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## Sensor Based Packaging Platform for Pharmaceuticals

Bahar Aliakbarian, Ph.D.



# Agenda

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# Introduction

The Axia Institute



# The Axia Institute Team



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Communications



**Swami Subramanian**  
Bus. Development Director



Research  
Leader

2020  
New Hire



**New**  
Research  
Leader

2020  
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Adjunct Instructor



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Professor Emeritus



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Professor



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**Drew Kalahar**  
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**Grace Sobeck**  
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# The Axia Institute Operating Model

## The Axia Institute

Value chains encompass the complete life cycle of a product.

The Axia Institute helps firms address some of industry's greatest challenges by providing high-impact solutions.

- #1 ranked Supply Chain Management program
- Leading value chain innovation center
- Institute model to help facilitate faculty research and company collaboration
- Open/consortia or proprietary research projects

The Axia Institute provides a neutral environment to foster collaboration and an integrated systems approach to value chain optimization.

## The Axia Institute Operating Model

### MULTIDISCIPLINARY APPROACH:

Delivering comprehensive solutions with input from across functional areas

### INDUSTRY PARTNER:

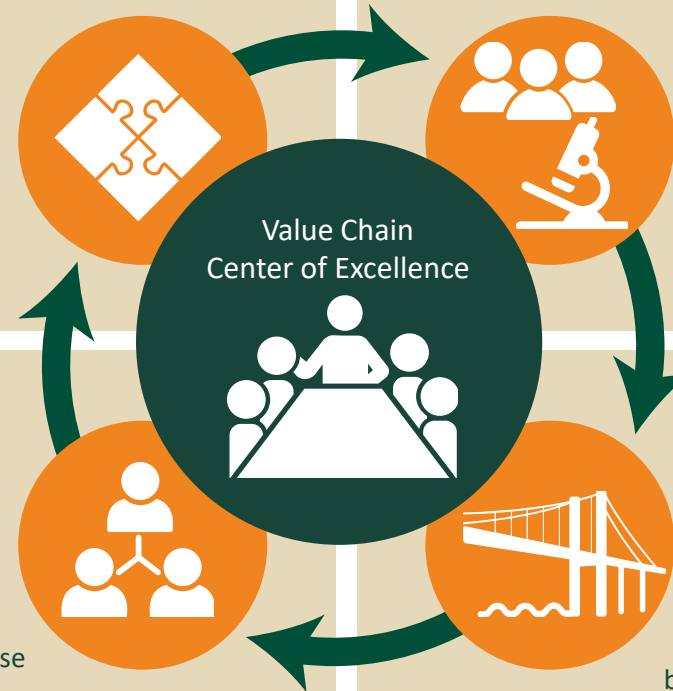
Solving grand challenges through collaborative and applied research

### EXPERIENTIAL ENGAGEMENT HUB:

Deepening expertise through capstone projects

### KNOWLEDGE NEXUS:

Bridging the gap between theory and practical real-world solutions





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# Grand Challenge

Drug Use Disorder



# Grand Challenge

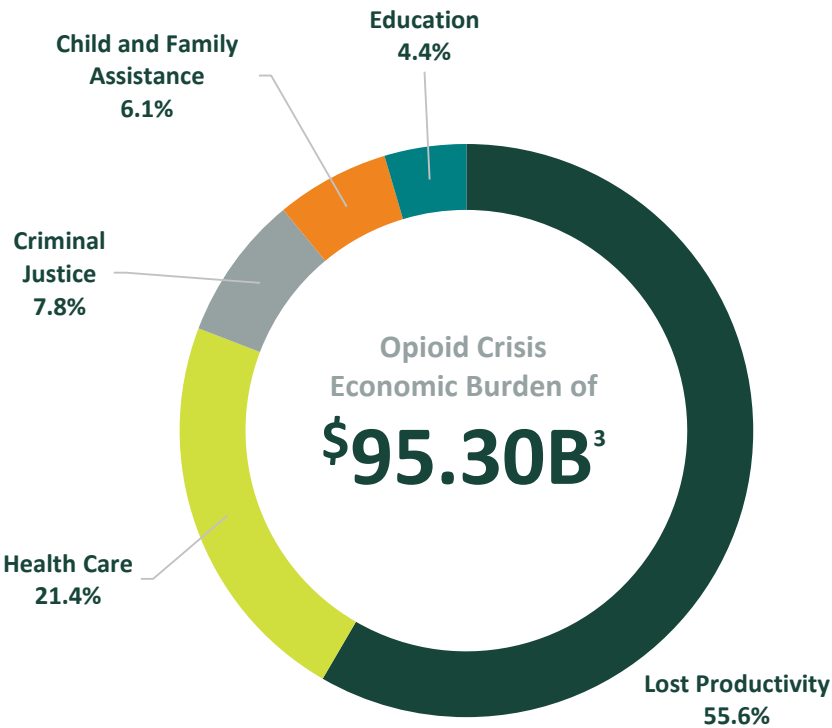
OVER  
**2 MILLION**

Americans have opioid-use disorders<sup>1</sup>

**Opioids killed more people**  
last year than either **car**  
**accidents** or **gun violence**

Almost **68,557**  
deaths from drug overdose  
in 2018<sup>2</sup>

66% of all drug overdose deaths



<sup>1</sup>Center for Behavioral Health Statistics and Quality. Results from the 2016 National Survey on Drug Use and Health: Detailed Tables. Rockville (MD): SAMHSA; 2018

<sup>2</sup>Provisional Counts of Drug Overdose Deaths; CDC 2018; <sup>3</sup>Rhyan et al., 2017: [https://altarum.org/sites/default/files/uploaded-publication-files/Research-Brief\\_Opioid-EpidemicEconomic-Burden.pdf](https://altarum.org/sites/default/files/uploaded-publication-files/Research-Brief_Opioid-EpidemicEconomic-Burden.pdf).

# Solutions



The Opioid Crisis Response Act (2018)

FDA, NIH, CDC, SAMHSA, DEA and the Health Resources and Services Administration

# Our Solution - MSU Sensor-Based Packaging

- *Smart packaging* solutions have the potential to enhance the safety of legally prescribed drugs by limiting exposure, reducing misuse and preventing new addiction.
- *Smart track and trace* strategies have the potential to reduce drug theft and diversion by enabling monitoring the patient's medication adherence and enhancing supply chain item level traceability.





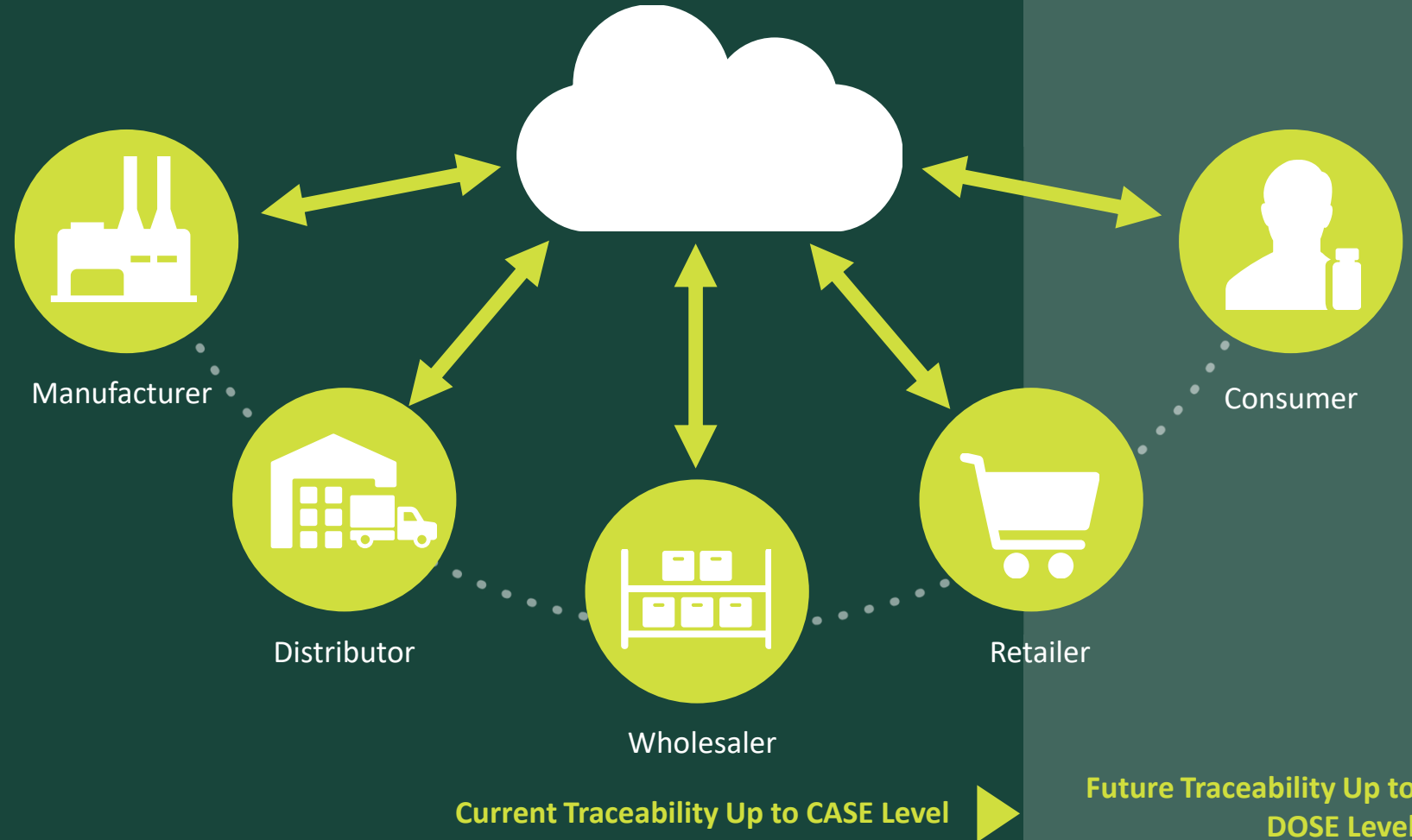
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# Technology

Smart Pharma System

# Aim

Develop a **platform** by integrating smart sensor-enabled software solutions into the existing pharmaceutical packaging to **enhance item-level traceability** and **medication adherence systems**.



# Target Issues



## Accidental Exposure

**100%** of unintentional exposures to children are from a family members' prescription<sup>1</sup>



## Non-Authorized Access

**50%** of misuser adolescents acquire from their own previous prescriptions, friends, or family members<sup>2</sup>



## Misuse

**30%** of patients prescribed for chronic pain misuse them<sup>3</sup>

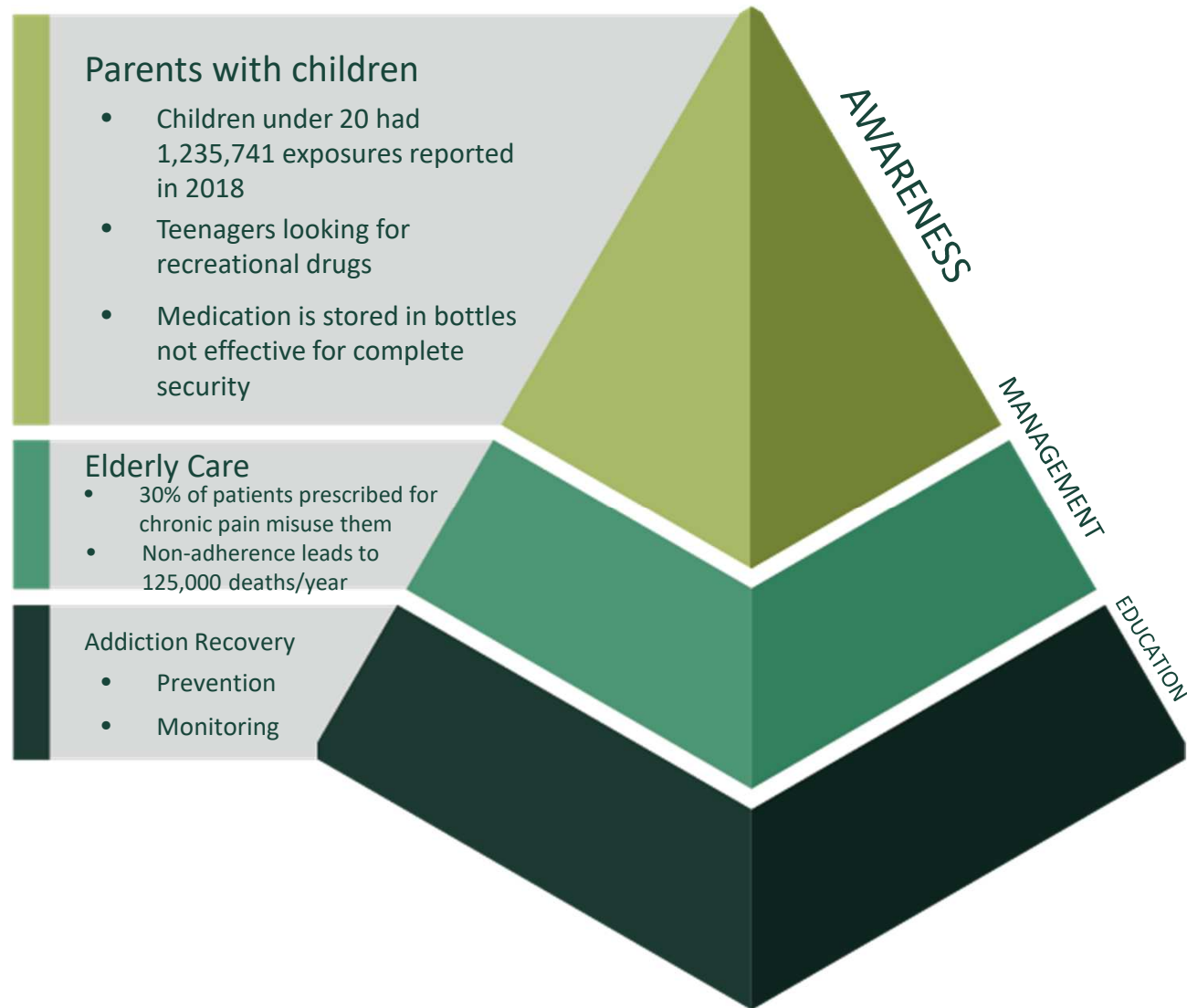
<sup>1</sup>Voepel-Lewis, et al. 2017, *JAMA Pediatr*, 171(1):5-698;

<sup>2</sup>CerdáM et al. 2015, *J Pediatr*, 167(3): 605-61;

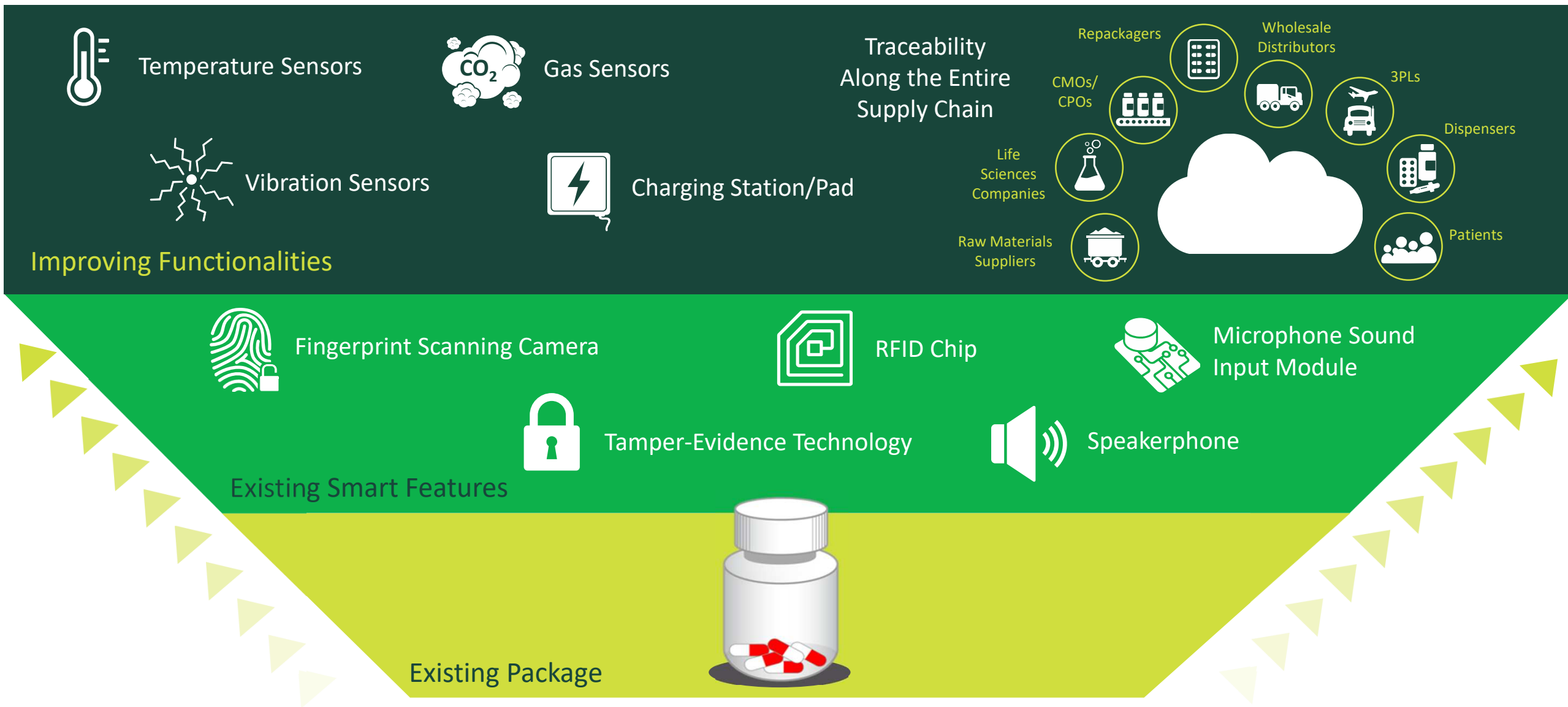
<sup>3</sup>Vowleske et al. 2015, *PAIN*, 156(4): 569-576.



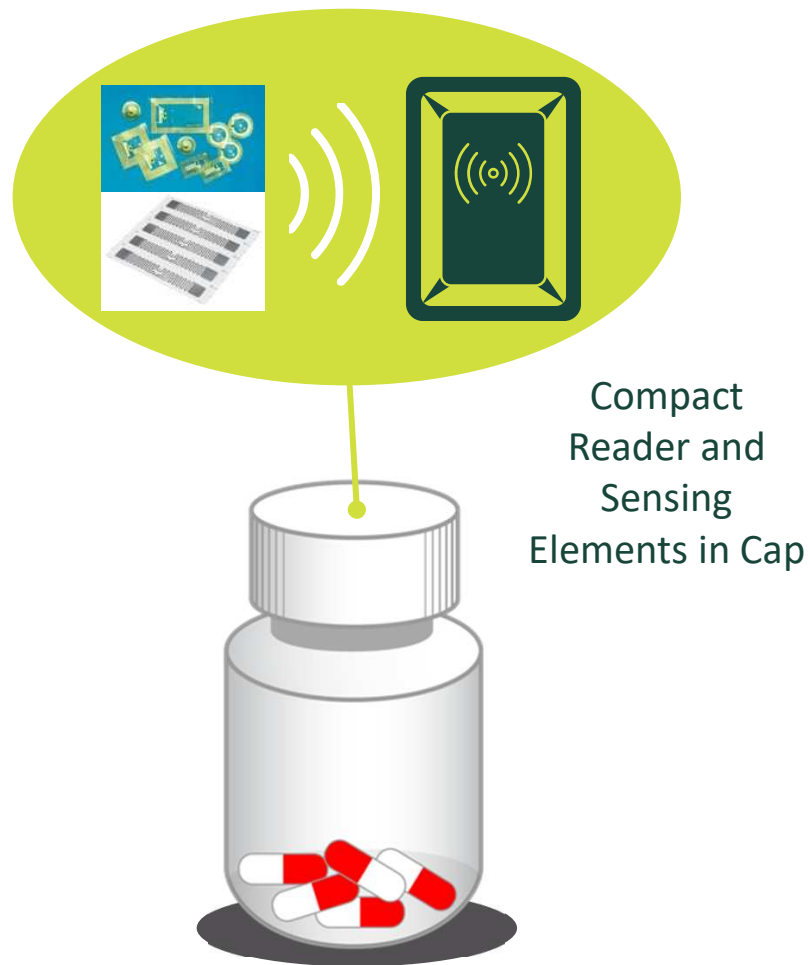
# Target End-Users



# Modular Platform



# Challenges



## Needs:

- **Traceability** – The RFID integration allows for unit-based traceability of prescription drugs.
- **Scalable Manufacturing** – RFID technology can be printed at mass manufacturing scale.
- **Increased Security** – Biometric authentication and packaging safeguards prevents unintended use of medication.
- **Enhanced Medication Adherence** – Hardware and software-based features enable monitoring and tracking of treatment adherence in long-term therapy.

## Challenges:

- **Economies of Scale** – Decline in unit costs of a product as the absolute volume per period increases.
- **Product Differentiation** – Incumbents have brand identification and customer loyalties. Customers would need to acclimate to a new prescription bottle.
- **Access to Distribution Channels** – Barrier due to logical distribution channels that are already established by incumbents.
- **Government Policy** – Governmental and FDA requirements can forestall production and move the market in different directions towards or away from the technology.

*B. Aliakbarian, (2019). Smart packaging: challenges and opportunities in the supply chain. CSCMP's Supply Chain Quarterly. Q1, February 2019*

# Innovation

## Biometrics

- Personalizes access to medicine
- Prevents non-users from entering medication
- Real solution to protect from medication exposure

## Dispensing Technology

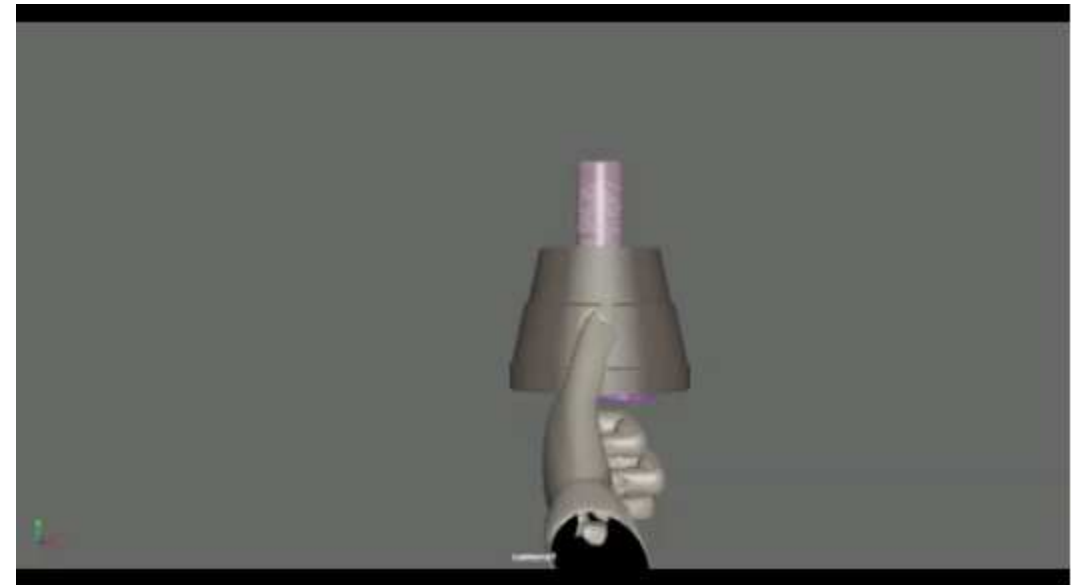
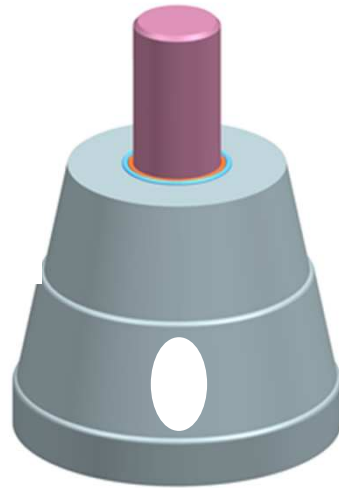
- Improves medication adherence
- Prevents misuse and overuse

## Aversive Properties

- Deters misusers from taking more than needed
- Creates a bitter taste so non-users discard medication instead of swallowing

# Innovation

Pill Bottle



Pill Dispenser with  
Fingerprint Sensor

*Aliakbarian et al.; US 2020/0085686 A1; Published on Mar. 19, 2020*

# Innovation

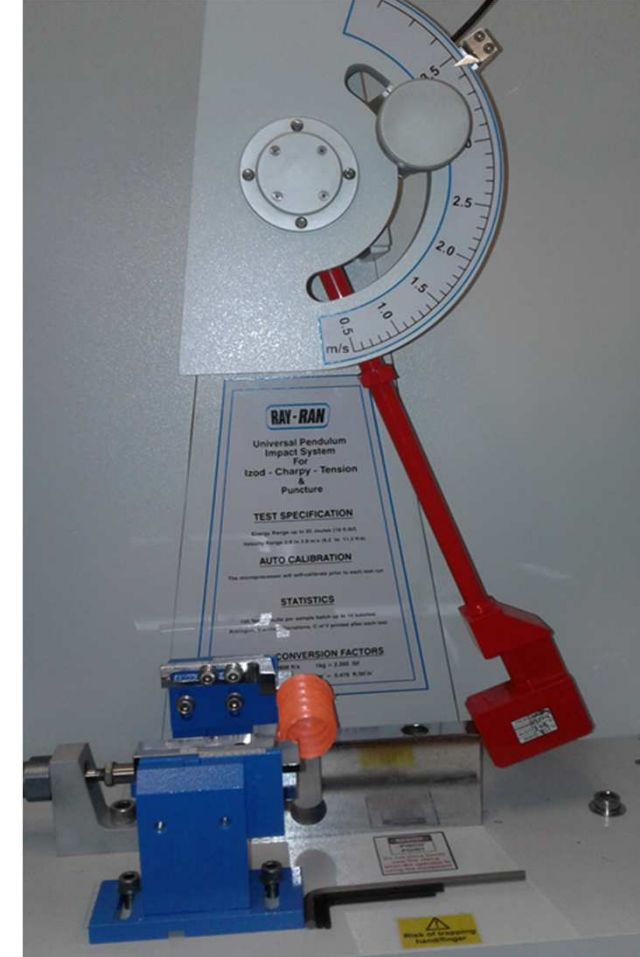
## Drop Test

Courtesy help: Shamila Hamdani

## Accelerated Shaking Test









## Hammer Test

## Charpy Impact Test





# Competitive Landscape

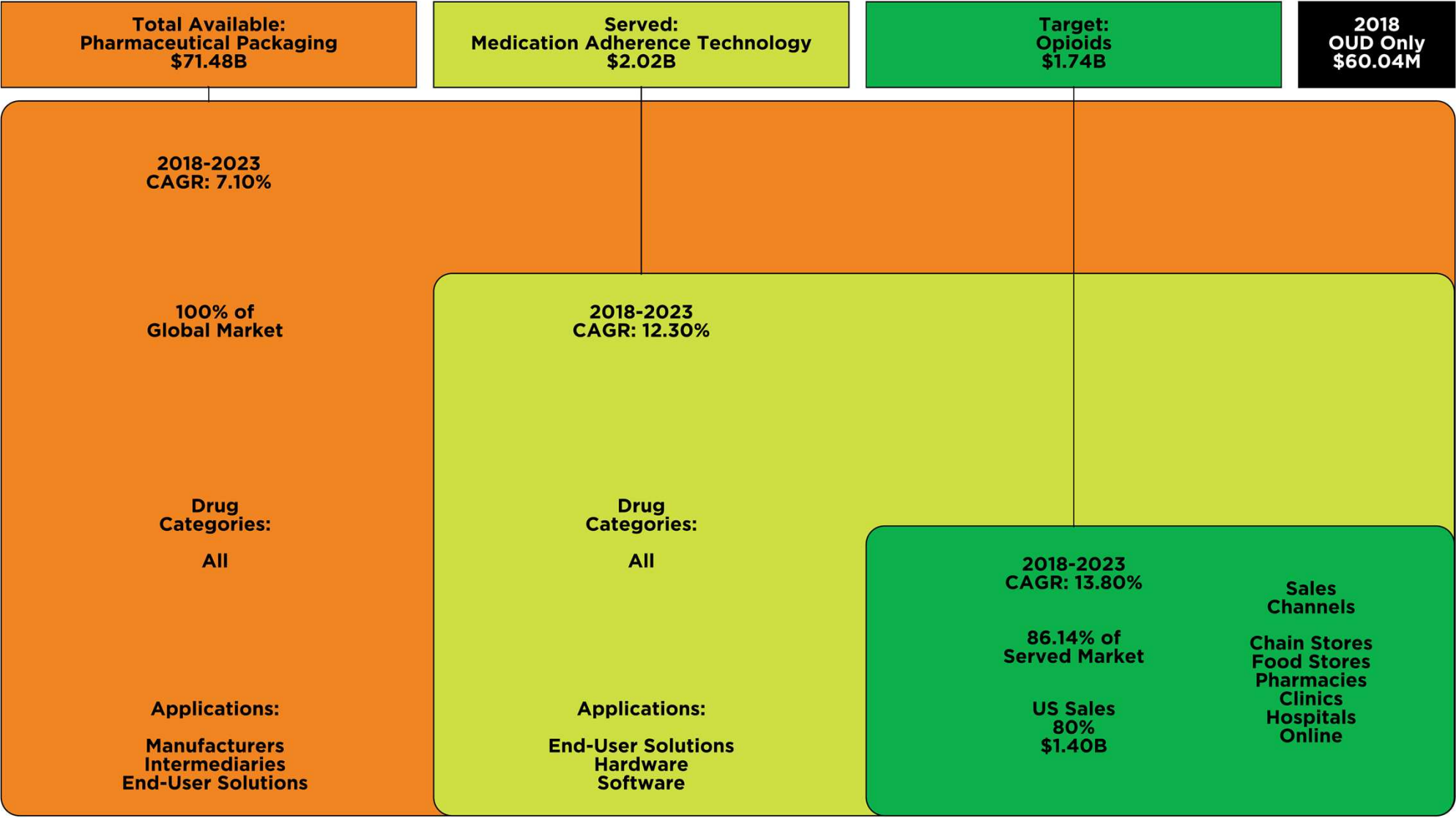
	GlowCap	Pillsy	MedMinder	PillDrill	Hero Health	Livi	E-Pill	MSU
Product								
Product Price	\$10	\$39.99	-	\$279	\$99.99	\$130	\$29.95 - \$824.95	Target is <\$100
Monthly Fee	\$15	-	\$49.99	-	\$29.99	\$99	-	-
On the Market?	No	No	Yes	Yes	Yes	Yes	Yes	Not Yet
Where it is sold:	Previously sold on Amazon	Previously sold on Amazon and Best Buy	MedMinder Website	PillDrill Website and CVS	Hero Health Website	Livi Website and featured on Amazon*	Sold on E-Pill Website and Amazon	TBD Pharmacy and Recovery Centers
Features:	<ul style="list-style-type: none"> <li>Connectivity through AT&amp;T</li> <li>Reminders</li> <li>Fits on most pill bottles</li> <li>Wall plug in with light and sound</li> <li><b>Adherence reports</b></li> <li>Button to call pharmacy for refill</li> </ul>	<ul style="list-style-type: none"> <li>Pill bottle with smart cap</li> <li>Mobile app</li> <li>Automatic dose tracking</li> <li>Blinking cap with notifications</li> <li><b>Adherence history</b></li> <li><b>Smart snoozing – reminds you when you are near medication</b></li> <li>Caregiver notifications</li> <li>Double-dose alerts</li> </ul>	<ul style="list-style-type: none"> <li>Custom alerts</li> <li>Pillbox with monthly compartment</li> <li>Weather updates</li> <li>Light up compartments</li> <li><b>Locking compartments</b></li> <li><b>Cellular connection and WiFi options</b></li> <li><b>Emergency medical alerts</b></li> </ul>	<ul style="list-style-type: none"> <li>Timely reminders</li> <li>Pill scanner</li> <li>Mood scanner</li> <li><b>Adherence tracking</b></li> <li><b>Notifications to care givers</b></li> <li><b>Pill container</b></li> </ul>	<ul style="list-style-type: none"> <li>Pill dispenser for up to 90 days of pills</li> <li><b>Password protection</b></li> <li>App integrated</li> <li>Share information with caregivers</li> <li><b>Holds up to 10 different medications</b></li> <li>Low pill warning</li> </ul>	<ul style="list-style-type: none"> <li><b>Holds up to 15 different medications</b></li> <li>Can dispense up to 24 times a day</li> <li>Light and sound notification</li> <li>Cellular connection through AT&amp;T</li> <li><b>Communicate on with care giver</b></li> </ul>	<ul style="list-style-type: none"> <li>Dispenses up to 28 times per day</li> <li><b>Locks with key</b></li> <li>Alarm</li> <li><b>Clinical study done by NHS</b></li> </ul>	<ul style="list-style-type: none"> <li><b>Locked by caregiver</b></li> <li><b>Biometric protection</b></li> <li><b>Dispenses right dose at a right time</b></li> <li><b>Adherence report</b></li> <li><b>Deter misuse opportunities</b></li> <li><b>Small and easy to handle</b></li> <li><b>refillable</b></li> </ul>

# Unique Value

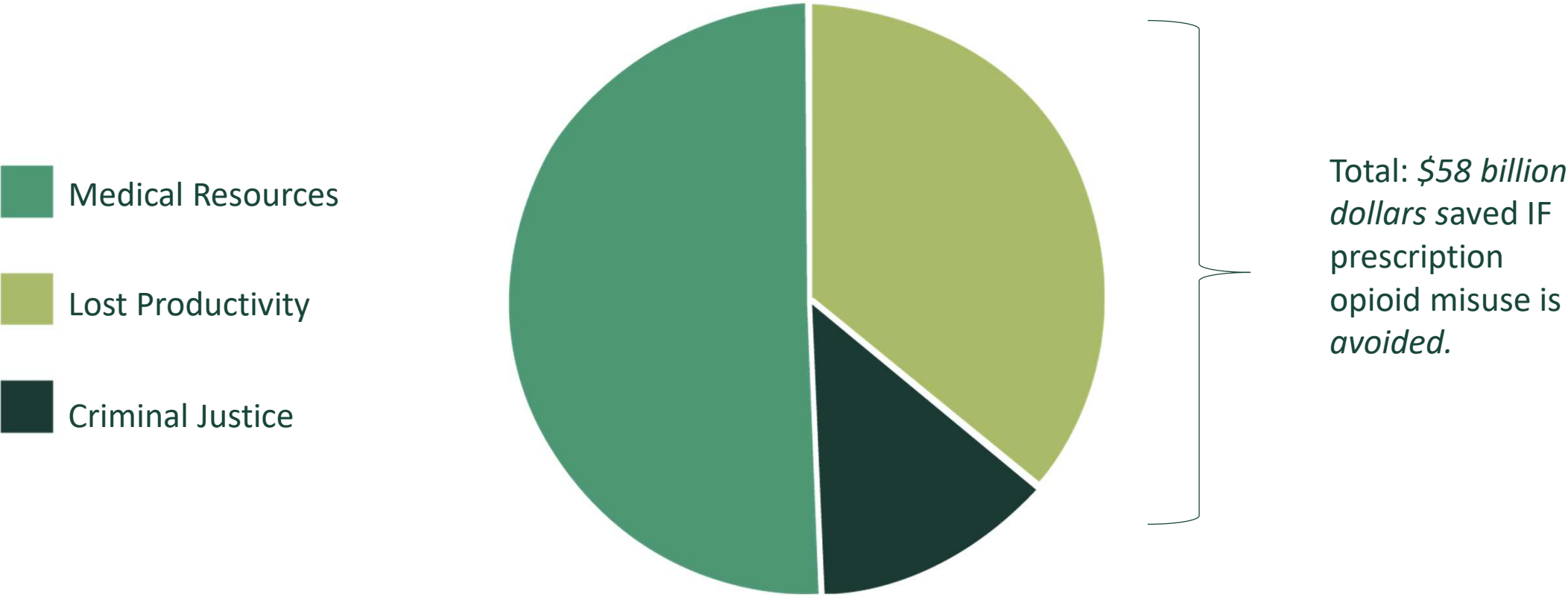
- There is nothing of its kind
  - Biometrics
  - Tracking
  - Aversive properties
- Most technologically advanced product available with abilities to:
  - Deter misusers
  - Protect non-users
  - Improve medication adherence
  - Prevent misuse opportunities
- Amidst a national opioid epidemic a feasible solution is finally here



# Global Market

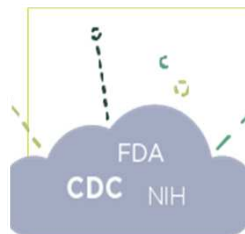


# Economic Value



# Target Groups

## Influencers



### Importance

- Influences consumer choices through laws or mandates
- Provides monetary support for research and development

### Our Offerings

- A one of a kind solution to the opioid misuse crisis
  - >Aversive properties
  - >Biometrics
  - >Tracking

## PBM's/Insurer's



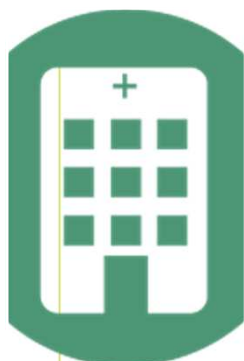
### Importance

- Influences pricing
- Connects consumer to innovation
- Covers costs

### Our Offerings

- Holistic and safe solution to opioid misuse
- Medication adherence technology
- Brand equity/customer bond strengthening

## Hospital/Pharmacy



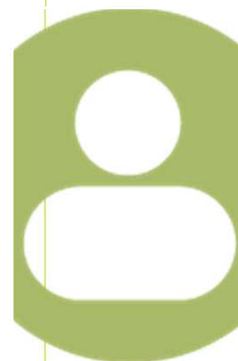
### Importance

- Provide clinical testing
- Scientific support
- Recommend to patients (possible)

### Offerings

- Holistic solution to opioid misuse prevention
- Possible disruption innovation
- Biometric, time-release, & aversion technology\*

## End-User



### Importance

- Final user
- Purchaser
- Advocate for use

### Our Offerings

- Safe solutions:
  - >Prevention
  - >Adherence
  - >Disruption

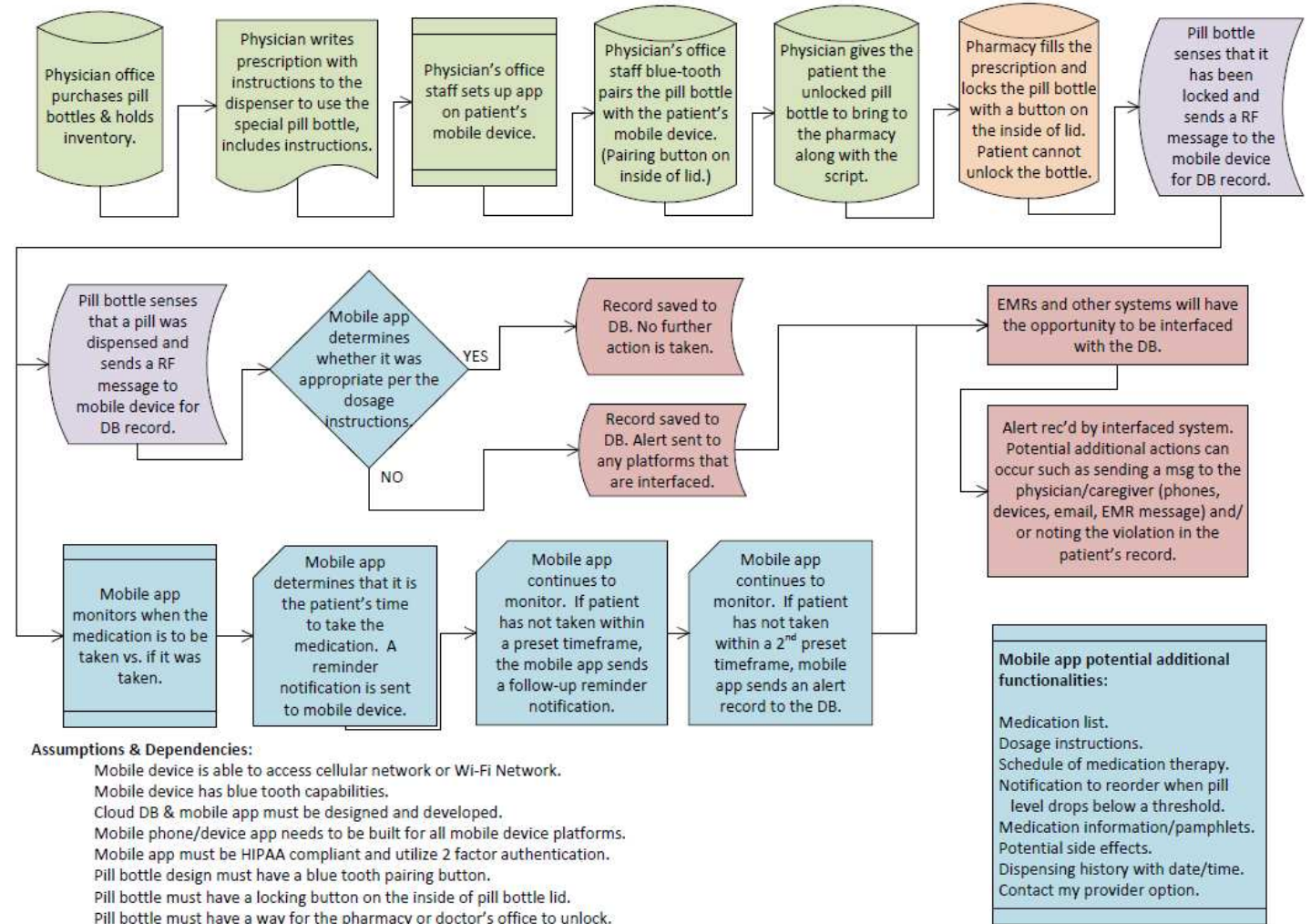


# Next Steps

- RFID Sensor Integration
- EMR/Other Systems Interface
- Survey to Collect Voice of Customer
- Clinical Trials to Support the Claims

## We are looking for:

- Licensing
- Research Projects
- Custom product Development





# Acknowledgements

## **This research was funded by:**

- The Axia Institute
- Targeted Support Grants for Technology Development (TSGTD) - MSU Foundation Funds

# Thank you!



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**MICHIGAN STATE UNIVERSITY**

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(<https://scholar.google.com/citations?user=LXa63g0AAAAJ>)

Department of Supply Chain Management AND School of Packaging  
The Axia Institute – Michigan State University

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in the mobile app**

**We need your input**

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