

Enhancing Neonatal Intubation with Deep Learning: Automated Identification of Airway Anatomy

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Summary

“We developed a deep learning model that identifies key airway anatomy during neonatal intubation. The model identified the glottis faster than the medical providers on average.”

Introduction

- Video laryngoscopy (VL) has benefits over direct laryngoscopy.
 - Improved success rate
 - Decreased procedural adverse events
 - Better view of airway anatomy

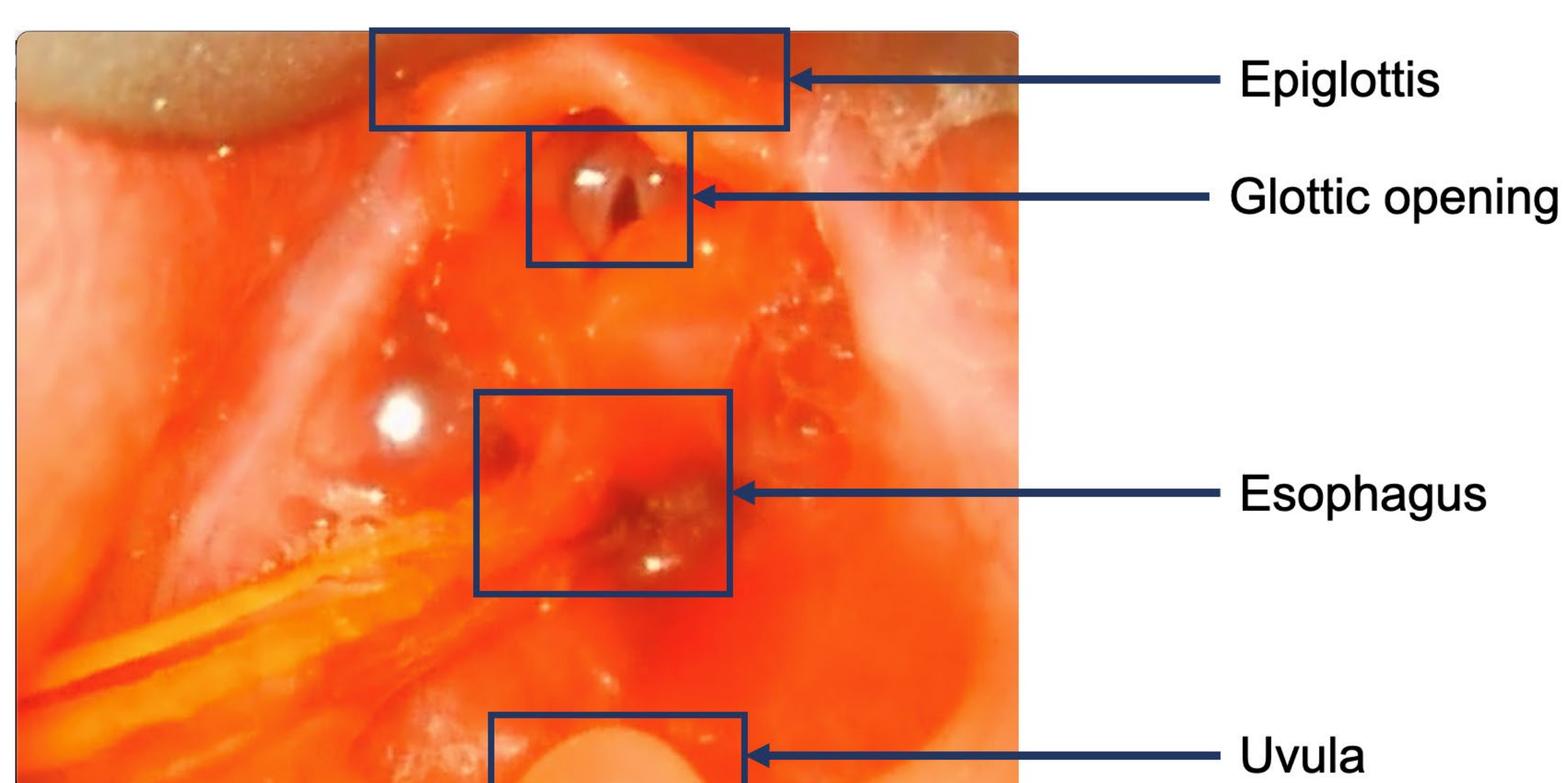
- Despite benefits of VL, procedural success requires rapid and correct identification of anatomy.

Objectives

- Use deep learning algorithms to identify the glottic opening in VL recordings.
- Compare the time taken by human subjects versus deep learning algorithms to accurately identify the glottic opening.

Methods

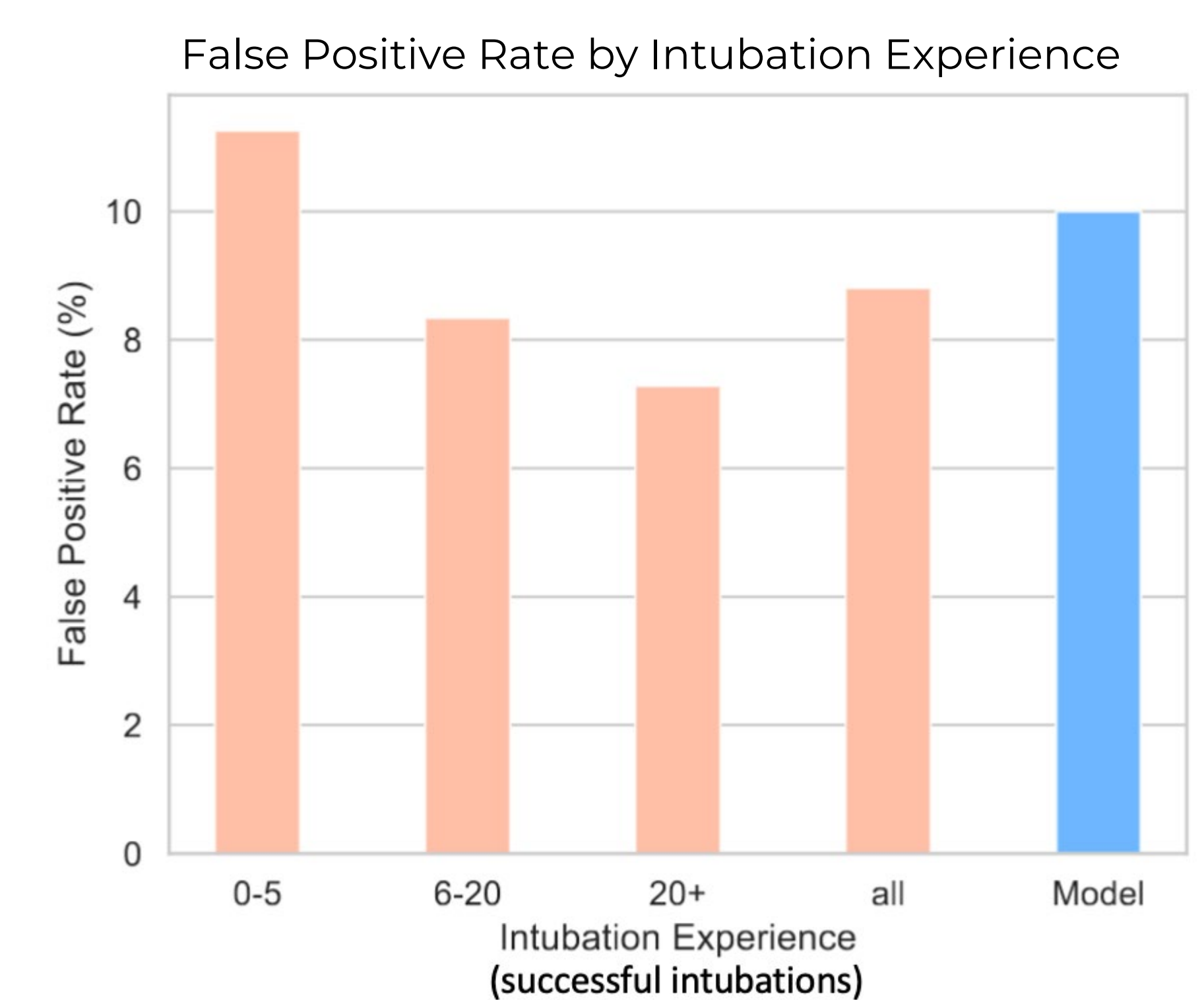
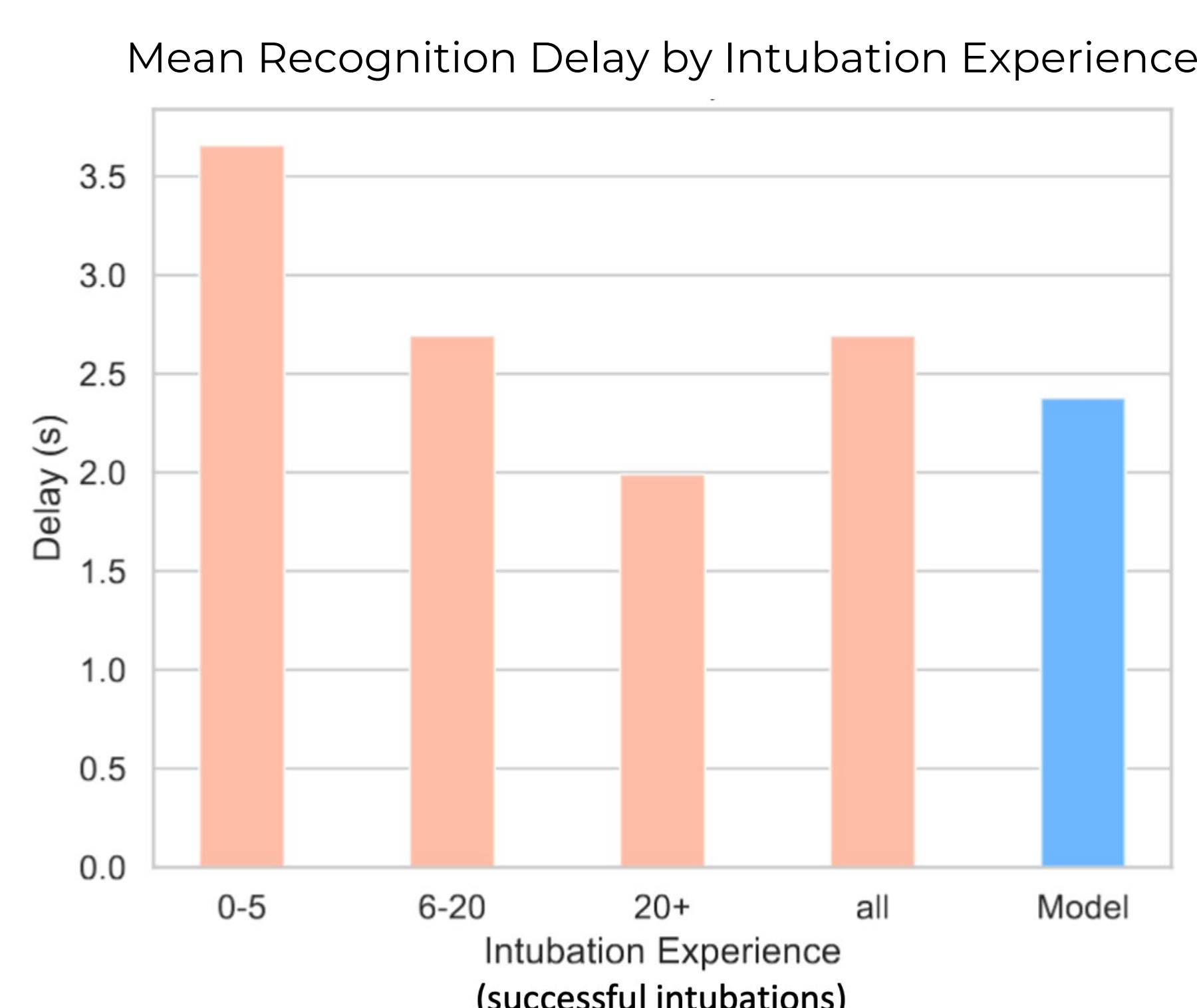
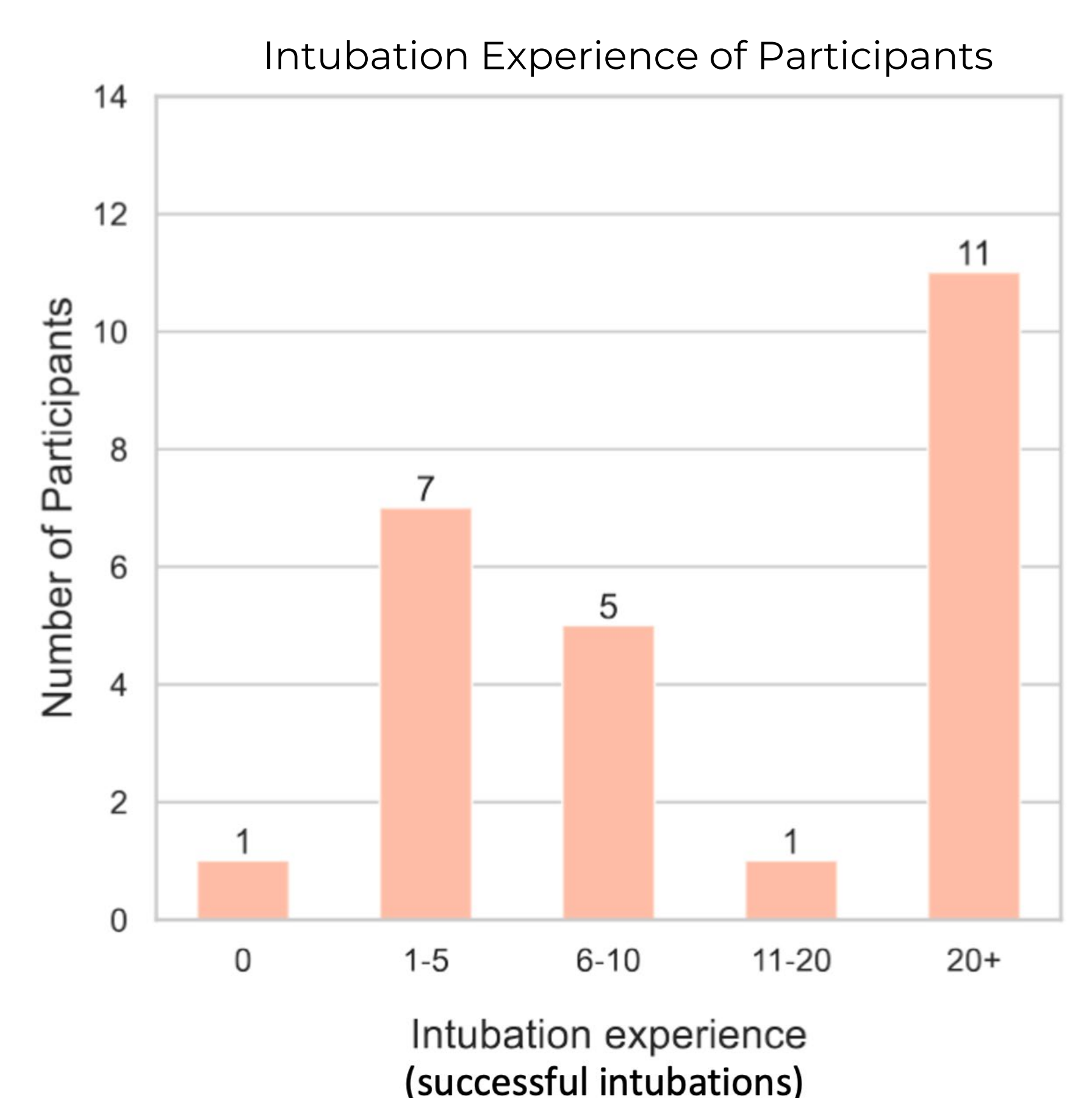
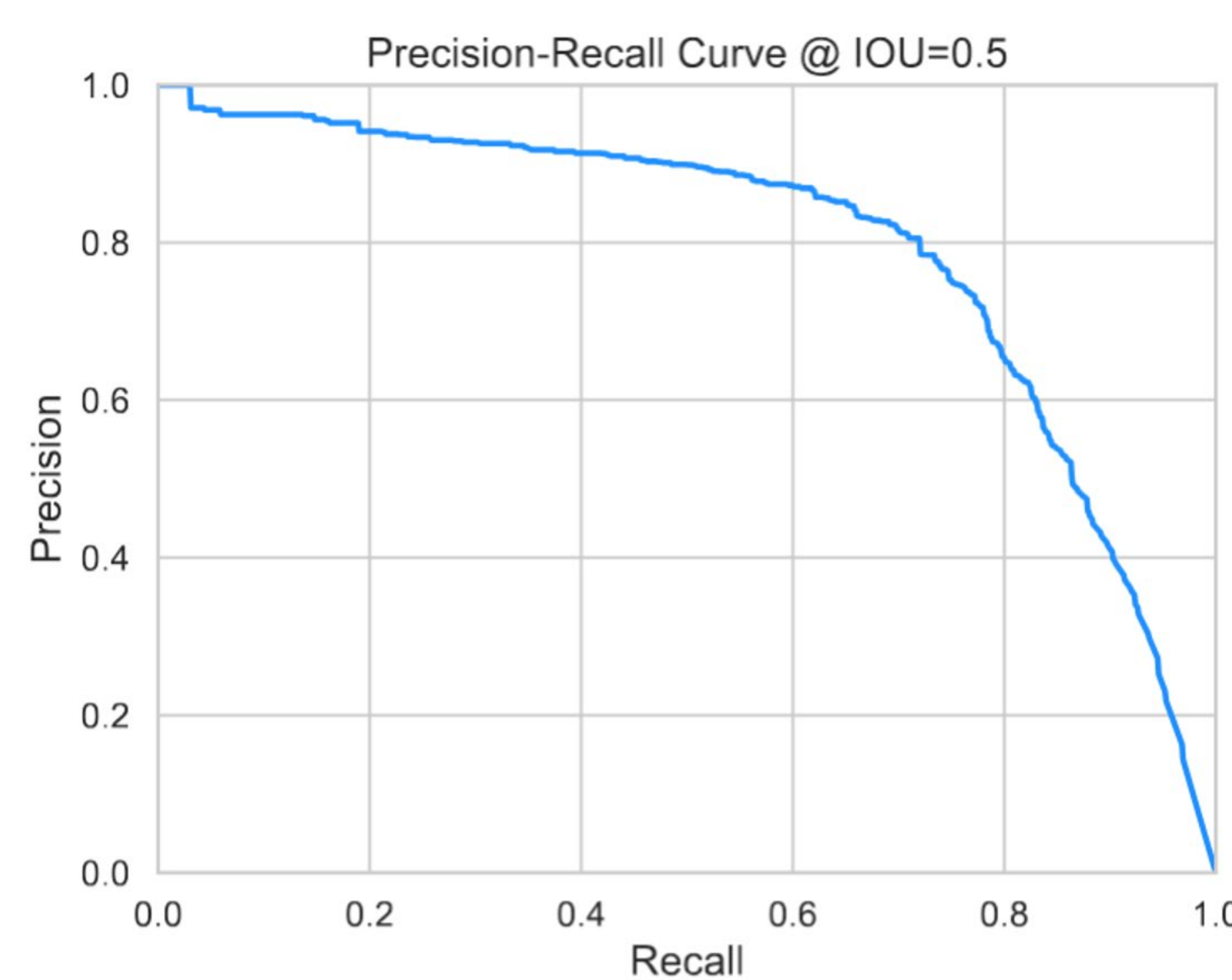
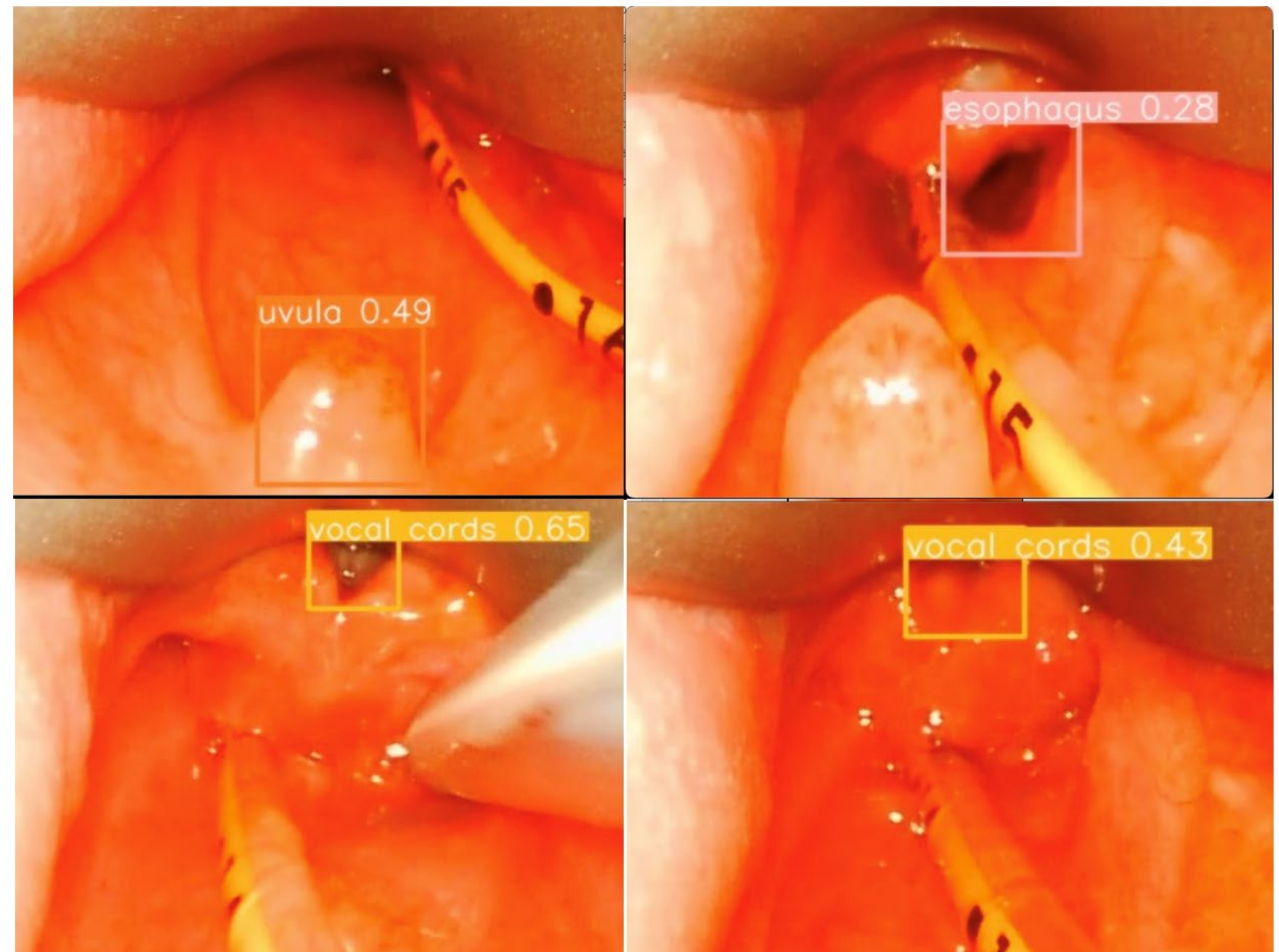
- 84 VL intubations routinely recorded for teaching purposes at 2 NICUs in Madison, WI.
- 2 neonatologists labeled airway anatomy with bounding boxes on 1,623 still frames.



- YOLOv8, a deep learning model, was trained using 74 videos to automatically detect anatomical landmarks.
- 10 test VL intubation videos were selected and blinded to the model and NICU medical providers.
- Timing and Identification of Glottic Opening: 25 NICU medical providers and an AI model were timed from the start of 10 test videos until they identified the glottic opening using a bounding box.
- Establishing Ground Truth and Assessment: 2 neonatologists marked the earliest visible glottic opening in each video and assessed the accuracy of the model's and participants' identifications.

Results

Model Output Examples



Model Performance:

- Average precision: 80.8% (SD = 11.0%)
- Average recall: 75.3% (SD = 11.0%)

Discussion

- Successful application of a deep learning algorithm to identify key airway anatomy during neonatal intubation.
- Identified glottic opening faster than many medical providers especially those with less intubation experience.
- Future potential of deep learning to assist in neonatal intubations which may improve procedural success and safety.

References

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