

# **Patient-Specific 3D Printed Airway Models for Applications in Anesthesiology**

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## 1. Abstract

*Background:* Effective airway management is a critical responsibility of anesthesiologists, who use airway trainers to practice intubation. These trainers prepare anesthesiologists for normal airway anatomies, but when presented with an abnormal airway, intubation becomes more difficult. While difficult trainers exist, they focus on craniofacial abnormalities, not internal airway irregularities. This limitation reduces their effectiveness in preparing clinicians for atypical anatomies, making it more difficult to manage difficult airways and increasing the risk of complications during procedures. This project aimed to develop a novel process for creating patient-specific airway trainers using MR imaging, segmentation, and 3D printing.

*Methods:* Airway models were generated from MR scans of the patients' upper airway while in the sniffing position. The DICOM files were segmented using 3D Slicer, and refined in Autodesk Fusion 360. Once converted to .3mf files, the airways were printed in various materials and tested in compression to determine the optimal material choice. In later iterations, an existing airway mold negative was adapted in Fusion to support difficult feature implementation including vocal cord inflammation, stenosis, and upper airway growths. This design was then casted in silicone before being integrated into a 3D printed base and tested for intubation, simulating clinical conditions. Material Testing for the airway included durability testing where the airway was intubated on until visible damage occurred, or until 50 iterations had passed. Compression testing was also performed on the airway, where deformation of each material was measured under a load of 24.6 Newtons. Qualitative testing of the airway manikin included feedback from airway professionals at the UW Health Department of Anesthesiology. Results were then collected with surveys after intubation took place. Additional testing included four

team members conducting repeated cycles of intubation on various neck angle positions to measure ease of use at each angle setting.

*Results:* Material testing determined that ductile materials like silicone and elastic resin are more optimal choices for intubation trainers, offering material properties that are more comparable to biological airway tissue. During repeated cycles of intubations, the silicone of the airway experienced tearing if lubrication spray was not applied intermittently. Qualitative testing resulted in positive feedback that the manikin had correct anatomical position, vocal cord inserts were an accurate representation, and intubation of the manikin accurately simulated intubation in real life. Negative feedback included mentions of airway silicone being too flexible, the head should be heavier, and the mouth should require more force to open. There was also a direct relationship between increasing neck angle and increased user intubation time.

*Conclusions:* This process demonstrates the feasibility of producing airway trainers that result from segmentation of patient MR imaging, but many difficulties persist in the use of MR imaging. The reduction in resolution resulting from conversion into a printable file causes a loss in physiological accuracy, and certain landmarks, such as the esophagus and tongue, cannot be effectively modeled using a segmented MRI scan. However, a customizable manikin that can be manipulated to represent complex airway scenarios fills a clinical gap that can be used to improve clinical outcomes.

## **2. Introduction**

### **2.1 Background and Need**

Emergency airway management is crucial during instances of respiratory distress, as clinicians typically only have on average 15-30 seconds to secure an airway before possible onset of hypoxia and brain damage [1]. Over 400,000 Americans each year are intubated in these

emergency settings, with 12.7% of these intubations failing on the first attempt. For difficult airways, upwards of 50% of intubations fail on the first attempt [1]. The failure to successfully intubate a patient on the first attempt leads to a 33% increase in likelihood for patients to experience complications from lack of oxygen [1]. Since the amount of endotracheal intubation (ETI) training for a clinician and not necessarily the type of clinician performing the procedure might be more important for a successful ETI, it has become increasingly important to create a wide range of airway trainers for clinicians to practice on [2].

While some current airway trainers can provide adequate ETI practice for clinicians, these trainers are not able to successfully simulate the varying endotracheal environments of the many patients clinicians will see each day. These trainers specifically struggle to simulate the anatomy observed during allergic reactions, inhalation burns, or trauma in the upper airway [3]. Improperly simulating the endotracheal anatomy of patients can lead to problems in the learning process for medical residents, leading them to be less prepared for emergency ETI and therefore at a greater risk for failure on their first attempt.

The stakes of inadequate airway training are substantial. Difficult airway during anesthesia is responsible for numerous cases of morbidity and mortality worldwide, particularly when unanticipated, and approximately 30% of all deaths attributed to anesthesia are related to unsuccessful intubation [4]. Simulation based training has demonstrated meaningful improvements in clinician performance during difficult airway scenarios. An analysis documented that simulation based airway management can effectively increase learner satisfaction, knowledge, technical skills and patient outcomes compared with traditional learning strategies. It is interesting to note that the development and maintenance of airway management skills through simulation is not limited just to trainees. Limited exposure to difficult airways also

poses the risk of skill deterioration for experienced anesthesiologists [5]. This suggests that high quality airway trainers serve a purpose beyond residency, but rather throughout the clinician's whole career.

## **2.2 Previous Work**

There have been limited attempts to use 3D printing as a means for creating lifelike models for airway management. Previous attempts to integrate 3D printing into airway management involved taking computed tomography (CT scans). In Malackany et al. they successfully printed out a model of a patient's tracheobronchial tree to help visualize the specific anatomy and develop an airway management plan [6]. The authors concluded that adequate preoperative planning is crucial in patients with potentially difficult airways to decrease complications [6]. In A Iliff et al, the authors proved the feasibility of creating 3D models from reconstructed CT imaging using PolyJet 3D printing techniques with a photopolymer and thermoplastic polyurethane in addition to filament printing [7]. In Cardell et al. a feasibility study was conducted on utilizing multimodal 3D printing to augment a commercial manikin for patient specific intubatable design, but no further results were posted beyond the outline of the study [8]. Our method for fabricating a pseudo-patient specific airway is different from these methods as we chose to instead use a reference model to then modify based on certain airway modularities. Ultimately, this was the most cost effective approach and simplest method for rapid prototyping which will be discussed in section 3.5.

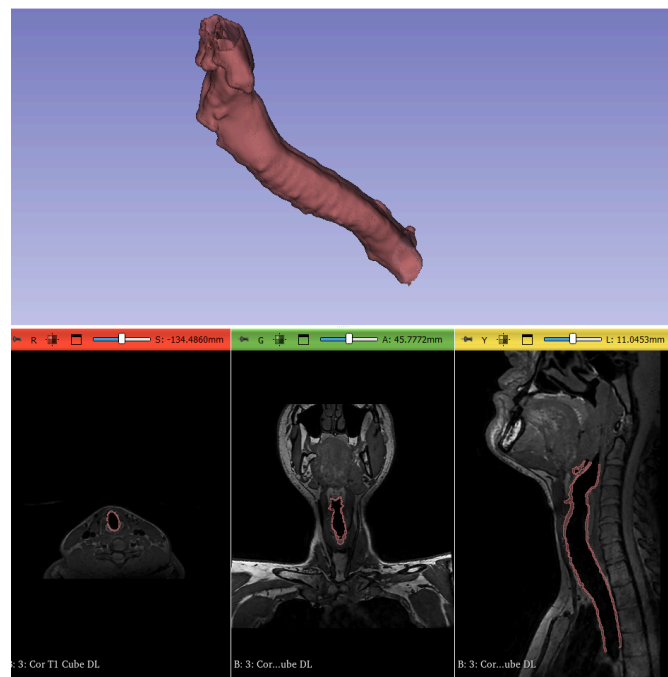
## **2.3 Outline and Summary**

In section 3.1 we outline the author's original plan for fabricating patient specific airway trainers by using Magnetic Resonance Imaging (MRI) of a volunteer in the "sniffing position" and then directly printing out that segmented portion of the airway. It should be noted that the authors have since changed the method for airway fabrication and have instead moved to take the negative of the airway space to then 3D print a mold from which a silicone model can be casted. One of the major difficulties of the initial fabrication technique was that the first scans collected by the authors did not reflect the opening of the airway when segmented, requiring an artificial opening to be created on the final model which was not reflective of patient anatomy. There were also difficulties in transferring the segmented airway model between the 3D Slicer software and Fusion Autodesk 360, which caused variations in anatomy due to the difference in resolution. In section 3.2 we describe the past fabrication technique and how this difference led to improvements in ease of fabrication as well as with segmenting the DICOM files for the final design. In section 3.6 there is discussion of the testing that is being conducted with airway management professionals for qualitative feedback on the final airway management prototype, as well as the time to intubate for individuals with varying degrees of experience with intubation.

## **3. Methods**

**3.1** The authors collected MRI data from a volunteer at the University of Wisconsin Hospital to determine the feasibility of directly printing a patient specific airway. Using the MRI data, 3DSlicer was used to segment the data, isolating the cartilage and muscular tissue surrounding the airway. This segmentation, shown in figure 2 below, was done with the help of thresholding based on density of the tissue, and cleaned up using smoothing features on 3DSlicer. This was

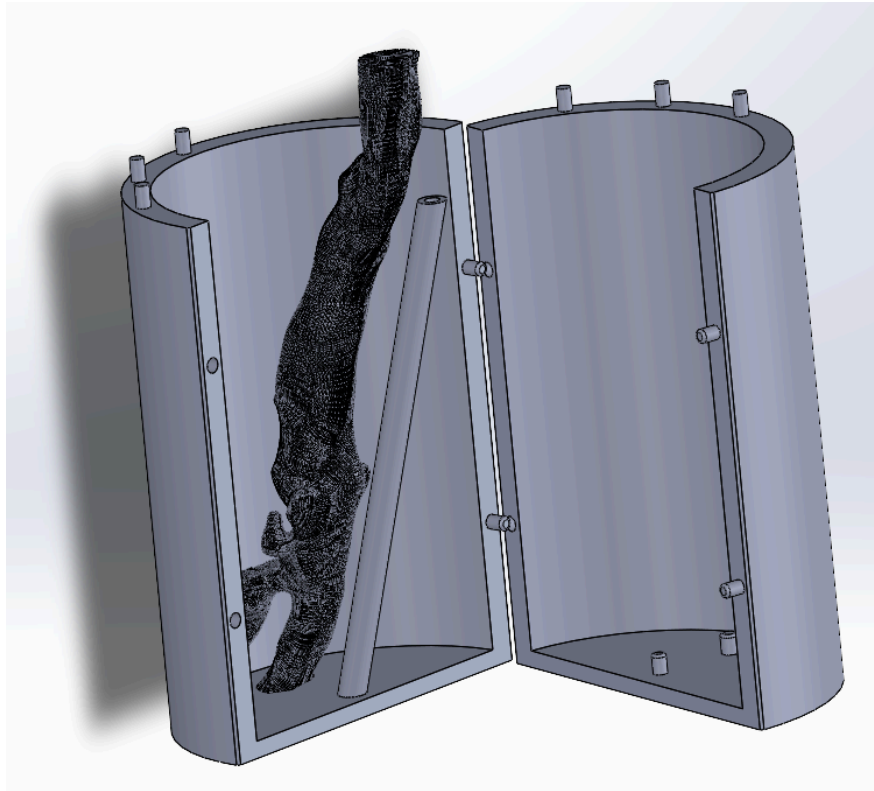
then converted to a solid body using Autodesk Fusion and into a printable file using SolidWorks. This file was then printed out of Thermoplastic Polyurethane (TPU), Flexible Resin, and Elastic Resin. This printing process proved difficult and fickle due to the complex geometries and thin walls of the airway. Supports from these prints were difficult to remove, and each print failed multiple times before a successful print was seen.



*Figure 2: Segmentation of Volunteer Airway using 3D Slicer*

**3.2** The second method utilized new volunteer scans, in which the volunteer assumed a sniffing position, or intubating position throughout the duration of the scan. This allowed for slightly improved airway modeling, as this position opens up the airway to a position seen during intubation. With this new airway, the same segmentation protocol was followed in 3D Slicer, with one adjustment. Rather than isolating the tissue surrounding the airway, the empty space

within the airway was isolated and thus converted into a solid body in Autodesk Fusion and into a printable file in SolidWorks, similarly to the prior method.



*Figure 3: 3D Render of Airway Mold and Outer Shell*

**3.3** Two additional parts were designed in SolidWorks to create a mold into which silicone could be poured. The outer shell created the neck of the intubation trainer, and the smaller cylinder was a mold into which a flexible lamp rod could be inserted, imitating a flexible spine of a human. All three parts, shown in figure 3 above, were printed out of polylactic acid (PLA). These prints were faster, cheaper, and more reproducible than the prior prints, and printed without fail multiple times. Silicone was poured into this mold and upon hardening, all of the PLA parts were removed, leaving just the silicone behind. This silicone was integrated with an existing mouth and upper airway mold and attached to a base as shown in figure 4 to allow for intubation to be practiced.



*Figure 4: Airway Manikin Prototype*

**3.4** This design proved effective in creating an airway trainer on which intubation could be practiced. However, this prototype did not incorporate the relevant patient-specificity needed to fulfill the design requirements of the client. In particular, the difficult features of the upper airway including the vocal cords and glottis size & location, were not patient-specific or difficult in this design. The prototype also did not meet the desired robustness outlined in the design specifications.

**3.5** Once it was found that there was limited feasibility in the conversion of an MRI to a scan, and the current prototype was not suitable for further iteration, the authors changed pathways to a modular airway manikin. Through this change, it was decided that a preoperative MRI scan would be performed on the patient to determine airway difficulties, and the airway manikin could be adjusted to match these difficulties. To allow for this adjustment, points of modularity were required, and were fulfilled in two ways. The first point of modularity is in the neck angle of the manikin, ranging from very open (easiest), as seen in figure 6 below to very closed (hardest), as seen in figure 7 below. This was done by using wooden blocks ranging from 75° to 100° as seen in figure 5 below, which can be easily placed beneath the head to make quick adjustments.



*Figure 5: Wooden Blocks of Varying Angles*

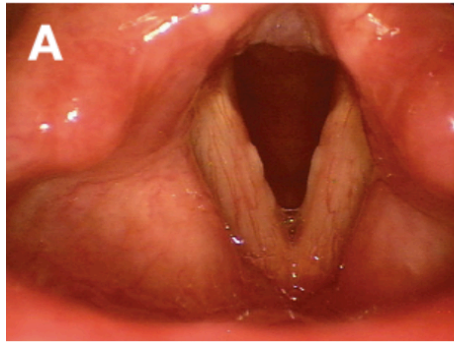


*Figure 6: Manikin at 75°*

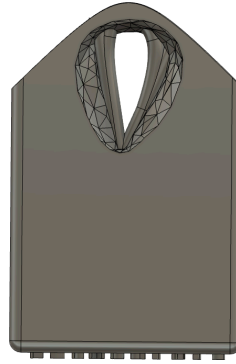


*Figure 7: Mankin at 90°*

The second point of modularity is at the vocal cord region of the manikin. To create modularity in this part of the training manikin, interchangeable airway inserts were modeled and 3D printed to replicate various airway conditions and pathologies. These included a healthy airway, laryngitis-affected airway, and a polyp-affected airway. These slides were modeled based on images, scans, and descriptions of the respective pathologies as can be seen in figure 8. A negative was modeled to fit around the primary airway mold negative to create the space for the inserts, and was 3D printed in PLA. For the aesthetics of the airway, a skull was downloaded from an open source 3D modeling website and then modified using SolidWorks and Blender to add thickness to the mesh as can be seen in figure 10. The face and the jaw were then printed separately out of PLA. To hold the airway manikin, a base was designed using SolidWorks and also printed out of PLA. There was a small pinhole added onto the side of the base to allow for direct connection to a smaller hinge piece that was also designed using SolidWorks and integrated seamlessly into the final design.



*Figure 8: Airway Affected by Laryngitis [9]*



*Figure 9: Modeled Laryngitis Airway Insert*



*Figure 10: Manikin Face*

**3.6** Airway professionals at the UW Health Department of Anesthesiology practiced intubating using varied neck angles and vocal cord slides. Results were generated from feedback collected through a form after their experience using our prototype. This form asked the airway

professionals to rate our manikin on a scale of 1-5 for varying aspects such as stability and similarity to other manikins they have seen. More information on the form used can be found in appendix C. This form also sought qualitative feedback on the general feel of the manikin and aspects that worked well and other aspects that did not. Much of the feedback received was not written down on the forms handed out, but instead was learned through conversations with the airway professionals as they tested the manikin. One main piece of feedback was that intubation was too easy. This was mostly due to the low stiffness and extreme compliance of the silicone material. Professionals also stated that there should be force required by the user to open the manikin's mouth and to hold the head up in order to further replicate intubation scenarios. There was agreement that everything was positioned correctly anatomically, however, this is also not reflective of intubation scenarios since patients do not position themselves perfectly to be intubated. Other general feedback praised the detail and accuracy of the vocal chord slides, and confirmed that the motions required to intubate the prototype were reflective of true intubation.

**3.7** Repeated intubation testing was performed by 4 members of the team to determine the effect that neck flexion angle has on time to intubate. Three intubations were performed and timed on the prototype while the neck flexion was at 75, 80, 85, 90, and 100 degrees with the average times calculated and plotted. The format of this test allows for comparison in difficulty between neck angles independent of the person intubating.

## **4. Results**

**4.1** Initial material testing revealed that TPU, followed by flexible resin, elastic resin, and EcoFlex silicon, is the least compressive of the materials tested. The team also tested the TruCorp rubber from an airway training manikin which had a similar stiffness to silicone.

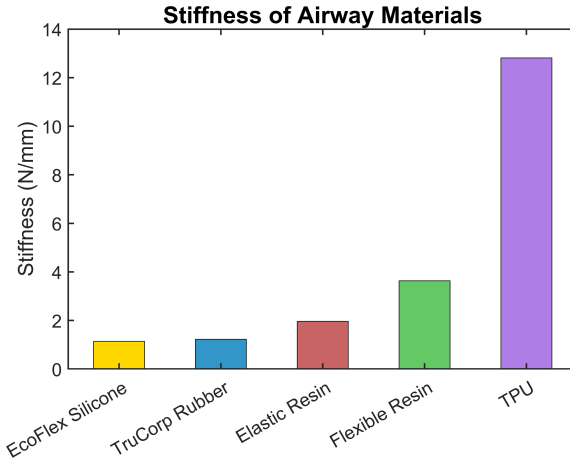


Figure 11: Graph Depicting Stiffness of Different Materials

Durability testing revealed that TPU and EcoFlex resin experienced the smallest change in natural shape after repeated intubation. Elastic and flexible resin experienced tearing after minimal intubations. The TruCorp Rubber also experienced no change in shape or properties after over 50 intubations.

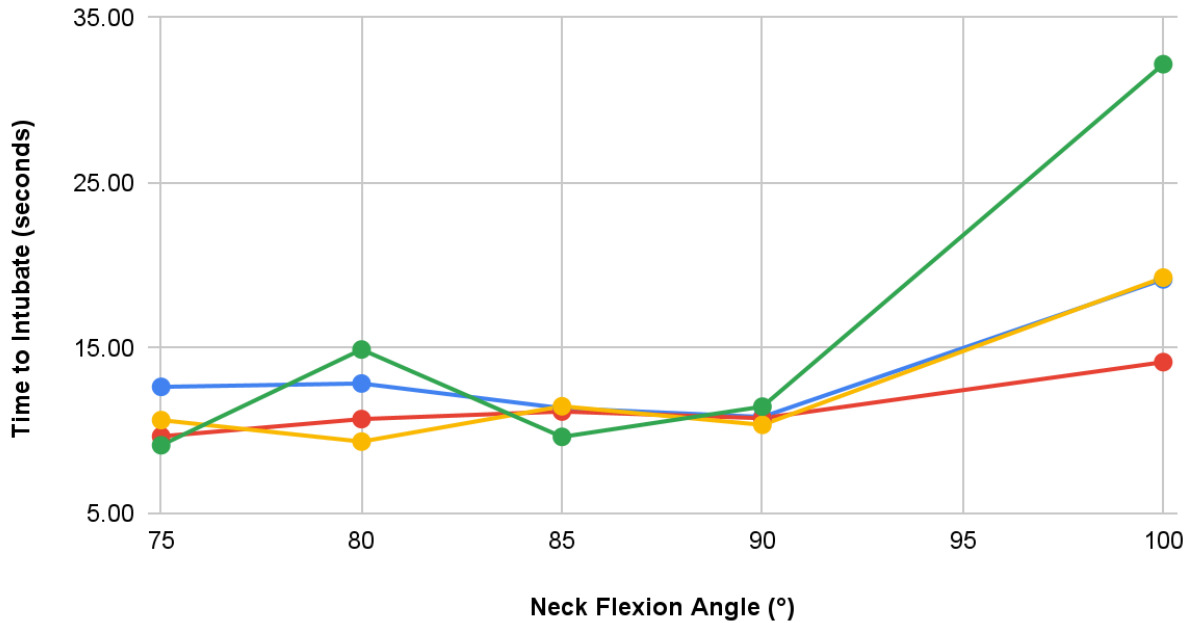
Material	EcoFlex Silicone	TruCorp Rubber	Elastic Resin	Flexible Resin	TPU
<b>Intubations until damaged</b>	>50 - Minimal Damage	>50 - No Damage	4	7	>50 - No Damage

Table 1: Durability Results For All Materials During Intubation

Although the hardness of TPU most closely matches that of airway cartilage, the material is not practical for use in an airway trainer. The tested material that allows for the best quality of intubation training is EcoFlex. The silicone material does not tear under significant pressure or during repeated use. However, the material deforms greater amounts than human tissue under typical intubation conditions. These factors make EcoFlex the most ideal material for creating an airway training manikin, although it must be noted that in a human intubation, the maximum

force applied before airway damage will be lower than during training.

## Intubation Time vs. Neck Flexion Angles



*Figure 12: Intubation Time vs. Neck Flexion Angles*

**4.3** Testing conducted with the airway professionals provided crucial insights into the usability of our manikin in the hospital setting. Using the 1-5 scale on base questions allowed for a box and whisker plot to be generated to show answers to key aspects of our design. In figure 13, the box and whisker chart categories refer to the different questions from the handout. The aesthetics and overall design of the manikin was spot on in the eyes of the professionals as well as the interchangeability of the airway inserts. A common theme was that the manikin lacked in real life simulation and applicability to surgery. Asking further questions to the professionals revealed the flexibility of the chosen silicone made intubation too easy in some cases which detracted from the applicability of the design. The professionals also noted how the head was too light and that there should have been some force required to open the mouth as would be seen in a real life

intubation scenario. While there was some negative feedback, there were also a lot of positive aspects of the final manikin. Some highlights of this feedback include how everything was in the correct anatomical position and how the visuals were very accurate, especially with the vocal cord inserts. Also, the cost effectiveness of the manikin was another major highlight. Overall, this testing provided a lot of useful information about the usability of the manikin in the clinical setting while setting further benchmarks to accomplish as the scope narrows and the manikin design process matures.

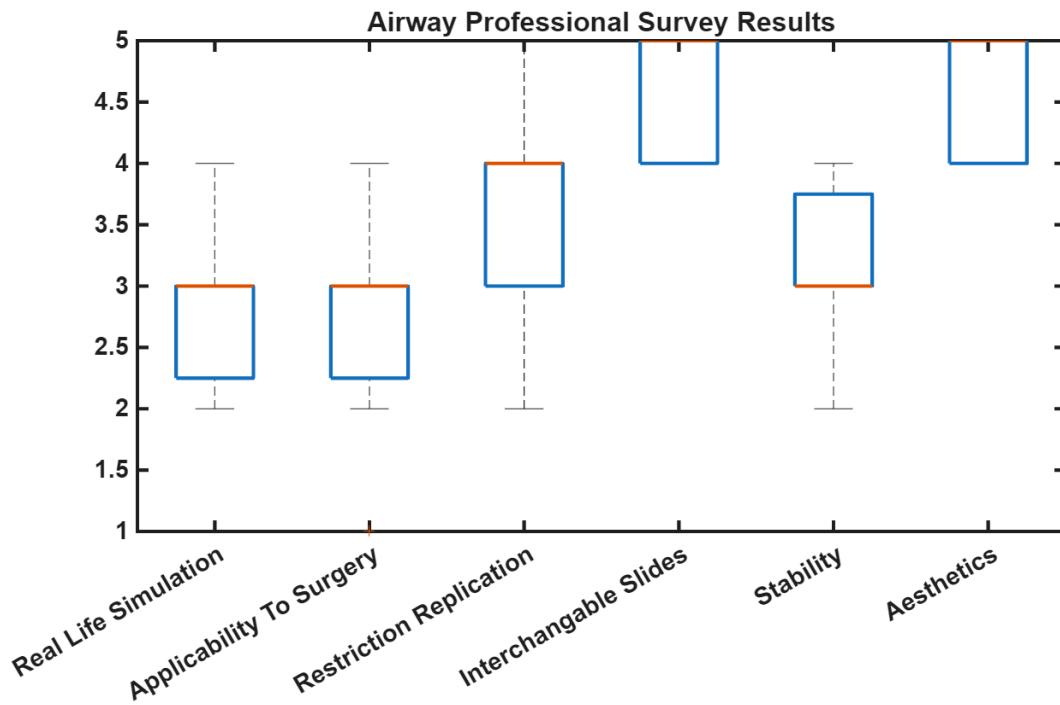


Figure 13: Box and Whisker Plot of Survey Results

## 5. Discussion

We outline the process to convert MR imaging of patient airways to patient-specific intubation trainers to improve airway management outcomes. This project identified several difficulties in designing and fabricating patient-specific airway trainers from MR imaging. MR imaging of the volunteer airways in the sniffing position, even with anaesthesiologist assistance, did not yield functional airway models. While the MR imaging achieved accurate airway size and represented patient-specific anatomy, the imaging failed to deliver a distinguishable esophagus and tongue, and required significant smoothing during segmentation to produce a single airway mesh. In early iterations of the design, the lack of an esophagus was remedied through manual modeling of an esophageal tube in an estimated location based on landmarks on the airway model and in the segmentation interface. While this addition created a necessary failure mode for the model during intubation, the guesswork involved in this step jeopardized the accuracy and realism of the model to the extent that the team felt uncomfortable using this process moving forward. Additionally, reduction of the mesh in Fusion before converting to a solid body resulted in a diminished resolution. When imported to Fusion, the airway meshes had between 25,000-30,000 faces which was too complex for the modeling software to compute and convert directly to a solid body. The necessary reduction to <10,000 faces leveled the topography of the tissue and led to a reduced anatomical accuracy of the model. Another hurdle encountered during this study was the direct 3D printing of airways in early interactions of the design. Though 3D printing has extreme potential in tissue modeling applications due to a wide variety of materials and variable infill density parameters, its integration into the MRI-driven process did not yield the best results. Additionally, physically creating a manikin with a seamless integration of 3D printed airways proved difficult. Distinguishing how much of the manikin should be rooted in patient-specific MR imaging versus constructed separately as a modular or adjustable base was a

persistent challenge. Ultimately, the team chose to use preoperative MR imaging solely to determine the difficulties in the patient's airway, then adjust an all-in-one, adjustable, modular manikin to represent the airway as accurately as possible. This was done by creating modularity in the vocal cords via airway slides and in the neck angle via a hinge and adjustable blocks. Through surveying airway professionals, mixed results were discovered. It was decided that the manikin was too easy to perform intubation on at the majority of the neck angles, which is nonrepresentative of real life intubation experiences. It was also agreed upon that the jaw required too little force to open when compared to existing trainers and patients. Additionally, the head was lighter than needed, and the airway material was too flexible when compared to human patients. The airway, however, was found to very closely match the anatomy of a human airway, a fact very beneficial in the training of anesthesiologists and EMTs. It was also noted explicitly that the vocal inserts very closely match human tissue and pathology, a key feature of this manikin. The modularity of the neck angle and vocal cords were also found to be positives, namely in the ease and stability of the modulations. For the existing cost of producing the manikin, \$155, the modularity and accuracy of the manikin are an incredibly beneficial improvement to an intubation training environment. Many simple changes could be introduced to the manikin at a low cost to address the concerns named by the clinicians. These changes include springs simulating skull weight and jaw tension, and increased stiffness in the silicone used to simulate the airway. Addressing these concerns leads to a modular and accurate airway manikin matching human airway and pathologies in a price effective manner that would be accessible to any intubation teaching environment.

## 6. Conclusions

- The first method for airway trainer fabrication was not appropriately reflective of patient anatomy and provided the authors with many difficulties that reduced team productivity. As a result, this method was scrapped.
- The new method for fabrication established a more feasible way for directly mimicking patient airway anatomy through the use of the negative space in the airway to create a mold which could then be cast out of silicone.
- Initial material testing was conducted during both phases. After discussion with the author's client it was determined that matching the material properties to trainers that exist on the market was more useful than attempting to directly match airway mechanical properties.
- Qualitative testing informed us on the feasibility of the final design for usability in the clinical setting while also providing crucial insight into necessary changes.
- Time to intubate testing conveyed how differences in neck angle impacted difficulty to intubate.
- The team successfully developed a method for creating a pseudo-patient specific airway manikin through the use of interchangeable vocal cord slides and variable neck angles.
- The cost effectiveness of the trainer was a major benefit, as the design only costs \$155 compared to trainers on the market costing around \$1,700
- Many simple changes could be made to the manikin to address clinicians concerns like using a spring to simulate head weight or stiffer silicone to make intubation harder
- Further research needs to be conducted to determine the feasibility of using patient specific imaging to generate airway models; potentially the usage of CT scans could generate areas with enough contrast to differentiate the airway tissues.

## Appendix

### A. Expense Table

3D Prints										
Decent Sim screws						10/24/2025	1	\$0.98	\$0.98	<a href="https://www.decentsimulators.com/simple-intubation">https://www.decentsimulators.com/simple-intubation</a>
Decent Sim outer mold piece 1						10/24/2025	1	\$30.70	\$30.70	
Decent Sim outer mold piece 2						10/24/2025	1	\$36.00	\$36.00	
Decent Sim inner airway						10/24/2025	1	\$5.89	\$5.89	
Decent Sim mold opener						10/24/2025	1	\$0.48	\$0.48	
Mold for our scan						11/21/2025	1	\$15.26	\$15.26	
Mold for our scan reprint						11/25/2025	1	\$8.56	\$8.56	
Airway mold and vocal insert						3/20/2026	1	\$3.12	\$3.12	
Face print 1						3/24/2026	1	\$2.13	\$2.13	
Jaw print 1						3/24/2026	1	\$0.31	\$0.31	
Face print 2						3/26/2026	1	\$4.29	\$4.29	
Jaw print 2						3/26/2026	1	\$0.99	\$0.99	
Face print 3						4/8/2026	1	\$5.83	\$5.83	
Jaw print 3						4/8/2026	1	\$2.25	\$2.25	
Laryngitis insert						4/8/2026	1	\$10.27	\$10.27	
Face print 4						4/13/2026	1	\$5.32	\$5.32	
Jaw print 4						4/13/2026	1	\$1.88	\$1.88	

						2026				
Base print 1						4/13/2026	1	\$14.25	\$14.25	
Vocal chord all slides elastic						4/13/2026	1	\$23.36	\$23.36	
Hinge piece print 1						4/16/2026	1	\$1.70	\$1.70	
Base print 2						4/16/2026	1	\$12.17	\$12.17	
Face print 5						4/20/2026	1	\$8.42	\$8.42	
<b>Materials</b>										
Silicone	Ecoflex 00-30 Trial Kit	Smooth-On	10007010			10/27/2025	2	\$67.58	\$135.16	<a href="https://www.smooth-on.com/products/Ecoflex-00-30/">https://www.smooth-on.com/products/Ecoflex-00-30/</a>
Lamp extension	PATIKIL 7.9" Universal Gooseneck Hose, 2Pcs M10/M8 Fine Thread 8mm Metal Bendable Flexible Arm Gooseneck Tube Extension for Multifunction DIY, Silver Tone					10/27/2025	1	\$9.80	\$9.80	<a href="https://www.amazon.com/dp/B0B6PW1VJK?smid=AF9CPILHGHOMP&amp;ref=chk_typ_imgToDp&amp;th=1">https://www.amazon.com/dp/B0B6PW1VJK?smid=AF9CPILHGHOMP&amp;ref=chk_typ_imgToDp&amp;th=1</a>
Longer lamp extension	PATIKIL 15.7" Universal Gooseneck Hose, 2Pcs M10/M8 Fine Thread 8mm Metal Bendable Flexible Arm Gooseneck Tube Extension for Multifunction DIY, Silver Tone					11/20/2025	1	\$12.82	\$12.82	<a href="https://www.amazon.com/PATIKIL-Universal-Gooseneck-Extension-Equipment/dp/B0B6PP8ZKR/ref=sr_1_4?crid=AU0FS4F4UAPT&amp;dib=eyJ2ljojMSJ9.GLVC3aL4ZQ3rnoOP04104sE3b-EqbFy_tXOchpDGmrQNgFbCcsCVHrLMpeKOM5BuMDJZ2UyGdzkvtq_v-hisXAsTquLvbJ5llrvOjBFPUT9-NuCMLh1un5VBMnzN1fePalJoY_fHUHNvNg-ChZ40alasCc_bnP2P8UIQZX2wbJP_I6QHVBcwJnmUVfwMeSTx54v4GsFWpqU0jnZBRGvponHdOKcBSXhePlqpkjI3DZi">https://www.amazon.com/PATIKIL-Universal-Gooseneck-Extension-Equipment/dp/B0B6PP8ZKR/ref=sr_1_4?crid=AU0FS4F4UAPT&amp;dib=eyJ2ljojMSJ9.GLVC3aL4ZQ3rnoOP04104sE3b-EqbFy_tXOchpDGmrQNgFbCcsCVHrLMpeKOM5BuMDJZ2UyGdzkvtq_v-hisXAsTquLvbJ5llrvOjBFPUT9-NuCMLh1un5VBMnzN1fePalJoY_fHUHNvNg-ChZ40alasCc_bnP2P8UIQZX2wbJP_I6QHVBcwJnmUVfwMeSTx54v4GsFWpqU0jnZBRGvponHdOKcBSXhePlqpkjI3DZi</a>

									<a href="https://www.google.com/search?q=qZS9thr3VhstsJPC4g6y1S8A5c-AFLfKoEAt7jDf7O9RzHuE4r0Zf936V73PasL4.3KUY9UA_t_aUswHKttEqNcOiAoOXlvX-wRjgvkFYAqfY&amp;dib_tag=se&amp;keywords=flexible%2Blamp%2Brod&amp;qid=1763665280&amp;sprefix=flexible%2Blamp%2Brod%2Caps%2C152&amp;sr=8-4&amp;th=1">qZS9thr3VhstsJPC4g6y1S8A5c-AFLfKoEAt7jDf7O9RzHuE4r0Zf936V73PasL4.3KUY9UA_t_aUswHKttEqNcOiAoOXlvX-wRjgvkFYAqfY&amp;dib_tag=se&amp;keywords=flexible%2Blamp%2Brod&amp;qid=1763665280&amp;sprefix=flexible%2Blamp%2Brod%2Caps%2C152&amp;sr=8-4&amp;th=1</a>
Silicone	Ecoflex					4/8/2026	1	\$34.80	\$34.80
									<b>\$386.</b>
								<b>TOTAL:</b>	<b>74</b>

## B. Time to Intubate Raw Data

P1 (Cody)					
Block Angle	Attempt 1	Attempt 2	Attempt 3	Mean	StDev
75	10.11	15.41	12.45	<b>12.66</b>	2.66
80	12.92	13.61	12.05	<b>12.86</b>	0.78
85	12.09	11.57	10.44	<b>11.37</b>	0.84
90	11.92	10.12	10.47	<b>10.84</b>	0.95
100	28.74	13.02	15.72	<b>19.16</b>	8.41
P2 (Lance)					
Block Angle	Attempt 1	Attempt 2	Attempt 3	Mean	StDev
75	9.4	9.32	10.27	<b>9.66</b>	0.53
80	9.84	10.29	11.99	<b>10.71</b>	1.13
85	11.02	11.77	10.7	<b>11.16</b>	0.55
90	10.29	10.99	11	<b>10.76</b>	0.41
100	14.34	13.45	14.67	<b>14.15</b>	0.63
P3 (Matt)					
Block Angle	Attempt 1	Attempt 2	Attempt 3	Mean	StDev

75	11.26	11.06	9.61	<b>10.64</b>	0.90
80	8.32	9.43	10.28	<b>9.34</b>	0.98
85	11.96	11.78	10.71	<b>11.48</b>	0.68
90	10.18	10.48	10.41	<b>10.36</b>	0.16
100	35.41	10.96	11.44	<b>19.27</b>	13.98
P4 (Elle)					
Block Angle	Attempt 1	Attempt 2	Attempt 3	Mean	StDev
75	8.28	9.03	10.06	<b>9.12</b>	0.89
80	18.21	16.13	10.41	<b>14.92</b>	4.04
85	9.66	9.65	9.58	<b>9.63</b>	0.04
90	13.36	11.71	9.31	<b>11.46</b>	2.04
100	37.02	43.31	16.22	<b>32.18</b>	14.18

### C. Airway Professional Handout

**On a scale of 1-5, how would you rate the following...**

Your intubation skills

How accurate is our trainer compared to a real life intubation

How well would this prepare you for a surgery with a restricted airway

How well do the airway slides represent actual restrictions

How easy is it to change the vocal cord slides

How stable is the trainer when conducting intubation

How well do the aesthetics of our manikin match an individual in the sniffing position

#### Short Answers

How does our trainer feel compared to other trainers you have used?

Could you see yourself using our trainer to prepare for a surgery?

What works well in our trainer?

What additions would you make to our trainer?

What would you remove from our trainer?

Any other general feedback or things we should know?

### D. Airway Professional Raw Data

Intubation Skills	Real life simulation	Applicability to surgery	Restriction replication	Interchangeable slides	Stability	Aesthetics
4	3	2	3	5	2	4
3	2	1	2	5	3	4
3	3	4	4	5	4	4
3	3	3	5	5	3	5
5	4	3	4	4	4	4
1	3	3	5	5	3	5
3	3	3	4	4	3	5
3	2	3	3	4	3	5
2	3	3	3	4	2	5
3	2	2	4	4	3	4
4	3	3	3	5	4	5

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