BIOE Team 11: A Modified Syringe Design to Simplify the Preparation of Weight-Based Pediatric Medication

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Objective

Adverse Drug Effects (ADEs): unintended, harmful effects attributed to medicine use, including dosage errors
- Can result in ineffectiveness of treatment, toxicity, or death
- Dosage errors are 3x more common in children than adults
- Reported incidence of ADEs in hospitals is 6.5 per 100 admissions

“Simplify current workflow by eliminating hand calculations, and instead use our modified syringe and dose adjustment dial to determine the correct dose”

Methods

- Dose Conversion Analysis:
  - Epinephrine as the main drug focus
  - Calculated dose → 0.01 mg/kg of body weight

- Time of Use Assessment:
  - Time trials to compare preparation time between workflow and syringe
  - Calculate the average time to adjust the syringe and estimate final time

- Weight (kg)  | mg  | mL
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Prototyping and Results

Figure 1. Computer rendered model of preliminary syringe design

Figure 2. CAD assembly of first prototype of modified syringe

Table 1. Appropriate dosage of 1:10000 Epinephrine in mg and mL given patient weight

- Innovative Approach to Syringe Design:
  - Cylindrical plunger with weight based markings
  - Dose adjustment dial for smooth sliding, rotating, and locking in place

- Results:
  - Typical time to dose is ~1 minute
  - Reduced time to draw and administer drug by 40%

Bioethical Implications

- Patients
  - Receive accurate doses tailored to weight, reducing the risk of under and overdosing

- Clinicians
  - Reduced risk of calculation error
  - Improved patient safety

- Hospital Administration
  - Cost savings
  - Reduced liability for the hospital

Conclusions

- Cost effective device that addresses the biomedical problem of medical dosage errors
- Prevents improper medication dose from being administered to patients
- Underdosing, overdosing, and adverse reactions
- Simplifies the dosing process
  - Setting the appropriate dosage vs. patient's weight
  - Reduces the risk of manual calculation errors
  - Streamlines the medication administration process

Future Work

- Usability Testing
  - Clinician Experience
    - Conduct user testing with clinicians
    - Gather feedback on ease of use, and overall satisfaction with the device

- Scaling and Manufacturing
  - Evaluate scalability of syringe manufacturing
  - Obtain necessary regulatory approvals

References