Clinical/Health IT Update
University of Michigan IT Council

Andrew Rosenberg MD
Chief Medical Information Officer
UMHS
Order of the Presentation
Health Delivery at Univ of Michigan

- UMHS
  - Hospitals and Clinics
  - Medical School
  - Nursing School

- UHS

- School of Dentistry & Dental Clinics

- SPH

Non HIPPA Covered Entity

- Institute for Human Adjustment
  - Psychology clinic (East hall)

- School of Social Work
  - Family Assessment clinic

- UM Athletics

- CAPS; Counseling and Psychological Services
Hospitals & Clinics
- 7 hospitals & Surgery Centers:
  - UH, Mott, VV women's, CVC, Kellogg Eye, EAA Surgery Center, Livonia Surgery Center
- 4 Specialty Centers:
  - Comprehensive Cancer, Diabetes, Depression, Geriatrics
- 120 + Clinics (40 Health Centers) - MI & OH

Facts:
- 22,000 Faculty & Staff
- 885 hospital beds expanding to 1035 (new Mott/VV)
- 45,000 inpatient admissions
- 80,000 Emergency Visits
- 1.8 million outpatient visits/surgeries
- $2.1 B Operating Revenue vs $2.02 B expenses.

Medical School
- 1600 Faculty (188 Endowed Professorships)
- 1850 enrolled students
- $436 Million Research Funding ($366M + NIH funding)
- 80 facilities, 4.6 million Gross ft2
- $1.3 B total Revenue

Nursing School
- 118 Faculty
- 1844 enrolled students
Statewide Reach of UMHS

- M-net; Referring Physician Communication Network
  - 12,000 physicians
  - >2000 items sent/day
  - +600 physicians direct access to Careweb
UHS & UM School of Dentistry

- **UHS**
  - 150 Employees (25 clinicians; 1^0^ care & Specialties)
  - 80,000 visits (70% student, 30% Fac/staff)
  - $18 million operating budget ($5M fee for service)

- **School of Dentistry**
  - 410 Faculty (110 full, 300 part time)
  - 650 Students (444 DDS, 104 hygiene, 81 Grad)
  - 145,000 visits
Unique Primary Care at UM

Wide Range of Patient Ages & Services.

Large and diverse Student Population
- Population care, Etoh & drug, STDs,
- Psych/Social, Injury(prevention),
- Lifestyle/health-education

International Students (and Foreign travel)
UMHS Destination Programs

- Skin Cancer/Melanoma
- Multidisciplinary Aortic
- Congenital Heart Disease
- Head & Neck Cancer Cranial Base
- Multidisciplinary Adrenal Cancer/Endocrine Oncology
- Multidisciplinary Liver Cancer
- Multidisciplinary Pancreatic CA
- Bladder Cancer
- Center for Stem Cell Transplantation

- Fetal Diagnosis and Treatment Center
- Heart Rhythm Center
- Michigan Sensitized Candidate Program (MISCAP)
- Multidisciplinary Cerebrovascular Disorders
- Multidisciplinary Craniofacial Anomalies
- Multidisciplinary Interstitial (Fibrotic) Lung Disease Sarcoma
- Thoracic Insufficiency Respiratory Syndrome
- University of Michigan Esophageal Cancer Program
Aging of US Population

Total number of persons age 65 or older, by age group, 1900 to 2050, in millions

- 65 or Older
- 85 or Older

Projected
Figure. Fertility rate: United States, 2005–2009 and provisional, June 2009–June 2010
The Epidemiology of Sepsis in the United States from 1979 through 2000

Greg S. Martin, M.D., David M. Mannino, M.D., Stephanie Eaton, M.D., and Marc Moss, M.D.

Mortality

Figure 4. Overall In-Hospital Mortality Rate among Patients Hospitalized for Sepsis, 1979–2000.
Severe Sepsis and Increasing Age

- Cases
- Incidence

Number of cases vs. Age (years)
Epidemiology of severe sepsis in the United States: Analysis of incidence, outcome, and associated costs of care

Derek C. Angus, MD, MPH, FCCM; Walter T. Linde-Zwirble; Jeffrey Lidicker, MA; Gilles Clermont, MD; Joseph Carcillo, MD; Michael R. Pinsky, MD, FCCM

1) 750,000 Hosp. Admits
2) 215,000 deaths
3) $16.7 billion (1995 dollars)
4) A top ten consumer US hospital Costs.
Asthma
Congestive Heart Failure
Diabetes
Hypertension
Coronary Artery Disease
COPD
Chronic Kidney Disease
Stroke
Dementia/Alzheimer’s
1. Affect more than 130 million Americans

1. Account for 70% of all deaths in the US.

1. Costs of care account for more than 75% of the nation’s $2 trillion medical care costs.
Figure 2. Trends in overweight, obesity, and extreme obesity among adults aged 20–74 years: United States, 1960–2008
Epidemiology of Heart Failure

- 5 million Patients with CHF in US
- 1% of population over 65 years old
- >400,000 new cases/yr.
- 160% increase in hospitalizations over past 10 years.
- ~ 50% mort. in 3 years
  - < half of 4200 patients on Tx list will receive a heart Tx.
Deaths from CVD: 1900-2000

Cooper, Circ 2000
Palliative Care
US Expenditures vs World

OECD, 2009
Health Care Spending in Selected Developed Countries, 2007

PER CAPITA SPENDING

- Private
- Public

Total Spending as a Percent of GDP

<table>
<thead>
<tr>
<th>Country</th>
<th>Per Capita Spending</th>
<th>Percent of GDP</th>
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</thead>
<tbody>
<tr>
<td>Korea</td>
<td>$1,688</td>
<td>6.3%</td>
</tr>
<tr>
<td>Spain</td>
<td>$2,671</td>
<td>8.5%</td>
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<tr>
<td>U.K.</td>
<td>$2,992</td>
<td>8.4%</td>
</tr>
<tr>
<td>Australia</td>
<td>$3,357</td>
<td>8.9%</td>
</tr>
<tr>
<td>Germany</td>
<td>$3,588</td>
<td>10.4%</td>
</tr>
<tr>
<td>France</td>
<td>$3,601</td>
<td>11.0%</td>
</tr>
<tr>
<td>Canada</td>
<td>$3,895</td>
<td>10.1%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>$4,417</td>
<td>10.8%</td>
</tr>
<tr>
<td>Norway</td>
<td>$4,763</td>
<td>8.9%</td>
</tr>
<tr>
<td>U.S.</td>
<td>$7,290</td>
<td>16.0%</td>
</tr>
</tbody>
</table>
Health spending exceeded $2.3 Trillion in ‘08, expected to exceed $2.5 trillion in ‘10.
35% health spending in elderly is private dollars.
Spending Distribution, by Category, 2008

TOTAL SPENDING: $2.3 TRILLION

- Hospital Care: 31%
- Personal Health Care: 83%
- Physician and Clinical Services: 21%
- Rx Drugs: 10%
- Dental/Other Professional: 10%
- Administration: 7%
- Other Medical Products: 3%
- Home Health Care: 3%
- Nursing Home Care: 6%
- Public Health Activity: 3%
- Investment: 7%
Life Expectancy vs Healthcare expenditures

Figure 1: Healthy Life Expectancy Total Population and Total Healthcare Expenditure/capita, 2003/2006

- Efficient: Countries like Spain, Italy, Iceland, Germany, France, Luxembourg.
- Effective: Countries like Switzerland, Norway, Sweden.
- Underfunded: Countries like Greece, Austria, Denmark, Ireland, Portugal.
- Wasteful: United States.

Size of bubbles indicate percentage share of total health expenditures that come from the private sector.

(Note: Relative differences between countries magnified (raised to the third power) to facilitate chart reading)

Total Healthcare Expenditure/Capita $USPPP, 2006 or Latest

# LEADING CAUSES OF DEATH

<table>
<thead>
<tr>
<th>Cause</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diseases of the Heart</td>
<td>726,974</td>
</tr>
<tr>
<td>Cancer (malignant neoplasms)</td>
<td>539,577</td>
</tr>
<tr>
<td>Cerebrovascular Disease</td>
<td>159,791</td>
</tr>
<tr>
<td>Chronic Obstructive Pulmonary Disease</td>
<td>109,029</td>
</tr>
<tr>
<td><strong>Medical Errors</strong></td>
<td><strong>44,000–98,000</strong></td>
</tr>
<tr>
<td>Accidents and Adverse Effects</td>
<td>95,644</td>
</tr>
<tr>
<td>(motor vehicle accidents = 43,458; all others = 52,186)</td>
<td></td>
</tr>
<tr>
<td>Pneumonia and Influenza</td>
<td>86,449</td>
</tr>
<tr>
<td>Diabetes</td>
<td>62,636</td>
</tr>
<tr>
<td>Suicide</td>
<td>30,535</td>
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<tr>
<td>Kidney Disease</td>
<td>25,331</td>
</tr>
<tr>
<td>Liver Disease</td>
<td>25,175</td>
</tr>
</tbody>
</table>

Medicine used to be simple, ineffective, and relatively safe.

Now it is complex, effective, and potentially dangerous.

“The mystical authority of the doctor used to be essential for practice, now we need to be open and work in partnership with our colleagues in health care and with our patients. We must recognize and encourage our patients’ right to make fully informed decisions about available treatments and provide care and support, not just technically advanced interventions.”

Chantler, 1999.
Major Trends in US Healthcare

Value (quality/cost) vs Control Costs

Safety

Accountable Care Organizations
Patient Centered Medical Homes

Personalized Medicine (Genomics)

Meaningful Use {of EMRs}
Features of the ‘Medical Home’

- Monitored, coordinated and integrated care using electronic medical records and personal health records
- Information technology is used to appropriately support optimal patient care, performance measurement, patient education, and enhanced communication
- Innovation such as …cyber-visits, …self-monitoring devices are available....
The ability to measure and Report on the Quality of Care—the goal is not just reduce costs, but to do so while maintaining or improving quality of care= **Value**

**Requires the ACO to accept accountability for the total costs of care and population-level quality outcomes.**

Miller, Harold
Different “levels” of ACOs

DIFFERENT FORMS OF ACCOUNTABLE CARE ORGANIZATIONS

HEALTH CARE PROVIDERS INCLUDED

<table>
<thead>
<tr>
<th>Level 4 ACO</th>
<th>Public Health</th>
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<tbody>
<tr>
<td></td>
<td>Safety-Net Clinics</td>
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</table>

<table>
<thead>
<tr>
<th>Level 3 ACO</th>
<th>Hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Other Specialists</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 2 ACO</th>
<th>Major Specialists (Cardiology, Orthopedics, Etc.)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Level 1 ACO</th>
<th>Primary Care Practice</th>
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<tbody>
<tr>
<td></td>
<td>Primary Care Practice</td>
</tr>
<tr>
<td></td>
<td>Primary Care Practice</td>
</tr>
</tbody>
</table>

EXAMPLES OF COST REDUCTION OPPORTUNITIES

<table>
<thead>
<tr>
<th>Level 4 ACO</th>
<th>Coordinated Health and Social Services Support</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Level 3 ACO</th>
<th>Improved Management of Complex Patients</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Level 2 ACO</th>
<th>Improved Outcomes and Efficiency for Major Specialties</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Level 1 ACO</th>
<th>Reduction in Preventable ER Visits &amp; Admissions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Appropriate Use of Testing/Referral</td>
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<thead>
<tr>
<th></th>
<th>Prevention &amp; Early Diagnosis</th>
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UNIVERSITY OF MICHIGAN
“I am fain to sum up with an urgent appeal for adopting ... some uniform system of publishing the statistical records of hospitals. There is a growing conviction that in all hospitals, even in those which are best conducted, there is a great and unnecessary waste of life ... In attempting to arrive at the truth, I have applied everywhere for information, but in scarcely an instance have I been able to obtain hospital records fit for any purposes of comparison ... If wisely used, these improved statistics would tell us more of the relative value of particular operations and modes of treatment than we have means of ascertaining at present.”
The first Informatician?

Florence Nightingale

Notes on Hospitals, London. 1863
Figure 1. Percentage of office-based physicians with electronic medical records/electronic health records (EMRs/EHRs): United States, 2001–2009 and preliminary 2010
Figure 2. Percentage of office-based physicians using any electronic medical record/electronic health record (EMR/EHR) system, by state: United States, preliminary 2010

NOTE: Significance tested at p<0.05.
SOURCE: CDC/NCHS, National Ambulatory Medical Care Survey.
### US EMR Adoption Model

<table>
<thead>
<tr>
<th>Stage</th>
<th>Cumulative Capabilities</th>
<th>2010 Final</th>
<th>2011 Q1</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>1.0%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Stage 6</td>
<td>Physician documentation (structured templates), full CDSS (variance &amp; compliance), full R-PACS</td>
<td>3.2%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Stage 5</td>
<td>Closed loop medication administration</td>
<td>4.5%</td>
<td>5.9%</td>
</tr>
<tr>
<td>Stage 4</td>
<td>CPOE, Clinical Decision Support (clinical protocols)</td>
<td>10.5%</td>
<td>10.7%</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Nursing/clinical documentation (flow sheets), CDSS (error checking), PACS available outside Radiology</td>
<td>49.0%</td>
<td>48.4%</td>
</tr>
<tr>
<td>Stage 2</td>
<td>CDR, Controlled Medical Vocabulary, CDS, may have Document Imaging; HIE capable</td>
<td>14.6%</td>
<td>14.1%</td>
</tr>
<tr>
<td>Stage 1</td>
<td>Anciliaries - Lab, Rad, Pharmacy - All Installed</td>
<td>7.1%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Stage 0</td>
<td>All Three Anciliaries Not Installed</td>
<td>10.1%</td>
<td>9.6%</td>
</tr>
</tbody>
</table>

Data from HIMSS Analytics™ Database © 2011

### Canada EMR Adoption Model

<table>
<thead>
<tr>
<th>Stage</th>
<th>Cumulative Capabilities</th>
<th>2010 Final</th>
<th>2011 Q1</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>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Stage 6</td>
<td>Physician documentation (structured templates), full CDSS (variance &amp; compliance), full R-PACS</td>
<td>0.2%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Stage 5</td>
<td>Closed loop medication administration</td>
<td>0.2%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Stage 4</td>
<td>CPOE, Clinical Decision Support (clinical protocols)</td>
<td>2.2%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Nursing/clinical documentation (flow sheets), CDSS (error checking), PACS available outside Radiology</td>
<td>33.0%</td>
<td>33.0%</td>
</tr>
<tr>
<td>Stage 2</td>
<td>CDR, Controlled Medical Vocabulary, CDS, may have Document Imaging; HIE capable</td>
<td>23.5%</td>
<td>23.8%</td>
</tr>
<tr>
<td>Stage 1</td>
<td>Anciliaries - Lab, Rad, Pharmacy - All Installed</td>
<td>12.1%</td>
<td>11.9%</td>
</tr>
<tr>
<td>Stage 0</td>
<td>All Three Anciliaries Not Installed</td>
<td>29.0%</td>
<td>28.6%</td>
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Data from HIMSS Analytics™ Database © 2011
Use of Electronic Health Records in U.S. Hospitals


1.5% = comprehensive EMR
8% = basic system
17% = CPOE
11% to 23% = CDS

45% have “NO Plans” for CPOE or CDS.
Use of Electronic Health Records in U.S. Hospitals

Ashish K. Jha, M.D., M.P.H., Catherine M. DesRoches, Dr.Ph., Eric G. Campbell, Ph.D., Karen Donelan, Sc.D., Sowmya R. Rao, Ph.D.,
Effect of CPOE Dose Limit Check/Alert

PATIENT SAFETY
Improving Safety with Information Technology

David W. Bates, M.D., and Atul A. Gawande, M.D., M.P.H.

**Figure 2.** Percentage of Medication Orders with Doses Exceeding the Maximum.
Data are the percentage of orders for doses exceeding the medication-specific recommended maximal dose according to year, after the implementation of a computerized system for order entry by physicians.23 The application suggested a default dose and displayed only potentially appropriate options, but it did not check for overly high doses. Even so, the percentage of orders exceeding the recommended safe maximum fell by more than 80 percent over a three-year period.
NIH and PCAST: Integrating the ‘Omics with the Phenotype is Key to staying competitive in research and patient care
Meaningful Use
Meaningful Use: 3 Stages

Implemented in three stages

- 2009: HIT-Enabled Health Reform
- 2011: HITECH Policies
- 2013: Stage 1 Meaningful Use Criteria (Capture/share data)
- 2015: Stage 2 Meaningful Use Criteria (Advanced care processes with decision support)
- 2015: Stage 3 Meaningful Use Criteria (Improved Outcomes)

Hersh, OHSU
ARRA, HITECH & Basis for MU

- **ARRA** = American Recovery and Reinvestment Act 2009
  - **HITECH** = Health Information Technology for Economic and Clinical Health Act
    - $27B incentives for EHR adoption by:
      - Eligible providers
      - Hospitals
    - $2B direct grants by Fed agencies; training, pilots, etc.
  - **ONC** = Office of the National Coordinator (Final rule July, 28th, 2010)
    - EHR Standards
    - Implementation specifications
    - Certification criteria
  - **CMS**; Ties incentive payments/penalties to MU specifications
    - Medicaid; CMS
    - Medicare; States.
ONC = Office of the National Coordinator

- HITECH technology interventions map to 5 goals for US Healthcare System:
  - Improving quality, safety & efficiency
  - Engaging patients in their care
  - Increasing coordination of care
  - Improving the health status of the US population
  - Ensuring privacy and security of patient data

- Requires use of certified EHR technology:
  1. In a meaningful manner. (CDS, CPOE)
  2. For electronic exchange of health information to improve quality of health care. (HIE)
  3. To submit clinical quality and other measures selected by the Secretary for HHS.
UMHS Hospital Incentive/Penalty Avoidance: Estimated.

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<tr>
<td>Medicare</td>
<td>$0</td>
<td>$2,406,428</td>
<td>$1,804,821</td>
<td>$1,203,214</td>
<td>$601,607</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$6,016,069</td>
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<tr>
<td>Medicaid</td>
<td>$0</td>
<td>$2,044,376</td>
<td>$1,635,501</td>
<td>$408,875</td>
<td>$0</td>
<td>$0</td>
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<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$4,088,753</td>
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<tr>
<td>Penalty</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$1,424,082</td>
<td>$2,848,164</td>
<td>$4,272,247</td>
<td>$4,272,247</td>
<td>$4,272,247</td>
<td>$4,272,247</td>
<td>$4,272,247</td>
<td>$25,633,479</td>
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<tr>
<td>Totals</td>
<td>$0</td>
<td>$4,450,804</td>
<td>$3,440,322</td>
<td>$1,612,089</td>
<td>$2,025,689</td>
<td>$2,848,164</td>
<td>$4,272,247</td>
<td>$4,272,247</td>
<td>$4,272,247</td>
<td>$4,272,247</td>
<td>$4,272,247</td>
<td>$35,738,301</td>
</tr>
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**TOTAL POTENTIAL EHR ADOPTION VALUE**

10 years - $35.7MM

Deloitte, 2011
Last Day to Meet Full Incentives

Medicare Incentive Timeline

- Physicians:
  - Max Incentive: 10-1-2012
  - Reduced Incentive
  - Penalties

- Hospitals:
  - Max Incentive: 7-1-2013
  - Reduced Incentive
  - Penalties
Objectives & Quality Measures

Meaningful Use
  - Eligible Professionals
  - Eligible Hospitals

Quality Measures
  - Menu (38)
  - Alt Core (3)
  - Core (3)

Objectives
  - Core (15)
  - Menu (10)

Objectives
  - Core (15)
  - Menu (10)

Quality Measures
  - Core (15)
EP/EH; ‘Core’ Objectives; Summary

**Functional Requirements**
1. Computerized Physician Order Entry (CPOE)
2. Drug-drug, Drug-Allergy Checking
3. Generate and Transmit Electronic Prescriptions (eRX); *EP only*
4. Maintain up-to-date Problem/Diagnosis List
5. Maintain Active Medication List
6. Maintain Active Medication Allergy List
7. Record Vital Signs
8. Record Demographics
9. Record Smoking Status
10. Report Quality Measures to CMS and the States
11. Implement Clinical Decision Support

**Health Information Exchange (HIE) Requirements**
12. Provide Patients with Clinical Summary of Office Visits
13. Provide Patient with Electronic Copies of Health Information
14. Implement Capability to Exchange Key Clinical Information

**HITECH Privacy And Security**
15. Implement Systems to Protect Patient Data
Michigan Health Information Network (MiHIN)
Conceptual Architecture

Architecture funded by State HIE Cooperative Agreement
Initial Michigan Sub-State HIE Regions
### Meaningful Use Eligible Professional Objective Measures

#### Summary by Measure

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<tr>
<td>5% or more above threshold</td>
<td>51%</td>
<td>31%</td>
<td>54%</td>
<td>91%</td>
<td>91%</td>
<td>89%</td>
<td>82%</td>
<td>81%</td>
<td>100%</td>
<td>58%</td>
<td>97%</td>
<td>0%</td>
<td>42%</td>
<td>34%</td>
<td>32%</td>
<td>68%</td>
</tr>
<tr>
<td>Less than 5% above threshold</td>
<td>49%</td>
<td>5%</td>
<td>46%</td>
<td>1%</td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>2%</td>
<td>6%</td>
<td>5%</td>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td>At or below threshold</td>
<td>0%</td>
<td>64%</td>
<td>1%</td>
<td>8%</td>
<td>7%</td>
<td>8%</td>
<td>8%</td>
<td>8%</td>
<td>0%</td>
<td>41%</td>
<td>2%</td>
<td>100%</td>
<td>36%</td>
<td>61%</td>
<td>63%</td>
<td>32%</td>
</tr>
<tr>
<td>% of providers with data</td>
<td>97%</td>
<td>85%</td>
<td>85%</td>
<td>88%</td>
<td>97%</td>
<td>85%</td>
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</tbody>
</table>

#### Breakdown by Provider

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>ALLEN, AMY</td>
<td>78.1%</td>
<td>25.3%</td>
<td>49.2%</td>
<td>49.0%</td>
<td>37.2%</td>
<td>41.1%</td>
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</tr>
<tr>
<td>BRADLEY, BART</td>
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<td>75.7%</td>
<td>100.0%</td>
<td>100.0%</td>
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<td>100.0%</td>
<td>88.9%</td>
<td>85.2%</td>
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<td>43.5%</td>
<td>88.9%</td>
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</tr>
<tr>
<td>CORTES, CARLOS</td>
<td>93.8%</td>
<td>56.5%</td>
<td>93.5%</td>
<td>93.1%</td>
<td>82.6%</td>
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<tr>
<td>DAVIDSON, DOLORES</td>
<td>59.7%</td>
<td>94.8%</td>
<td>78.7%</td>
<td>98.3%</td>
<td>85.2%</td>
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</tr>
<tr>
<td>EMERSON, ELLEN</td>
<td>88.9%</td>
<td>56.5%</td>
<td>73.8%</td>
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<td>85.2%</td>
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<tr>
<td>FAROOQ, FARAZ</td>
<td>40.3%</td>
<td>70.2%</td>
<td>79.1%</td>
<td>91.1%</td>
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<tr>
<td>GUPTA, GANESH</td>
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<td>66.7%</td>
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<td>85.2%</td>
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<tr>
<td>HIBBERT, HEATH</td>
<td>84.9%</td>
<td>94.7%</td>
<td>78.8%</td>
<td>95.7%</td>
<td>85.2%</td>
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<tr>
<td>IGNATIUS, IVAN</td>
<td>0.0%</td>
<td>12.5%</td>
<td>50.0%</td>
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<td>85.2%</td>
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<td>0.0%</td>
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</tr>
<tr>
<td>JIANG, JUE</td>
<td>100.0%</td>
<td>66.7%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>85.2%</td>
<td>100.0%</td>
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</tr>
<tr>
<td>KENDRICKSON, KENNETH</td>
<td>81.9%</td>
<td>92.4%</td>
<td>76.7%</td>
<td>97.6%</td>
<td>85.2%</td>
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<td>0.0%</td>
</tr>
<tr>
<td>SEEGER, MARTY</td>
<td>62.5%</td>
<td>87.5%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>85.2%</td>
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<td>0.0%</td>
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<td>0.0%</td>
</tr>
</tbody>
</table>

### Meaningful Use Eligible Professional Objective Measures - Provider Lookup

<table>
<thead>
<tr>
<th>ID</th>
<th>Type</th>
<th>Measure</th>
<th>Numerator</th>
<th>Denominator</th>
<th>Percentage</th>
<th>Passing?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Core</td>
<td>Enter orders using CPOE</td>
<td>264</td>
<td>270</td>
<td>98%</td>
<td>YES</td>
</tr>
<tr>
<td>2</td>
<td>Core</td>
<td>Maintain an active problem list</td>
<td>260</td>
<td>304</td>
<td>86%</td>
<td>YES</td>
</tr>
<tr>
<td>3</td>
<td>Core</td>
<td>E-Prescribing</td>
<td>475</td>
<td>619</td>
<td>77%</td>
<td>YES</td>
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<tr>
<td>4</td>
<td>Core</td>
<td>Maintain an active medication list</td>
<td>299</td>
<td>304</td>
<td>98%</td>
<td>YES</td>
</tr>
<tr>
<td>5</td>
<td>Core</td>
<td>Maintain an allergy list</td>
<td>301</td>
<td>304</td>
<td>99%</td>
<td>YES</td>
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<tr>
<td>6</td>
<td>Core</td>
<td>Record patient demographics</td>
<td>204</td>
<td>304</td>
<td>67%</td>
<td>YES</td>
</tr>
<tr>
<td>7</td>
<td>Core</td>
<td>Record vital symptoms</td>
<td>290</td>
<td>304</td>
<td>95%</td>
<td>YES</td>
</tr>
<tr>
<td>8</td>
<td>Core</td>
<td>Record smoking status</td>
<td>144</td>
<td>295</td>
<td>49%</td>
<td>NO</td>
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<tr>
<td>9</td>
<td>Core</td>
<td>Incorporate discrete lab-test results</td>
<td>700</td>
<td>712</td>
<td>98%</td>
<td>YES</td>
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<tr>
<td>10</td>
<td>Core</td>
<td>Send Reminders to Patients</td>
<td>0</td>
<td>196</td>
<td>0%</td>
<td>NO</td>
</tr>
<tr>
<td>11</td>
<td>Core</td>
<td>Provide an electronic copy of health information</td>
<td>33</td>
<td>0</td>
<td>0%</td>
<td>NO</td>
</tr>
<tr>
<td>12</td>
<td>Core</td>
<td>Provide patient with electronic access</td>
<td>33</td>
<td>0</td>
<td>0%</td>
<td>NO</td>
</tr>
<tr>
<td>13</td>
<td>Core</td>
<td>Provide patient with after visit summary</td>
<td>290</td>
<td>304</td>
<td>95%</td>
<td>YES</td>
</tr>
<tr>
<td>14</td>
<td>Core</td>
<td>Provide patient education resources</td>
<td>20</td>
<td>304</td>
<td>7%</td>
<td>NO</td>
</tr>
<tr>
<td>15</td>
<td>Core</td>
<td>Reconcile medications at transitions of care</td>
<td>338</td>
<td>449</td>
<td>75%</td>
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<tr>
<td>16</td>
<td>Core</td>
<td>Provide summary care record for transitions of care</td>
<td>51</td>
<td>56</td>
<td>91%</td>
<td>YES</td>
</tr>
<tr>
<td>17</td>
<td>Core</td>
<td>Provide summary care record for transitions of care</td>
<td>51</td>
<td>56</td>
<td>91%</td>
<td>YES</td>
</tr>
</tbody>
</table>
Other Major Clin IT projects

- Data Center Migration (completed)
- E-Prescribe
- Exchange Server & MS Outlook
- Coded Diagnoses
- C&W Activation & Unified Communications
- Lab System Cerner to SCC
- Radiology IS Upgrade
- CPOE System upgrade
- ICD-10 conversion; Oct, 1st, 2013
- Window’s 7 migration
- Health Information Exchange (HIE)
- Education for Clinical IT
  - Implementation
  - Advanced Training
  - Updates
The Problem; Current State Complexity
Operational Management (Historical, e.g. quality, billing, reporting etc.)

Biomedical Research

Patient Care (Electronic Health Record)

Multiple Clinical Systems

Clinical Data Repository

Administration Systems

External Organizations

Clinical Data Warehouse

Quality Reports

Comparative Effectiveness Research

Research Warehouse

Trials

- De-identification
- Consents

- Identity Management
- Vocabulary Mapping

External Organizations

Population Research

‘Omics Repository

J. G. DeWitt, 2010
The Problem: Current State Complexity

University of Michigan Hospitals and Health Centers
IT Systems Environment

Current

Key

University of Michigan Hospitals and Health Centers
Enterprise Systems FinalFebruary19.mmd

Last update: 3/18/2019 03:55
12,000 Active users

1,500 Order sets

11,000 Individual order items

>400 Active maintenance/enhancements

>150 New configuration requests/month

19 Million Orders to date
  • 500,000 orders/month
Metrics on Clinical Improvement

Turnaround Time for Stat and Now Orders

![Bar chart showing turnaround time in minutes]

- **Pre-UMCL**
- **Post-UMCL**
- **Recent (PICU)**

**Time (Minutes)**

**Minutes**

- Vertical axis: 0 to 120
- Horizontal axis: Pre-UMCL, Post-UMCL, Recent (PICU)
Reduced Med Errors

UMHS Risk Management Data
Medication Error Comparison - Multiyear
FY’06, 07, 08

Pre-Activation

Post-Activation

Mott

UH/CVC
# High Risk Medications

<table>
<thead>
<tr>
<th>Medications, Pain Management</th>
<th>Date</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>oxycodone - 5 - 15 mg solution oral every 4 hours PRN</td>
<td>11-26-2008 Routine</td>
<td>Active</td>
</tr>
<tr>
<td>Moderate-Severe Pain. Per G-Tube: May use liquid if patient is unable to swallow tablets/capsules.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>acetaminophen UH - 650 mg solution, oral oral every 6 hours</td>
<td>11-26-2008 Routine</td>
<td>Active</td>
</tr>
<tr>
<td>fentanyl patch - (Duragesic) 75 microgram/hour topicaly every 72 hours</td>
<td>11-26-2008 Routine</td>
<td>Active</td>
</tr>
<tr>
<td>Fentanyl Patch 75 mcg Documentation - &lt;Continuous&gt;</td>
<td>11-26-2008</td>
<td>Active</td>
</tr>
<tr>
<td>hydromorphone =/&gt; 50 kg or 13 yr - (Dilaudid) 0.2 - 0.5 mg IV every 3 hours PRN Pain</td>
<td>11-26-2008 Routine</td>
<td>Active</td>
</tr>
<tr>
<td>fentanyl injection UH - 25 - 50 microgram IV every 5 minutes PRN severe pain Maximum dose 200 mcg Per PACU protocol</td>
<td>12-03-2008 Routine</td>
<td>Active</td>
</tr>
</tbody>
</table>
## CDS: Novel Pain Order Sets

### Combined Measurements:
- **Height (cm):** 180.3
- **Actual Weight (kg):** 70
- **BSA:** 1.87

### Creatinine Clearance:
- **Creatinine (mg/dl):**
  - **Cockcroft-Gault (>17 yr):**
    - **Estimated:** 7
    - **Actual:** 17.4

- **Resulted:** 08-27-2009 15:15

### Opioid Tolerance
- **Opioid naive:** [ ]
- **Opioid tolerant:** [ ]

### The following analgesic orders are intended for the average patient who is NOT opioid tolerant (defined as morphine < 80 mg/day; oxycodone < 40 mg/day; hydromorphone < 20 mg/day; fentanyl < 25 mcg/hr patch; hydrocodone < 80 mg/day; codeine < 480 mg/day):

### The following analgesic orders are intended for the average patient who is opioid tolerant (defined as morphine >= 80 mg/day; oxycodone >= 40 mg/day; hydromorphone >= 20 mg/day; fentanyl >= 25 mcg/hr patch; hydrocodone >= 80 mg/day; codeine >= 480 mg/day; methadone > 2 weeks):

### Nursing

<table>
<thead>
<tr>
<th>Order</th>
<th>Frequency</th>
<th>Special Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>☑ Notify Clinician</td>
<td></td>
<td>If pain uncontrolled, contact primary service for new order or PCA order.</td>
</tr>
</tbody>
</table>

### NOTE:
Make adjustments for patient's age, size, renal/hepatic function where pharmacologically appropriate. Patients with CONTINUOUS DISCOMFORT should have SCHEDULED (not PRN) medication. If pain relief is not acceptable, move up to the next level of treatment or use PCA. Convert parenteral opioid to equianalgesic PO dose as soon as patient is able to take PO.

### Link for Adult Analgesic Guideline
- [http://www.med.umich.edu/l/pain/staff.htm](http://www.med.umich.edu/l/pain/staff.htm)

### Link for Adult IV Opioid Monitoring F&P
- [http://www.med.umich.edu/l/policies/umr7/07-01-030.html](http://www.med.umich.edu/l/policies/umr7/07-01-030.html)
## CDS: Novel Pain Order sets

### Opioid Naive Patient

**Fever / Anticipated pain - Mild/Mod.**

<table>
<thead>
<tr>
<th>Order</th>
<th>Ordering Info</th>
<th>Dose From To</th>
<th>Units</th>
<th>Route</th>
<th>Frequency</th>
<th>PRN</th>
<th>PRN Reason</th>
<th>Additional Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>acetaminophen (multi route) - UH</td>
<td></td>
<td>325-650 mg</td>
<td>PO/P</td>
<td>every 4 hours</td>
<td>Mild pain</td>
<td>Fever, first choice, may,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ibuprofen UH</td>
<td></td>
<td>400-800 mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or moderate,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ketorolac injection UH</td>
<td>30</td>
<td></td>
<td>IV</td>
<td>every 6 hours</td>
<td>Breakthrough pain,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>acetaminophen/codeine 300mg/30 mg</td>
<td>1</td>
<td>2</td>
<td>tablet, oral</td>
<td>every 4 hours</td>
<td>Mild or moderate,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hydrocodone/acetaminophen 10mg/325mg</td>
<td>1</td>
<td>2</td>
<td>tablet, PO</td>
<td>every 4 hours</td>
<td>Mild or moderate,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>oxycodone/acetaminophen 5mg/325mg</td>
<td>1</td>
<td>2</td>
<td>tablet, PO</td>
<td>every 4 hours</td>
<td>Mild or moderate,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tramadol</td>
<td>Adjust for</td>
<td>50</td>
<td>mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or moderate, Maximum 200 mg/day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>morphine IMMEDIATE release</td>
<td>15</td>
<td>30</td>
<td>mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or moderate,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HYDROMORPHINE</td>
<td>2</td>
<td>4</td>
<td>mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or moderate,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>oxycodone</td>
<td>5</td>
<td>10</td>
<td>mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or moderate,</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**1 Liquids Formulation Required - 5 item(s):**

<table>
<thead>
<tr>
<th>Order</th>
<th>Ordering Info</th>
<th>Dose From To</th>
<th>Units</th>
<th>Route</th>
<th>Frequency</th>
<th>PRN</th>
<th>PRN Reason</th>
<th>Additional Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>ibuprofen UH</td>
<td>Liquid</td>
<td>400-800 mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or moderate,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>morphine</td>
<td>Liquid</td>
<td>15-30 mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or moderate,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HYDROMORPHINE</td>
<td>Liquid</td>
<td>2-4 mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or moderate,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>oxycodone</td>
<td>Liquid</td>
<td>5-10 mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or moderate,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hydromorphone acetamin...</td>
<td>Liquid</td>
<td>5-10 ml</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or moderate,</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Fever / Anticipated pain - Mod/Severe

**Use scheduled IV ketorolac and oral opioid (IV, if NPO) together. If ketorolac not an option, use acetaminophen. If pain control not adequate, IV PCA with ketorolac IV. (or acetaminophen) is preferred, particularly for opioid tolerant patients.**

<table>
<thead>
<tr>
<th>Order</th>
<th>Ordering Info</th>
<th>Dose From To</th>
<th>Units</th>
<th>Route</th>
<th>Frequency</th>
<th>PRN</th>
<th>PRN Reason</th>
<th>Additional Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>acetaminophen (multi route) - UH</td>
<td></td>
<td>325-650 mg</td>
<td>PO/P</td>
<td>every 4 hours</td>
<td>Mild or severe, Fever, first choice, may,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ibuprofen UH</td>
<td></td>
<td>400-800 mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or severe,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ketorolac injection UH</td>
<td>30</td>
<td></td>
<td>IV</td>
<td>every 6 hours</td>
<td>Breakthrough pain,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>morphine IMMEDIATE release</td>
<td>15</td>
<td>30</td>
<td>mg</td>
<td>oral</td>
<td>every 3 hours</td>
<td>Severe pain, Repeat,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HYDROMORPHINE</td>
<td>4</td>
<td>10</td>
<td>mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Severe pain, Repeat,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>oxycodone</td>
<td>10</td>
<td></td>
<td>mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Severe pain, Repeat,</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**1 NPO - 2 item(s):**

<table>
<thead>
<tr>
<th>Order</th>
<th>Ordering Info</th>
<th>Dose From To</th>
<th>Units</th>
<th>Route</th>
<th>Frequency</th>
<th>PRN</th>
<th>PRN Reason</th>
<th>Additional Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>morphine injection UH</td>
<td>2</td>
<td>mg</td>
<td>IV</td>
<td>every 2 hours</td>
<td></td>
<td>Severe pain, Repeat,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HYDROMORPHINE</td>
<td>0.3</td>
<td>mg</td>
<td>IV</td>
<td>every 2 hours</td>
<td></td>
<td>Severe pain, Repeat,</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**1 Liquids Formulation Required - 4 item(s):**

<table>
<thead>
<tr>
<th>Order</th>
<th>Ordering Info</th>
<th>Dose From To</th>
<th>Units</th>
<th>Route</th>
<th>Frequency</th>
<th>PRN</th>
<th>PRN Reason</th>
<th>Additional Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>ibuprofen UH</td>
<td>Liquid</td>
<td>600 mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or severe,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>morphine</td>
<td>Liquid</td>
<td>15</td>
<td>mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or severe,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HYDROMORPHINE</td>
<td>Liquid</td>
<td>4 mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or severe,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>oxycodone</td>
<td>Liquid</td>
<td>10</td>
<td>mg</td>
<td>oral</td>
<td>every 6 hours</td>
<td>Mild or severe,</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
VTE Assessments; Alerts & ‘Alert Fatigue’

UM-CareLink VTE Assessment Orders vs Reminder Alert

UMHS Policy in place re VTE Assessment

VTE Reminder Assessment Alert in Production on 10/22/2008
Workflow, then Tech, then... The Stick

UM-CareLink VTE Assessments vs Reminder Alert

![Graph showing VTE assessments and reminder alerts over time]

**VTE 'set-within-set' and hard-stop on order set placed in production on June 24th**

**August results extrapolated through 8/31**
The Electronic Age is Upon Us

84 Years
Organizational characteristics of the austere intensive care unit:
The evolution of military trauma and critical care medicine;
applications for civilian medical care systems

LTC Kurt W. Grathwohl, MD, FS, FCCP; LTC (Ret) Steven G. Venticinque, MD

<table>
<thead>
<tr>
<th></th>
<th>No Intensivist</th>
<th>Intensivist Consult</th>
<th>IDT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU LOS (Days)</td>
<td>9</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>% Mortality</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unadjusted All Cause ICU Mortality and LOS

ICU LOS

ICU Mortality

U.S. Army
When You Leave the Room, We'll Still Be There.
SPECIFICITY IMPROVEMENT FOR NETWORK DISTRIBUTED PHYSIOLOGIC ALARMS BASED ON A SIMPLE DETERMINISTIC REACTIVE INTELLIGENT AGENT IN THE CRITICAL CARE ENVIRONMENT

James M. Blum, MD¹, Grant H. Kruger, DTech², Kathryn L. Sanders, BSE ME, MSE BME², Jorge Gutierrez, BS³ and Andrew L. Rosenberg, MD¹

Blum JM, Kruger GH, Sanders KL, Gutierrez J, Rosenberg AL. Specificity improvement for network distributed physiologic alarms based on a simple deterministic reactive intelligent agent in the critical care environment.

UMHS Data Architecture Future State: Unifying the Three Missions--Education, Research, & Patient Care

Common Identifier Services (Patient, Provider, Research, Specimens, External Mappings)

Vocabulary & Terminology Mapping Services (ICD-9/10 SNOMED, IMO, caDSR, ...)

Messaging Bus, ETL & External Collaboration Services (SOA, caGRID, SHRINE, ...)

HIPAA/IRB Services (Honest Broker, De-ID Consent Management, ...)

Education
- Admissions
- Comprehensive Clinical Assessment Exam
- Clinical Scheduling
- Curriculum Evaluation System
- CTools/Sakai 3
- M-Pathways
- Others...

Research Administration Systems
- Research Pre, Post- Award
- Research Core Facilities/‘Omics’
- Next-Gen Sequencing
- Bioinformatics
- Proteomics
- Metabolomics
- Tissue Biorepositories
- ULAM

Research Data Management Systems
- Research Data Warehouse
- SPORES
- i2b2

Quality Metrics Reporting & Peer Review
- Populations
- Individuals
- Diseases
- Demographics
- Others...

Patient Care Systems
- Legacy +
- Epic EHR
- Epic Clarity
- CareLink/ Eclipsys
- Pharmacy
- Pathology
- Radiology
- Centricity Documentation
- Ambulatory
- Emergency Med.
- Revenue Cycle
- Scheduling
- Others...

IT Security
- IT Security
- • Reporting
- • Visualization
- • Analysis &
- • Data Mining

Health Sciences Library Resources
- NIH-Specific & External Data Resources (PubMed, GenBank, KEGG, GO, etc.)

Bioinformatics and Systems Biology Workbenches

High Performance Cloud Computing & Data Storage

Data Sharing with External Collaborators
- caBIG TCGA
- i2b2/SHRINE
- CTSA

International
- Industry: Pharma/Biotech
- Portals/Providers/Payers/P. Health Databases/HIE/NHIN

Brian Athey
& ECRIT 11/11/11