Eye Drop Assistant

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Client: Dr. Beth Martin

Advisor: Prof. Tracy Jane Puccinelli

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Overview

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- Problem Statement
- Competing Design
- Design Specification
- Preliminary Designs
  - Design 1: The Eye Lash Curler
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  - Design 3: Stopper Buddy
- Design Criteria
- Future Work
- References

Figure 1: Team Picture

Client Description

- Dr. Beth Martin, PhD, MS, RPh
  - **Pharmacy Practice** & Translational Research Division
  - Assistant Dean for Teaching & Learning at UW Pharmacy School
  - Clinical practice setting is Oakwood Village University Woods Retirement Community

Figure 2: UW-Madison School of Pharmacy [1].

Motivation for Fabricating an Eye Drop Assistant

- Ophthalmic diseases are most prevalent in elderly population
  - Reduced dexterity, especially for those with arthritis
- Eye drop bottles are most common method for distribution of ophthalmic medications
  - Example: glaucoma eye drops

Figure 3: Variety of eye drop bottles [2].

Background Statistics

- Difficulty using eye drops can result in inconsistent treatment due to cost
  - 25% of patients report missing doses because they run out of their medication early [3]
- Difficulty dispensing a single drop leads to eye drop waste
  - 6.8–37.3% miss the eye with the drop [4]
- Improper use can lead to contamination as the patient touches the tip of the bottle to their eye [4]

Figure 4: Medicated eye drops [5].

Eye Drop Administration

- **Drop Size**
  - Current droppers release 21.5 µl- 69.4 µl
  - Suggested 5 µl - 15 µl
    - Effective, reduced drainage, lower cost [6]
- **Proper Eye Drop Technique**
  - Tilt head back slightly and look up
  - Use one hand to pull lower eyelid away from eye
  - Hold dropper directly over eyelid pocket (conjunctival sac)
  - Squeeze bottle gently and allow drop to fall into pocket [7]

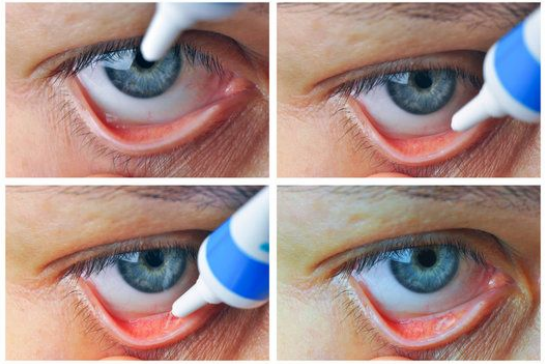


Figure 5: Proper eye drop technique [8].

Problem Statement

The eye drop bottle is difficult to use for those with reduced dexterity, therefore, we propose an eye drop assistant solution that:

- Ensures the release of consistent dose of medication
- Allows for proper eye drop technique
- Improves ease of administration

Competing Designs: In Market

- **Droppy Eye Drop Dispenser**
  - Advantage: Mechanical Leverage
  - Drawback: Does not allow for proper eye drop technique, assembly required
- **GentleDrop Eye Drop Guide**
  - Advantage: Stability
  - Drawback: does not ensure one drop

Figure 6: Droppy Eye Drop Device [9].

Figure 7: Gentle Eye Drop Device [10].

Patents

- **Bandolier Cartridge**
  - Advantage: Eyelid retracting legs
  - Drawback: Contamination, improper technique
- **Eye Drop Applicator**
  - Advantage: Single drop
  - Drawback: Contamination

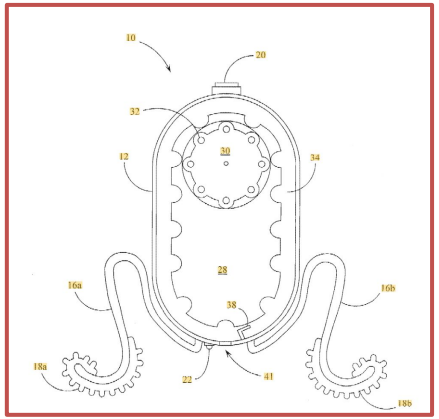


Figure 8: Bandelier Cartridge [11].

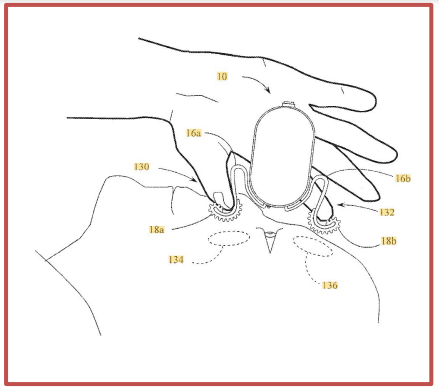


Figure 9: Bandelier Cartridge [11].

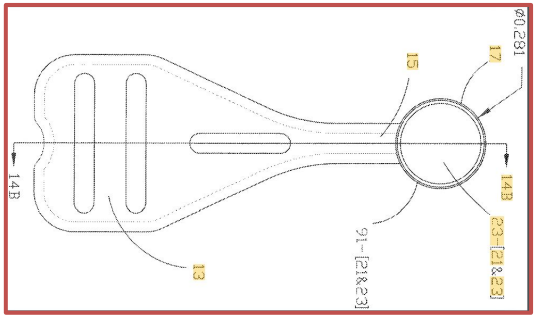


Figure 10: Eye Drop Applicator [12].

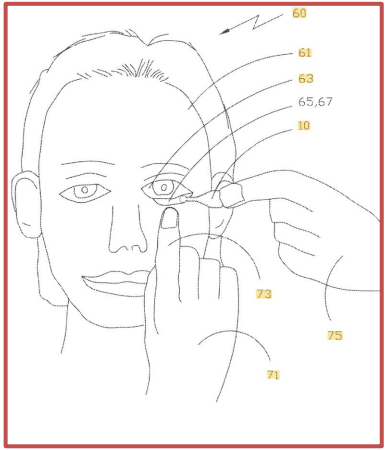


Figure 11: Eye Drop Applicator [12].

Design Specifications

- Device supports correct eye drop administration technique
- Adjustable device to fit different bottle sizes and shapes
  - Height range: 4.7cm - 8.0 cm, Diameter Range: 1.8 cm - 2.5 cm
- Enhance grip for elderly or arthritic patients
  - Squeeze force capability < 5N [13]
  - Squeezing force required ≥ 14.7 N [13]
- Minimize eye drop solution waste by dispensing only 1 drop
  - Drop size = 21.5 ul to 69.4 ul [6]
- Maintain project expenses within $500

Design 1: Eye Lash Dropper

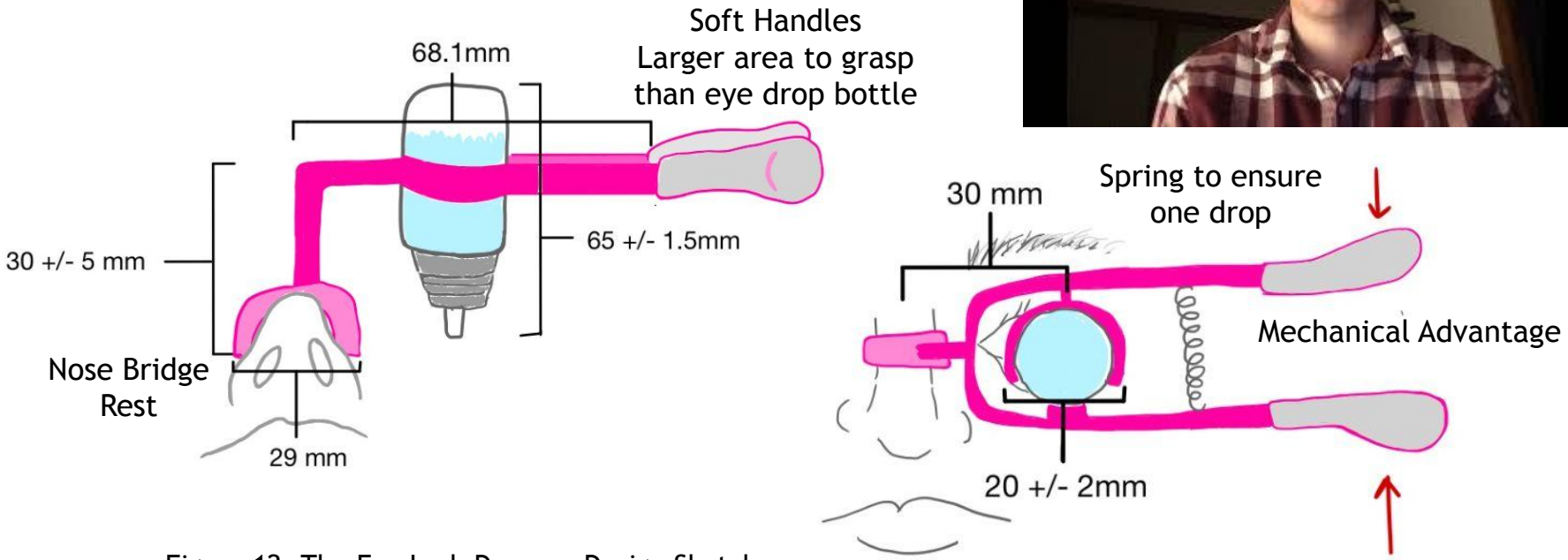


Figure 12: The Eye Lash Dropper Design Sketch

Design 2: The Slider

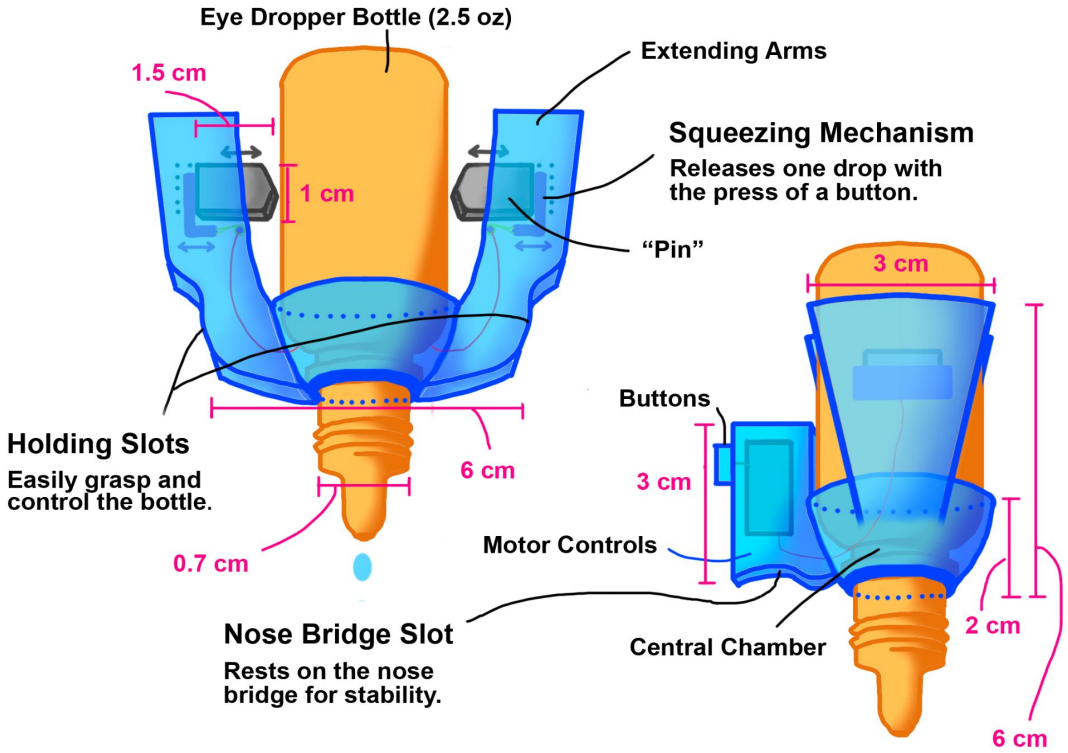


Figure 13: The Slider design sketch

Design 3: Stopper Buddy

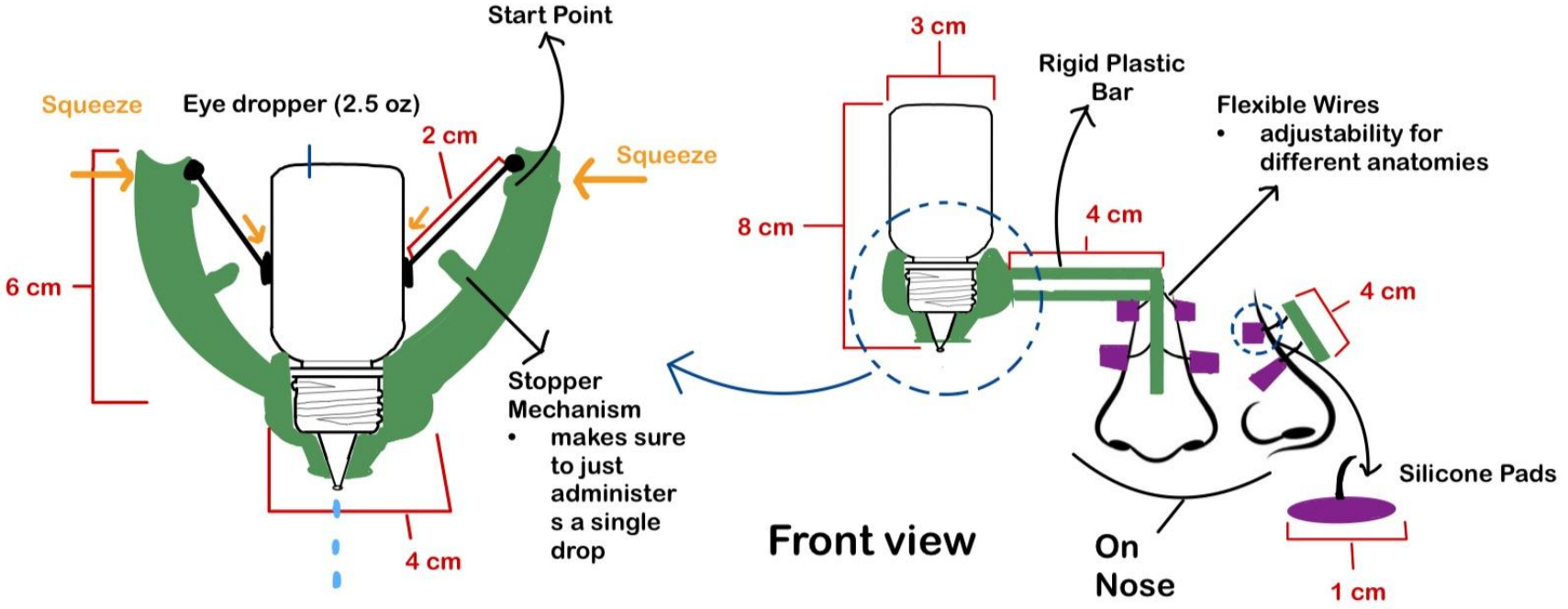


Figure 14: The Stopper Buddy Sketch

Design Criteria

- **Injury & Contamination Risk**: Minimize the potential for the device to cause harm to the patient
- **Ease of Use**: Patients can comfortably hold the device and dispense eye drops
- **Accuracy**: The device can be used consistently to dispense eye drops into the proper location of the eye
- **Adjustability**: The device fits various patient anatomy and bottle sizes and shapes
- **Cost**: The device is cheap to fabricate to ensure accessibility to all patients
- **Ease of Fabrication**: The device is easily and efficiently produced

Design Matrix

Design Categories (Weight)	Design 1 - The Eye Lash Dropper		Design 2 - The Slider		Design 3 - Stopper Buddy	
Injury & Contamination Risk (30)	5/5	30	3/5	18	3/5	18
Ease of Use (20)	4/5	16	5/5	20	3/5	12
Accuracy (20)	4/5	16	5/5	20	4/5	16
Adjustability (15)	4/5	12	3/5	9	3/5	9
Cost (10)	4/5	8	2/5	4	5/5	10
Ease of Fabrication (5)	3/5	3	1/5	1	4/5	4
Total Points:	**85**		**72**		**69**	

Table 1: The Design Matrix, ranking each design

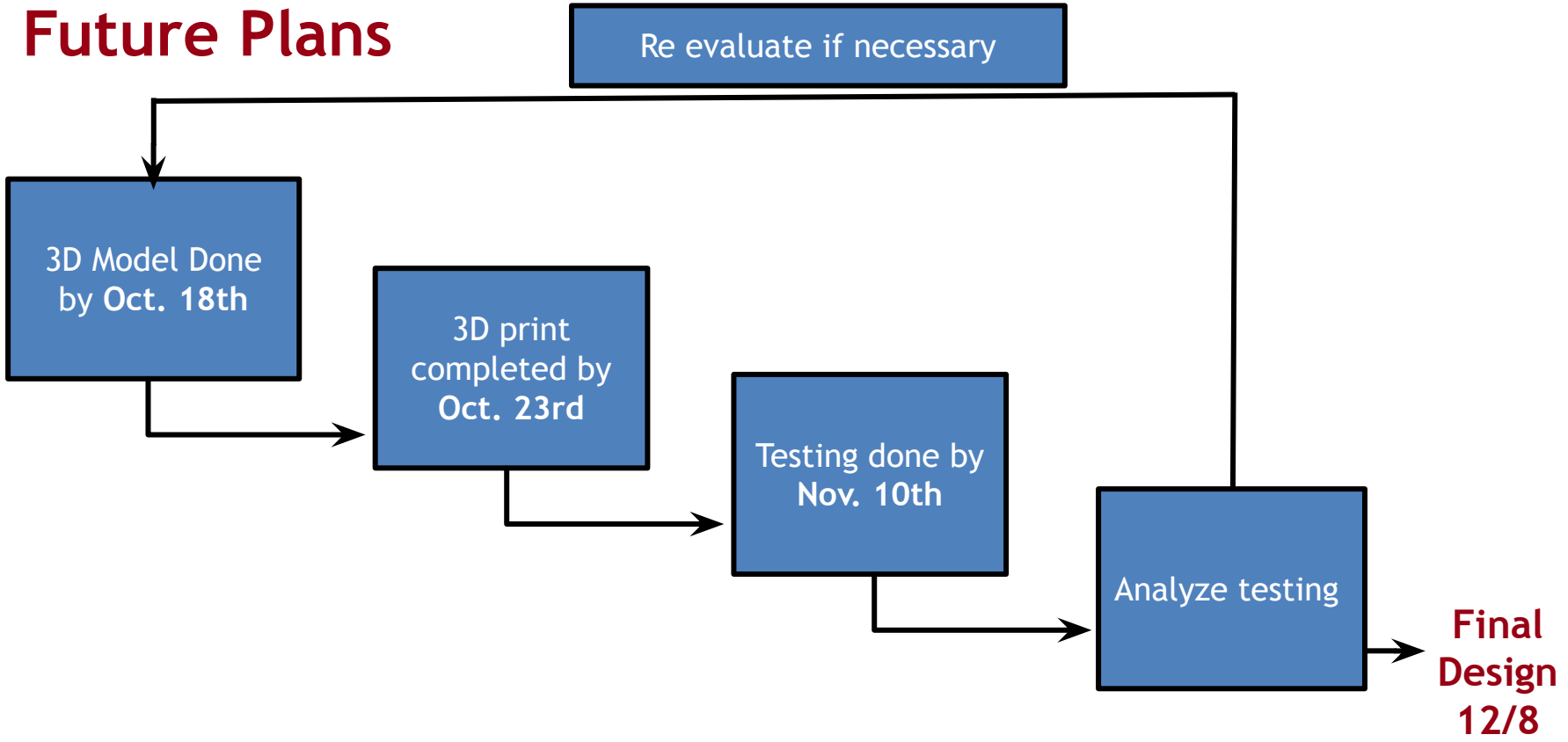
Materials + Testing

- Initial prototypes - 3D printed at Makerspace
- Client will get opinions from patients at retirement community
  - Obtain IRB
- How does the squeezing force of the bottle change as volume of eye drop solution decreases?
  - Consider viscosity, surface tension, design of tip, shape of bottle [13]

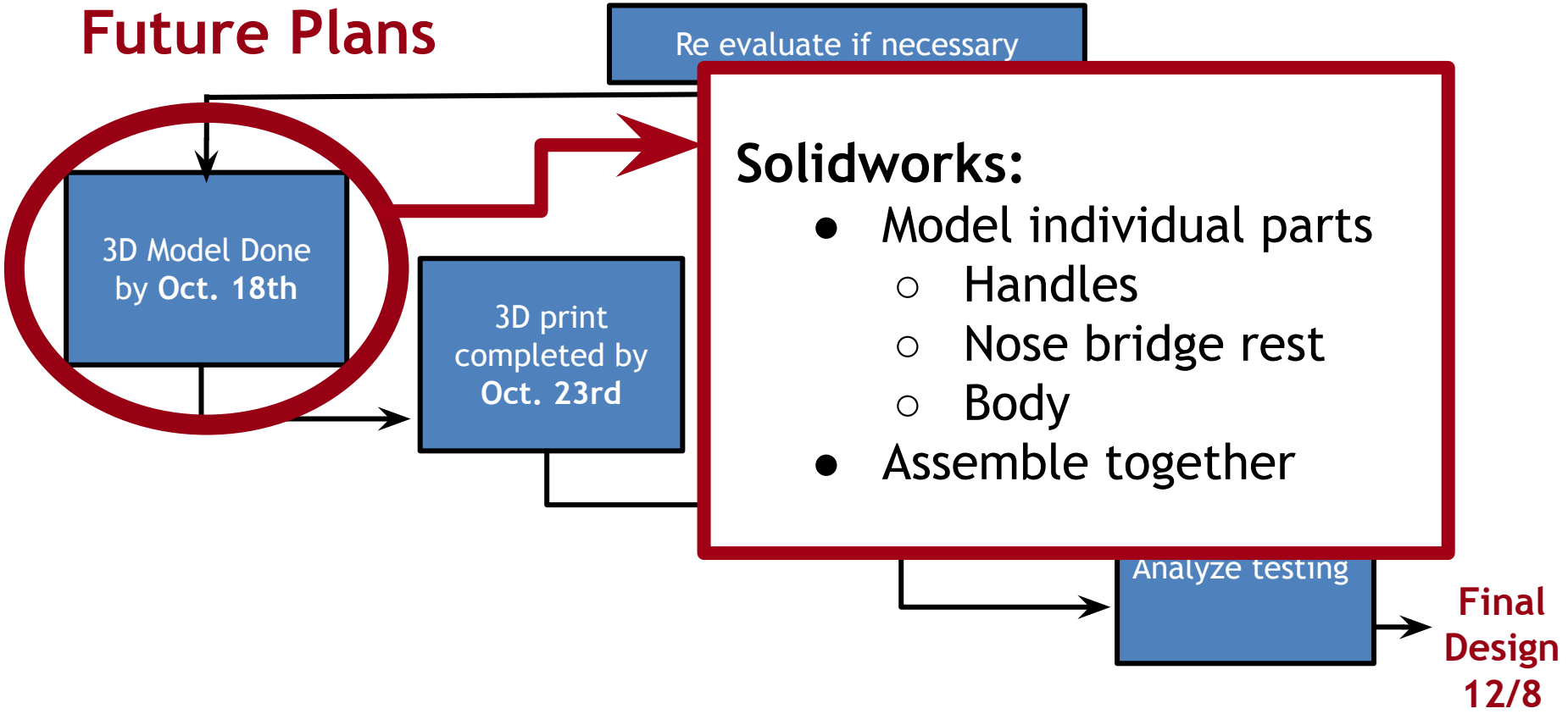
Figure 15: UW Pharmacy School [14].

Figure 16: Oakland Village University Woods Retirement Community [15].

Future Plans



Future Plans



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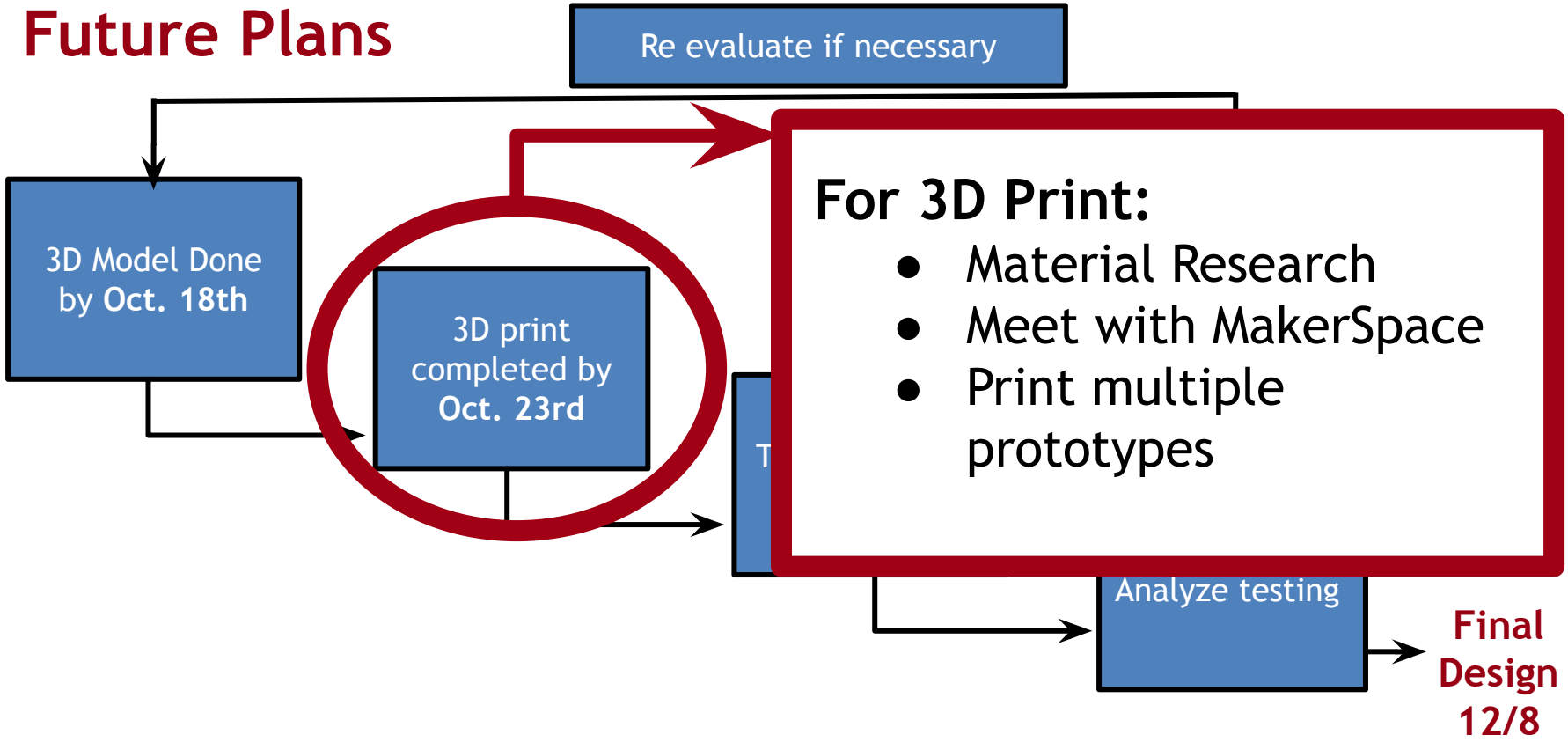

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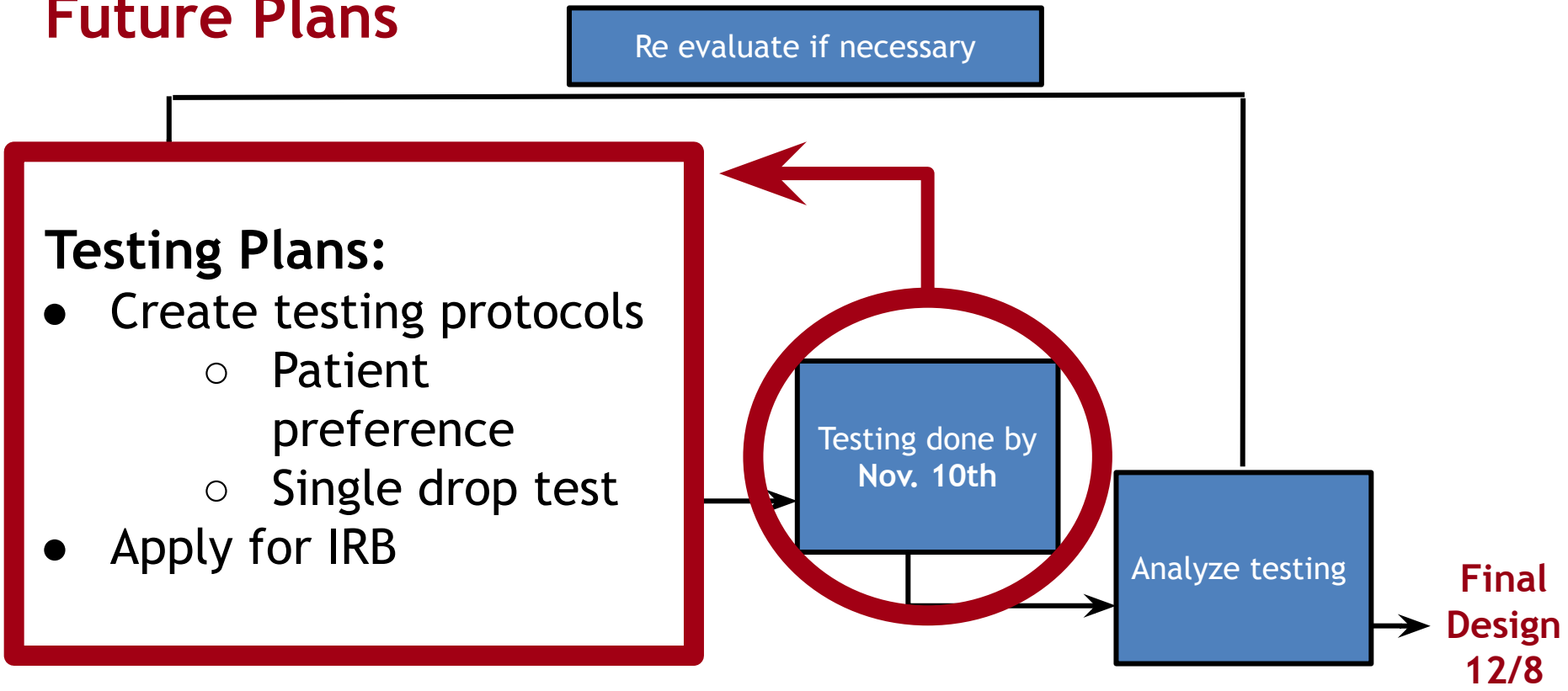

Acknowledgments

Thank you!
Dr. Beth Martin
Prof. Tracy Jane Puccinelli

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Questions and Comments?