The Future of Intelligent Care

James Mault, MD, FACS
Senior VP & Chief Medical Officer
Landmark transformations of human productivity

- **Industrial Revolution**
  - Physical Context: Stream engine, Trains, Electricity, Cars & Highways, Assembly Lines

- **Computing & Communications Revolution**
  - Digital Context: Telecommunications, Computers, Internet, Smartphone, Enterprise software

- **Cognition Revolution**
  - Physical & Digital: Internet of Things, Predictive Analytics, Robotics, 3D printing, Hyper-personalization

**TIME**

**TODAY**
Profound Moments in the History of Medicine

1846: Anesthesia
1865: Germ Theory
1895: X-rays
1915: Vaccines
1928: Antibiotics
1987: Lovastatin
2018: HIV Driven Intelligent Care

// FIRST COMMERCIALLY AVAILABLE YEAR //
During 2008, the number of things connected to the Internet exceeded the number of people on Earth.

By 2020 there will be 50 billion things connected to the Internet.
New Biometric Sensors and Wearables

- **Days**
  - Lab Test Facility

- **Seconds**
  - Portable Meter

- **Near Real-time**
  - On-body Sensors
Physician Activities over Next 10 Years

More time on the following activities:
- Using data from apps and wearables: 85%
- Triaging patients: 67%
- Managing medically-complex patients: 65%

Less time on the following activity:
- Conducting in-person care: 55%
Less than 0.1% Percent of medical device data generated is recorded in the EMR for an OR or ICU patient

21.6 million The number of data points generated by an ICU patient daily (when connected to 10 devices)

In the life and death care of patients in the ICU and OR, clinicians are missing more than 99.9% of the information that could allow for far better care

Data Overload in the ICU

* ICU Patient when connected to 10 devices. Data on file. Qualcomm Life 2017
Evolving Data Volume Exceeds Cognitive Capacity*

1970: Cockpit

Crash 1:1,000,000 Flights

2018: Intelligent Cockpit

Crash 1:20,000,000 Flights
Making Predictive Analytics a Routine Part of Patient Care

by Ravi B. Parikh, Ziad Obermeyer and David Westfall Bates, MD

APRIL 21, 2016
According to the National Academy of Medicine, the U.S. health care system spends almost a third of its resources — $750 billion annually — on unnecessary services and inefficient care.

New predictive analytics tools promise to reduce waste and improve care by forecasting the likelihood of an event and allowing providers to tailor treatments and services accordingly.

These tools will be applied across the continuum of care, from disease surveillance to chronic disease prevention to identifying patients who are at risk of deterioration.
Intelligent Care: From Hindsight to Foresight

HINDSIGHT

DESCRIPTIVE
“What Happened?”

INSIGHT

DIAGNOSTIC
“What did it happen?”

PREDICTIVE
“What will happen?”

FORESIGHT

PRESCRIPTIVE
“What should I do?”

Real-Time Streaming Data Enables Predictive Analytics and Artificial Intelligence Engines

Value

Expanding Sources and Quality of Data
Software as a Medical Device (SaMD)

**SaMD Inputs**
- Patient Data (lab results, image, medical device data, physiological status, symptoms, etc.)

**SaMD Algorithm**
- Algorithm, inference engine, Equations, Analysis engine, Model based logic, etc.
- Reference Data Knowledge Base, Rules Criteria

**SaMD Outputs**
- SaMD Defined Outputs (inform, drive, diagnose, treat)
SaMD Predictive/Prescriptive Analytics
Hypotension: MAP = 52
Cumulative time for MAP < 55 = 22 minutes.

## SaMD Command Center Dashboard

<table>
<thead>
<tr>
<th>Patient</th>
<th>Status</th>
<th>BMI</th>
<th>Notes</th>
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<tr>
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<td>G/P 2/0</td>
<td>32</td>
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<td>22 AP</td>
<td>G/P 1/0</td>
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<td>07 AP</td>
<td>G/P 4/0</td>
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<tr>
<td>05 L/FL</td>
<td>G/P 3/2</td>
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<tr>
<td>03 L 6 cm</td>
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<tr>
<td>06 L 5 cm</td>
<td>G/P 2/0</td>
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<tr>
<td>12 L 5 cm</td>
<td>G/P 1/0</td>
<td>26</td>
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<tr>
<td>14 L 3 cm</td>
<td>G/P 1/0</td>
<td>37</td>
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<tr>
<td>15 L 0 cm</td>
<td>G/P 1/0</td>
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<tr>
<td>18 L</td>
<td>G/P 1/0</td>
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<td>26 L 3 cm</td>
<td>G/P 1/0</td>
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<tr>
<td>29 L 5 cm</td>
<td>G/P 1/0</td>
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<tr>
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<td>G/P 3/3</td>
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<tr>
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### Legend
- **Alert**: Critical condition
- **Airway Status**: Unstable airway
- **Pre-X**: Pre-existing condition
- **Multiple**: Multiple complications
- **H/O CS, TOLAC**: History of cesarean section, trial of labor after cesarean
- **Epidural**: Epidural analgesia
- **IV Size**: IV catheter size
- **Care Note**: Additional care notes

### Triage Levels
- **Triage**: Initial assessment
- **Antepartum**: Pregnancy phases
- **Labor**: Labor and delivery
- **Postpartum**: Post-delivery recovery
- **Readmit**: Readmission
- **Fetal Loss**: Fetal loss

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SaMD Operating Room Results

Outcomes Measures*

<table>
<thead>
<tr>
<th></th>
<th>SaMD Group n = 8,042</th>
<th>Historical Controls: n = 8,008</th>
<th>p-value</th>
<th>Parallel Controls: n = 11,055</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Myocardial Infarction n (%)</strong></td>
<td>124 (1.5%)</td>
<td>221 (2.8%)</td>
<td>&lt;0.001</td>
<td>237 (2.1%)</td>
<td>0.003</td>
</tr>
<tr>
<td><strong>Kidney Failure n (%)</strong></td>
<td>1111 (16.3%)</td>
<td>1331 (19.5%)</td>
<td>&lt;0.001</td>
<td>1650 (17.5%)</td>
<td>0.048</td>
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<tr>
<td><strong>30-day mortality n (%)</strong></td>
<td>186 (2.3%)</td>
<td>263 (3.3%)</td>
<td>&lt;0.001</td>
<td>297 (2.7%)</td>
<td>0.86</td>
</tr>
<tr>
<td>Median LOS, days</td>
<td>5</td>
<td>6</td>
<td>&lt;0.001</td>
<td>6</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Note: A one-day reduction in LOS per surgery would save $220 billion in the US$^4$

*Presented at STA Jan 2017; Accepted for Publication in Journal of Anesthesia
Hypertension. Systolic = 168
Needs current airway exam.
PeriGen Overview

- OB patient safety platform: FDA-cleared, NICHD-validated, AI-driven interpretation tools
- Scalable, secure enterprise architecture; intuitive UI design
- 301 clients; comprehensive interfacing to all EMRs
- Currently supporting 466k births/year; 1.8M in last five years
- Committed to evidence-based medicine with 50 peer-reviewed publications:
  American Journal of Obstetrics and Gynecology, Becker’s, Journal of Healthcare Information Management
PeriCALM Cues:

*Highlights regions of potential interest*

- Long-term trend view with color coded classification of tracing based on hospital-defined rules
PeriGen Leads to Positive Outcomes

Ten Year Trends

- Study of 78,459 term singleton births at MedStar Health*
- Stabilization of cesarean rates despite increasing patient complexity
- 52% reduction in NICU transfers
- 54% reduction in fetal resuscitation

Pharma Black Hole

Diagnosis & e-Prescription → Fulfilment → NO DATA

Intelligent Medication Management

- Diagnosis & e-Prescription
- Medication Appropriateness
- Precision Medication Intelligence: Dose Adjustment & Medication Outcomes Reporting
- Fulfilment
- Connected Drug Monitoring
- Connected Drug Delivery
Data + Clinicians + Mathematicians = Intelligent Care
Thank you.

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