NEAT Team
New Effusion Alternative Test Team

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Point of Interest

- Client Information
- Background
- Problem Statement
- Competition
- Alternative Designs
- Design Matrix
- Final Design
- Future Work
- Conclusions
- Questions
Client Information

- Dr. Steven Yale
- Marshfield Clinic
  - Director of Clinical Research
  - Specializes in Internal Medicine
  - Interested in pleural effusion

http://www.marshfieldclinic.org/patients/images/logo.gif
Background

- Pleural effusion
  - Excess fluid in the pleural space
  - Can restrict breathing
  - Two types
    - Transudative
    - Exudative

- Diagnosis

- Thoracentesis – process of fluid drawn from pleural space

http://www.clevelandclinic.org/THORACIC/Chest/images/pleural-effusion_airway.gif
Problem Statement

- Clinical method for the characterization of the pleural fluid properties
  - Cost efficient
  - Convenient
  - Quick
  - Determination of transudative or exudative
Magnetic resonance spectroscopy (MRS)
Ultrasound
Pleural fluid analysis
Fast EEM Probe

- Reflectance spectrofluorimeter
  - Ten laser pulses
  - Two white light pulses
- Fiber optic probe
- Excitation and emission wavelengths differ for various molecules
- Cons: expensive, requires data analysis and hardware

http://web.mit.edu/spectroscopy/research/biomedresearch/TMS_fasteem.html
EIT Belt

- Eight electrode thoracic belt
- Measures resistivity
- PulmoTracePro program uses algorithm to determine resistivity values and plot
- Cons: measurements can be skewed by edema, no compartmentalization of resistivity, cannot characterize fluid

Protein Analysis

- Use bedside test to determine protein concentrations
- Assay and quantification
- Analyze results using Lights criteria
- Cons: Invasive, not feasible, time consuming, requires lab equipment

http://upload.wikimedia.org/wikipedia/commons/e/e6/Spombe_Pop2p_protein_structure_rainbow.png
Rapid Bedside Test

- Combine multiple tests into one
  - pH
  - Glucose
  - Hydrogen Peroxide
- Conduct test quickly at the bedside
- Pros: Feasible, low cost, portable, easy to analyze

http://upload.wikimedia.org/wikipedia/commons/2/24/Electroporation_Cuvettes.jpg
http://www.nationalscrubs.com/ProductImages/Medline09/Optium%20New%20High.jpg
# Design Matrix

<table>
<thead>
<tr>
<th></th>
<th>Weight</th>
<th>Fast EEM/Rame Probe</th>
<th>EIT Belt</th>
<th>Rapid Bedside Test</th>
<th>Bedside Protein Analysis</th>
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<td>2</td>
<td>6</td>
<td>7</td>
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<tr>
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<tr>
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<td>23.25</td>
<td>21.25</td>
<td>27</td>
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</table>
Design Specifications

- 3 cuvettes 40x20x16.7 mm (7.1 mL)
- Over all dimensions 4 x 2 x 10 cm
- Connected and set into a base
- Cover will be designed to seal all cuvettes
- Fluid will be inserted into cuvettes via an attachment that allows the syringe to be screwed onto the cover
Tests

- **Glucose**
  - Glucose meter will be attached to an external cuvette in an enclosed case
  - Clear, visible digital display

- **pH**
  - Diagnostic test strips will be used to identify pH

- **Hydrogen Peroxide**
  - 10 microliters of 30% hydrogen peroxide will be pre-packaged in a sealed cuvette
  - A minimum of 200 microliters of pleural fluid will be needed for a conclusive test
Future Work

• Finalize design logistics
  • Materials
  • Additional tests (albumin, LDH, cholesterol)

• Test Device
  • Predesigned fluids
  • Sensitivity and specificity

• Integrate with thoracentesis kit

Conclusions

- Improve clinical experience
  - Eliminate need for lab work
  - Minimize diagnostic time
  - Increase accuracy
- Suitable for less equipped hospitals
- Clear and simple results

http://www.alternativelearninglane.com/Career%20Transition/careertransition.htm
Acknowledgements

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- Professor John Webster – BME Department
References


Questions