Scaling and Deploying an Advanced Visualization Platform at Ochsner Health

At the intersection of Neuroscience and Biodesign

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Ochsner BioDesign Lab

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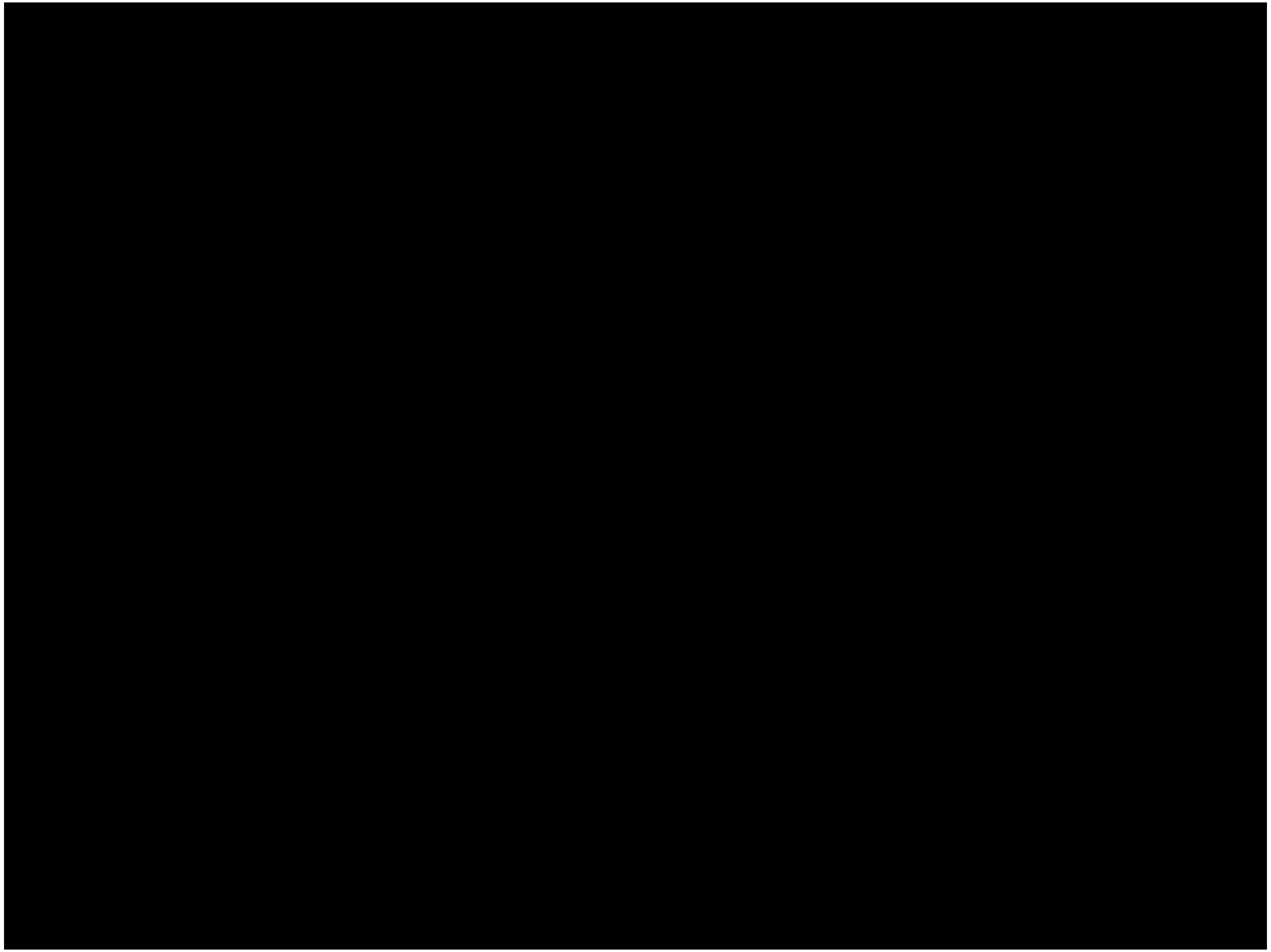
sclosures & Fundi

1. Advisory Roles: Doximity, XRHealth
2. Medical Legal
3. Funding:
    1. Ochsner LSU-Shreveport Collaborative Intramural Research Program
    2. Terence C. D'Souza, MD, Fellowship in Neuroscience
    3. Ochsner Philanthropy, Academics, & Neurosciences

Outline

1. Advanced Visualization: Why & How
2. Intracerebral Arterio-Venous Malformations (iAVMS)
3. Next Steps & Discussion

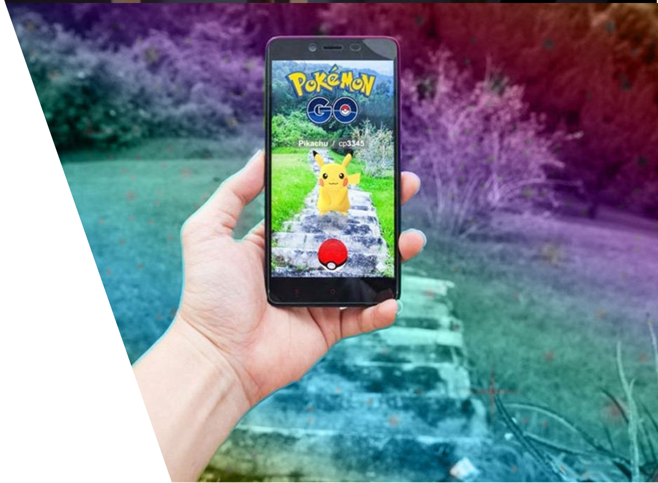
Rotational Angiography: Axial Series



Mixed Reality: AR and VR

- Virtual Reality is an artificial environment which is experienced through sensory stimuli (such as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment
- Augmented Reality is a form of technology that superimposes a virtual image onto the user's view of the real world, offering a life-like and often interactive virtual overlay onto a real world environment

mXR



3D Printing

Workflow

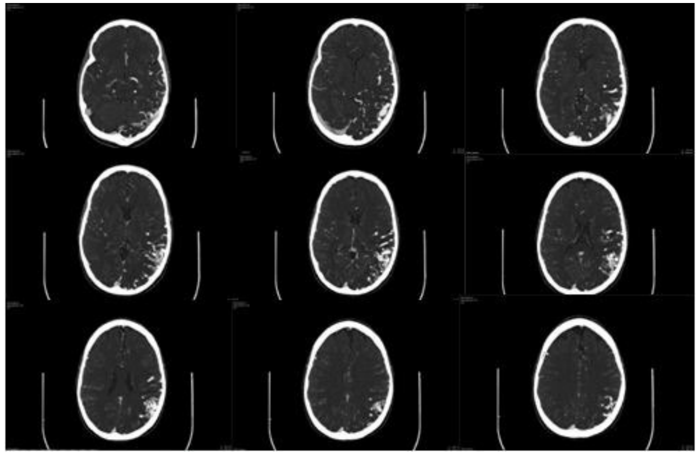
Clinical Imaging Needs → Image Acquisition → Segmentation → Advanced Modeling

Radiology

3D Rendering Process

- Neuroscience
- Transplant
- Cardiac
- Orthopedics

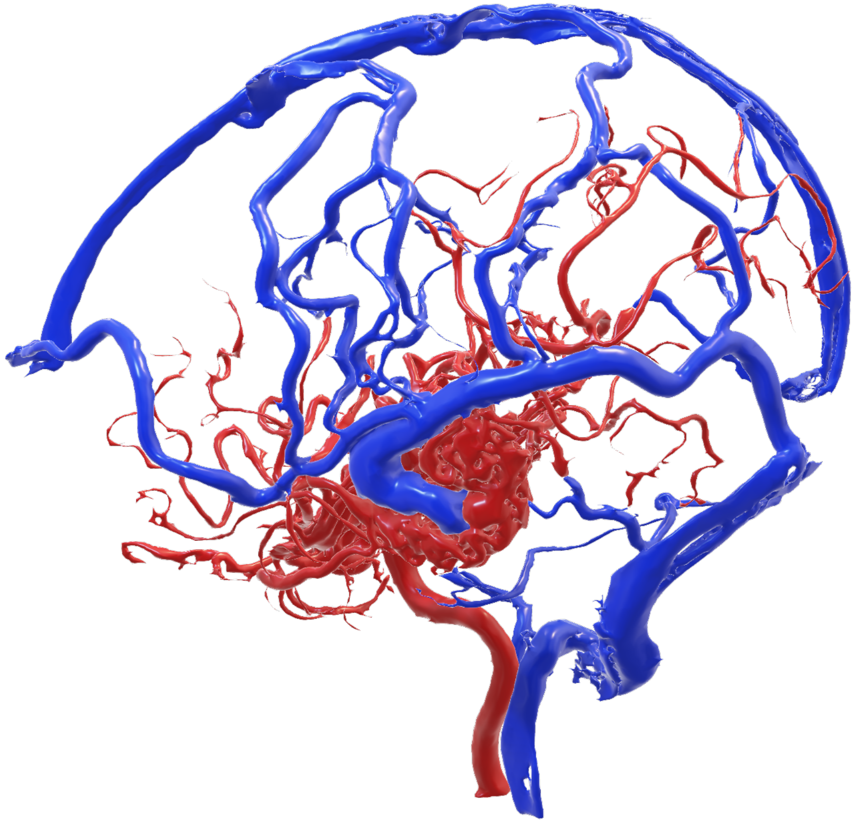
Image Ordering

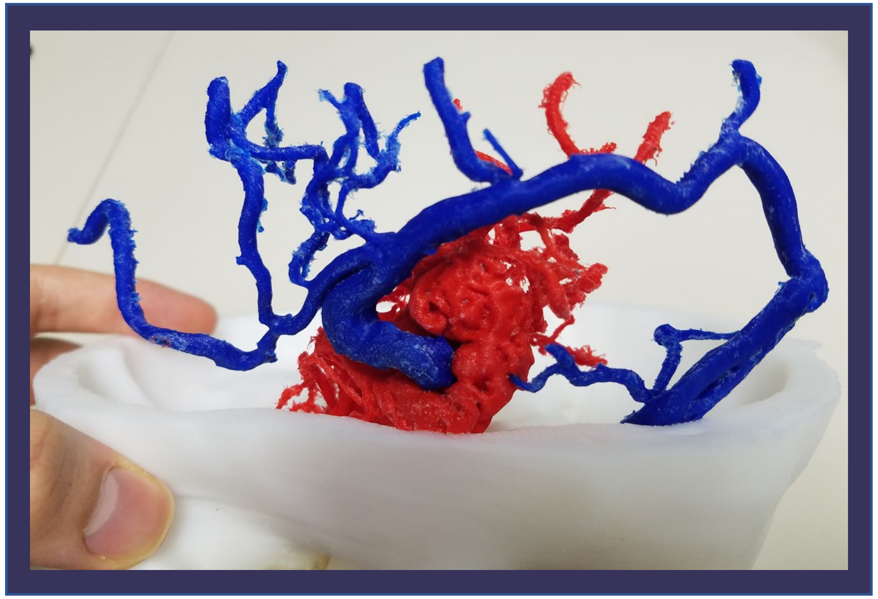


EMR Order: Model Request

3DV → 3DP, VR, AR/Holo

Intracerebral
erio-Venous Malformation (AVMs





Research Questions

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1. Is it feasible to produce & assess the use of patient-specific anatomical AV models in the clinician training and care of iAVMs.
2. Can we describe when & how patient-specific anatomical AV models are being used in iAVMs?
3. Is there a differential utility of AV models across different experience levels?

Aims & Approach

1. Establish a **digital fabrication & assessment pathway** to create and evaluate patient-specific anatomical 3D AV models based on clinical neuro-imaging
2. Identify **epidemiological, clinical, and utilization attributes** associated with the use of patient-specific AV models in CVD.
3. **Assess the utility** of patient-specific AV anatomical models when compared to traditional 2D viewing across different clinical experience levels

Study

CVD AV Model

Prospective

N = 18 clinicians

Null Hypothesis: There is no difference in reported complexity/ utility of 3D Viewers based on experience

Retrospective

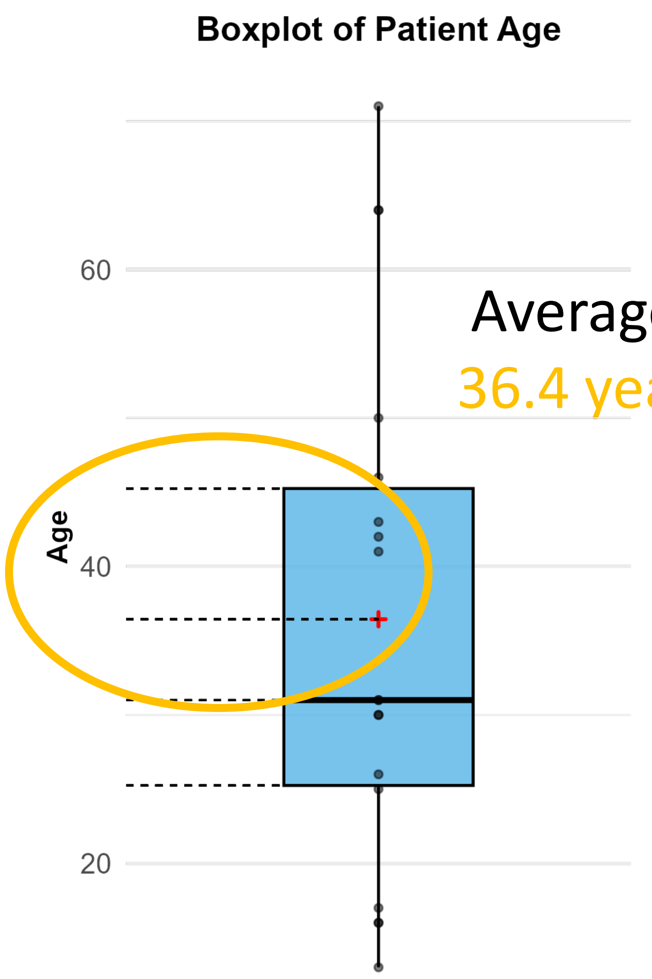
N = 19 AVM models

Describing associations between AV models in CVD and clinical & utilization metrics

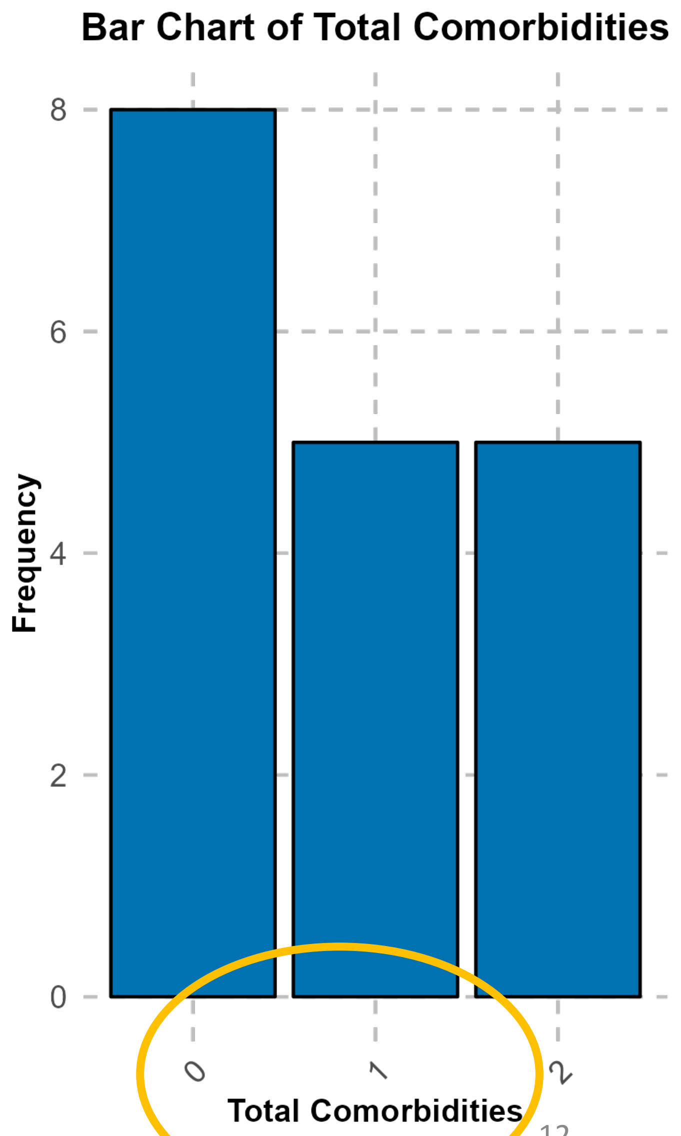
Epidemiological and Utilization Attributes

-June 2022

- 19 AVM AV Models
- 42.1% (n=8) were associated with a **neurovascular procedure**
- **Medicaid** (n = 11, 57.8%)
- 31.6% (n=6) **Female** patients
- 47.4% (n=9) were for **African-American** patients



Average age:
36.4 years old



Clinical and Utilization Attributes

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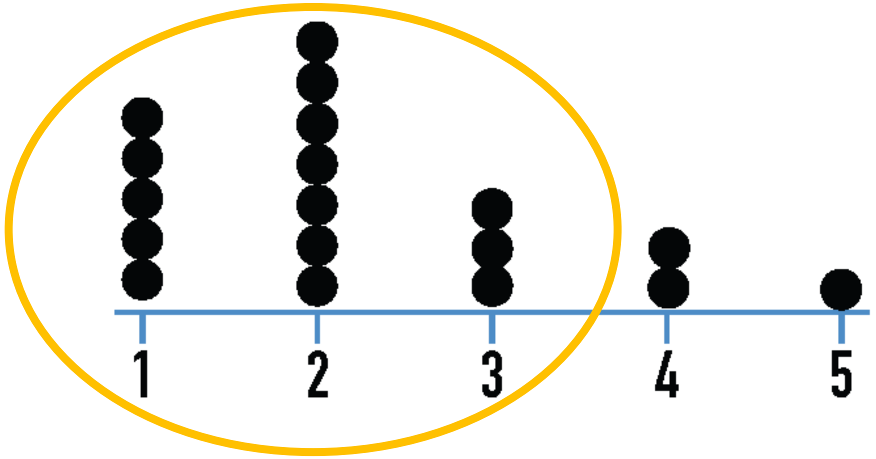
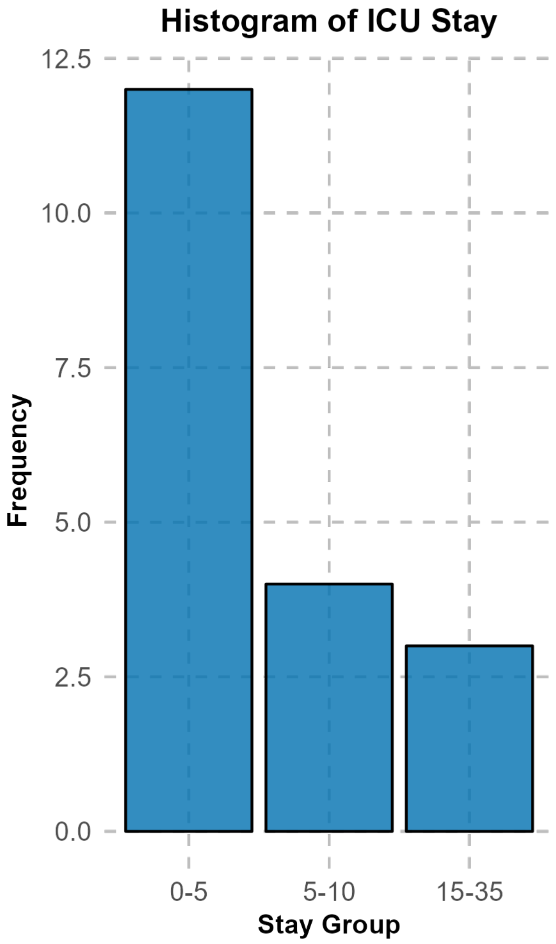
Spetzler-Martin Grading (SMG) Score

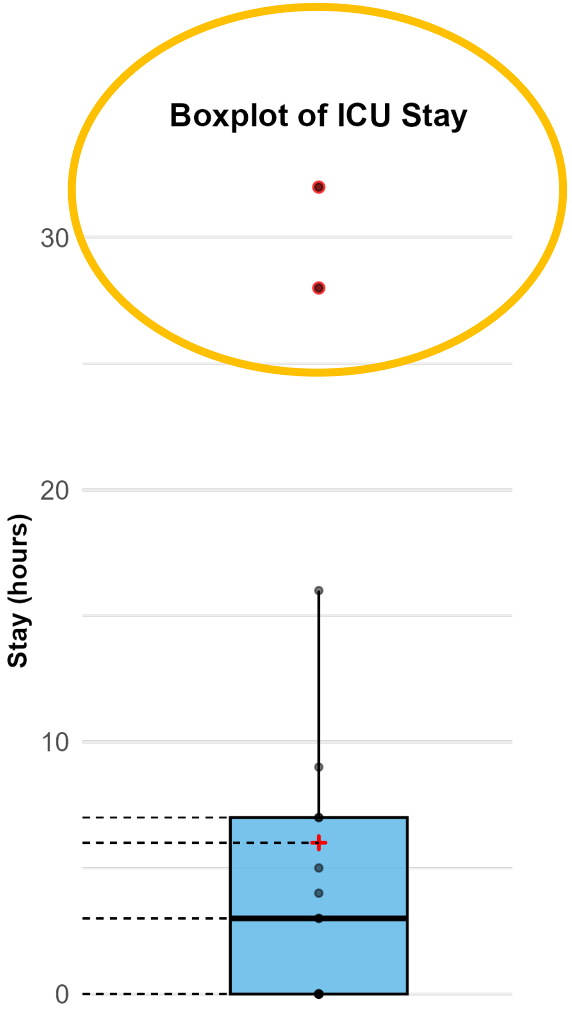
	CHARACTERISTIC	POINTS ASSIGNED
SIZE	SMALL (<3 cm)	1
	MEDIUM (3-6 cm)	2
	LARGE (>6 cm)	3
ELOQUENCE	NO	0
	YES	1
VENOUS DRAINAGE	SUPERFICIAL ONLY	0
	ANY DEEP	1



68.4% of cases associated with an ICU stay

Mean length of 6 days





P CVD Clinicians

I 3D Viewer

C Experience Level

O Reported Utility

Study Design

CVD AV Model

Prospective

Retrospective

N = 18 Clinicians

N = 19 AVM Models

Null Hypothesis: There is no difference in reported complexity/ utility of 3D Viewers based on experience

Describing associations between AV models in CVD and clinical & utilization metrics

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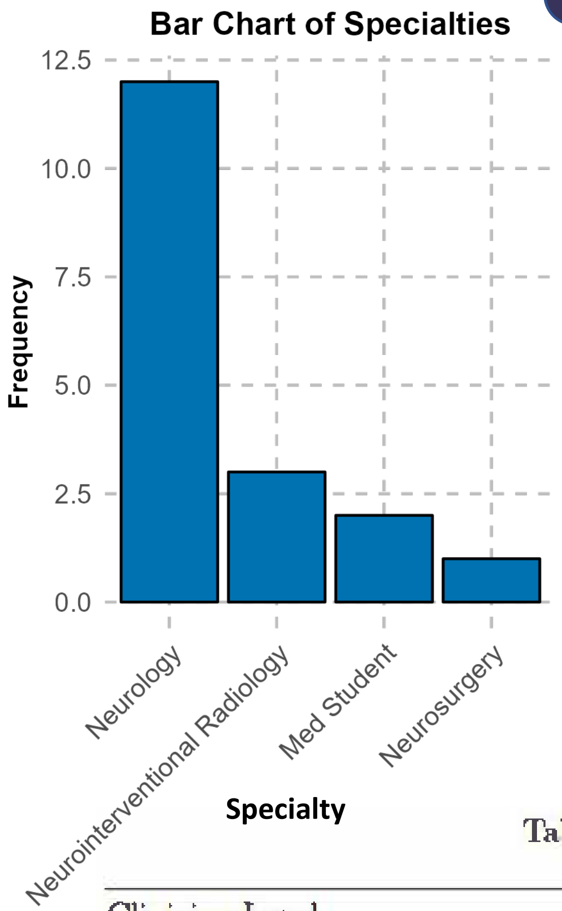
Clinician Subjects



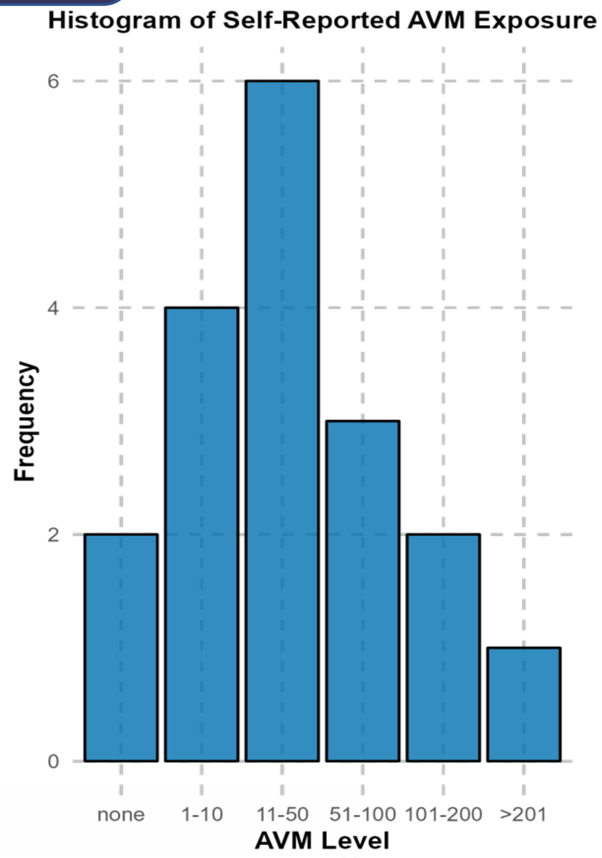


Table 1: Summary Statistics for Clinician Levels

Clinician Level	Frequency	Frequency Percentage
Medical Student	2	11.1%
Resident	4	22.2%
Advanced Practice Provider	5	27.8%
Fellow	1	5.6%
Junior Attending (< 5 years from terminal training)	3	16.7%
Senior Attending (> 5 years from terminal training)	3	16.7%
Total	18	100.0%

Survey Core

1. How **complex** would you rate this case? 1-10
2. How **helpful** did you find the on-screen 3D Model? 1-10

3 a. Were you able to appreciate any **normal anatomy** in 3D that you were not able to in 2D?

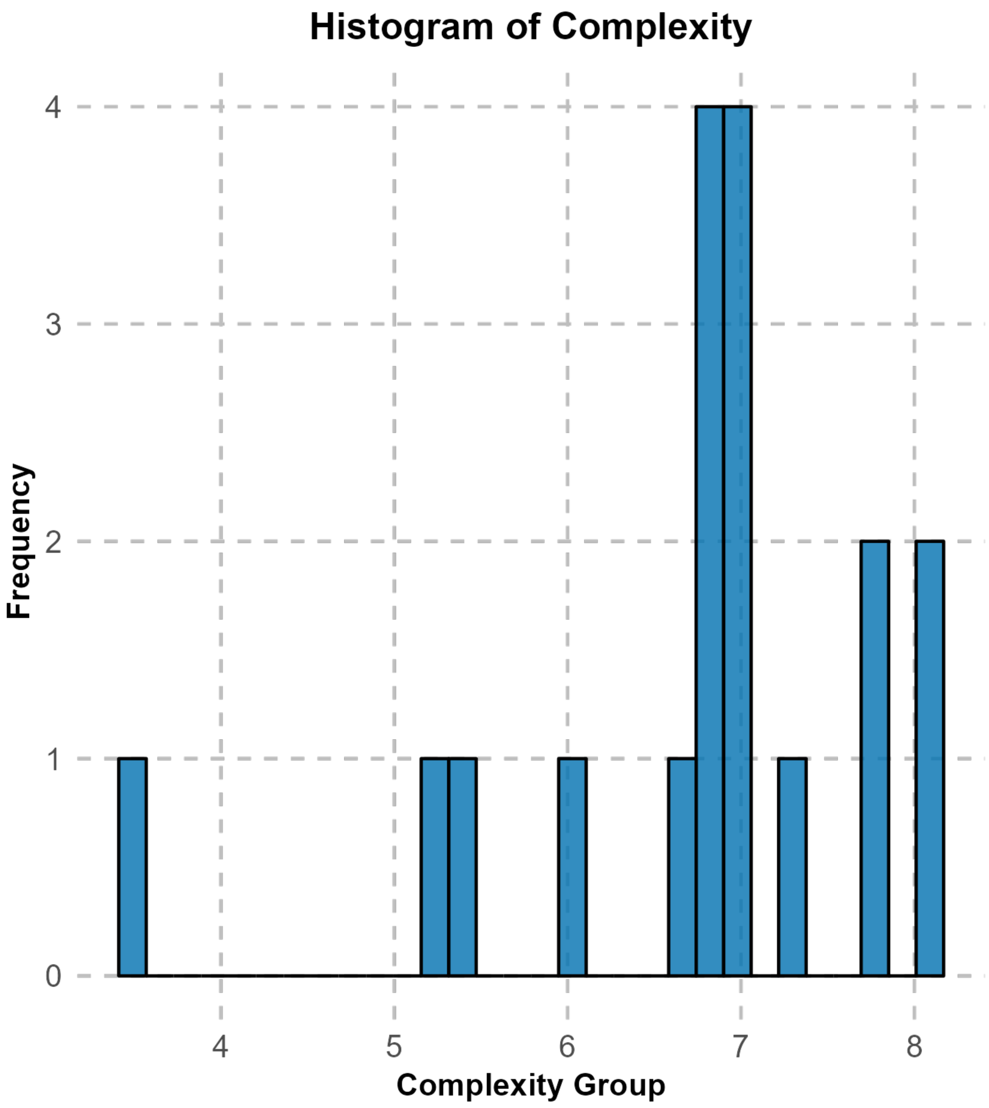
b. Did you appreciate any **abnormal pathological defects** in the 3D model that you were not able to in 2D?

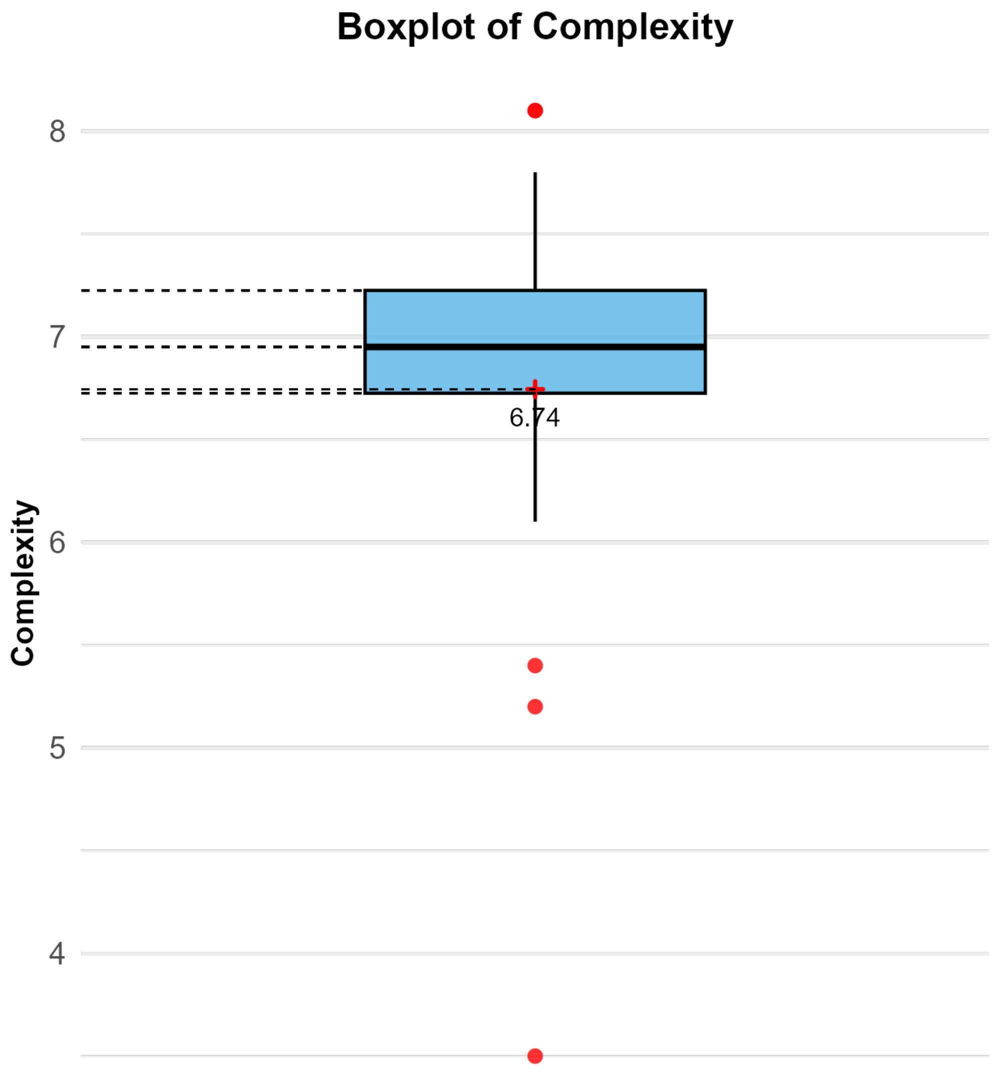
4. If you were responsible for clinical decision making, would access to the 3D Model have changed your
   a. **Diagnosis**: Yes No
   b. **Therapeutic** and/or procedural approach Yes No

10 model surveys sent to each clinician subject

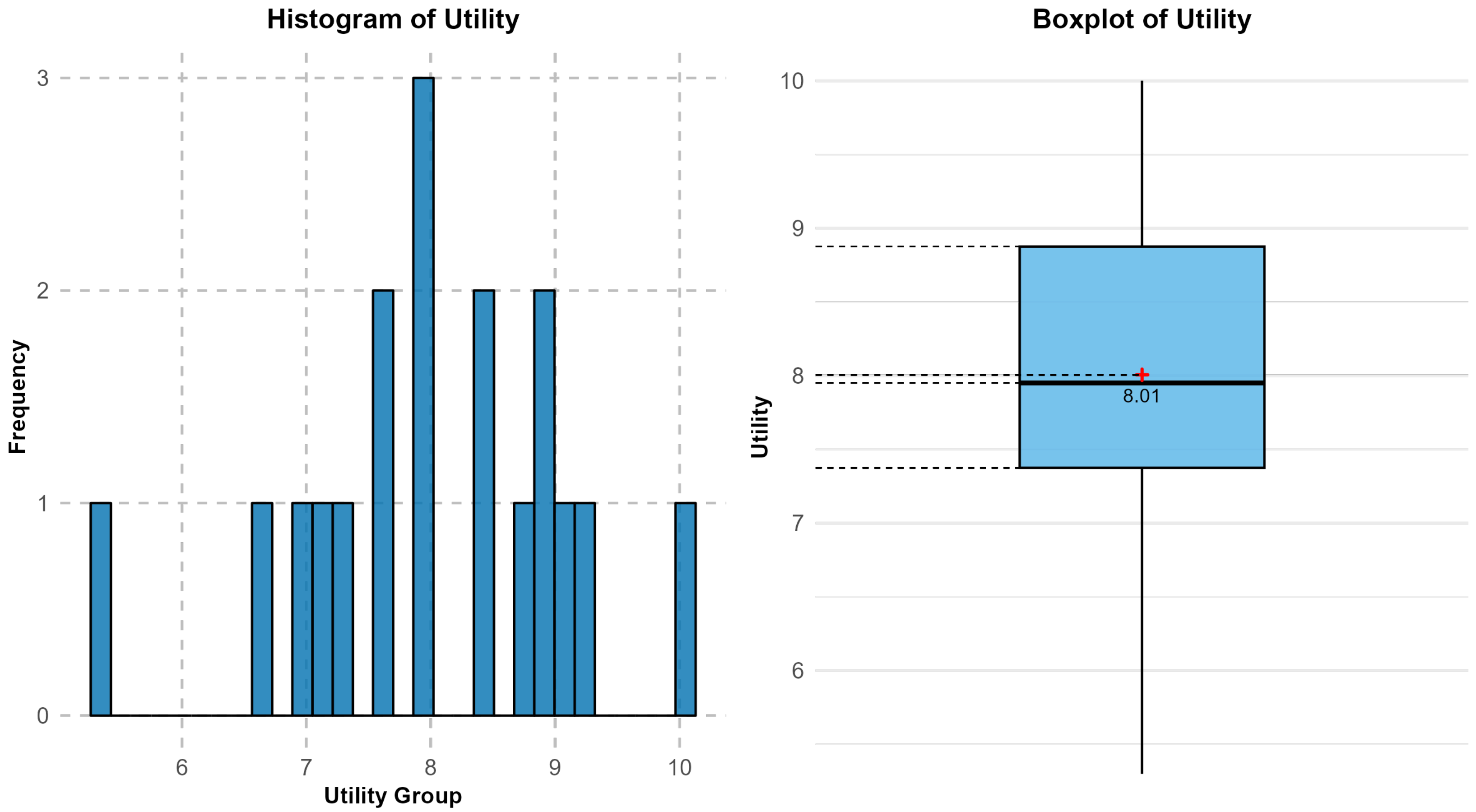
92.2% completion rate (166/180)

Complexity: 6.74, 3.5-8.1

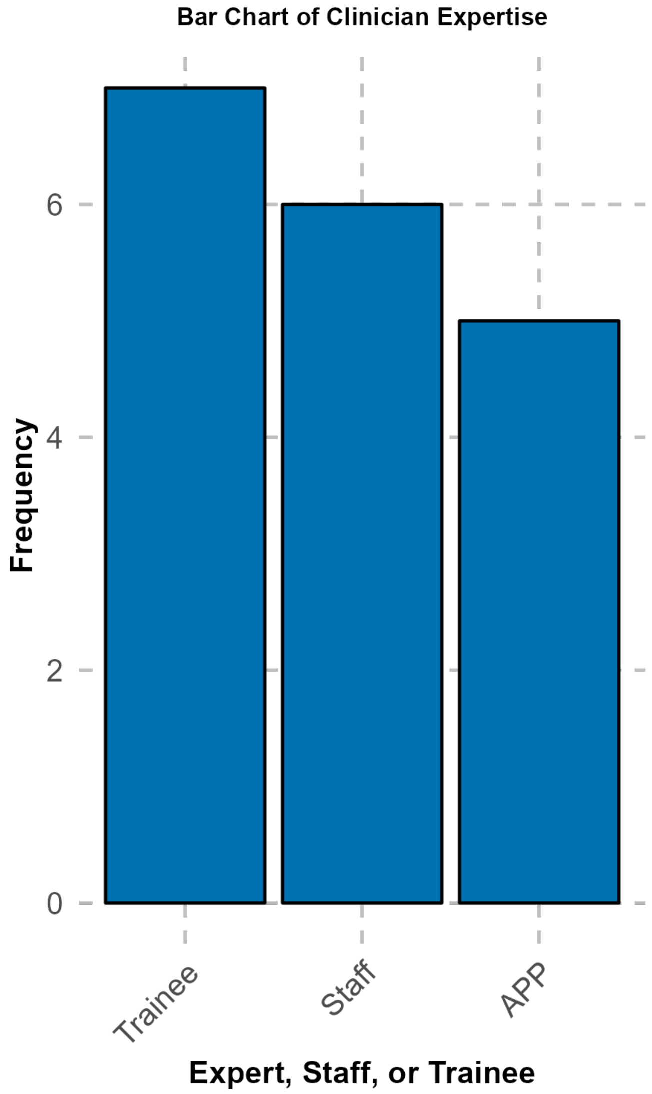




Utility: 8.01, 5.3-10

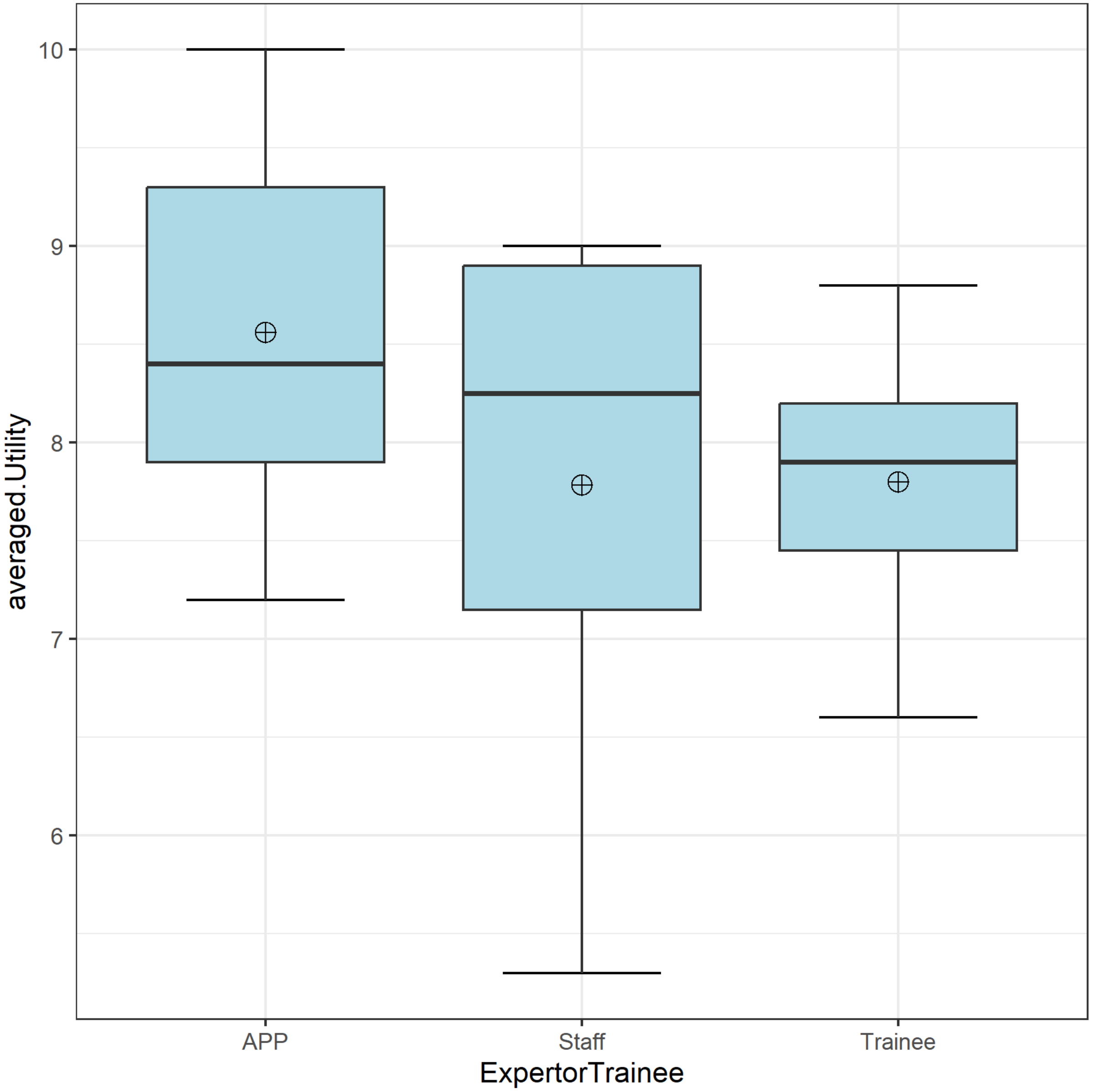


ility by Experience Lev



- Imposed Independence by using Average Utility
- Null Hypothesis: No Difference in Reported Utility between Experience Levels

Hypothesis Testing: Kruskal-Wallis H

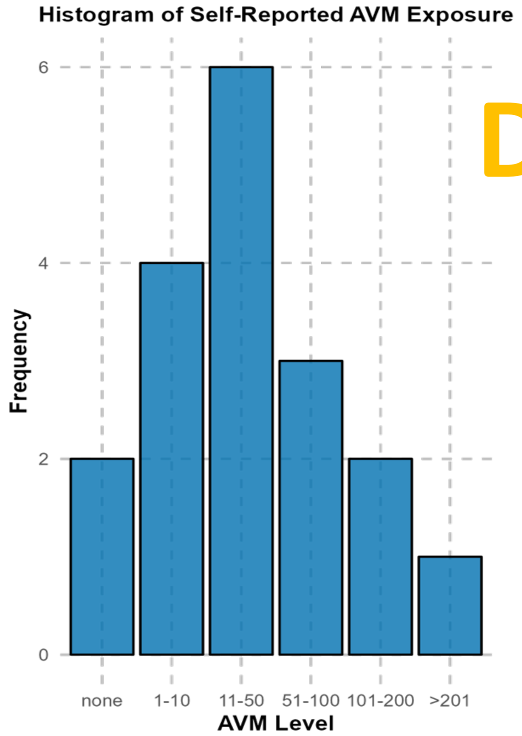


Combined Kruskal-Wallis Test Results for Complexity, Utility, and Improvement grouped by

Metric	statistic	df	p.value
Complexity	0.6669883	2	0.7164161
Utility	1.4484604	2	0.4846975
Improvement	0.9984830	2	0.6069909

- Can NOT reject the null hypothesis
- Conclude there is NO difference in reported utility between Experience Levels

Dunning-Kruger Effe



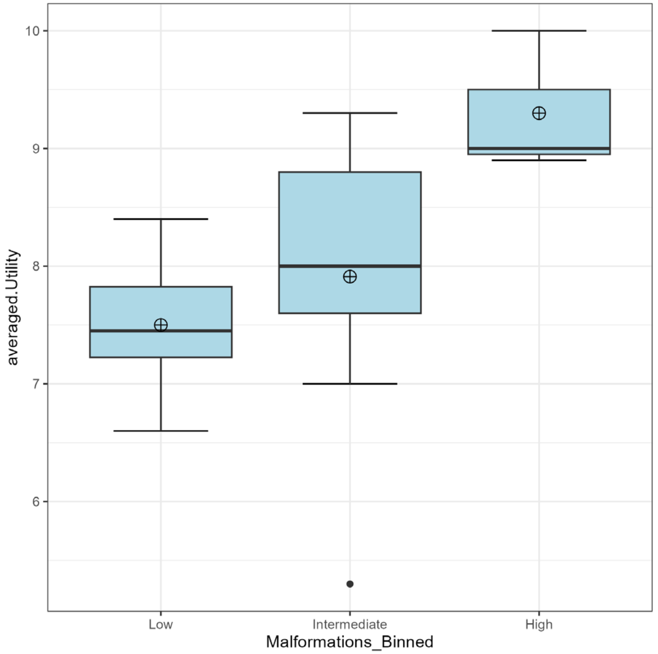


Table 21: Combined Kruskal-Wallis Test Results for Complexity, Utility, and Improvement grouped by expertise

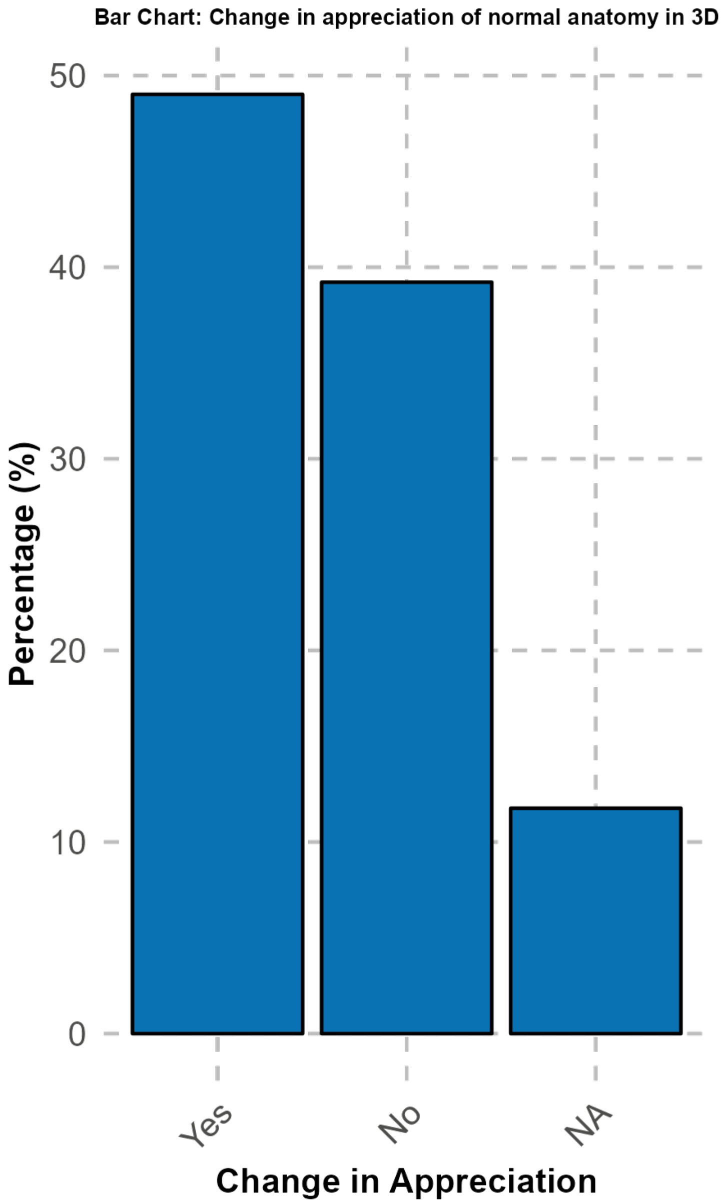
Metric	statistic	df	p.value
Complexity	4.262856	2	0.1186677
Utility	6.931635	2	0.0312475
Improvement	1.435871	2	0.4877583

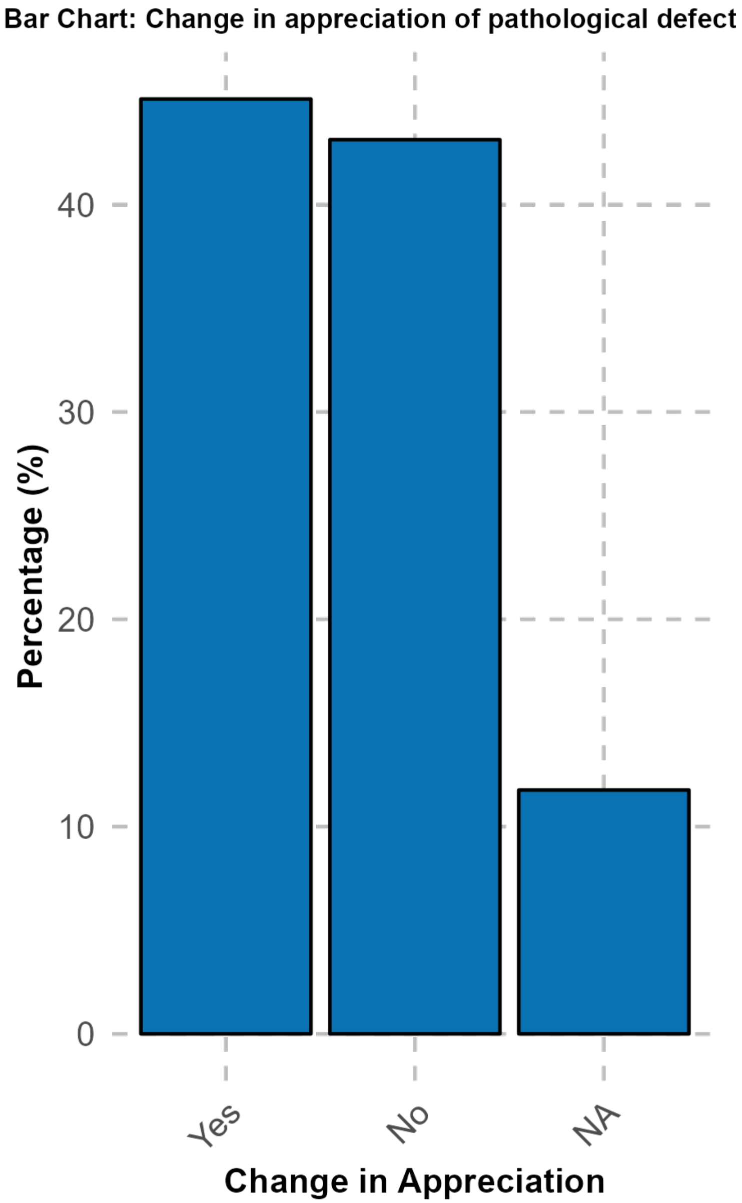
Table 22: Post-hoc Results for Utility Groupings

Comparison	Observed_difference	Critical_difference	Significant
High-Intermediate	6.722222	8.520287	FALSE
High-Low	9.916667	9.037076	TRUE
Intermediate-Low	3.194444	6.735838	FALSE

Cognitive Bias: whereby people with low ability, expertise, or experience regarding a certain type of task or area of knowledge tend to overestimate their ability or knowledge. Some researchers also include the opposite effect for high performers: their tendency to underestimate their skills

l ab/normal Anatomical Insights (S





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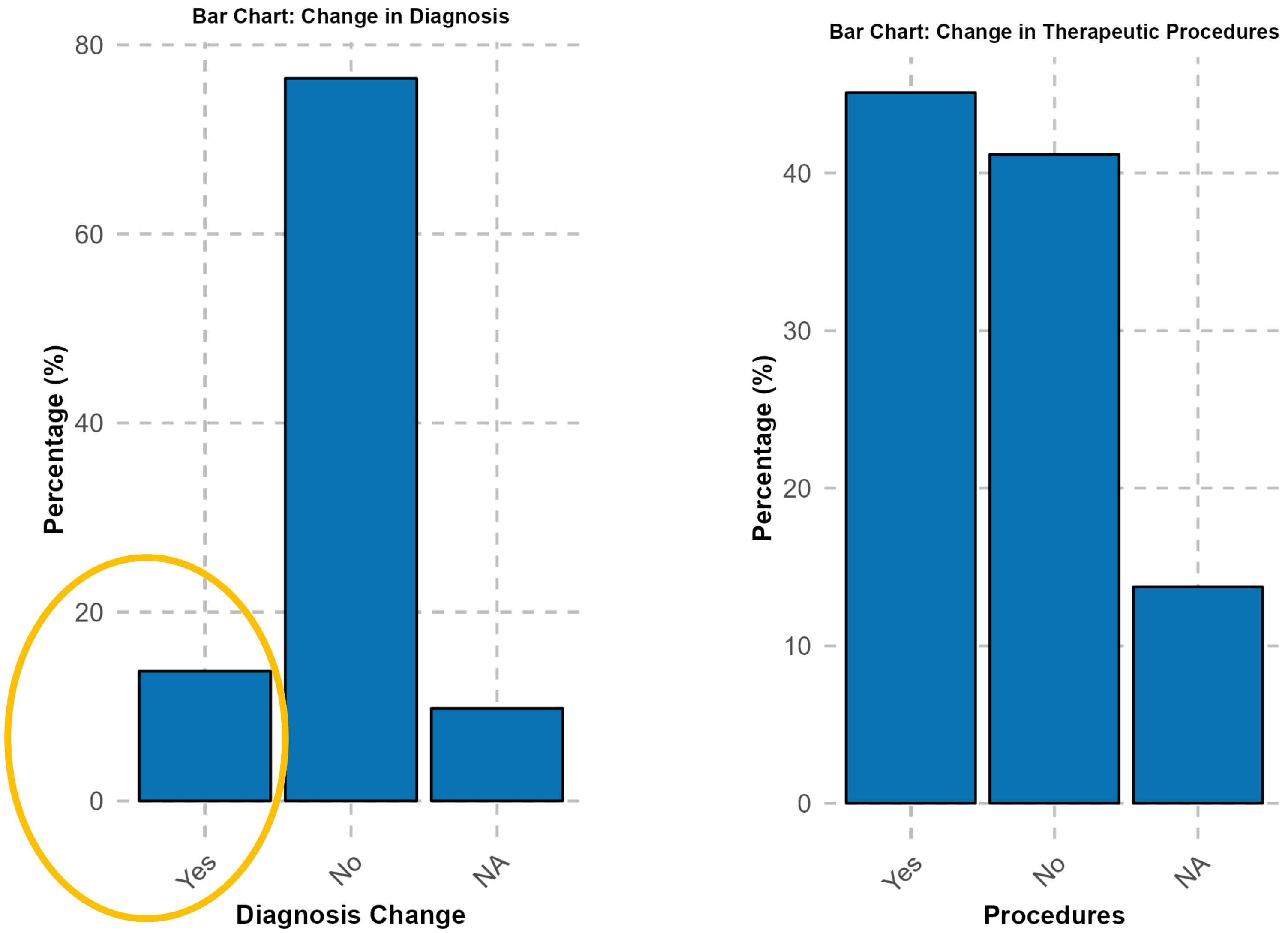
nge in Diagnosis or Therapy(S



Summar y

- Established a scalable digital fabrication & assessment infrastructure for patient-specific AV models
- Publicly insured, young, healthy, diverse patients with a complex disease requiring effective but resource-intensive care
- Highly engaged & diverse clinician subjects
- On a set of AVMs of varying complexity, clinicians affirmed the substantial utility of AV
- AV frequently provided staff clinicians with anatomical and therapeutic insights not conventionally appreciated

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Limitations & Future Direction

- Non-randomized, small sample, non-validate instrument
- Replicate with:
  - Larger sample sizes
  - Randomization
  - Other disease states
  - Different visualization modalities, e.g. XR vs 3DP

AR

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BioDesign Lab

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Manager

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Director of Clinical Research

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Biomedical Engineer

Kimberly Hughes
Sr. Project Coordinator

Jack McGee
Biomedical Engineer

Alec Slayden
Immersive Tech Developer

Rahim Abdul
Biostatisican

Vishal Bhimarasetty
Data Coordinator

How it started

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How's it going

Ochsner Health System

- Core Services Include 3D Printing, Virtual Reality and Augmented Reality
- Allow for Anatomical Modeling, Medical Education/Pre-Operative Planning and Procedural Training
- Current Applications in Transplant, Neurosurgery, Neurology and Orthopedics
- Planned Future Growth to Include True Medical Additive Manufacturing, Design and Peri-Procedural Guidance

How's it going to be? Ochsner Neuroscience Institute

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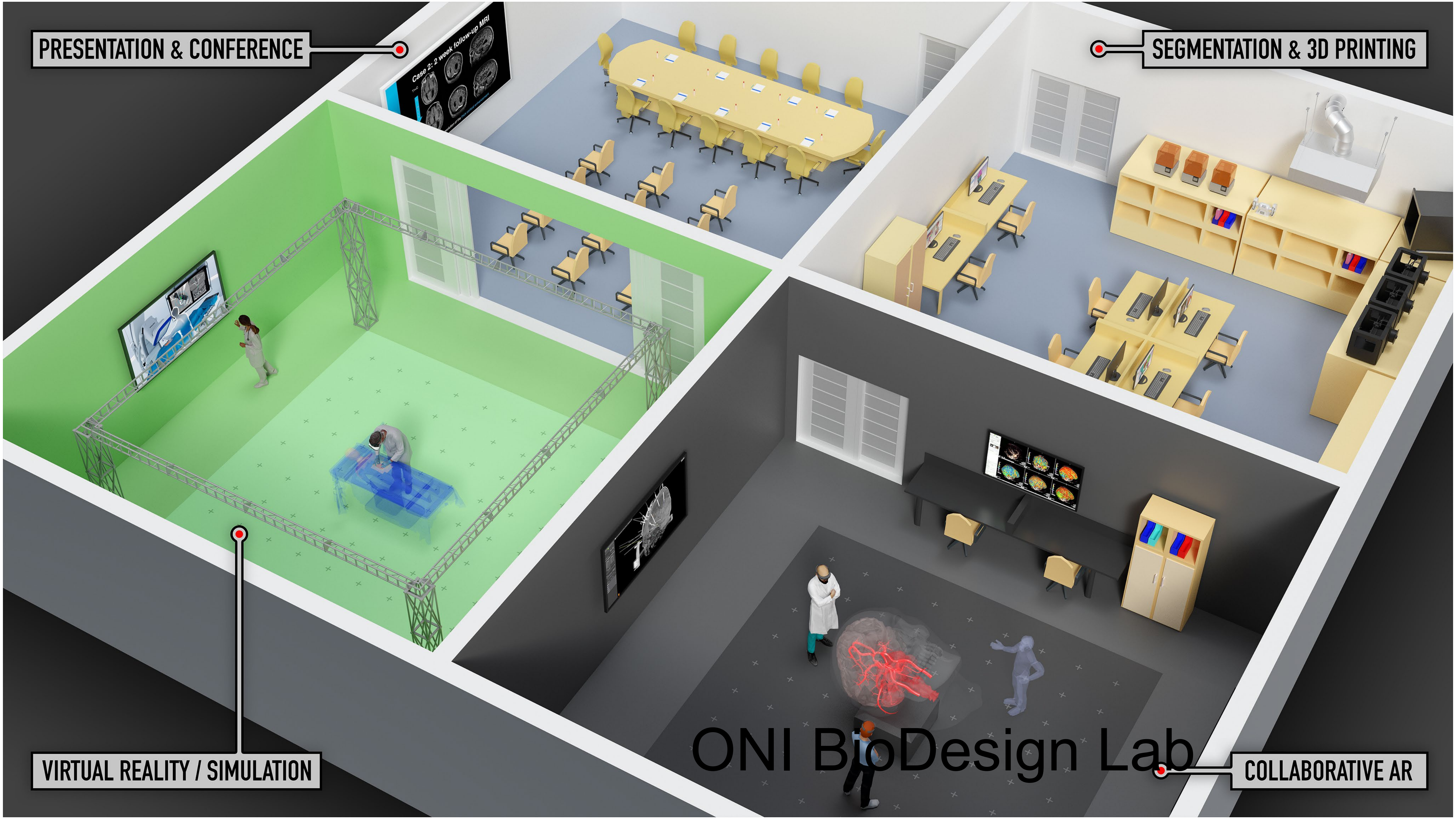
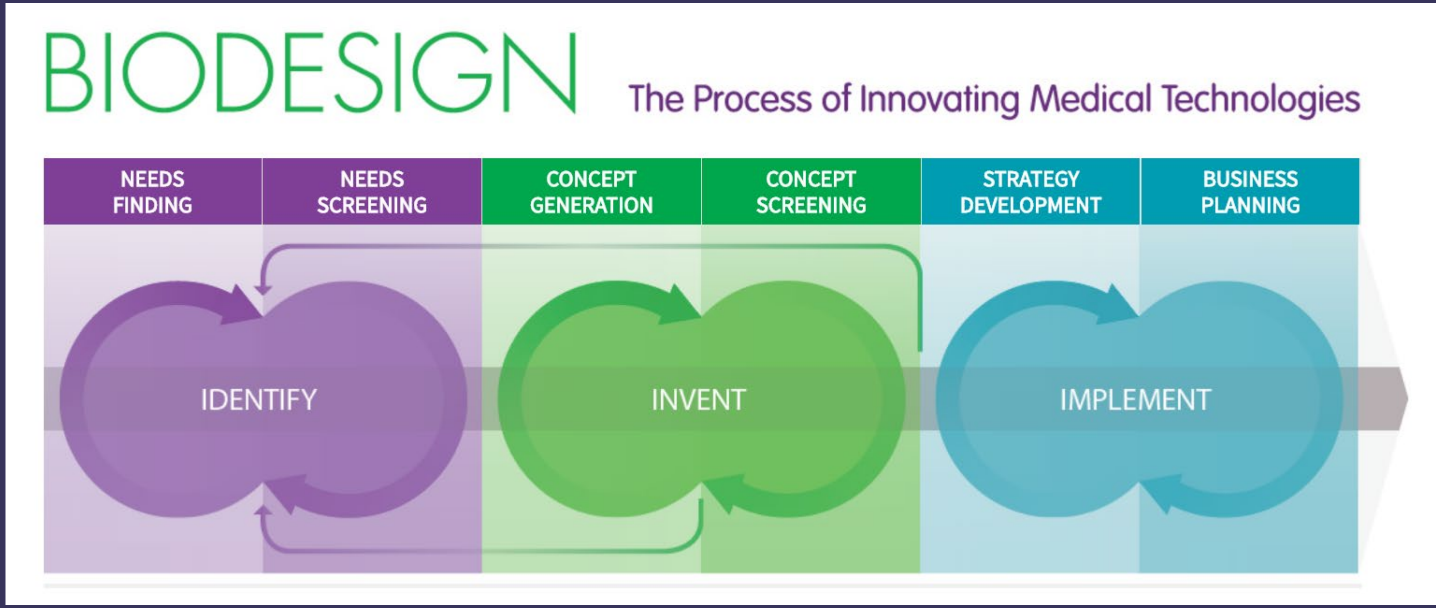

PRESENTATION & CONFERENCE
SEGMENTATION & 3D PRINTING
VIRTUAL REALITY / SIMULATION
COLLABORATIVE AR
Case 2: 2 week follow-up MRI
ONI BioDesign Lab

AR

BioDesign

- Needs Finding
- Prototyping/Brain Storming
- Compliance/Regulatory
- Defensibility
- Sustainability
- Clinical Integration



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Roadmap

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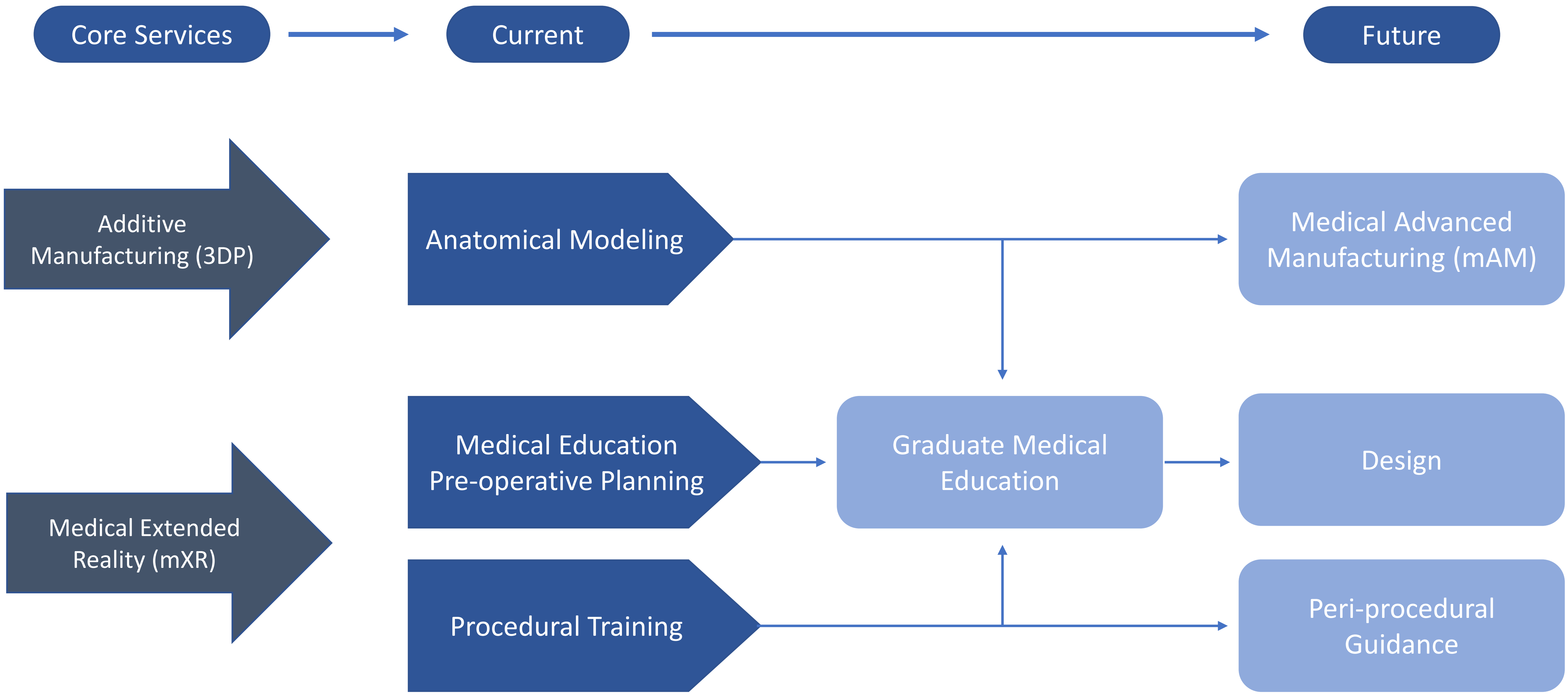

Advocacy

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The 5 P's	SMART
Passion	Specific
Partnerships/People	Measurable
Purpose	Achievable
Persistence	Relevant
Participation/Presence	Timing

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Study Design

P CVD Clinicians
I 3D Viewer
C Experience Level
O Reported Utility

CVD AV Model

Retrospective

N = 19

Describing associations between AV models in CVD and clinical & utilization metrics

Prospective

N = 6

Qualitative: Reflexive Analysis with a goal of thematic saturation assessing senior trainees and stuff experiences with physical 3DP anatomical models

N = 18

Null Hypothesis: There is no difference in reported complexity/ utility of 3D Viewers based on experience