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3D-PRINTED MODELS FOR COMPLEX PEDIATRIC SURGICAL CASES:

MULTI-DISCIPLINARY PERSPECTIVES ON A "MODEL" FOR QUALITY IMPROVEMENT

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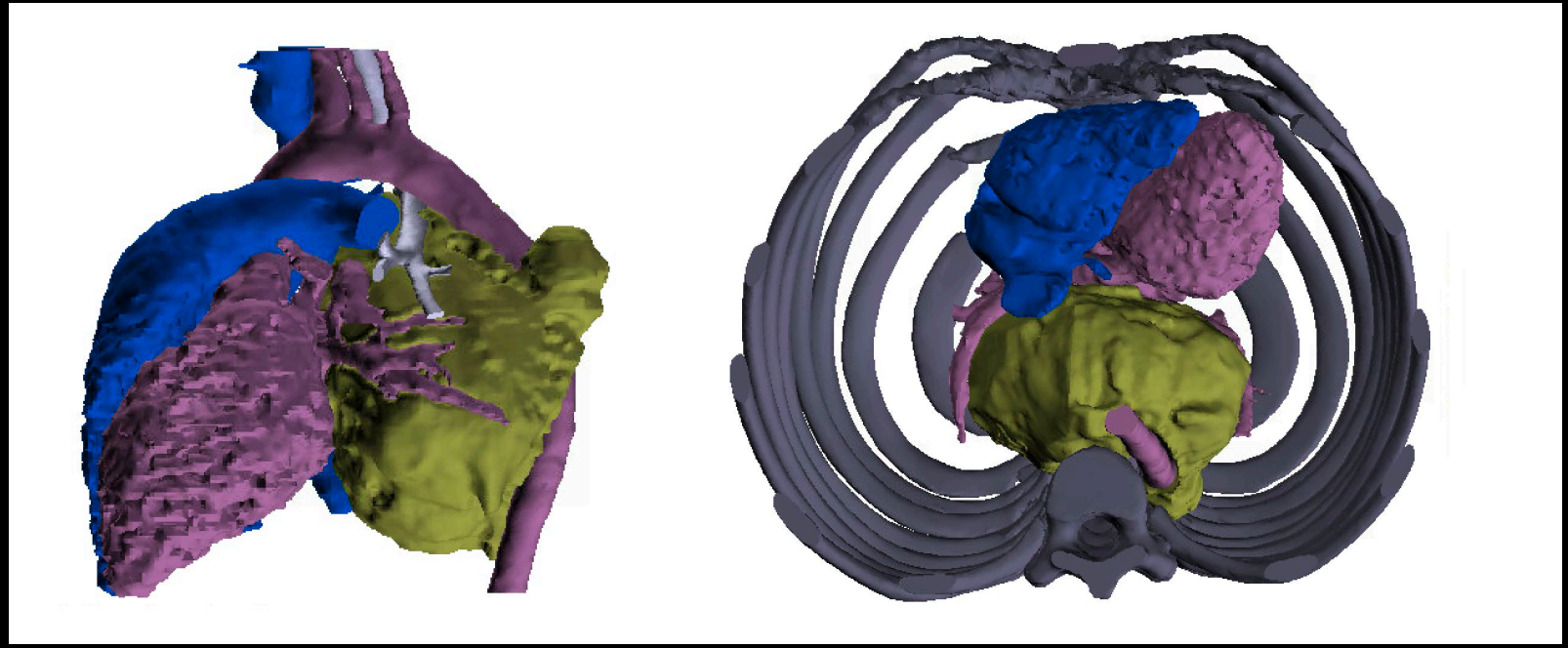
Introduction

- **Three-dimensional (3D) modeling** has been increasingly used in surgical planning across multiple disciplines.
- At our institution, 3D-printed models have recently been incorporated into our **pediatric general surgery** practice for several **complex cases**; however, we have yet to seek **clinician feedback** regarding their use.
- Therefore, we aimed to assess the impact of 3D-printed models on **surgical planning** and **multidisciplinary team discussion**.

Methods

- **3D-printed models** were generated from **photon-counting CT scans** (Naeotom Alpha, Siemens Healthineers) using Materialise online 3D-printing service and printed on a Stratasys J750 PolyJet printer.

3D Rendering of a Mediastinal Malignant Rhabdoid Tumor *(in yellow)*



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Methods

- We utilized the **"Plan-Do-Study-Act" (PDSA) Quality Improvement** framework, focusing on the **study** of recent implementation of these models at our large academic institution.
- A **Qualtrics survey** was distributed to the **care team** involved in recent complex pediatric surgical cases utilizing 3D-printed models
- Using Likert scales (1 = strongly disagree; 5 = strongly agree) and free responses, we assessed the models' **usefulness in preoperative and intraoperative planning.**

- Pediatric oncologists
- Pediatric anesthesiologists
- Pediatric cardiothoracic surgeons
- Pediatric neurosurgeons
- Trainees (medical students/residents/fellows)

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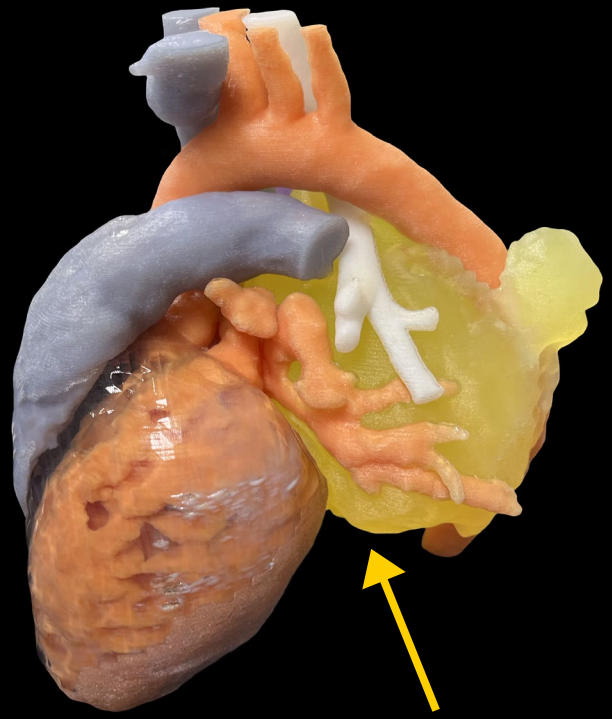
Models - Examples

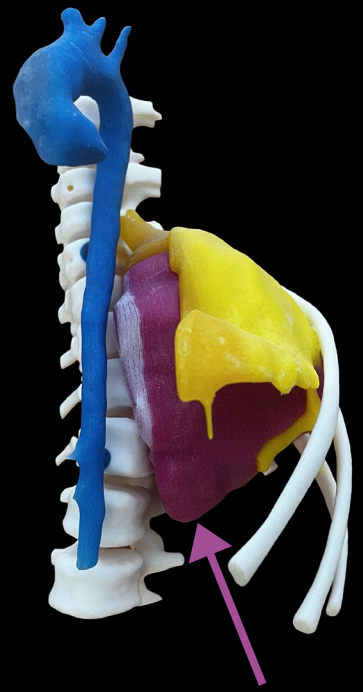


Mediastinal Malignant Rhabdoid Tumor

Tumor (*Yellow; Arrow*); Aorta, Left Atrium, Left Ventricle, Pulmonary Veins (*Red*); Trachea and Bronchi (*White*); Pulmonary Arteries, Left Atrium (*Blue*)

Paraspinal Ganglioneuroma

Tumor (*Light Yellow, Posterior; Arrow*); Aorta, Left Atrium, Left Ventricle (*Blue*); Right Atrium (*Red, Anterior)*; Esophagus (*Red, Posterior*); Superior Vena Cava, Inferior Vena Cava (*White, Anterior*); Pulmonary arteries (*Dark Yellow, Anterior*); Spine (*White, Posterior*)



Paraspinal Ganglioneuroblastoma

Tumor (*Purple; Arrow*); Aorta (*Blue*); Lung (*Yellow*); Spine/Ribs (*White*)

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Results - Demographics

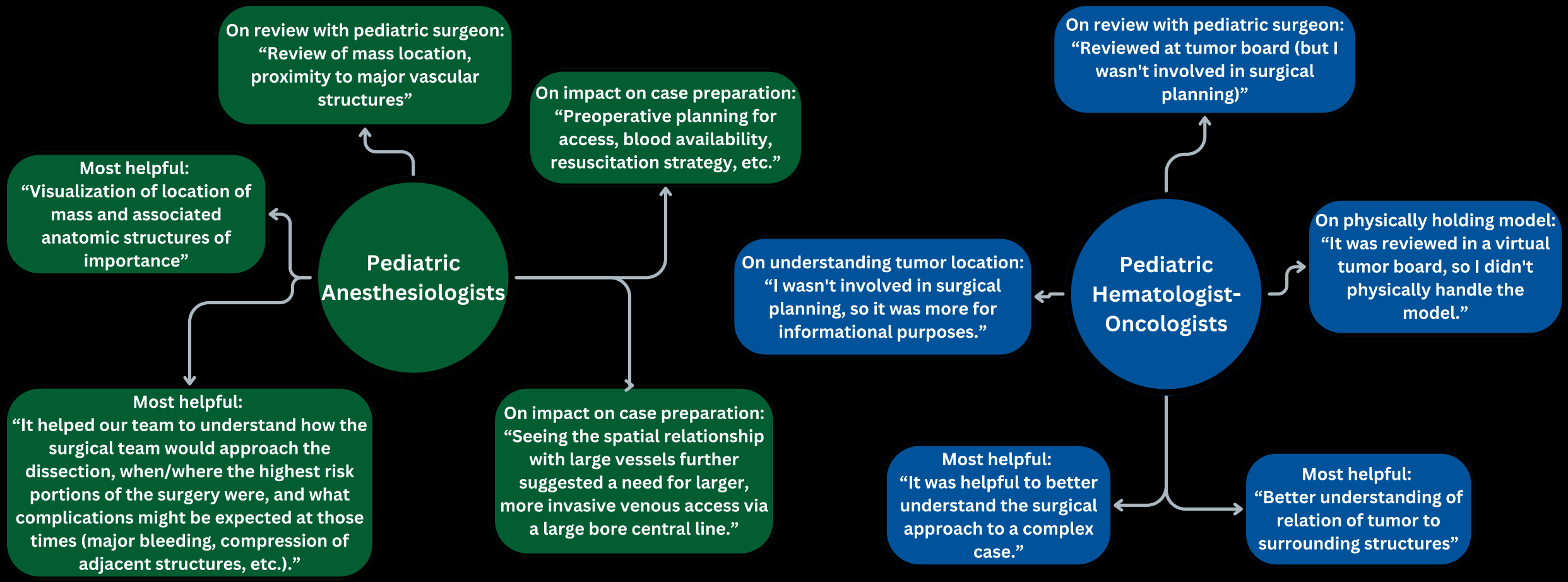
Eight respondents completed the survey:

- 2 pediatric oncologists
- 2 pediatric anesthesiologists
- 2 general surgery residents
- 1 pediatric cardiothoracic surgeon
- 1 fourth-year medical student on the pediatric surgery service

Results - Summary

- All participants (8/8; 100%) reviewed the models with the primary pediatric general surgeon.
- All either strongly agreed or somewhat agreed that the model helped them **better understand the "tumor location"** (mean Likert score 4.5) and **"anatomy close to the tumor"** (mean 4.6).
- The majority (7/8; 88%) strongly agreed or somewhat agreed that the model impacted their **case preparation** (4.3), noting its help with "**visualization of location of mass and associated anatomic structures of importance,"** and "**preoperative planning** for access, blood availability, and resuscitation strategy."
- Even "reviewing the model in **virtual tumor board**" helped clinicians; 5/8 (63%) strongly agreed that **physically holding the model** (mean 4.3) was necessary for it to be helpful.

Results – By Specialty



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Results – By Specialty

General Surgery Residents (Pediatric Surgery Rotation)

- Most helpful: "Quality of model"
- Most helpful: "[seeing the tumor's] location to the aorta and spine"
- On review with pediatric surgeon: "We went over the model the day prior to the case and then brought the model into the OR for the case"

Medical Students (Pediatric Surgery Rotation)

- Most helpful: "Visualizing structures close to the bullet."
- On review with pediatric surgeon: " We reviewed the CT scan numerous times so I had an idea [before the surgery]"
- On physically holding model: "It was super helpful to be able to hold the model in my hands, turn it around and look at it from different angles to understand what anatomy and structures were close."

Pediatric Cardiothoracic Surgeons

- Most helpful: "Saw that it was doable."
- On impact on case preparation: "Guided bypass strategy. Showed where difficulty would be."

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More on this topic…

For more on **3D-printing for surgical planning** as a **quality improvement initiative**, please read our recent case report on a **mediastinal malignant rhabdoid tumor** (PMID: 39156536)

QR code to case report

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