Applied Health Informatics Through the Lens of an Integrated Care Delivery System

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"I think that's the single best piece of advice: constantly think about how you could be doing things better and questioning yourself."

Elon Musk
Learning Objectives

- Provide context on the importance of applied health informatics for care delivery organizations in operational innovation and research efforts
- Demonstrate the role of integrated delivery systems in accelerating the impact of health informatics on daily patient care
- Present brief case studies of applied informatics at Baylor Scott & White Health (including lessons learned)
- Discuss key opportunities for the health informatics community to support and collaborate with integrated care delivery systems
Baylor Scott & White Health (BSWH)

- More than 500 patient care sites including 43 hospitals in North and Central Texas
- 5.3 million patient encounters annually
- 34,000 employees
- 6,000 affiliated physicians
- Scott & White Health Plan
- $8.3 billion in total assets
- $5.8 billion in total net operating revenue
The Imperative
Increasing Demand for Health Care

U.S. Population by Age Cohorts

2000

2010

2030


Projected Growth in Population with Chronic Conditions, 2013-25

Source: Health Care Demand Microsimulation Model projections.
$900 Billion in Waste

Shift to Value-Based Reimbursement

Share of Traditional Medicare Payments Flowing Through Alternative Payment Models: Historical and Goals

Percent of payments

0% 20% 30% 50%

2010 2014 2016 2018

HHS Goals

Value=Quality/Cost
Practice Adoption Gap

Care Delivery

Knowledge
The IHI “Triple Aim”

Better Care for Individuals
As described by the six dimensions of health care performance listed in the Institute of Medicine’s 2001 report “Crossing the Quality Chasm”: safety, timeliness, effectiveness, efficiency, equity, and patient-centeredness (i.e. STEEEP™ Health Care).

Better Health for Populations
Through attacking “the upstream causes of so much of our ill health.”

Reducing Per-Capita Costs
Costs should be reduced by eliminating “waste, needless hassle,” and “what does not make sense in our health care system.” Costs should not be reduced by eliminating any helpful care or by increasing the risk of harm (i.e. flat cuts in reimbursement do not meet this parameter).
The Health IT Paradox for Delivery Systems
Common Forms of Applied Health IT

• Electronic Health Records (EHRs)
• Analytics (use of “Big Data”)
• Patient Portals
• Biotechnologies
# US Deployment of EHRs

## US EMR Adoption Model℠

<table>
<thead>
<tr>
<th>Stage</th>
<th>Cumulative Capabilities</th>
<th>2014 Q2</th>
<th>2014 Q3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 7</td>
<td>Complete EMR; CCD transactions to share data; Data warehousing; Data continuity with ED, ambulatory, OP</td>
<td>3.2%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Stage 6</td>
<td>Physician documentation (structured templates), full CDSS (variance &amp; compliance), full R-PACS</td>
<td>15.0%</td>
<td>16.5%</td>
</tr>
<tr>
<td>Stage 5</td>
<td>Closed loop medication administration</td>
<td>27.5%</td>
<td>29.5%</td>
</tr>
<tr>
<td>Stage 4</td>
<td>CPOE, Clinical Decision Support (clinical protocols)</td>
<td>15.3%</td>
<td>14.5%</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Nursing/clinical documentation (flow sheets), CDSS (error checking), PACS available outside Radiology</td>
<td>25.4%</td>
<td>23.9%</td>
</tr>
<tr>
<td>Stage 2</td>
<td>CDR, Controlled Medical Vocabulary, CDS, may have Document Imaging; HIE capable</td>
<td>5.9%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Stage 1</td>
<td>Ancillaries - Lab, Rad, Pharmacy - All Installed</td>
<td>2.8%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Stage 0</td>
<td>All Three Ancillaries Not Installed</td>
<td>4.9%</td>
<td>4.4%</td>
</tr>
</tbody>
</table>

Data from HIMSS Analytics℠ Database © 2014

N = 5,447   N = 5,453
Mixed Reviews of EHR Impacts to Date

**EXHIBIT 1**

Evaluations Of Outcome Measures Of Health Information Technology, By Type And Rating

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Number of Study Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to care</td>
<td></td>
</tr>
<tr>
<td>Preventive care</td>
<td></td>
</tr>
<tr>
<td>Care process</td>
<td></td>
</tr>
<tr>
<td>Patient satisfaction</td>
<td></td>
</tr>
<tr>
<td>Patient safety</td>
<td></td>
</tr>
<tr>
<td>Provider satisfaction</td>
<td></td>
</tr>
<tr>
<td>Effectiveness of care</td>
<td></td>
</tr>
<tr>
<td>Efficiency of care</td>
<td></td>
</tr>
</tbody>
</table>

- **Positive**
- **Mixed-positive**
- **Neutral**
- **Negative**

**SOURCE** Authors’ analysis of published peer-reviewed studies. **NOTE** A total of 278 outcome measures were evaluated across all studies included in our final sample.

Buntin et al, *Health Affairs* 2011
Analytics

A systematic approach to discover and communicate meaningful patterns in data.

• Descriptive (reports)

• Predictive (modeling identifies a future state)

• Prescriptive (results guide intervention)
More Information is Better?

Volume, Velocity, Variety....and Veracity!
Patient Portals
Impact Greatest in High-Risk Populations

BENEFITS OF REMOTE MONITORING
STUDY OF 6,000 PATIENTS SUFFERING FROM DIABETES, HEART FAILURE OR COPD

- Mortality Rates: DOWN 45%
- Emergency Room Visits: DOWN 15%
- Emergency Admissions: DOWN 20%
- Total Costs Per Patient: DOWN 8%

Source: National Health Service (NHS) in England and 3millionlives.com
Biometrics

Health Services with Coupled Devices

DEVICES SENSORS
- Glucose
- Weight
- Blood pressure
- O2
- ECG

NETWORK
- WIFI
- Bluetooth
- Cellular
- NFC
- RFID

DEVICE CONNECTOR
- Data collector
- Data gateway
- Location (space)
- Time

CORE
- Data aggregator
- Data analysis alerts
- Communications gateway

USERS
- Care providers
- Hospital
- Physician
- Family
“Omics”
• **Clinical Decision Support** is a process for enhancing health-related decisions and actions with pertinent, organized clinical knowledge and patient information to improve health and healthcare delivery. Information recipients can include patients, clinicians and others involved in patient care delivery; information delivered can include general clinical knowledge and guidance, intelligently processed patient data, or a mixture of both; and information delivery formats can be drawn from a rich palette of options that includes data and order entry facilitators, filtered data displays, reference information, alerts, and others.

Improving outcomes with clinical decision support: an implementer’s guide. Second Edition. HIMSS. 2011
IT Platforms Converge in ACOs

• Accountable Care is a method of health care reimbursement that holds providers responsible for delivering high-quality, low-cost care

• ACOs are provider-led organizations with a strong base of primary care that are measured by quality and total per capita costs across the full continuum of care for a population of patients

• Integration and coordination are the cornerstones of ACO operations

• Reliable and progressively more sophisticated health IT will be required to support ACOs
The Fully Wired Quality Alliance

The infrastructure to enable the operation of a quality-driven, shared risk organization is complex, and success requires full integration along the care and data continuum.

- Evidence-based Decision support tools
  - Messaging via Email or Web at outset
  - Messaging integrated into EMR at fully operational
- BQA Core Foundational Systems
  - Eclipsys
  - Ambulatory EMRs
  - Lawson
- Patient, Physician and Payor Portals
- Mobile, Messaging, Social Media
- Communications:
  - BQA → Physician
  - BQA → Patient
  - BQA → Payor
- External clinical data
  - Multiple systems/platforms
  - Community of providers
  - HIE enabled
  - LPR creation is critical step

- Best Practice Care Protocol Dissemination
- Point of Care and BQA Data Entry

- Data Aggregation

- Cost and Quality Reporting
- Clinical Outcomes Analytics
  - BI Tools
  - Population Health
  - Physician Profiling
    - Contract Management
    - Risk Modeling/Actuarial Analytics
  - Confidential Information for the sole benefit and use of BQA

- Data Warehousing – Storage
  - Business Intelligence Tools
  - Distribution and access controls
ACO Success Mandates a Robust Data Model

Level of Data Needed to Enable Migration of Care Delivery Model

- Individual Health Profile
- Biometric, Genetic Analysis
- Basic Health Information
- Pharmacy Data
- Demographic Data
- Financial Indicators
- Claims Data

Granularity of Data

Difficulty to Obtain

Advisory Board Issue Brief: Implications of Accountable Care for Biopharmaceutical Firms
How Providers are Measured in ACOs

Key Metrics for Accountable Payment Models

<table>
<thead>
<tr>
<th>Performance Risk</th>
<th>Utilization Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Care</td>
<td>Quality of Care</td>
</tr>
<tr>
<td></td>
<td>Volume of Care</td>
</tr>
</tbody>
</table>

**Bundled Pricing**
- Episodic Efficiency
- Readmission Reduction
- Care Standardization

**Pay-for-Performance**
- Clinical Quality
- Care Efficiency
- Patient Experience

**Shared Savings**
- Chronic Care Management
- Care Substitution
- Disease Prevention

Advisory Board Issue Brief: Implications of Accountable Care for Biopharmaceutical Firms
Truly Bending the Cost Curve

Miller, How to Create an Accountable Care Organization, 2009.
www.CHQPR.org
Applied Informatics Examples at BSWH
Development of Enterprise Data Warehouse (EDW)
## Hierarchy of Reliability

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Predicted Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>No protocol</strong> (“State of Nature”)</td>
<td>40%</td>
</tr>
<tr>
<td>2</td>
<td><strong>Pseudo-protocol</strong>: decision support exists but not linked to order writing, or prompts within orders but no decision support</td>
<td>50%</td>
</tr>
<tr>
<td>3</td>
<td><strong>Protocol</strong>: well-integrated into orders at point-of-care</td>
<td>65-85%</td>
</tr>
<tr>
<td>4</td>
<td><strong>Enhanced protocol</strong>: complementary strategies increase use of protocol</td>
<td>90%</td>
</tr>
<tr>
<td>5</td>
<td><strong>Measure-vention</strong>: oversights identified &amp; addressed in real time</td>
<td>90+%</td>
</tr>
</tbody>
</table>

* Protocol = standardized decision support, embedded within an order set

Structured Documentation to Facilitate Workflows

<table>
<thead>
<tr>
<th>Patient List</th>
<th>Orders</th>
<th>Results</th>
<th>Patient Info</th>
<th>Documents</th>
<th>Flowsheets</th>
<th>Clinical Summary</th>
<th>Vitals/Info</th>
<th>Meds View</th>
<th>Orders View</th>
<th>myBaylorEMR</th>
</tr>
</thead>
</table>

**02 Critical Care FS, From 09/03/2013 to 09/05/2013**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Sedation Vacation/Daily Awakening Trial</th>
<th>Exercise/Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/04/2013</td>
<td>6:00</td>
<td>Did the Patient Receive a Sedation Vacation Today?</td>
<td>Did the Patient Receive Exercise/Mobility Therapy Today?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If Not, Why Not Was the Sedative Infusion Resumed?</td>
<td>If Not, Why Not What Level Was Achieved?</td>
</tr>
<tr>
<td>09/04/2013</td>
<td>7:00</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>09/04/2013</td>
<td>7:32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Vital Signs**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Heart Rate</th>
<th>Blood Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/04/2013</td>
<td>6:00</td>
<td>60</td>
<td>120/80</td>
</tr>
<tr>
<td>09/04/2013</td>
<td>7:00</td>
<td>70</td>
<td>130/90</td>
</tr>
<tr>
<td>09/04/2013</td>
<td>7:32</td>
<td>65</td>
<td>110/70</td>
</tr>
</tbody>
</table>

**Ventilator-Associated Pneumonia**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Oral care</th>
<th>Head of Bed Elevated 30 - 45 Degrees</th>
<th>VTE</th>
<th>Stress Ulcer Prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/04/2013</td>
<td>6:00</td>
<td>brush</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09/04/2013</td>
<td>7:00</td>
<td>all criteria</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09/04/2013</td>
<td>7:32</td>
<td>all criteria</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CRRT**

**Sedation Scale**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Ramsay Sedation Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/04/2013</td>
<td>6:00</td>
<td>level 2</td>
</tr>
<tr>
<td>09/04/2013</td>
<td>7:00</td>
<td>level 2</td>
</tr>
</tbody>
</table>

**Confusion Assessment Method - ICU**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Confusion Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/04/2013</td>
<td>6:00</td>
<td>B.A.S.S. Ramsay's Step 1, IFRASS: -4 or -5 or Ramsay 5 or 6, STOP Reassess later</td>
</tr>
<tr>
<td></td>
<td>7:00</td>
<td>Feature 1: Acute Onset or Fluctuating Course</td>
</tr>
<tr>
<td></td>
<td>7:00</td>
<td>Feature 2: Inattention</td>
</tr>
<tr>
<td></td>
<td>7:00</td>
<td>Feature 3: Altered Level of Consciousness</td>
</tr>
<tr>
<td></td>
<td>7:00</td>
<td>Feature 4: Disorganized Thinking</td>
</tr>
<tr>
<td></td>
<td>7:00</td>
<td>CAM-ICU: negative</td>
</tr>
</tbody>
</table>

**Meds View**

**Orders View**

**myBaylorEMR**
Real-Time Information for “Measure-Vention”
Delirium Bundle Uptake

Adherence (%)

Basic Sites
Enhanced Sites

Baylor Scott & White Health
Clinical Decision Support: Glycemic Control

Select the glucose reading from below that is being used for this dose or enter the glucose into the box below. Then, if this is standard protocol, select an algorithm to use for determining the ordered dose.

Treating Glucose

Available Glucose Readings

For Blood Glucose

Charted Sliding Scale Task

Start Hypoglycemia protocol!!! Do NOT give any insulin
Electronically Derived Reports

BHCS Hypoglycemic Events (< 40 mg/dL) - Critical Care, All Adult POC
October 2013 - September 2014

Each point represents the % for the month; in Sept the system was @ 0.71%, not meeting the Level 3 goal of 0.67%

The Trend graph provides information for each MONTH for the past 12 months which allows for data trending.
Baylor Scott and White Patient Portals

**NTX**
- Hospital
- HTPN (ambulatory)
- Oncology (ambulatory)
- Follow My Health
- NTX Cancer Portal
- > 260,000 accounts

**CTX**
- Hospital and Ambulatory
- Epic
- Various Portal Products
- > 300,000 accounts

**BSWQA affiliated**
- Ambulatory
- Various EMR systems
- Data unavailable
Improving Access-to-Care

*Consumer-driven access initiatives reach beyond traditional access points*

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**Traditional Access Point**
- Office Visit

**Consumer Oriented Access Points**
- Team-based Care
- Patient Access Center
- Extended Hours
- eVisits
- Retail Clinics
- Telehealth

---

Thank you for selecting Aetna Whole Health – Baylor Scott & White Quality Alliance as your new health care plan.

Our network of primary care and specialty doctors at Baylor Scott & White Quality Alliance has the expertise to address virtually any medical need at a care site near you.

Find a BSWQA Doctor, Call 1.844.BSW.QLTY (1.844.279.7589)
Platforms for Analytics

Data Aggregation
Measure Computation

Risk Stratification
Member Website

MSSP Quick Reports
CMS ACO Measures

Exploration/Visualization
Claims Analytics

Interoperability
Examples of Analytics Output

Physician dashboard with drill-through

Administrative dashboard with drill-through

Executive Scorecard

JOC Physician Engagement

Network Utilization with drill-through

Predictive Modeling / Risk Stratification
"It's a one-year timer. It gives an added sense of urgency to my research grant."
BSWH-Core Laboratories

Centers of Excellence

<table>
<thead>
<tr>
<th>GENOMIC MEDICINE</th>
<th>IMMUNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Develop Biomarkers / Discover Targets”</td>
<td>“Develop Therapeutics”</td>
</tr>
<tr>
<td>Autoimmunity</td>
<td>Cancer</td>
</tr>
<tr>
<td>Metabolic Disease</td>
<td>Transplant</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>Inflammation</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>Infectious Disease</td>
</tr>
</tbody>
</table>

Research Support

<table>
<thead>
<tr>
<th>GENOMIC CORES</th>
<th>COMMON CORES</th>
<th>THERAPEUTIC CORES</th>
</tr>
</thead>
<tbody>
<tr>
<td>RNA/DNA Genomics</td>
<td>Flow Cytometry</td>
<td>Protein engineering</td>
</tr>
<tr>
<td>Metabolomics</td>
<td>Animal Resources</td>
<td>Monoclonal antibodies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preclinical development</td>
</tr>
<tr>
<td>Bioinformatics</td>
<td>Imaging</td>
<td>Biostatistics</td>
</tr>
<tr>
<td>Biostatistics</td>
<td>Clinical Samples</td>
<td></td>
</tr>
</tbody>
</table>

Baylor Scott & White Health
Novel Biotechnology Discovery

Biosignature Platform: Robust, Versatile and Validated

Validated Clinical Applications

Autoimmune
- Lupus
- SOJIA

Cancer
- Melanoma

Infectious Disease
- TB (latent or acute)
- Staphylococcus aureus
- Septicemic melioidosis

Cardiology
- Cardiac Disease

Other
- Organ transplantation
- Kawasaki Disease

Multiple Clinical Uses

- Stratification of patient
- Diagnosis
- Prognosis
- Monitoring treatment
EHRs as tools for Research

- Access to rich clinical datasets
  - less resource intensive
  - population screening
  - applicable in many study designs

- Linkage of discrete observations
  - limited NTX capacity pre-ACO

- Important limitations:
  - loss of pre-EHR history
  - missing values
  - developed for frontline care
  - deceptive sample sizes

- Pooling data from multiple sites
PCORnet
National Patient-Centered Clinical Research Network

• Distributed network of 11 Clinical Data Research Networks (CDRNs) and 18 Patient Powered Research Networks (PPRNs)
• Created to improve the nation’s capacity to conduct patient-centered comparative effectiveness research (CER)
CDRN App Suite Details

**Patient App**

**Engagement Mode:**
- HiOH - join patient network
- Consumer Health - clinic/system defined interactive content

**Research Mode:**
- Recruitment - consents, screening
- Trial participation - scheduling, surveys, reminders/prompts

**HiOH Portal**
Web-based platform that provides patients with:
- Access to Patient App engagement and research functions
- General & study specific data results and analytics

**Research App**

**Research Mode:**
- Recruitment: Performs screening and eligibility
- Trial Management: Enrolls patients, collects trial data, tracks trial tasks

**Tablet version syncs with EHRs in clinic**

**Mobile version enables direct patient access**

**Researcher Portal**
Web-based platform that provides researchers with:
- Access to Research App research functions
- Study specific data results and analytics

- Logs in users through tablet
- Notifications of patients consented to be contacted
Looking Forward: Opportunities

WELCOME ABOARD, PETERSON. I UNDERSTAND WE'RE GOING TO BE WORKING TOGETHER.
Translational Roadmap


The "3T's" road map to transform US health care: the "how" of high-quality care. Dougherty D, Conway PH.
For Your Elevator Speech...

- Synthesis
- Integration
- Workflow
- Value
Closing Thoughts

• Installation [of any new system or approach] is **hard**, and mainly technical

• Implementation is **really hard**, and mainly organizational

• Transition (lasting change) is **incredibly hard**, and purely human

• Transformation is a state of profound **new personal and enterprise behavior**

Marc Overage MD PhD, Regenstrief Institute, Inc: A Healthcare Laboratory and a Community of Scholars
Questions?