External Intubation Air Device

Airmid Advancements

Sponsored by: Centre for EMERGENCY HEALTH SCIENCES

UTSA Klesse College of Engineering and Integrated Design

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INTRODUCTION

Currently, 313 million endotracheal intubations are performed each year. 1 in 4 of these intubation tubes are misplaced during intubation, leaving a concerning margin of error. Most mistakes happen due to the inability to clearly see the patient's airway. A device that solves this issue in a pre-hospital setting is not currently on the market. Airmid Advancements has a mission to provide a device that can properly align the patient's airway, giving a clear line of sight for the correct placement of endotracheal intubation tubes. We aim to reduce the number of misplaced intubations each year and increase prehospital patient survival.

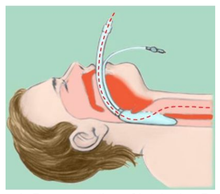
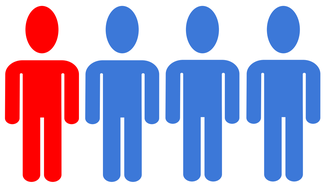
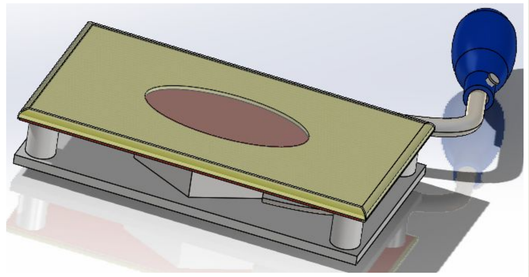


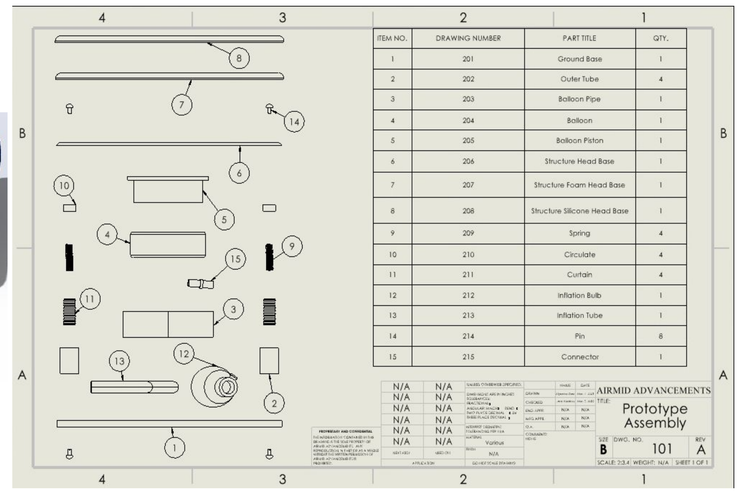
Figure 1: Demonstration of Intubation Procedure

1 in 4 Intubation Tubes Are Misplaced



FINAL PRODUCT





ITEM NO.	DRAWING NUMBER	PART TITLE	QTY.
1	201	Ground Base	1
2	202	Outer Tube	4
3	203	Balloon Pipe	1
4	204	Balloon	1
5	205	Balloon Piston	1
6	206	Structure Head Base	1
7	207	Structure Foam Head Base	1
8	208	Structure Silicone Head Base	1
9	209	Spring	4
10	210	Circulate	4
11	211	Curtain	4
12	212	Inflation Bulb	1
13	213	Inflation Tube	1
14	214	Pin	8
15	215	Connector	1

AIRMID ADVANCEMENTS
TITLE: Prototype Assembly
SIZE B | DWG. NO. 101 | REV A
SCALE: 2.3:4 WEIGHT: N/A SHEET 1 OF 1

Figure 2: Rendered image of (a) assembled view of the device and (b) exploded view drawing of the device

PERSONNEL & REPORTING

Labor Category	Hourly Rate
Senior Project Manager	$200
Senior Engineer	$125
Engineer	$100
Technician	$50
Machine Shop	$25
Secretary	$20
Laborer	$15

Table 3: Hourly Labor Rates For Senior Design II Project

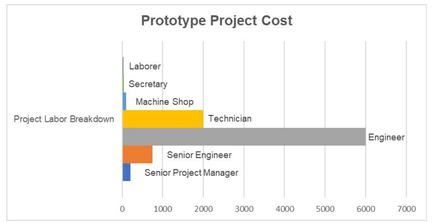


Figure 3: Graph Of The Cost Of Project

Prototype Project Total: $9,120

MANUFACTURING COSTS

Total Prototype Cost: $60.06

CLAIMS

- Reaches a Maximum Height of 6 Inches
- Compact
- Able To Hold Weight of Up To 20 Lbs
- Accommodates Bariatric Patients
- Light Weight

CUSTOMER STATEMENT

Customer interviews were conducted to better understand intubations, the difficulties encountered when perform the procedure, specifications of the device operation and the conditions the device would be used in. These interviews resulted in the customer statement below.

Create a non-invasive, prehospital use device that will properly elevate and secure a patient's head for a clear line of sight of the airway for intubation procedures in emergency environments.

FUNCTIONAL SPECIFICATIONS

User Need	Design Criteria
Adjustable Position	1 moveable y-axis at least 4 inches in height.
Small Compact Size	Fit within the dimensions of a 10 inches x 10 inches x 10 inches : L x W x H compartment.
Quick Deployment	Ready to operate within 30 seconds of deployment
Easy Operation	Operated in no more than 4 steps
Stable	Not translate more than 1 inch when loaded
Disposable	Single use and able to be discarded after operation
Light Weight	Weigh no more than 3 lbs
Durable	Withstand being dropped repeatedly from no more than 2 meters and remain operational

Table 1. User Needs And Design Criteria For The External Intubation Aid Device

TRACEABILITY MATRIX

Test Plan	Description	User Needs
Human Factor/Usability Test	Determine end user opinions of device features and evaluate device operation	Easy Operation, Light Weight, Small Compact Size, and Stable
Inflation Test	Test the maximum height the balloon can attain and how much weight the device can hold for certain periods of time	Adjustable Position and Quick Deployment
PVC Adhesive Test (ASTM D2564-12)	Evaluate the strength of the adhesive that is holding the device together	Durable
Vibration/Shipping Test	Verify that the device can be shipped and be operational after being unpacked.	Durable
Benchmark Performance Test	Test the full functionality of the device.	Adjustable Position, Stable, Quick Deployment
Cadaver/Mannequin Test	Validate that the device will elevate adults' heads to a height to see the full opening of their glottal opening.	Adjustable Position and Easy operation
Biocompatibility-Cytotoxicity (ISO 10993-5)	Determine if material exposure will cause cytotoxic or apoptotic effects to cells.	Disposable
Biocompatibility-Sensitization (ISO 10993-10)	Ensure that material exposure produces only a mild to moderate erythema.	Disposable
Biocompatibility-Irritation (ISO 10993-10)	Ensure that severe erythema and oedema formations do not occur when skin cells are exposed to the device material.	Disposable

Table 2: Traceability Matrix To Determine The Correlation Between Tests And User Needs

TESTING RESULTS

TP 01 - Human Factors/ Usability Test

Acceptance Criteria
Device is able to be used by an emergency service professional with minor instructions. ***Pass:*** *The device is given an average score of 8 and above.* ***Fail:*** *The device is given an average score less than 8.*

Non-Engineering: 9.50
Engineering: 9.14
Urban Paramedics: 9.43
Rural Paramedics: 9.17

Overall Usability Score: 9.31
Test Passed

TP 02 - Height Inflation Test

Acceptance Criteria
The balloon must extend vertically greater than 4 in when fully inflated. ***Pass:*** *The balloon inflates to a height greater or equal to 4 in.* ***Fail:*** *The balloon inflates to a height lower than 4 in.*

To Be Determined

TP 03 - Weight Inflation Test

Acceptance Criteria
The balloon must be able to hold while inflated without decreasing in height ***Pass:*** *The balloon height decreased less than 2cm for all 3 weights* ***Fail:*** *The balloon height decreased more than 2cm after 5 minutes on at least one weight trial.*

10lbs:Pass - No height change
15lbs:Pass - .254cm decrease
20lbs:Pass - .635cm decrease
Ballon passed each weight trial

TP 04 - Adhesive Test

Acceptance Criteria
The balloon must be able to operate in all weather conditions. ***Pass:*** *Device maintains its connectivity and operates flawlessly after a 20 minute test run in each testing group condition.* ***Fail:*** *Device is no longer connected or operable after a 20 minute test run in each testing group condition.*

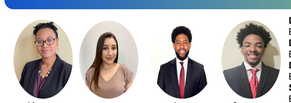
Oven (100 - 120) °F: Pass
Freezer (20 - 40) °F: Pass
Normal Weather Conditions (60 - 90) °F: Pass
Each Sub-Assembly passed each temperature trial

CONCLUSIONS

We have a passionate team dedicated to furthering technology and saving lives. We welcome you to be pioneers with us in our groundbreaking developments.

- The goal of our device is to decrease intubation tube misplacements, therefore increasing patient survival.
- The development of this device will pave the way for a new market of pre-hospital intubation aids.
- With the aid of this device, emergency services can conduct better resource allocation to help more patients at one time, This will decrease the need to triage air management when responding to emergency medical situations.
- This type of device has potential to be redesigned for pediatric applications.

TEAM MEMBERS & MENTORS



Aiyanna Doss — Project Lead
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Jerry McElroy — Business Coordinator
Cameron Charles — Public Relations

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Dr. Robert Delorenzo - Emergency Medicine Mentor - Professor of Emergency Medicine
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Mr. Dave Kuenstler -Machine Shop Manufacturer- Director of UTSA Makerspace Machine Shop

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