Reducing Child Distress and Improving Satisfaction Using 3D-Printed Scanners in Pediatric Cross-Sectional Imaging: A Quality Improvement Report

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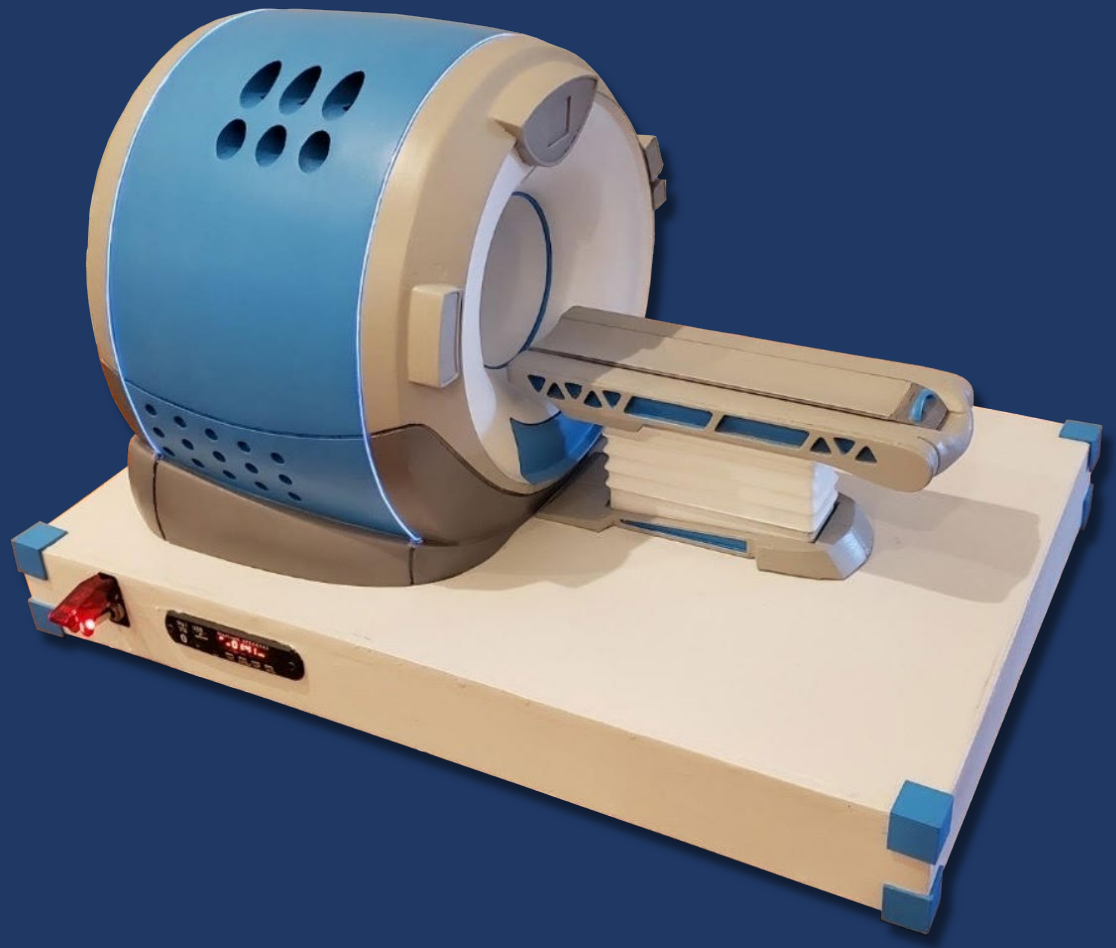


Children's Hospital New Orleans
LCMC Health

Note: Audio featured on slide 5

Purpose

- Pediatric patients undergoing cross-sectional imaging and their caregivers benefit from Certified Child Life Specialists, whose role in radiology includes preparation prior to imaging exams and procedures.

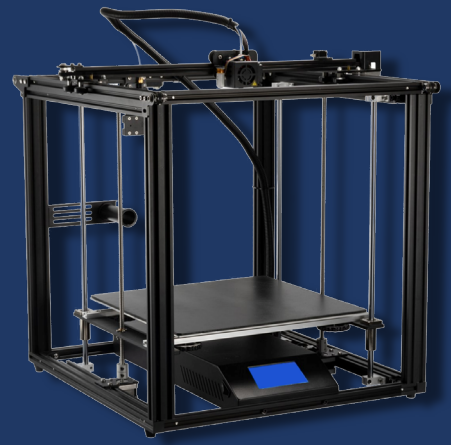
- Child Life Services that employ the use of mock scanners have been shown to improve imaging quality, compliance, and reduce the need for sedation.

- We propose that pre-exam preparation with a mock 3D-printed scanner will reduce child distress and improve caregiver and technologist satisfaction.

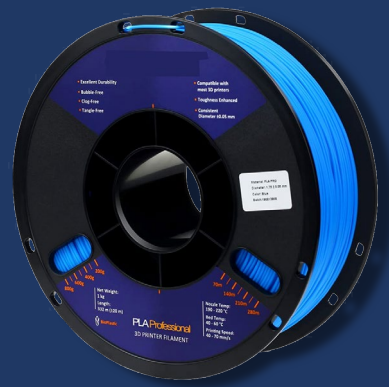
Methods

- Virtual CT and MRI scanner models were purchased from an online 3D model repository.
- The virtual 3D models were modified and converted to stereolithography (.STL) file format using free or open-source modeling software.
- Physical 3D models were printed from polylactic acid (PLA) filament using commercially available fused deposition modeling (FDM) 3D printers.
- Standard electronic components were obtained and assembled prior to use of the MRI sound module.
- A short Likert scale survey was completed by child life specialists, imaging technologists, and radiology attending physicians after routine introduction of the scanner models.

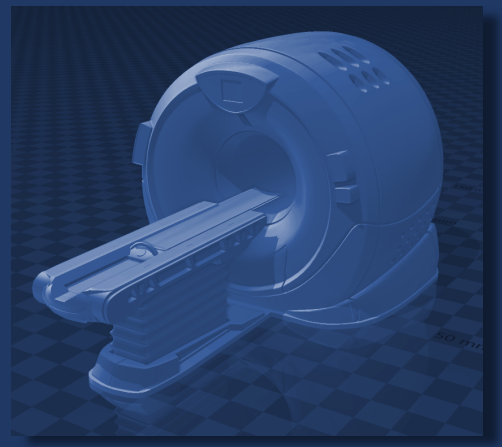
Essential Materials



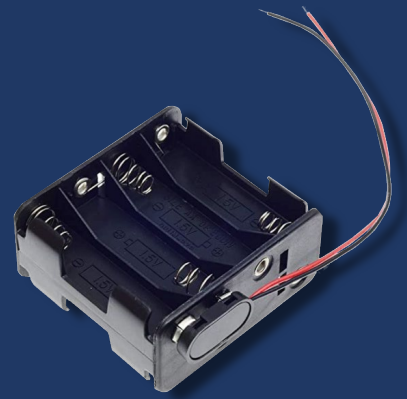
FDM 3D Printer



PLA Filament

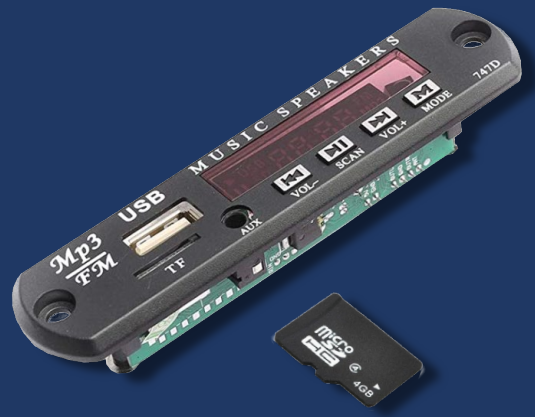


3D Model (stereolithography)

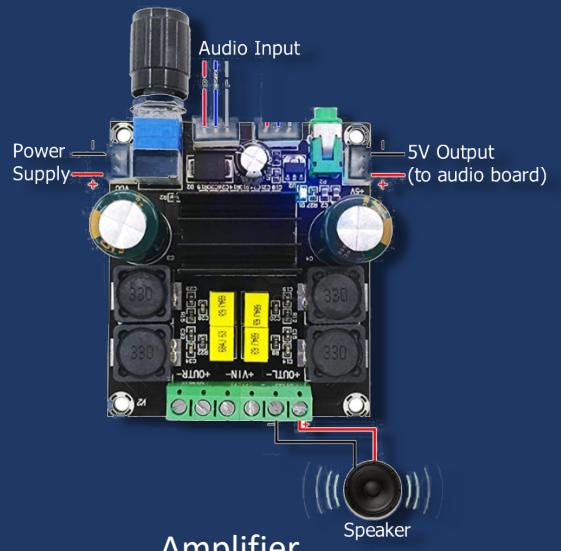


12 Volt Power Supply

Switch



Audio Board + MicroSD card



Amplifier

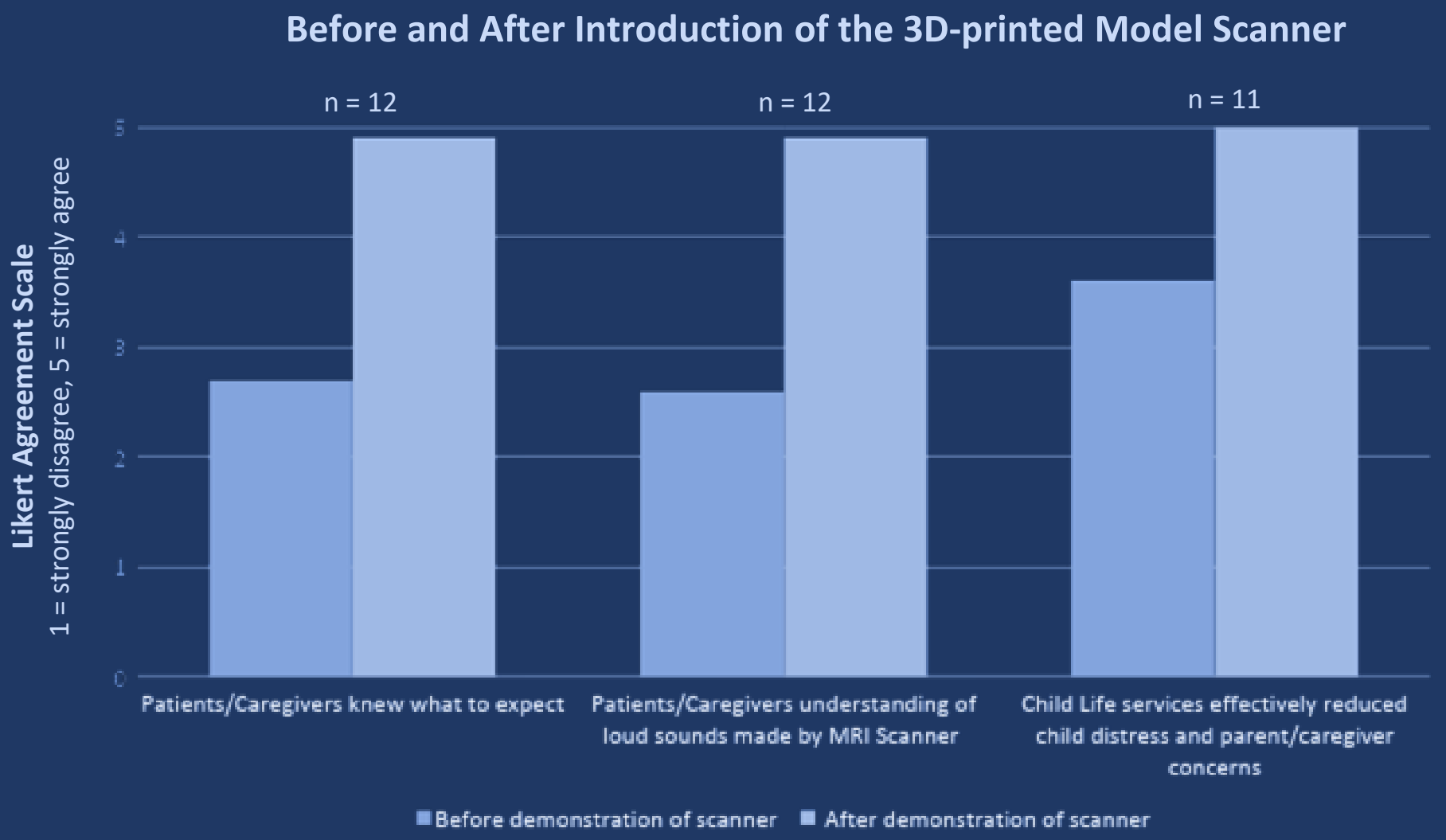
Full Range Speaker

Audio and Video Demonstration

Scanner volume in this video clip is low. Volume can be adjusted to match the loudness of a real MRI scanner.

Note: This slide features audio

Primary Survey Results



Secondary Survey Results

- The mock MRI scanner is an important adjunct tool to prepare pediatric patients for cross-sectional imaging exams.
  Average Likert score = 4.9 (n = 18)
- I would recommend the use of mock scanners in other pediatric imaging departments.
  Average Likert score = 5.0 (n = 18)
- Children who played with the mock scanners were more cooperative.
  Average Likert score = 4.5 (n = 10)
- Subjectively, some children who would normally need sedation did not need sedation after playing with the mock scanner.
  Average Likert score = 4.3 (n=10)
- Use of the MRI scanner increased my satisfaction of care provided.
  Average Likert score = 4.7 (n = 9)
- Parents and caregivers expressed satisfaction with use of the mock scanner.
  Average Likert score = 4.6 (n = 11)
- In general, exams of children who prepared with the mock scanner were technically easier to perform.
  Average Likert score = 4.0 (n = 3)
- In general, exams of children who prepared with the mock scanner had less motion artifacts.
  Average Likert score = 3.0 (n = 3)

Likert Agreement Scale

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

Conclusions

- Mock 3D-printed MRI and CT scanners were universally well-received by certified child life specialists, technologists, radiology attending physicians, pediatric patients, and parents/caregivers.
- Mock scanners can be an important adjunctive tool for improving patient care, increasing satisfaction, and reducing child distress.
- As 3D-printing utilization continues to increase in the medical setting, pediatric imaging departments and certified child life specialists should be aware of the wide availability of 3D printers, the 3D-printing process, and the use of 3D-printed medical toys for implementation in their departments.

Contributing author's son playing with the 3D-printed MRI scanner. Child depicted is not a patient.

Future Directions

Currently, data is being collected regarding MRI imaging sedation rate before and after the introduction of the 3D-printed scanner. Preliminary data suggest that use of the scanner can reduce sedation rate by up to 16% (n = 2642).

Future IRB approval will allow for direct survey of patients, parents, and caregivers.

Aside from MRI and CT scanners, additional models can be created, including but not limited to C-arms, interventional radiology suites, fluoroscopy tables, MRI head coils, and other equipment that may be helpful in reducing child distress and improving satisfaction if pre-exam play sessions with child life services are implemented.

Acknowledgements

Special thank you to Hannah Dimmit, MS, CCLS, imaging department child life specialist at Children's Hospital New Orleans (CHNOLA), whose creative ideas inspired this project, and who facilitated routine use of this new tool in the CHNOLA imaging department.

Special thank you to Gavin Langston, who collected and organized the sedation rate data before and after introduction of the 3D-printed MRI scanner.

References

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