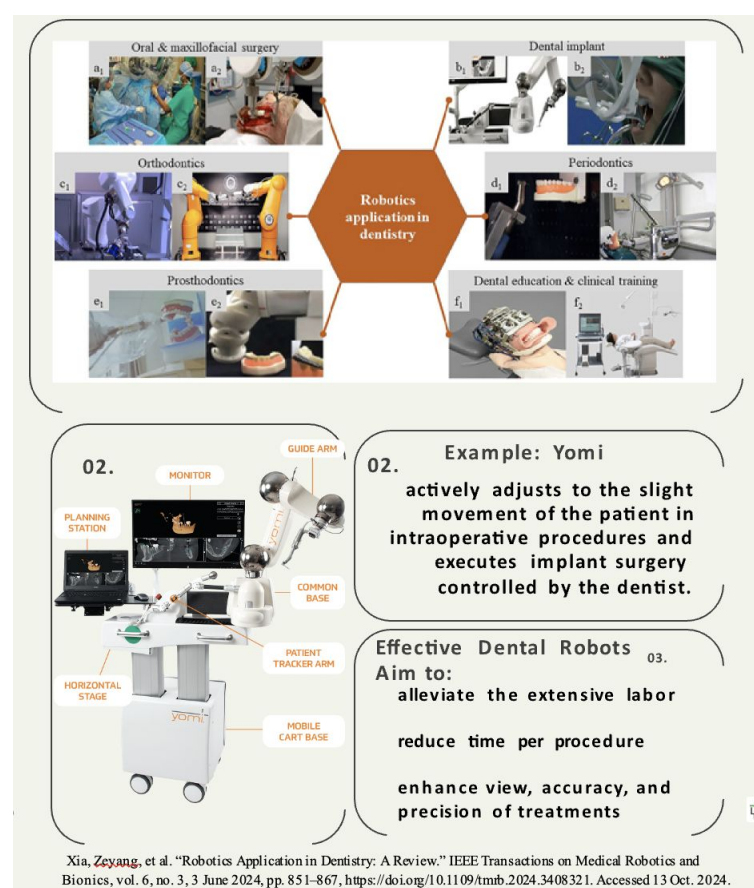


Fig. Brief overview of current dental robots and their applications.

Dentists Survey & Interview

Survey

- Years practiced
- Specialty
- Prior use
- Effectiveness of improving dental procedures
- Concerning-ness on robotics replacing dental workers

(Each followed by open response)

Interview

- Inductive approach
- Prompts on perceived advantages, disadvantages, human involvement, and future directions of dental robots

Participants

Dentist

- 20 dentist offices in person
- Recruited 6 practicing dentists
 - 86 years of practicing experience



Table. Demographic data collected from participating dentists in survey study.

Dentist	Years Practicing	Dental Specialty
D1	10	General Dentist
D2	19	General Dentist
D3	40	General Dentist
D4	5	Oral Maxillofacial Surgeon
D5	8	Pediatrics
D6	4	General Dentist

Patients

- 17 patients across various dentists' offices in Florida completed the survey

Qualitative Data Analysis

Coding

- Codebook of themes
- Developed from repeated concepts and words with Nvivo 15.1

Interrater reliability

- Reviewed by two independent researchers
- Cohen's kappa of 0.86

Quantitative Data Analysis: Bayesian Approach

Bayesian analysis vs. frequentist approach

- Quantify evidence for two hypotheses
- Updates evidence as data comes in
- More intuitive than p-values

$$\underbrace{\frac{P(\mathcal{H}_1 \mid \text{data})}{P(\mathcal{H}_0 \mid \text{data})}}_{\text{Posterior Odds}} = \underbrace{\frac{P(\text{data} \mid \mathcal{H}_1)}{P(\text{data} \mid \mathcal{H}_0)}}_{\text{Bayes Factor (BF)}} \times \underbrace{\frac{P(\mathcal{H}_1)}{P(\mathcal{H}_0)}}_{\text{Prior Odds}}$$

Key measure: Bayes Factor

- Example: $\text{BF}_{10} = 5$ means the data are 5× more likely under H_1 than H_0

Patient Survey Results

Can dental robots replace dental workers?

- $BF_{10} = 134$
- Suggests that patients may view robotics as an assistive technology rather than a replacement for the dentist

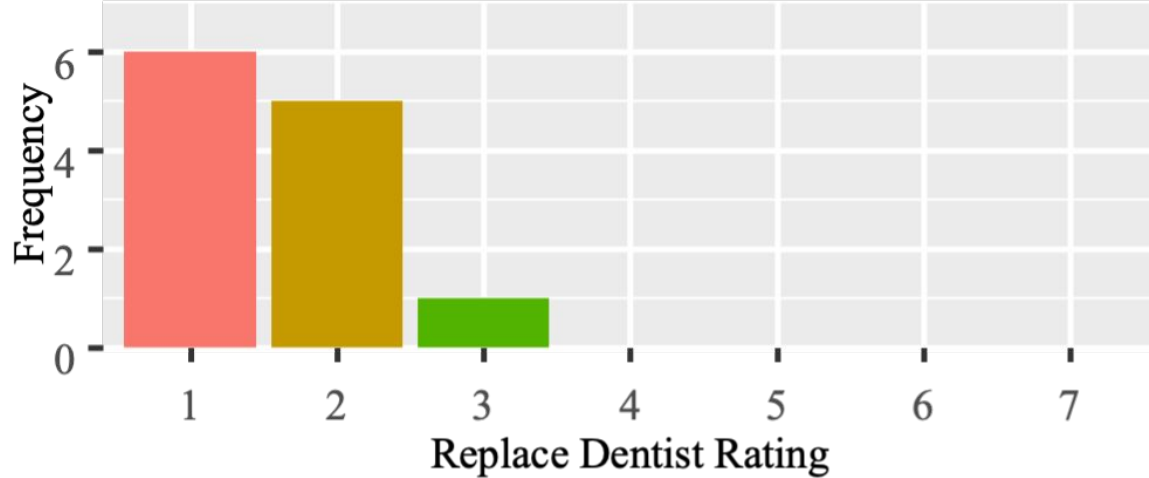


Fig. Patient disbeliefs about robots completely replacing dentists ($BF_{10}=10$), how likely a dental robot will replace a dental worker.

Patient Survey Results

- **Trust in robotics to improve dental care** had a mean of 4.17 out of 7
- **Willingness to undergo a dental procedure involving robotics,** had a mean of 4.17 out of 7
- **Comfort with robotic-assisted procedures** had a mean of 4.42 out of 7
- Taken together, these findings suggest that patients were generally **neutral rather than strongly for or against robotic dentistry**
- Optimistic future of opportunities for robotic dentistry to continue being developed and integrated into the dental field today

Patient Survey Results

How important is patient education on how technology will be used?

- Average of 5.75 out of 7
- $BF_{10} = 125.5$
- Opportunities for increasing education and dentist-patient communication to further acceptance of dental robots.

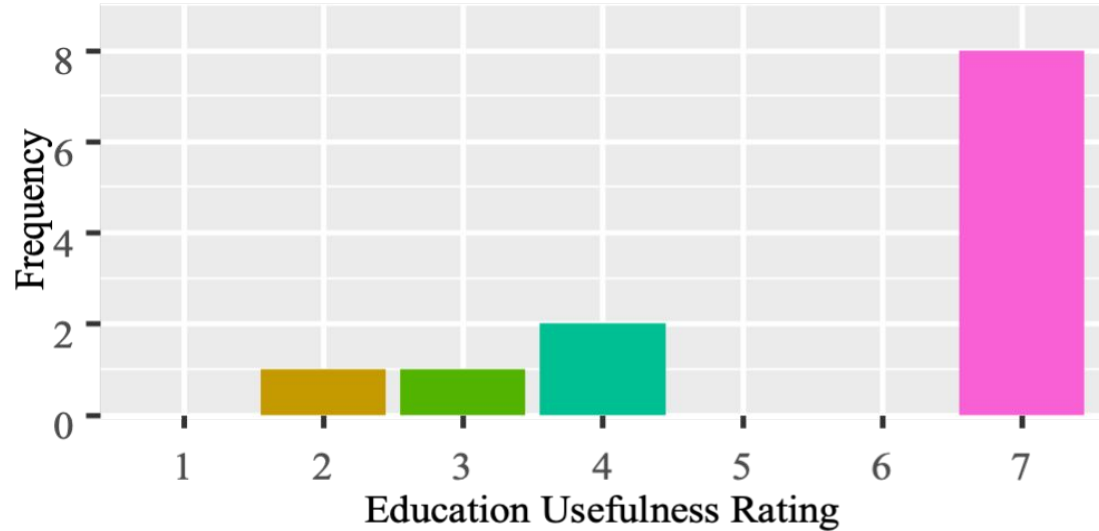


Fig. Patients highlight on importance of understanding robotics before their dental procedure; Education on Robotics Before Procedure ($BF_{10} = 125.522$). The distribution plot represents the number of patients who selected each response.

Patient Survey Results

How important is the patient-clinician conversation?

- Average response was 4.92 out of 7
- Patients value a tailored and personal clinical experience, not automation
- Suggests there may be an opportunity to increase acceptance through better education and communication.

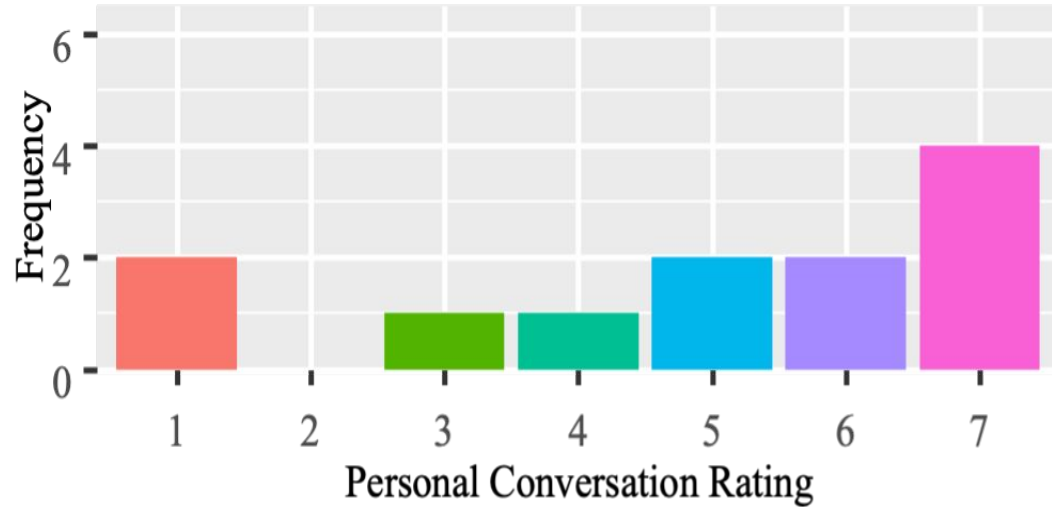


Fig. Importance of personable conversations between patients and dentists. Moderate evidence favors no difference ($BF_{01} = 3.344$). The distribution plot represents the number of patients who selected each response.

Patients Open-Responses

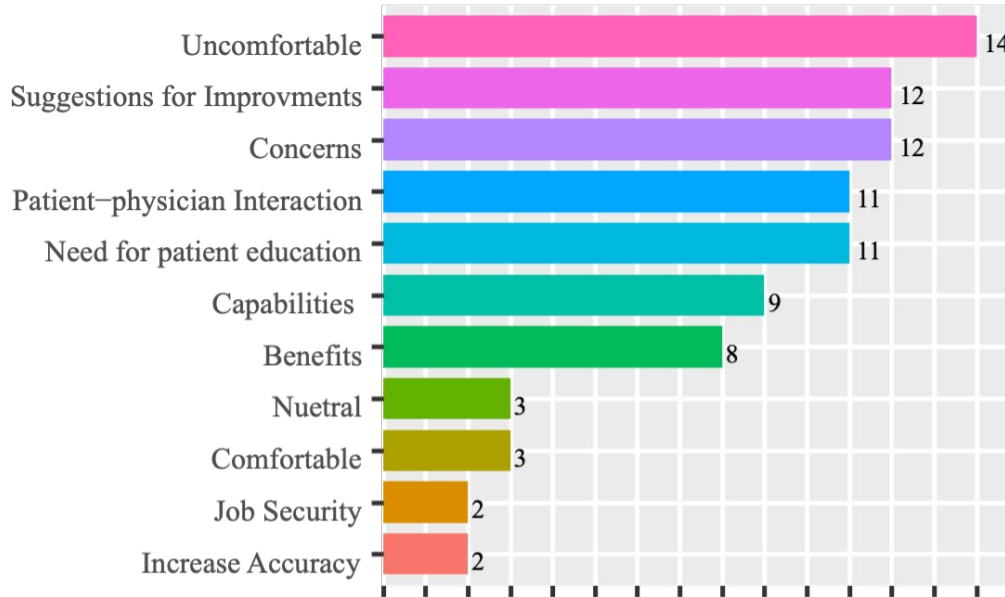


Fig. Number of entries per code found in the patient free response questions. Codes with the most responses increase reading down the xaxis of the graph, where response percentages include *Improvements* at 12, *Concerns* at 12, and *Uncomfortable* at 14.

Uncomfortable
*"anxious to
think about
automating"*

Patients Open-Responses

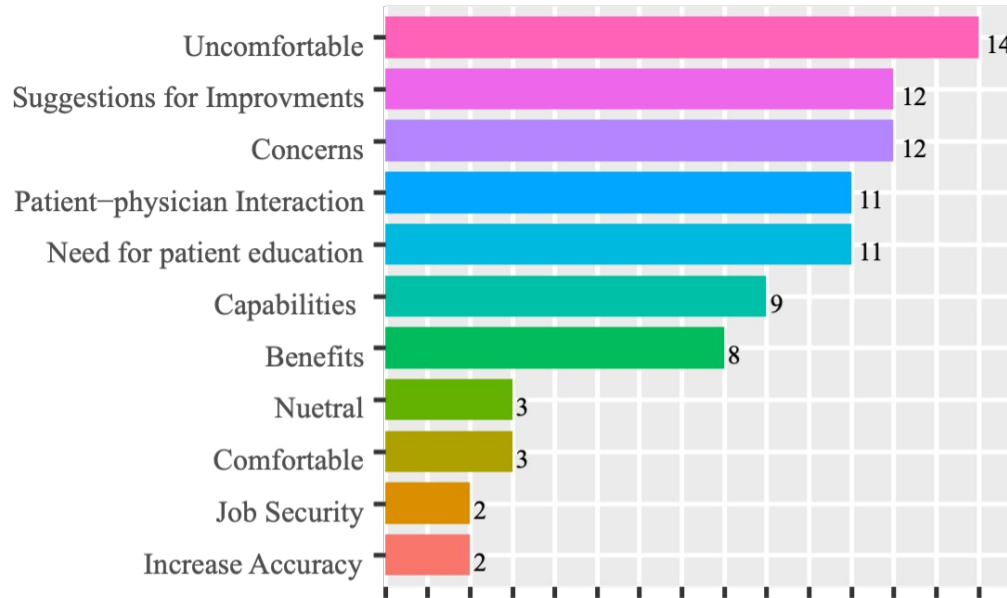


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Uncomfortable
"anxious to think about automating"

Suggestions for Improvement
"understanding pain management"

Patients Open-Responses

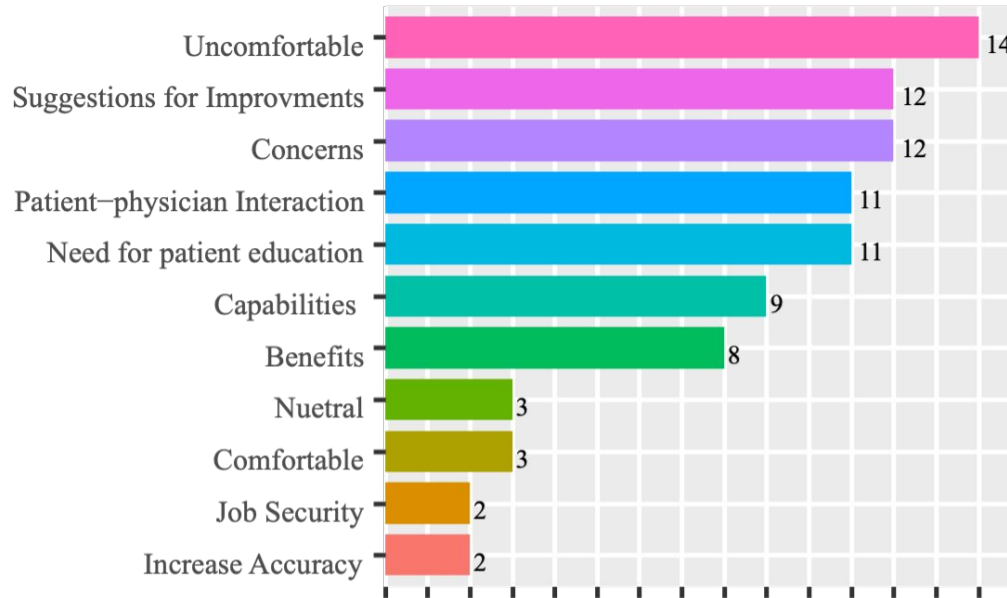


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Concern
"malfunction could occur and harm me"

Patients Open-Responses

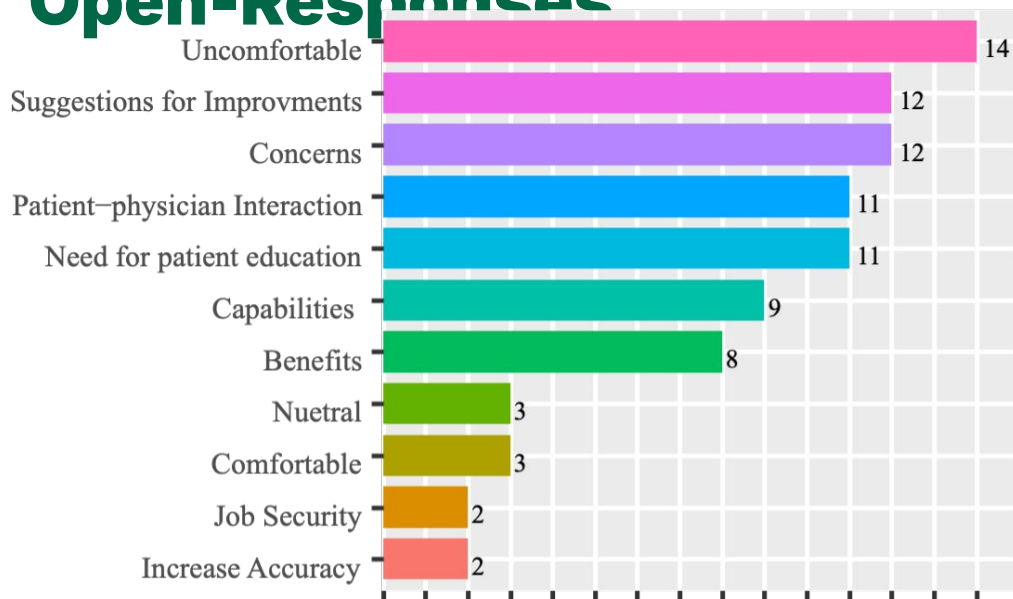


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Uncomfortable
"anxious to think about automating"

Suggestions for Improvement
"understanding pain management"

Concern
"malfunction could occur and harm me"

Interaction *"the dentist takes into consideration my concerns and needs"*

Patients

Open-Responses

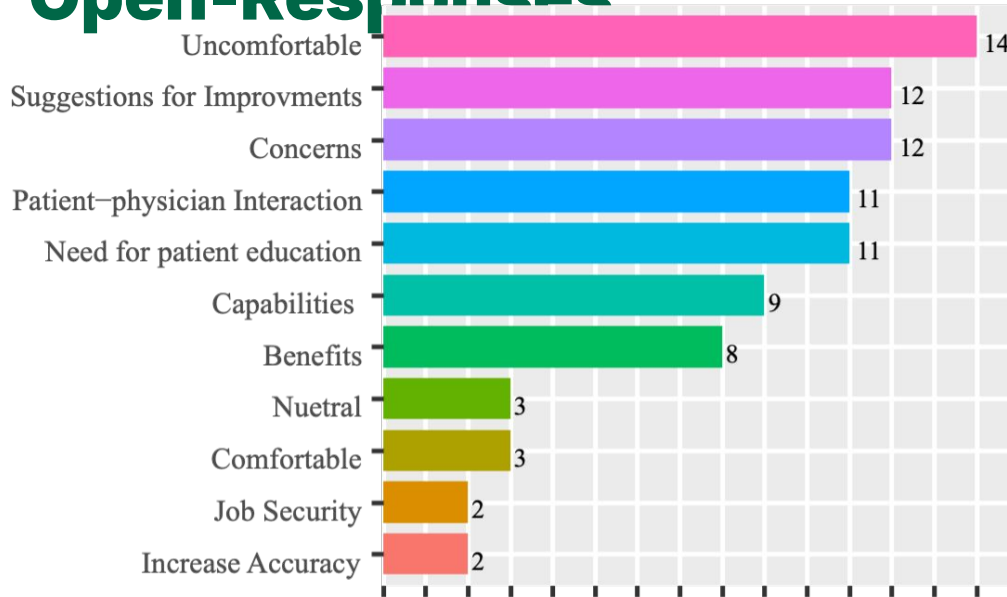
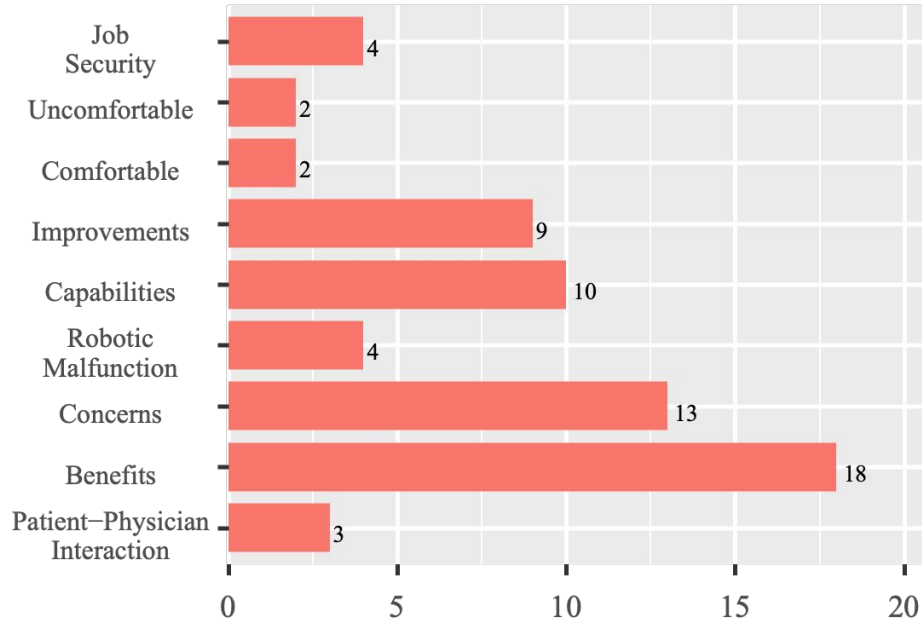


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Overall, patient open responses suggest that the technology may be most acceptable when it **enhances the dentist's capabilities rather than attempting to remove the dentist** from the treatment process.

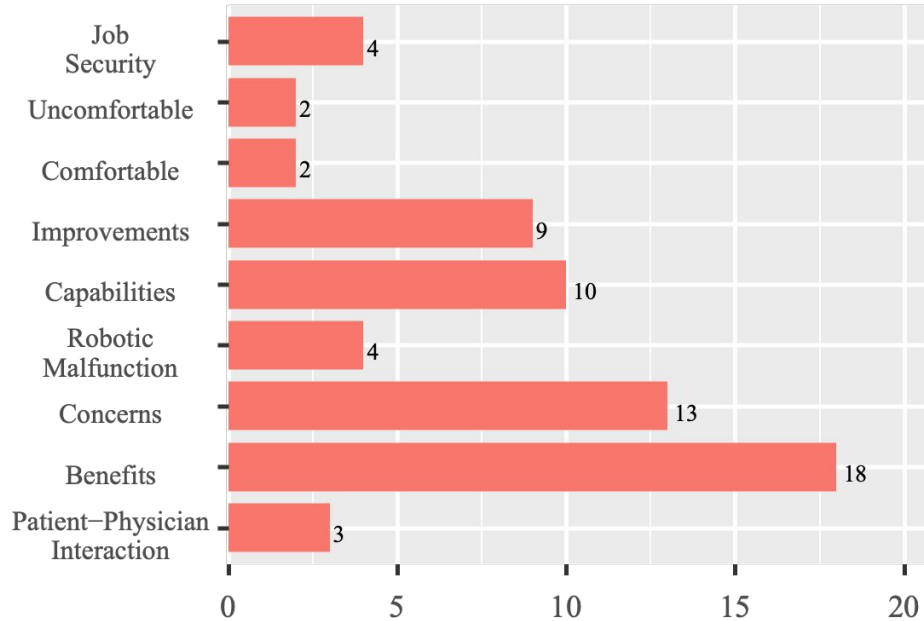
Dentist Interview Codes



Benefits and Capabilities
*"diagnostics...instant
second opinion"*

Fig. 5. Dentist Interview Codes. Number of entries per code from the four inductive interviews with dentists.

Dentist Interview Codes

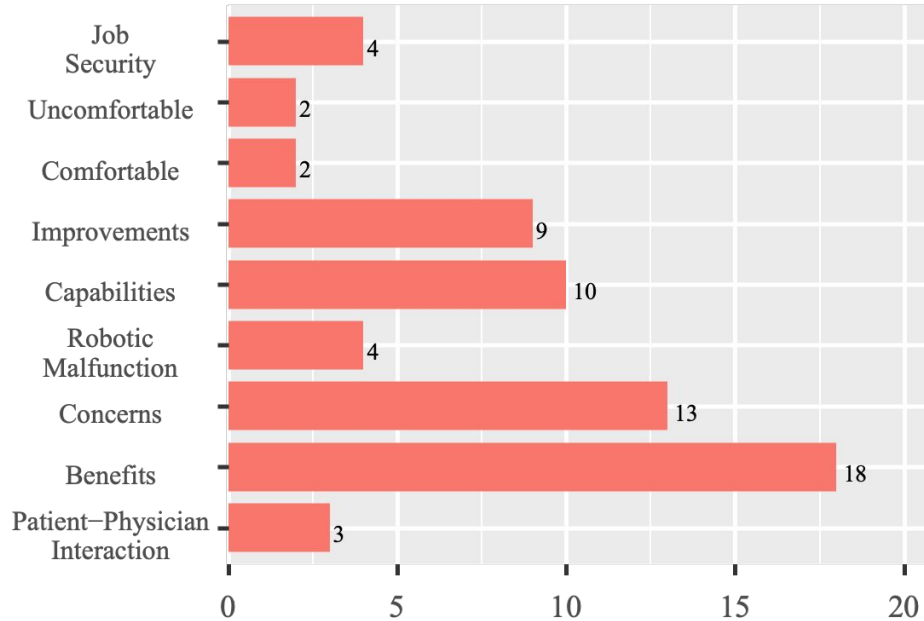


Benefits and Capabilities
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Concerns *"How it will
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Fig. 5. Dentist Interview Codes. Number of entries per code from the four inductive interviews with dentists.

Dentist Interview Codes



Benefits and Capabilities
*"diagnostics...instant
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Concerns *"How it will
handle unforeseen
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Improvements *"ensure
it targets the areas
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Fig. 5. Dentist Interview Codes. Number of entries per code from the four inductive interviews with dentists.

Dentist Interview Codes

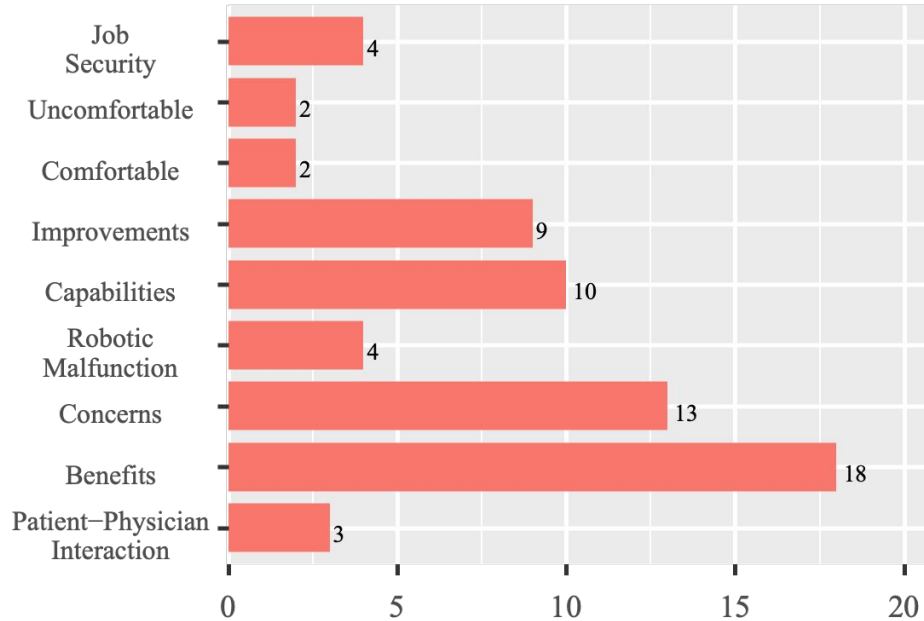


Fig. 5. Dentist Interview Codes. Number of entries per code from the four inductive interviews with dentists.

Benefits and Capabilities
"diagnostics...instant second opinion"

Concerns *"How it will handle unforeseen circumstances"*

Improvements *"ensure it targets the areas being operated on"*

Patient-Physician Interactions *"it would take away the element of the patient-doctor relationship if it was too involved with patient care"*

Dentist Survey Results

On Replacing Dentists Themselves

- All experts dismissed job security concerns
- Bayesian analysis revealed $BF_{01} = 1.649$
- Dentists' belief that dental robots could replace them is inconclusive.

On Procedure Improvement Effectiveness

- Moderate evidence ($BF_{01}=3.299$) against any difference in responses.

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Key Takeaways

1. Dental robots are more acceptable as **assistive tools** than **replacements**.

Dentists

Preferred assistive roles over full autonomy.
E.g., sterilization, suction, diagnostics

Patients

No patients supported complete replacement of dentists.
 $BF_{10} = 134.487$

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Key Takeaways

2. Future dental robots need **better adaptability** and **strong human oversight**.

Dentists

Concerned about adaptability to unexpected situations. E.g., sudden patient movement.

Patients

Preferred continuous dentist oversight. Dentists should be able to stop or adjust the robot.

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Key Takeaways

3. **Patient education** and **dentist-patient interaction** should be preserved.

Dentists

Concerned that robots may reduce patient-doctor interaction.

Patients

Highly valued robot education before procedures.
 $BF_{10} = 125.522$