STA 2016
JAN 6-9TH
FLORIDA

3D PRINTING IN PEDIATRIC ANESTHESIA
EXPERIENCES - CHALLENGES - OPPORTUNITIES

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SickKids
UNIVERSITY OF TORONTO

DISCLOSURES

NO CONFLICTS OF INTEREST TO DECLARE

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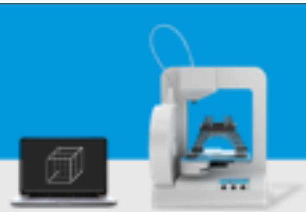
SickKids Perioperative Services Innovation Fund
SickKids Summer Student Research Program

SUPPORTED BY: CIGITI

OBJECTIVES

01. A Case
02. Background on 3D Printing and History
03. 3D printing in Anesthesia/Medicine
04. Our 3D Printing Experience - lab and ministry
05. Lessons and Summary

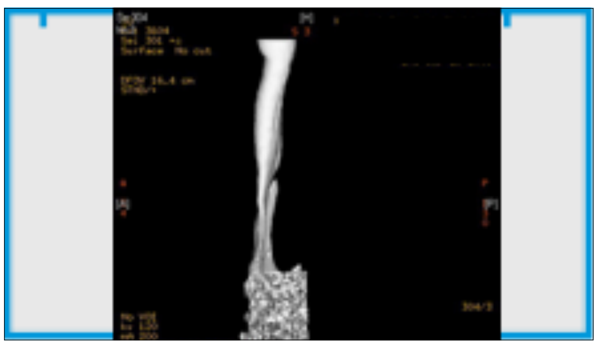
OBJECTIVES



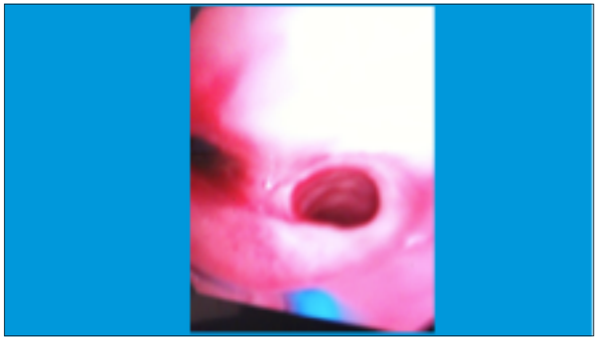
01. A CASE

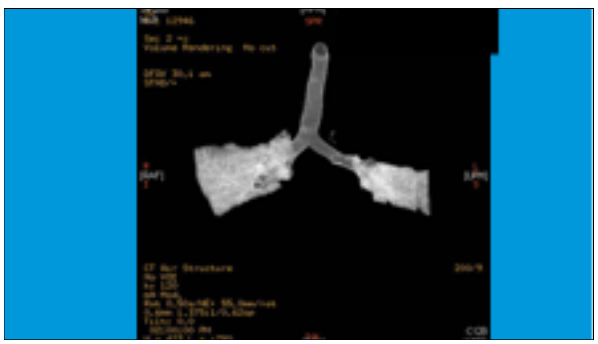
POTENTIAL FOR 3D IMAGING AND PRINTING


A CASE STORY




A CASE STORY

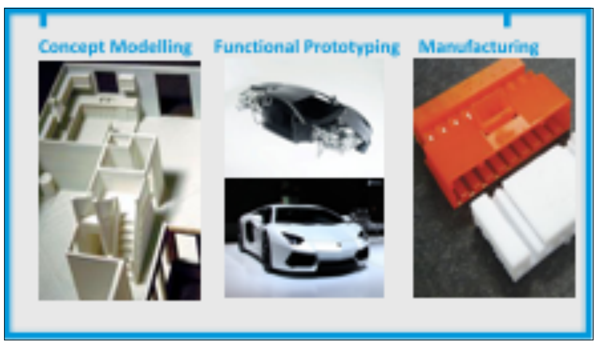




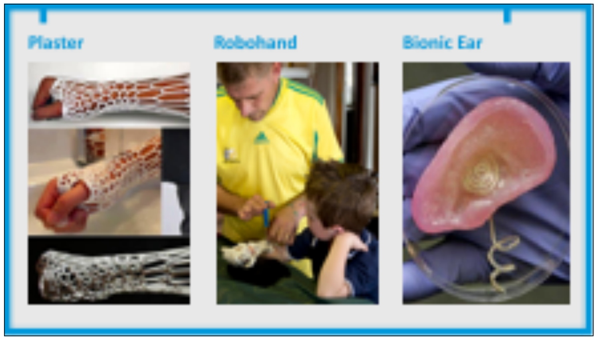

02. 3DPRINTING ADVANCES
A SHOWCASE

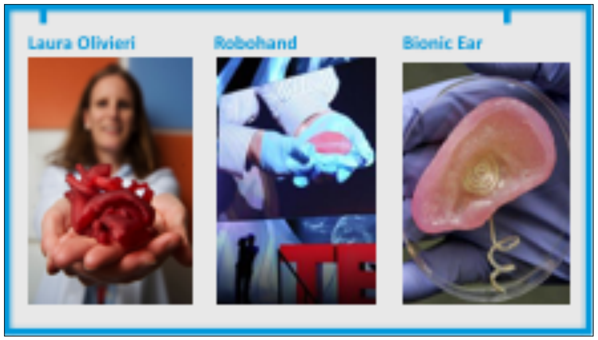

History of 3D Printing
1984-8
6
Charles Hull
2000
Human Kidney
1999
First 3D printer
2006
Laser Sintering Machine
1999
Printing Human Organs
2009

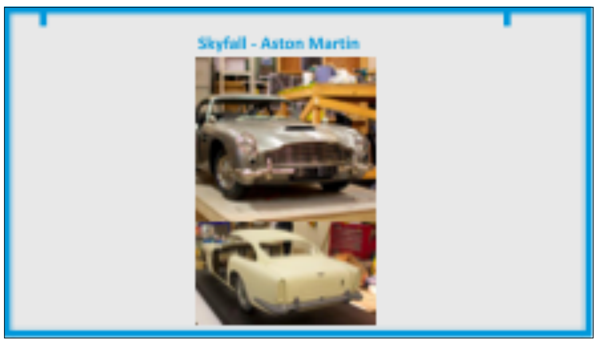

Projected Growth of 3D Printing
$5.2
BILLION
$3.1
BILLION
$1.3
BILLION


Concept Modelling
Functional Prototyping
Manufacturing

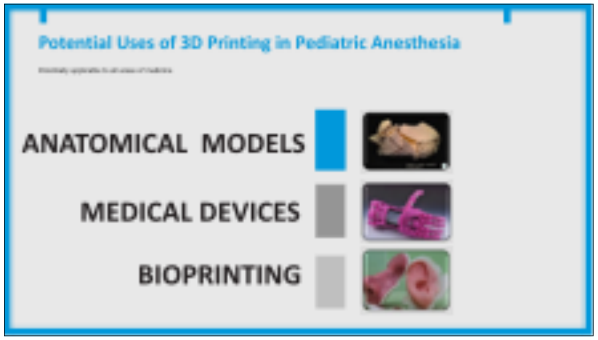

End Use Parts
Finishing

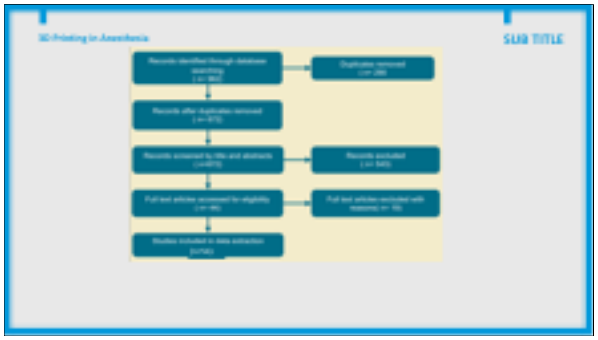

Plaster
Robohand
Bionic Ear


Laura Olivieri
Robohand
Bionic Ear

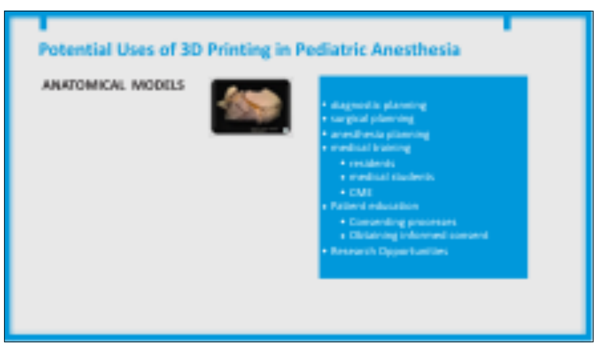

Skyfall - Aston Martin

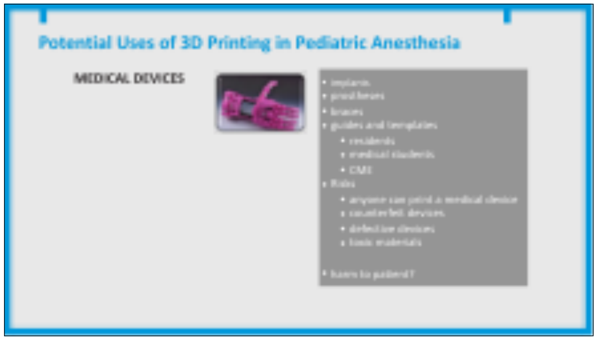

03. 3DPRINTING IN ANESTHESIA

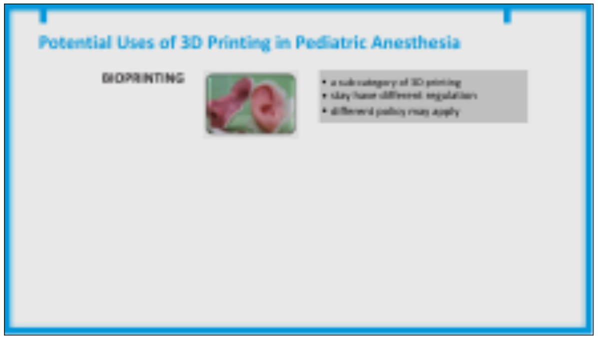

Potential Uses of 3D Printing in Pediatric Anesthesia
ANATOMICAL MODELS
MEDICAL DEVICES
BIOPRINTING


3D Printing in Anesthesia
SUB TITLE

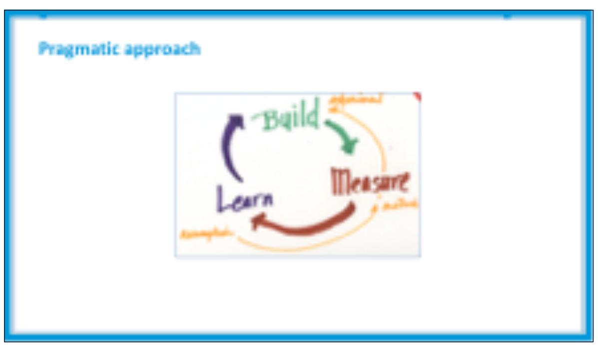

The Valley of Death
3D Printers in Medicine?
3D Printers in Anesthesia?
Gartner


Potential Uses of 3D Printing in Pediatric Anesthesia
ANATOMICAL MODELS
• diagnostic planning
• surgical planning
• anesthesia planning
• medical training
• residents
• medical students
• CME
• Patient education
• Consenting processes
• Obtaining informed consent
• Research Opportunities

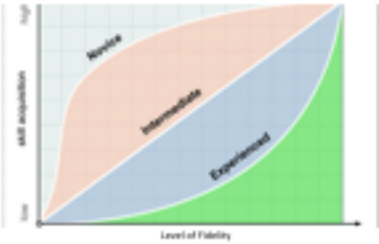

Potential Uses of 3D Printing in Pediatric Anesthesia
MEDICAL DEVICES
• implants
• prostheses
• braces
• guides and templates
• residents
• medical students
• CME
• Risks
• anyone can print a medical device
• counterfeit devices
• defective devices
• toxic materials
• harm to patient?


Potential Uses of 3D Printing in Pediatric Anesthesia
BIOPRINTING
• a subcategory of 3D printing
• may have different regulations
• different policy may apply

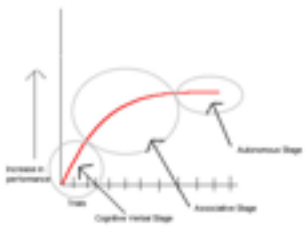

04. OUR 3D PRINTING EXPERIENCE
LUCK AND MISTAKES


Pragmatic approach
Build
Measure
Learn

Theory/Hypothesis driven



Theory/Hypothesis driven



Theory/Hypothesis driven

Identify and Leverage Resources

CIGITI

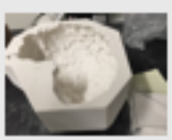
Focus

Airway	Education	Medical Device/Tool
Build a library of 3D difficult congenital airways - Crouzon's, Pierre Robin Sequence, Goldenhart, Treacher Collins Trachea for surgical airway	Airway Anatomy Caudal Space	Laryngoscopes

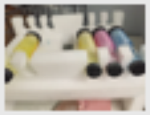
Our Space

Our Space

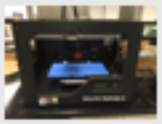
Our Space

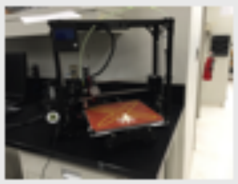


Our Space



Our Space

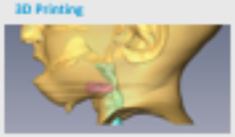


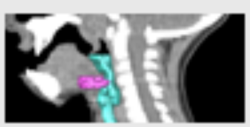


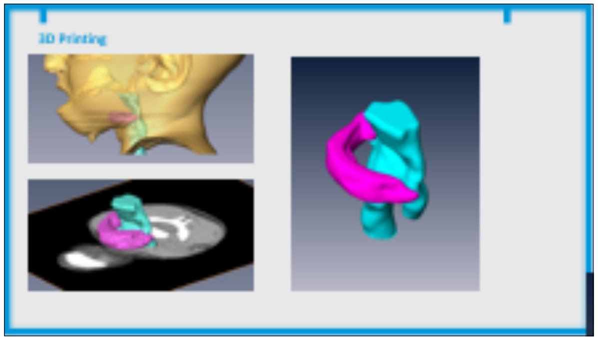
3D Printing

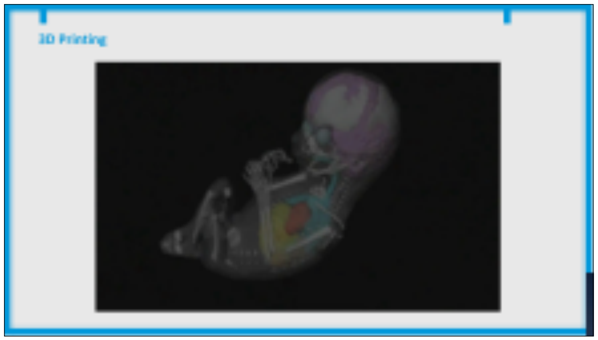
3D Printing

SUB TITLE






3D Printing


3D Printing


3D Printing


3D Printing

Lessons

Identification of appropriate CT Scans

- Retrospective evaluations limiting useable CTs
- Inadequate C-Spine levels included in the CT Scan
- Low dose CT Scans used for children limiting the voxel resolution.

Cost of Software

- Opensource software is of varied quality
- Licenced software is expensive and requires key licences
- Identifying patients with enough time to get consent for use of images can be challenging

Image processing

- Ill defined borders seen between cartilaginous structures and soft tissues (i.e thyroid cartilage and epiglottis compared with surrounding muscle and fat) likely due to low dose scanning

Lessons

Materials

- Modulus of elasticity
- behaviour with a finite element analysis of the baseline airway used for segmentation
- (deformability) of applying force on the airway in 3 dimension

Standards

- Nomenclature for anesthesia

Measure and assess

SUMMARY

01. A Case
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OBJECTIVES


Acknowledgements to team
Stephanie Holowka
Fahad Alam


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THANK YOU