# Metered Dose Inhaler (MDI) Drug Delivery System for Rats

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# Overview

- ➔ Background
- ➔ Problem Statement + PDS
- ➔ Design Ideas
- ➔ Design Matrix
- ➔ The Next Step

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# Background

- Current Research:
  - Side effects of Inhaled Corticosteroid Medications
    - Musculature of Tongue and Upper Airway
- Goal:
    - Mimic delivery of medication to rats
- Rat Behavior:
    - Naturally lick or gnaw to eat
    - Challenge to train rat to follow such action
    - Rats naturally breathe through their noses

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# Problem Statement

Research is being conducted on the side effects of corticosteroid medications, in particular the effects on the musculature of the tongue and upper airway because atrophy of those muscles can lead to sleep apnea. The goals of this project are to **modify the mouthpiece** of a metered dose inhaler (MDI) to allow for use by rats in a laboratory setting and **integrate an automated system** to dispense the medicine. The mouthpiece may be fitted with a custom nozzle sized appropriately for rat usage, as well as account for the fact that the rats will probably not voluntarily put their mouths around the nozzle. A way to train the rats to voluntarily and correctly use the mouthpiece must also be developed.

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# Product Design Specifications

- Appropriate sizes for rat usage
- Detachable from the inhaler mouthpiece
- Automated dispensing system
- Material:
    - Withstand rat bites
    - Can be sterilized
    - Biocompatible
- Train rats for proper usage
- Budget: $1000

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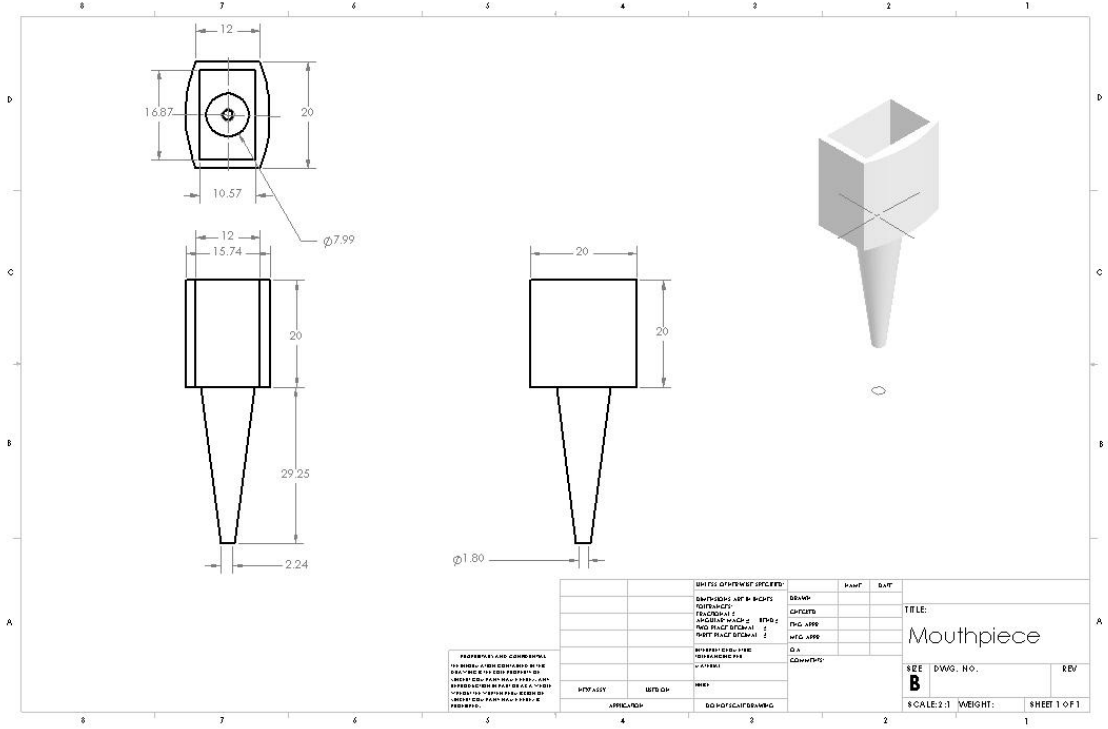
# Nozzle Design

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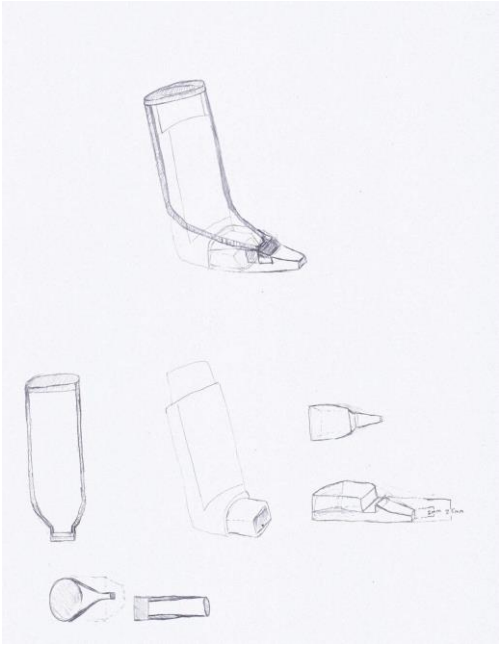
# Design 1

- Hard plastic nozzle and bite-activated triggering mechanism
- Trigger components:
  - Bite plate in nozzle compartment
  - Braces situated on sides of MDI
  - Circular plate on top



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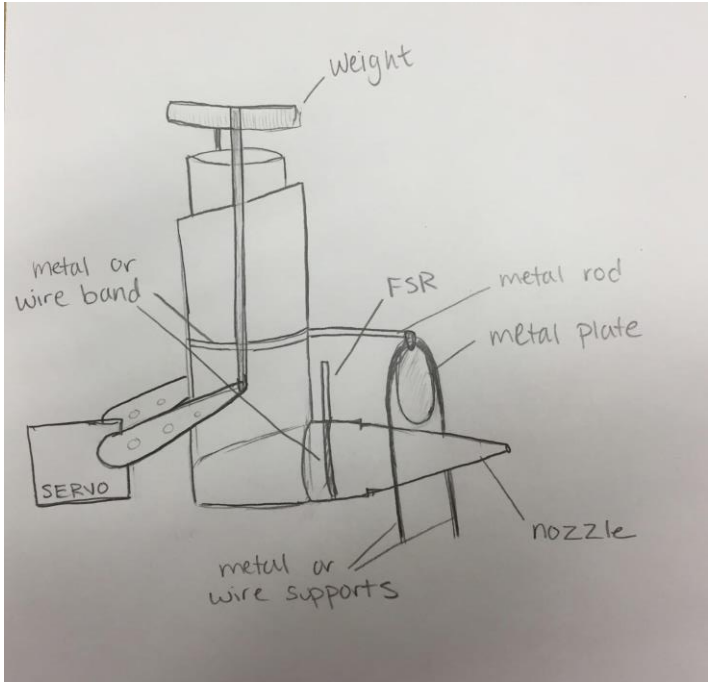
# Design 2

- Hard plastic nozzle and force sensitive resistor (FSR) automated trigger system
  - metal attachments to MDI and cage
  - FSR, arduino, servo motor system
  - servo motor takes input from FSR data

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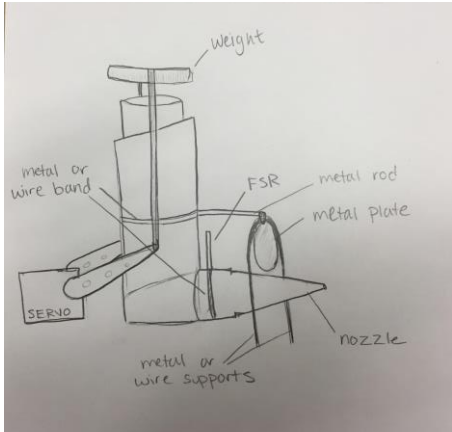
# Design 3

- Soft plastic (silicone) nozzle and FSR automated trigger system
  - Same automation system as Design 2
  - Mouthpiece material possibly better suited for training purposes

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# Design Matrix

| Design / Criteria (weight) | Hard Nozzle with Mechanical System | | Hard Nozzle with Force Sensor | | Soft Nozzle with Force Sensor | |
|---|---|---|---|---|---|---|
| Accuracy of Simulation (25) | 2/5 | 10 | 4/5 | 20 | 4/5 | 20 |
| Ease of Fabrication (25) | 4/5 | 20 | 3/5 | 15 | 3/5 | 15 |
| Durability (20) | 2/5 | 8 | 4/5 | 16 | 3/5 | 12 |
| Ease of Use (15) | 4/5 | 12 | 4/5 | 12 | 4/5 | 12 |
| Safety (10) | 5/5 | 10 | 5/5 | 10 | 5/5 | 10 |
| Cost (5) | 5/5 | 5 | 3/5 | 3 | 4/5 | 4 |
| Total (100) | | 65 | | **76** | | 73 |

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# Future Work

- Multiple nozzle sizes
- Different nozzle shapes and materials
- Rat training

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# Acknowledgments


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- Prof. Rogers
- Dr. Puccinelli


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# Questions?

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