

Team B9: Accessible Ventilation Coach for Opioid Overdose Bystanders

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Motivation

Need for accessible and cost effective method to help overdose victims

- **+110,000 drug overdose deaths** in the US in 2023
- Main cause of death from opioid overdose is **respiratory failure**
- EMS response takes **7-14 minutes**
- Currently **no safe bystander options** for ventilation

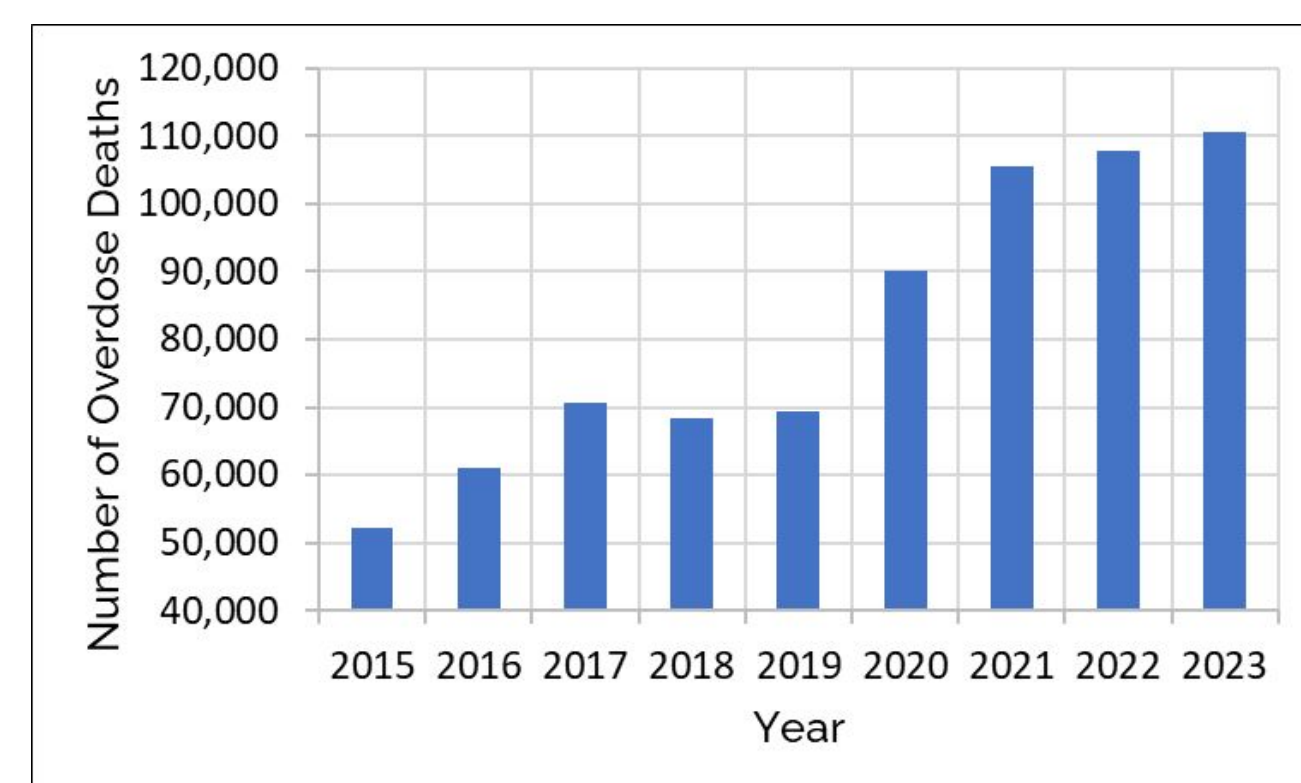


Figure 1. Drug Overdose Death Count in the US

Objectives

Develop an adjunctive device to the Bag Valve Mask to coach and empower bystanders to perform rescue breaths to overdose victims safely and effectively

- < 225 grams
- > 25 min battery life
- < \$30 at production scale
- Coach 500ml compression
- Guide 15 breaths/min
- Instruct "E-C Seal"

Methods

Device Calibration Using Lung Simulator

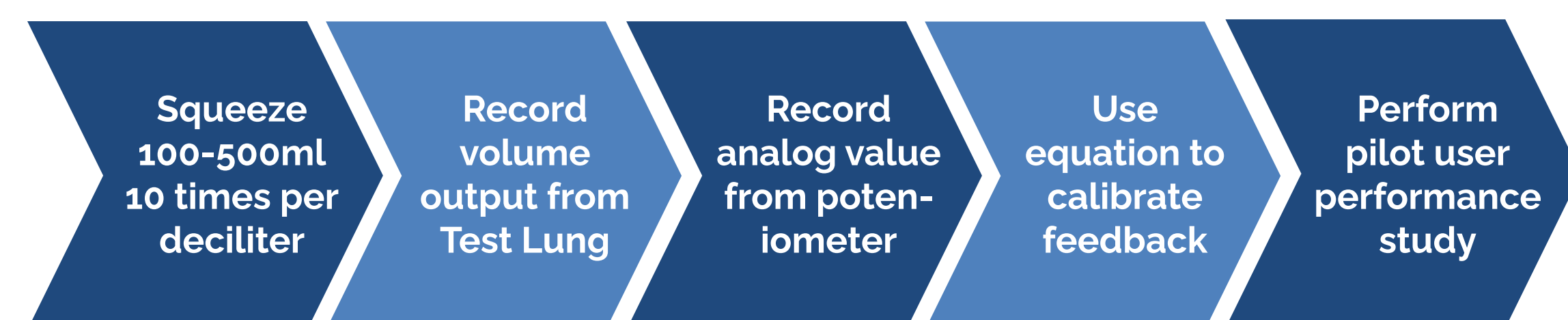


Figure 2. Michigan Test Lung

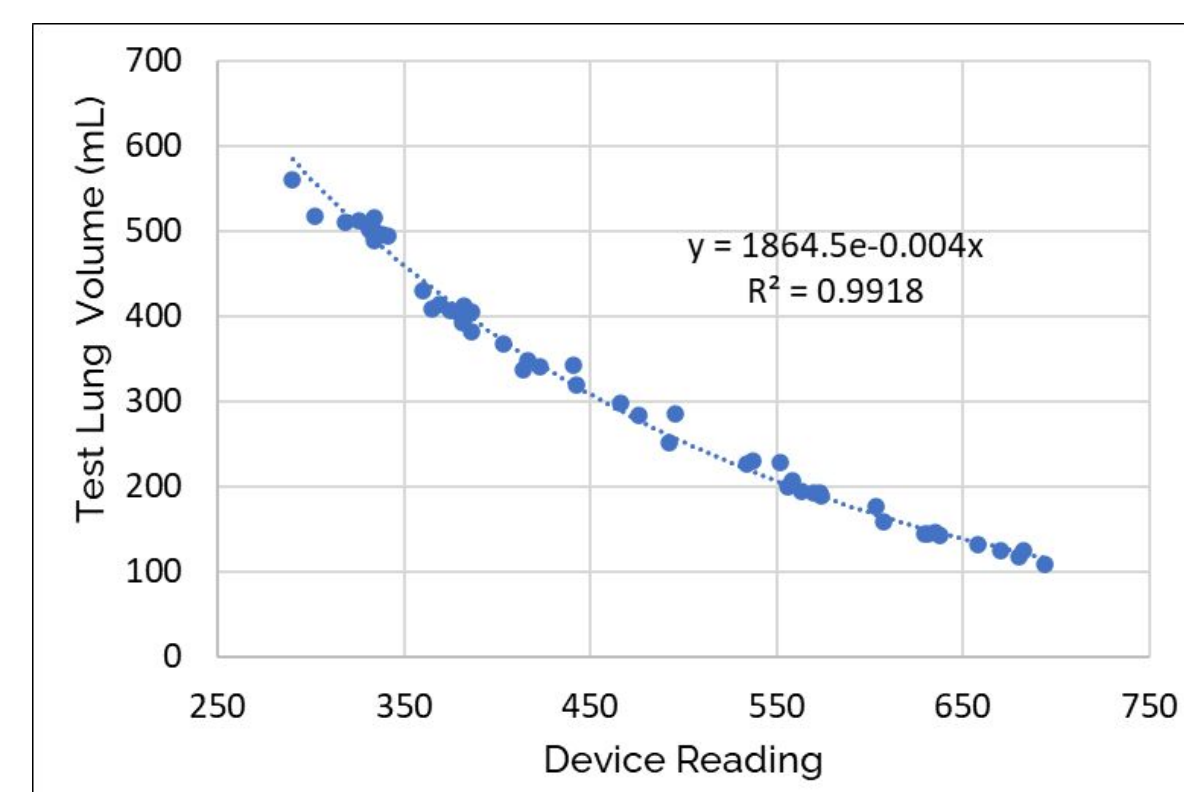
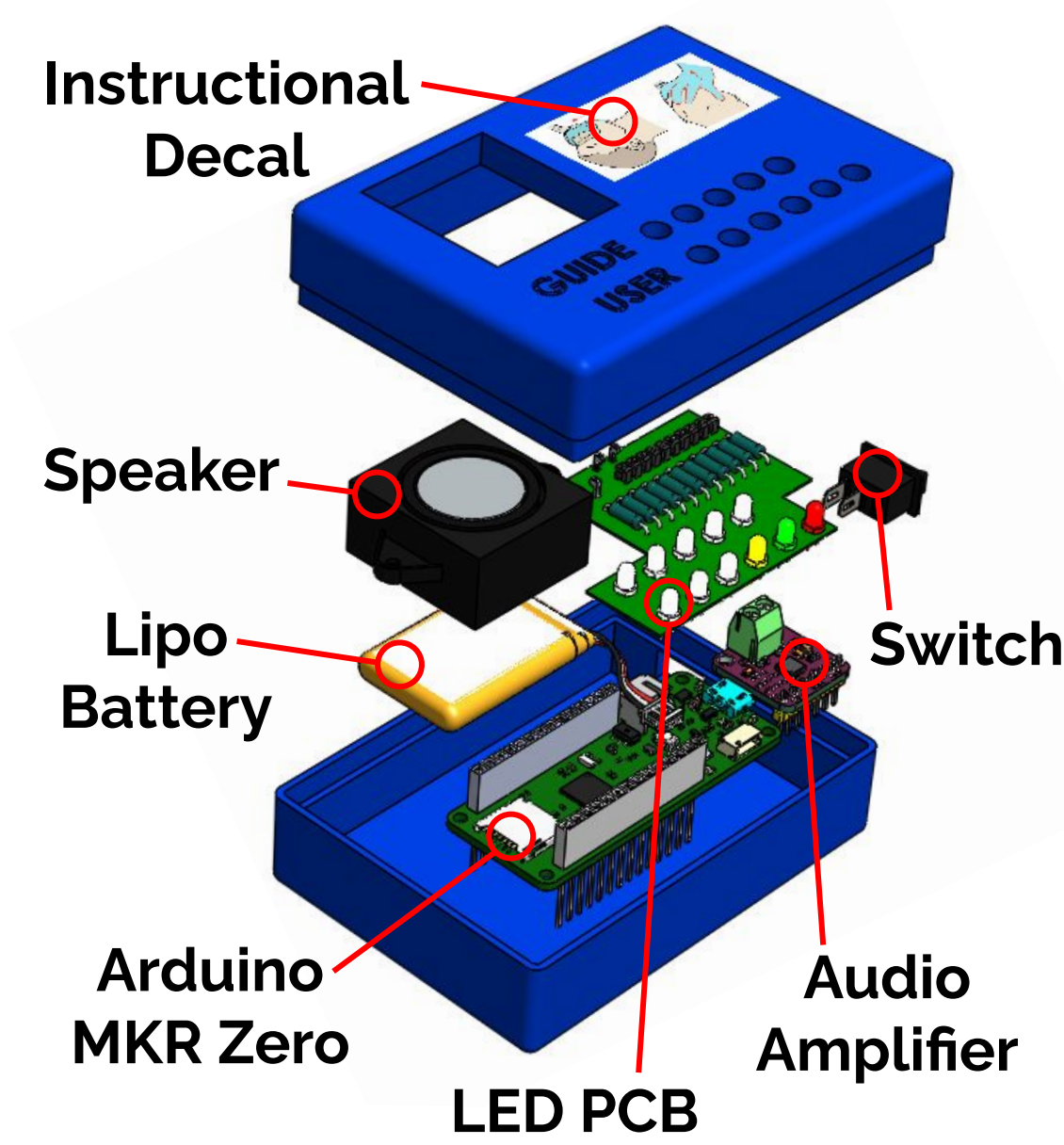
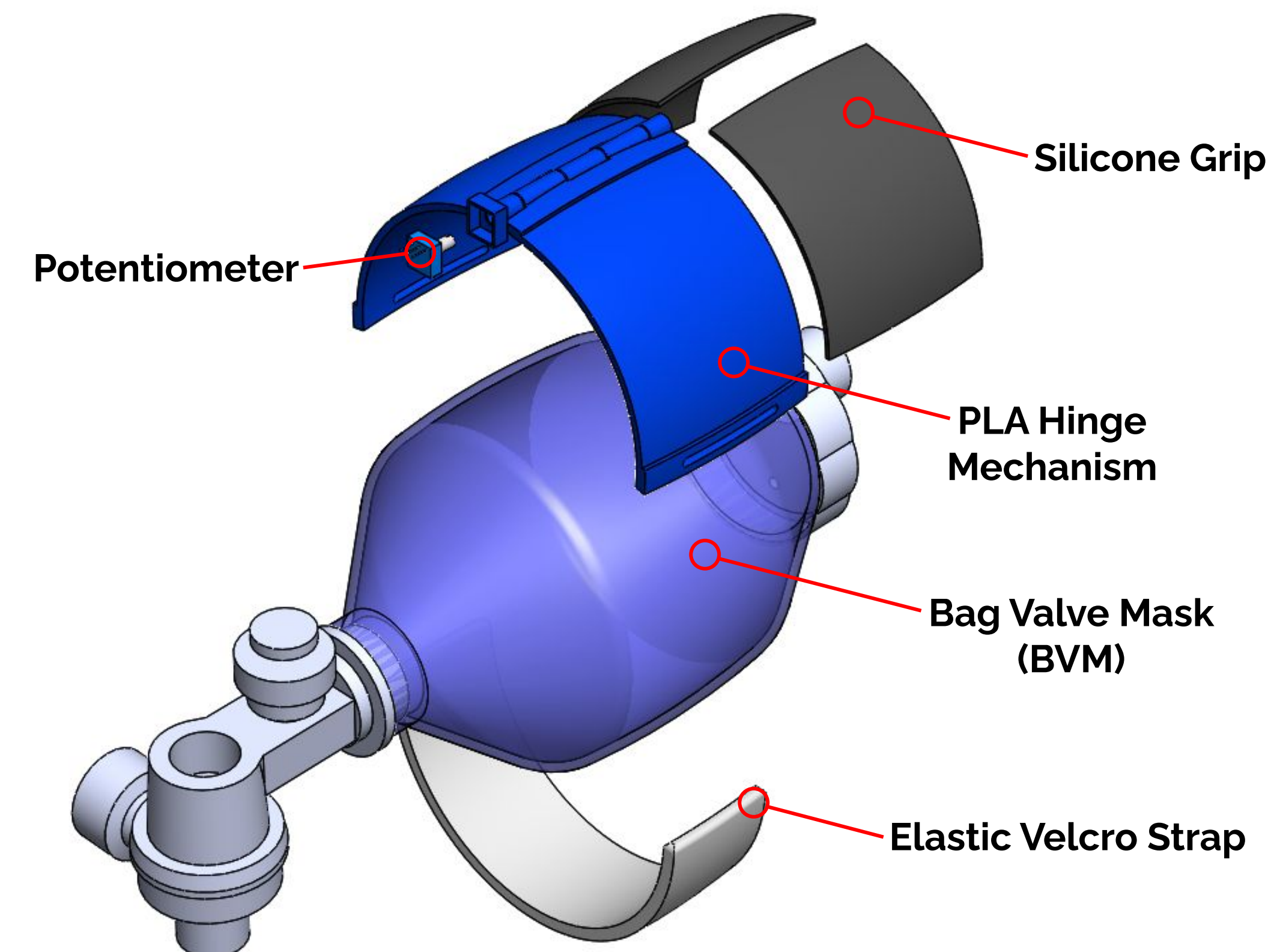


Figure 3. Relationship Between Measured Volume and Device Reading

Solution



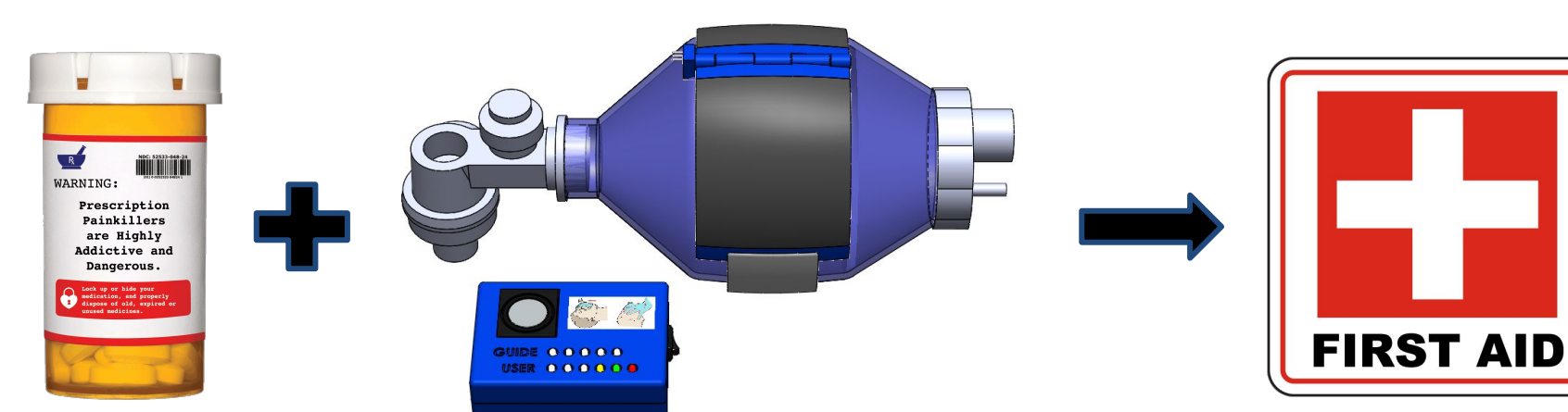
Feedback Features

GUIDE	Over Ventilate >550ml	"Squeeze Softer"
USER		
GUIDE	Under Ventilate <450ml	"Squeeze Harder"
USER		
GUIDE	Hyperventilate >15 bpm	"Squeeze Slower"
USER		
GUIDE	Hypoventilate <15 bpm	"Squeeze Faster"
USER		

Bioethical Implications

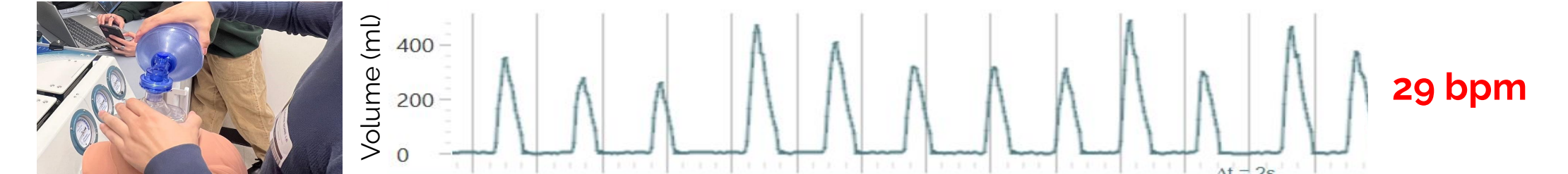
Revolutionize untrained bystander opioid overdose management

- Reduce overdose mortality rates
- Provide **emergency care** for patients in **respiratory arrest**
- **Affordable solution** distributed with opioid prescription
- Provide **increased usability and safety** for manual resuscitation



Results

Without Device



With Device

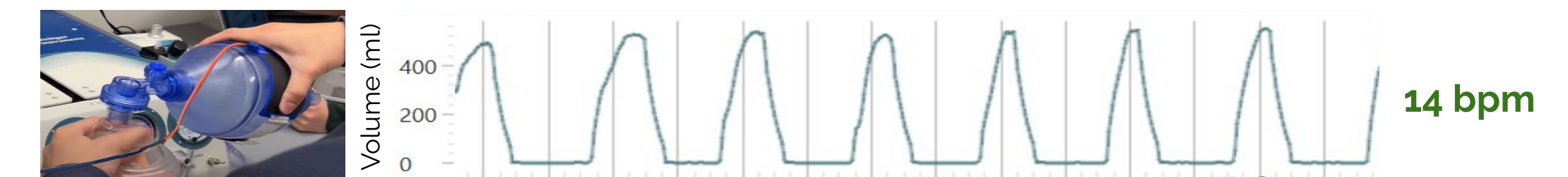


Figure 4. Michigan Test Lung Volume Output

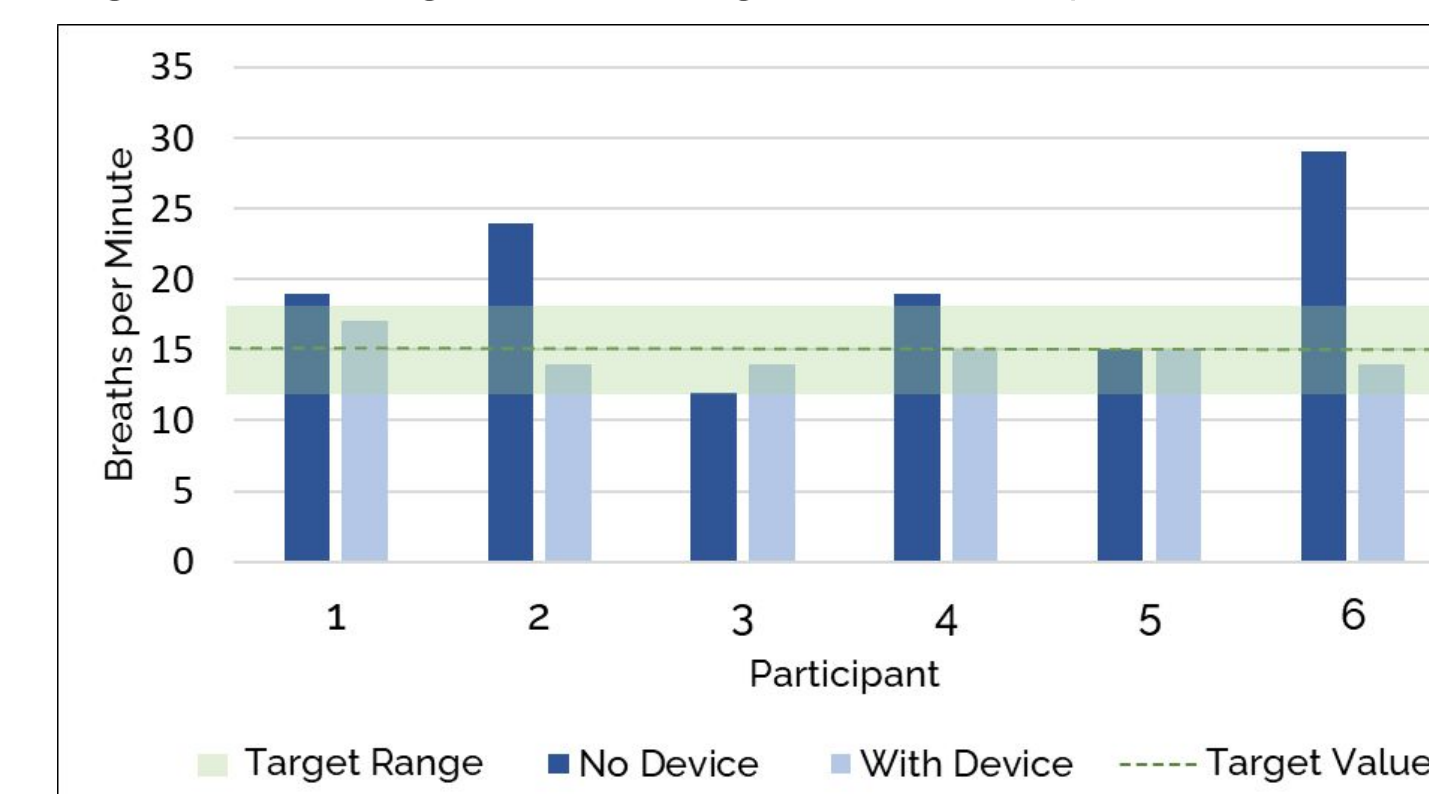


Figure 5. Pilot Test Compression Rate

All participants achieved target compression rate with device.

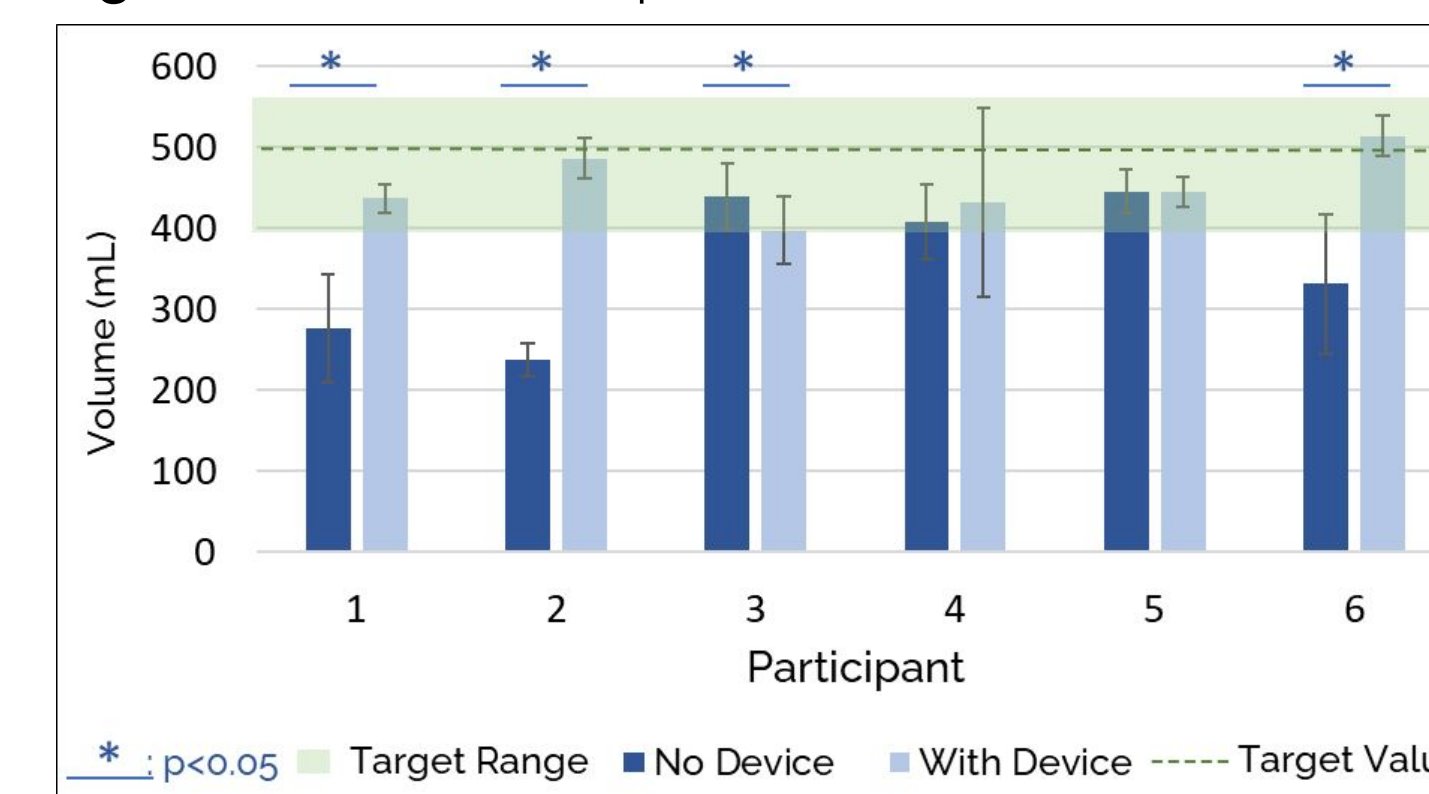


Figure 6. Pilot Test Volume Output

All participants reached target volume output range with device.



Conclusion & Future Work

Data indicates that **audio and visual feedback support bystander confidence and patient safety** when performing rescue breaths

Pilot test involving **6 participants** showed increase in BVM user efficacy when using device

Accomplished all 6 design objectives



Testing & Validation

- Perform large-scale user performance feedback study
- Iterate design with feedback

Commercialization

- File provisional patent
- Consult **contract manufacturing organization**
- Patent & trademark
- **510k regulatory pathway**

References

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2. Products - Vital Statistics Rapid release - Provisional drug overdose data. (n.d.). <https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.html>
3. Bucher, J. T., Vashisht, R., Ladd, M., & Cooper, J. S. (2023, May 21). Bag-Valve-Mask ventilation. StatPearls - NCBI Bookshelf. <https://www.ncbi.nlm.nih.gov/books/NBK441924/>
4. Bag valve mask ventilation. (n.d.). Default. <https://clinicaltrials.gov/ct2/show/study/NCT01111111>
5. NCHS. National Vital Statistics System. Estimates for 2022 and 2023 are based on provisional data. Estimates for 2015-2021 are based on final data (available from: https://www.cdc.gov/nchs/nvss/mortality_public_use_data.html).