Under Pressure: Unobtrusive Blood Pressure Monitoring in the Operating Room

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**Background**

- Blood pressure (BP) is an early indicator of complications
- Prolonged gaps in BP reading can lead to fatalities in the operating room (OR)

**Existing Solutions**

<table>
<thead>
<tr>
<th>Core Functions</th>
<th>Current Solutions</th>
<th>Automatic Pressure Cuff</th>
<th>Arterial Line</th>
<th>Ultrasound Patch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuously measure blood pressure</td>
<td>X</td>
<td>✓</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Non-invasive</td>
<td>✓</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportable/Portable</td>
<td>X</td>
<td>X</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

**Unmet Need**

A way for anesthesiologists to measure patient blood pressure in real time, so that complications to the patient and technical burdens for the anesthesiologists are decreased in the operating room.

**Total market volume: $1.25 billion / year**

**Total Growth Rate: 10.1% by 2026**

**UW Medicine**

**Two Available Methods in OR**

- Arterial Line
  - Invasive
  - Most accurate
  - Continuous

- BP Cuff
  - Non-invasive
  - Less accurate
  - Non continuous

44,000 Total Surgeries (UW Medicine)
Design Concept

A smart 3-sensor device placed on the carotid artery of the neck

Prototype

- ECG Placement locations
- PPG Placement locations

Future

- Post EIH Course: Summer 2021
- Onwards

Finalize Prototype
- Integrate Neural Network Training
- EIH Summer Incubator
- Design and 3D Print Sensor Housing

Clinical Trials
- Test prototype against A-line on patients in the OR
- Optimizing sensor placement

Ultrasound Sensor
- In-house manufacturing of ultrasound transducers

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Results

- Ground truth BP from BP Cuff
- PPG & ECG Waveforms from sensors

Calculated Systolic BP

Systolic BP Equation (Least Square Regression)

$SBP = \alpha_1 \ln(PAT) + \alpha_2 HR + \alpha_3$