Topical probiotics for reducing infections by multidrug resistant bacteria

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Overview
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Background

- **Probiotics**
  - "Live microorganisms, which, when administered in adequate amounts, confer a health benefit on the host." – WHO
  - To stop or suppress the growth of harmful microorganisms
  - To offset side effects caused by antibiotics by restoring balances

Motivation

- MRSA
- Longer hospital stays
- Economic burden
  - > $14 billion in 2003
- 30% of people have colonies in their nasal cavities
- LGG can produce peptides to inhibit growth of Staph
Problem Statement

- Research the efficiency of the probiotic LGG applying in the interior nasal passage in preventing Staph a. infections
- Trade name: Culturelle

Need:

- A delivery device of LGG into nasal cavity is needed for clinical trials
- A solution in which suspend and deliver the bacteria needs to be found.

Design Specifications

- Delivery Device must:
  - Accurately deliver 1 billion LGG organisms
  - Keep bacteria viable for up to 2 weeks
  - Repeatability of delivered dose
  - Prevent far insertion in nasal passage
  - Be able to be refrigerated
  - Be opaque

Solution must:

- Be biocompatible
- Allow bacteria to live up to 2 weeks
- Survives in nose for min. of 1 day
- Prevent overgrowing

Design Alternatives

- Dry Powder Nasal Spray
- Liquid Nasal Spray
- Gel with Blister Pack Applicator

Design I

Dry Powder Nasal Spray

- Powder form of LGG
  - Powder with LGG lands directly on interior nasal surface
- Storage conditions known
  - Stored for 2 weeks
  - May cause sneezing
### Design II
#### Liquid Nasal Spray
- Liquid form of LGG
- LGG powder + 0.9% saline solution
- Positive results from preliminary testing
- Opaque bottle
- Shorter spray nozzle is needed

### Design III
#### Gel with Blister Pack Applicator
- Applied close to edge of nostril
- Aliquoted into blister pill packs
- Nasal gels already in use for antibiotics
- Must be a survivable environment for bacteria

### Design Matrix

<table>
<thead>
<tr>
<th></th>
<th>Dry Powder Nasal Spray</th>
<th>Liquid Nasal Spray</th>
<th>Gel &amp; Blister Pack</th>
</tr>
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<tbody>
<tr>
<td>Preference (5)</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Distance (5)</td>
<td>3</td>
<td>3</td>
<td>5</td>
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<tr>
<td>Ease of Use (5)</td>
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<tr>
<td>Bacteria Viability (5)</td>
<td>5</td>
<td>4</td>
<td>3</td>
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<tr>
<td>Consistent Delivery (5)</td>
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<tr>
<td>Total Score (25)</td>
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<td>20</td>
<td>21</td>
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</tbody>
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### Final Design
- Gel with Blister Pack Applicator
  - Client’s preference
  - Highest popularity from survey
  - Appropriate delivery distance
  - Further testing is needed

### Future Work
- Survivability in media of choice
- 3 day followed by week long study
- Salts or glucose added for biocompatibility
- Delivery of 1 billion cells
  - How much product is applied
  - Swab nose to determine how many are applied
  - Bacteria must live in nose for up to 24 hours

### Acknowledgment
- **Client** Dr. Nasia Safdar  
  School of Medicine and Public Health  
  Department of Medicine  
  Division of Infectious Disease
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References