Exploiting Health IT to Improve Health
(case studies from the MetroHealth Davies award)

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DISCLAIMER: The views and opinions expressed in this presentation are those of the author and do not necessarily represent official policy or position of HIMSS.
Conflict of Interest

David Kaelber, MD, PhD, MPH

Consulting Fees:
UpToDate North America Advisory Board

Other:
CareSource Board of Directors
Agenda

• Background

• Case Discussions
  – HIV/Hepatitis C
  – Diabetes
  – Acinetobacter/MDRO
  – Other Cases

• Discussion
Learning Objectives

• Summarize areas where health information technology can improve care

• Analyze different types of health IT interventions and they way in which they can improve care

• Identify one new area in your own healthcare system where health information technology can be used to improve care
MetroHealth and Epic

System Overview
- 1 tertiary care academic hospital
- 21 outpatient facilities
- 300+ resident/fellow physicians
- 500 staff physicians
- 1,200 nurses
- 30,000 inpatient stays/year
- 100,000 ED visits/year
- 1,000,000 outpatient visits/yr
- Affiliated with CWRU
- Cleveland’s public healthcare system

Total EHR data
- 1.1 million patients
- 15 million visits
- 120 million labs/pathology
- 750,000 imaging studies
- 10 years of data in Epic

- 1999 - Ambulatory EHR (EpicCare w/ Cadence, Prelude, & Resolute)
- 2004 - EHR in ED (ASAP)
- 2009 - Inpatient EHR (Epic w/ Inpatient Willow and Beacon)
- 2011 - CareEverywhere, e-Rx, MyChart, Nurse Triage
- 2012 - Epic Enterprise Contract, MU Stage 1
- 2013 - BCMA, EpicCare Link, Welcome
- 2014 - ADT, Beaker, Bedtime, OpTime, Research, SBO
- 2015 - Epic 2014, Kaleidoscope (3/7/15)

1st public healthcare system in US to install Epic in the outpatient setting (1999)!!!
1st public healthcare system in US with Epic to achieve HIMSS Stage 7 EMRAM Ambulatory & Hospital recognition (2014)!!!
HIT-enabled External Recognition

- **Underdiagnosis of Hypertension in Children and Adolescents**
  (2007 – American Health Association top 10 cardiac research advances)

- **Electronic Medical Record Assisted Design of a Cluster-Randomized Trail to Improve Diabetes Care**
  (2008 – Cluster randomized for informatics research recognized by the American Medical Informatics Association (AMIA) as one of the top 10 informatics advances)

- Electronic disease reporting for public health
  (2009 – 2nd site to implement Electronic Support for Public Health (ESP) software)

- **Electronic Health Records and Quality of Diabetes Care**
  (2011 – one of the AMIA top 10 informatics advances)

- **Advanced Clinical Decision Support for Vaccine Adverse Event Detection and Reporting**
  (2011 – 1st site in the US to automate detection and reporting of vaccine adverse events to the CDC)

- Using the EHR to combat *Acinetobacter*
  (2011 – Association of Medical Directors of Information Services (AMDIS) award)

- **Stepping Stones of Pediatric Hypertension: Advanced Decision Support Helps Identify High Blood Pressures**

**Over 30 vendor presentations**
**Over 75 peer-reviewed abstracts/publications**
**Over a dozen external research grants**
**More Epic “clinical programs” then any other Epic customer**
Case #1 - HIV/Hepatitis C

Opportunity Statement

How can the electronic health record be used to increase evidence based screening of infectious diseases of “high prevalence” among the population MetroHealth served.

Special thanks to Dr. Ann Avery, Dr. Peter Greco, and Dr. Melissa Osborn
HIV/Hepatitis C Reminders

Alerts in EHR to providers

Alerts in PHR to patients
HIV Results

<table>
<thead>
<tr>
<th>HIV</th>
<th>Pre-Intervention</th>
<th>Post-Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Tests</td>
<td>10,350</td>
<td>34,628</td>
</tr>
<tr>
<td>Tests per month</td>
<td>172.5</td>
<td>577.1</td>
</tr>
<tr>
<td>Total positive tests</td>
<td>79</td>
<td>88</td>
</tr>
<tr>
<td>Positive tests per month</td>
<td>1.3</td>
<td>1.5</td>
</tr>
<tr>
<td>Proportion of tests positive for HIV</td>
<td>0.8</td>
<td>0.3</td>
</tr>
</tbody>
</table>
## Hepatitis C Results

<table>
<thead>
<tr>
<th></th>
<th>Pre-Intervention</th>
<th>Post-Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Tests</strong></td>
<td>5,066</td>
<td>19,833</td>
</tr>
<tr>
<td><strong>Tests per month</strong></td>
<td>32.5</td>
<td>826.4</td>
</tr>
<tr>
<td><strong>Total positive tests</strong></td>
<td>776</td>
<td>790</td>
</tr>
<tr>
<td><strong>Positive tests per month</strong></td>
<td>5.0</td>
<td>32.9</td>
</tr>
<tr>
<td><strong>Proportion of tests positive for HCV</strong></td>
<td>15.3%</td>
<td>4.0%</td>
</tr>
</tbody>
</table>
HIV Financial ROI

225% increase in screening for HIV
11% increase in positive HIV tests
50% decrease in proportion of positive HIV

~2-3 new HIV cases (FROM SCREENING) being diagnosed per year

Early HIV diagnosis (we have seen increase in CD4 count in newly diagnosed patients) can:
- Save $75,000 in healthcare costs for the person diagnosed
- Decrease horizontal and vertical transmission which can save up to $400,000 lifetime costs per HIV case.

$75,000 X 2 = $150,000 in potential healthcare savings annually
~$10 cost per test X ~7,000 pt/year = ~$70,000/year in additional costs
(estimated initial costs of EHR/technology implementation - ~$10,000)
(estimated annual ongoing costs of EHR/technology implementation - ~$1,000)


2500% increase in screening for Hepatitis C

560% increase in positive Hepatitis C tests

60% decrease in proportion of positive Hepatitis C tests

~335 new HCV cases being diagnosed per year

Diagnosing someone with Hepatitis C at Stage 1 of liver cirrhosis instead of Stage 3 liver cirrhosis can save up to $10,000 of lifetime expenses

$10,000 X ~335 = ~$3,350,000 in potential healthcare savings annually

$92 cost per screening test X 7,383 pt/yr = ~$679,282

$504 cost per confirmation test X 335 pt/yr= ~$168,840

Total healthcare costs for screening = ~$848,122/yr

(estimated initial costs of EHR/technology implementation - $10,000)

(estimated annual ongoing costs of EHR/technology implementation - $1,000)
Opportunity Statement

How can the electronic health record be used to increase evidence based processes and long-terms outcomes for chronic diseases (in this case diabetes) among the population MetroHealth served (over almost a decade)

Special thanks to Dr. Randy Cebul and Dr. Peter Greco
Diabetes

BestPractice Alerts (View Only)

Consider prescribing ACE inhibitor or ARB (Microalbumin 30 or higher)

(Last MICROALB=34 on 3/3/2005)
(Last CR=1.3 on 7/31/2001)
(Last K=4.3 on 5/8/2001)

BestPractice Advisories

Lipid profile is recommended yearly
Last LDL=92 mg/dL on 8/29/2014
Prev LDL=59 mg/dL on 8/25/2013
Prev LDL=70 mg/dL on 5/29/2013

HbA1c is recommended every 6 months
Last HBA1C=12.1 % on 12/31/2014
Prev HBA1C=9.3 % on 8/29/2014
### Diabetes

#### How are My Diabetic Patients Doing? (PCP=

<table>
<thead>
<tr>
<th></th>
<th># of DM Patients</th>
<th>Female %</th>
<th>Age mean (range)</th>
<th>Race % Caucasian</th>
<th>A1c mean (range)</th>
<th>LDL mean (range)</th>
<th>BP mean (range)</th>
<th>BMI mean (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MY Diabetic Patients</td>
<td>101</td>
<td>45</td>
<td>60 (32-69)</td>
<td>61</td>
<td>7.1 (5-11)</td>
<td>114 (27-244)</td>
<td>135 (60-199)</td>
<td>34 (20-73)</td>
</tr>
<tr>
<td>All MHS Adult Diabetics</td>
<td>6211</td>
<td>63</td>
<td>69 (19-97)</td>
<td>39</td>
<td>7.5 (4-18)</td>
<td>115 (4-391)</td>
<td>136 (66-258)</td>
<td>33 (13-81)</td>
</tr>
</tbody>
</table>

#### Percent of Diabetics Meeting ADA Criteria

- A1c <= 7.0
- LDL <= 100.0
- Non-Smoker
- Proteinuria & on ACE/ARB
- Eye Visit Within 1 Year
- Systolic BP <= 130
Diabetes

HIMSS 2016
Diabetes Care

Diabetes care measures:
- diabetic eye exam performed (EYEEX)
- pneumococcal vaccination (PNEUMO)
- Monitoring/treating kidney impairment with ACE inhibitors or ARBs (NEPHRO)
- A1c performed (A1CDONE)

Interventions:
1-updated BPAs, 2 – comparative reports (initial), 3 – diabetic patient care plans (letters), 4 – discrete documentation for eye and foot exams, 5 – comparative reports w/ financial incentive, 6 – updated diabetic patient care plans (goals, barriers, and interventions functionality), 7 – Synopsys reports, 8 – updated provider level diabetic patient lists
Diabetes outcome measures:
- not smoking (NONSMOKING)
- body mass index <30 (BMILT30)
- achieving optimal glycemic control (HbA1c <8%) (A1CLT8)
- blood pressure <140/90mmHg (BPLT14090)
- LDL<100 or on statin (LDLLT100STAT)

Interventions:
1-updated BPAs, 2 – comparative reports (initial), 3 – diabetic patient care plans (letters), 4 – discrete documentation for eye and foot exams, 5 – comparative reports w/ financial incentive, 6 – updated diabetic patient care plans (goals, barriers, and interventions functionality), 7 – Synopsys reports, 8 – updated provider level diabetic patient lists
Diabetes in Cleveland area
(www.betterhealthpartnership.org)

~8% of diabetics (881 patients) had overall improved care

A1C, lipids, and blood pressure control program saves 7-10% of healthcare expenses for diabetic patients
(~$75-$100 per patient per month; ~$900-$1200 per patient per year)

$1020 \times 881 = \sim$900,000 in healthcare savings annually
(estimated initial costs of EHR/technology implementation - ~$250,000)
(estimated annual ongoing costs of EHR/technology implementation - ~$25,000)

Changes in Hospitalizations for ACSC in Cuy. Co. DM, HF, & HBP

-4.7%

-9.6%

+3.9%
AVERTED: **2,200 HOSPITALIZATIONS**  **$15.4 MILLION IN COSTS**

**Averted Hospitalizations Increased Each Year**

<table>
<thead>
<tr>
<th>Year</th>
<th># of Hospitalizations Averted</th>
<th>Cost Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>532 ($3.5M)</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>830 ($5.7M)</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>848 ($6.3M)</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,210 ($15.4M)</strong></td>
<td></td>
</tr>
</tbody>
</table>

Academy Health, 2013
Diabetes Financial ROI

17 amputations averted!!!!!!

BETTER CARE -> BETTER HEALTH -> LOWER COSTS
Case #3 – Acinetobacter/MDRO

“We are having an outbreak of multi-drug resistant Acinetobacter. This is an emergency. **You** have to fix this as soon as possible.”

-Director of Infection Control
(call to CMIO cell phone)
Opportunity Statement

How can the electronic health record be used to assist in an overall MetroHealth System response to Acinetobacter specifically and multi-drug resistant organisms generally.

Special thanks to Matt Kaufman and Jen Conti
MDRO in Patient Header

Patient Information:
- Name: Bill L. Mtest Jr.
- Age: 54 y.o. (10/6/1956)
- Allergies: Penicillin V, Unable to Verify, Codeine Phosphate, Cefaclor, Oxycodone, Ultram (Tramadol)
- Problems: Anemia B Twelve Deficiency, MDRO (multiple drug resistant organisms) resistance

Allergies:
- Penicillin V: Anaphylactic Shock
- Codeine Phosphate
- Cefaclor
- Oxycodone
- Ultram (Tramadol)
- Penicillin G Ammonium

Medications:
- Hospital Medications
- Phenylephrine (NEO-SYNEPHRINE) infusion
- Vecuronium infusion
- Diltiazem (CARDIZEM) iv infusion
- Sodium Chloride 0.9% iv BOLUS
- Heparin (porcine) 25,000 units in D5W 500 mL infusion
- Milrinone (PRIMACOR) iv infusion
- Norepinephrine (LEVOPHED) iv infusion
- Sodium Chloride 0.9% iv BOLUS
MDRO in Patient Name Hyperlink

**Special Reports**

**PROBLEM LIST ITEMS OF NOTE**

- **Code**: V09.91E
- **Description**: MDRO (multiple drug resistant organisms) resistance, MRSA, ESBL, E. coli

**ADVANCE DIRECTIVE SCAN**

- 06/10/10 12:00 AM: Healthcare Power of Attorney [100010]
- 06/10/10 12:00 AM: Living Will [100009]
- 06/10/10 12:00 AM: DNR [100008]
- 06/10/10 12:00 AM: Healthcare Power of Attorney [100010]

**Resistant Organisms (past 365 days)**

<table>
<thead>
<tr>
<th>Organism</th>
<th>Specimen Taken</th>
<th>Culture Type</th>
<th>Site</th>
<th>order #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus aureus: This organism exhibits Methicillin Resistance.</td>
<td>Sun Mar 13, 2011 12:31 AM</td>
<td>MRSA SREGION</td>
<td>Wound</td>
<td>68478265</td>
</tr>
<tr>
<td>Staphylococcus aureus: This organism exhibits Methicillin Resistance.</td>
<td>Wed Mar 9, 2011 2:21 AM</td>
<td>MRSA SREGION</td>
<td>Wound</td>
<td>68478279</td>
</tr>
<tr>
<td>Staphylococcus aureus: This organism exhibits Methicillin Resistance.</td>
<td>Sat Mar 5, 2011 1:56 PM</td>
<td>PYOGEN CULTURE, MSC</td>
<td>Wound</td>
<td>68478267</td>
</tr>
<tr>
<td>Escherichia coli: This organism exhibits an unusual resistance to beta-lactam antibiotics</td>
<td>Tue Feb 15, 2011 5:40 PM</td>
<td>PYOGEN CULTURE, MSC</td>
<td>Wound</td>
<td>68185101</td>
</tr>
</tbody>
</table>
MDRO Clinical Decision Support

![Best Practice Alert - Dorner, Christy]

This patient has an active MDRO on their problem list. Order Contact Precautions. In addition, order Droplet Precautions if the patient has an MDRO in their respiratory secretions.

- Open order Contact Precautions
- Open order Droplet Precautions

![Isolation / Precaution Orders]

<table>
<thead>
<tr>
<th>Start</th>
<th>Order</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/04/11 2345</td>
<td><strong>Contact Precautions</strong> CONTINUOUS</td>
<td>Ordered 04/04/11 2333</td>
</tr>
<tr>
<td></td>
<td>Authorizing Provider: Test Provider</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Order Set: --</td>
<td></td>
</tr>
<tr>
<td></td>
<td>References: Environmental Contact Precautions - Signage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guidelines for the Care of Patients with Clostridium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UMSH - Guidelines for Care of Patients with VRE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Question: Reason for Isolation/Precaution Answer: MDRO</td>
<td></td>
</tr>
</tbody>
</table>

| 04/04/11 2345  | **Droplet Precautions** CONTINUOUS |             |
|                | Authorizing Provider: Test Provider |             |
|                | Order Set: -- |             |
|                | References: Droplet Precaution - Signage |             |
|                | Question: Reason for Isolation/Precaution Answer: MDRO |             |
MDRO Notification to Other Staff

[Image of a computer screenshot showing a patient information system with relevant fields filled out.]

**Situation**

**Admission Information**
- Admission Date/Time: 04/16/09 10:02
- Discharge Date/Time: 06/30/02

**Isolation**
- Airborne
- Contact
- Droplet

**PERIOPERATIVE SERVICES Department (All Providers)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Patient</th>
<th>MDRO?</th>
<th>MRN</th>
<th>Age</th>
<th>Sex</th>
<th>Type</th>
<th>EC Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 AM</td>
<td>No</td>
<td></td>
<td></td>
<td>83 year old</td>
<td>F</td>
<td>PROCEDURAL</td>
<td>Closed: Exam-Rm</td>
</tr>
<tr>
<td>10:00 AM</td>
<td>No</td>
<td></td>
<td></td>
<td>77 year old</td>
<td>M</td>
<td>PROCEDURAL</td>
<td>No Show</td>
</tr>
<tr>
<td>10:00 AM</td>
<td>No</td>
<td></td>
<td></td>
<td>34 year old</td>
<td>F</td>
<td>PROCEDURAL</td>
<td>Comp</td>
</tr>
<tr>
<td>10:00 AM</td>
<td>No</td>
<td></td>
<td></td>
<td>45 year old</td>
<td>F</td>
<td>PROCEDURAL</td>
<td>Closed: Comp</td>
</tr>
<tr>
<td>10:00 AM</td>
<td>Yes</td>
<td></td>
<td></td>
<td>68 year old</td>
<td>M</td>
<td>PROCEDURAL</td>
<td>No Show</td>
</tr>
<tr>
<td>10:15 AM</td>
<td>No</td>
<td></td>
<td></td>
<td>44 year old</td>
<td>F</td>
<td>PROCEDURAL</td>
<td>Comp</td>
</tr>
<tr>
<td>10:30 AM</td>
<td>No</td>
<td></td>
<td></td>
<td>41 year old</td>
<td>F</td>
<td>PROCEDURAL</td>
<td>Exam-Rm</td>
</tr>
</tbody>
</table>
Acinetobacter Population Reporting

Tool for infection control staff along with:
- Daily emails
- Paging upon admission of positive patient or positive culture
Association of Medical Directors of Information Services (AMDIS) Award in 2011

1 – hyperlinked patient header, 2 – hyperlinked isolation status, 3 – MDRO SBAR report, 4 – MDRO schedule column, 5 – MDRO best practice alert, 6 – Acinetobacter/MDRO patient lists with daily emails, 7 – MDRO patient pages from ADT system to infection control staff, 8 – MRDO surveillance culture order
Hand Hygiene Compliance
Monthly Composite for 2010-2014

Summary for Hospital Acquired MDR Acinetobacter 2009-2014

2010-2011 IT interventions include: 1 – hyperlinked patient header, 2 – hyperlinked isolation status, 3 – MDRO SBAR report, 4 – MDRO schedule column, 5 – MDRO best practice alert, 6 – MDRO patient lists with daily emails, 7 – MDRO patient pages from ADT system to infection control staff, 8 – MRDO surveillance culture order. 2013-2014 IT – EVS notification
~33% decrease (12/month to 9/month) in baseline Acinetobacter cases (continuing to decrease)

$25,000 \times 36 \text{ patients} = $900,000 \text{ in healthcare savings annually}

(estimated initial costs of EHR/technology implementation - $100,000)
(estimated annual ongoing costs of EHR/technology implementation - $10,000)
<table>
<thead>
<tr>
<th>Case</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heparin (high risk medications)</td>
<td>EHR tools/processes to improve Heparin use</td>
<td>PSN heparin errors with harm from 3 in 2011 to 0</td>
</tr>
<tr>
<td>Code Status Reconciliation</td>
<td>Code status reconciliation at discharge</td>
<td>&gt;3 fold increase in non-full code code status orders</td>
</tr>
<tr>
<td>Depression Screening</td>
<td>Advanced CDS for screening and initial management</td>
<td>Increased screening by 15 fold and detection by 230%</td>
</tr>
<tr>
<td>Vaccine Adverse Event Reporting (VAERS)</td>
<td>Automated detection and reporting of VAERS to CDC</td>
<td>30 fold increase in VAERS reports</td>
</tr>
<tr>
<td>Automated Patient Clinical Messaging</td>
<td>Automated texts and calls for patient reminders</td>
<td># needed to message 4 (immunizations, labs, radiology)</td>
</tr>
<tr>
<td>Internal Referral Completion</td>
<td>Reporting and processes to increase internal referrals</td>
<td>30-day referral “completion” rate 48%-&gt;61%</td>
</tr>
<tr>
<td>Hospital Acquired Conditions (HACs)</td>
<td>EHR tools/processes to decrease CAUTIs and VAPs</td>
<td>Annually 102 infection (1 death) and $2.6 M saved</td>
</tr>
<tr>
<td>Core Measures</td>
<td>EHR tools/processes to improve CHF and ETOH measure</td>
<td>10-15% CHF measure increase</td>
</tr>
<tr>
<td>Blood Pressure (HTN) Diagnoses Research</td>
<td>EHR research/tools/processes for pediatric/adult HTN diagnosis</td>
<td>21% improved vital signs &gt;100% in diagnosis</td>
</tr>
<tr>
<td>and Improvement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Davies Award Financial Value Cases

<table>
<thead>
<tr>
<th>Case</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical Ambulatory EHR ROI</td>
<td>Cost/benefit analysis of ambulatory EHR (1999-2005)</td>
<td>Ambulatory “break-even” @ yr 5; $9.3 M direct annual benefit</td>
</tr>
<tr>
<td>Last 5 years EHR ROI</td>
<td>Cost/benefit analysis of integrated EHR (2009-2014)</td>
<td>~$20 M direct annual benefit; ROI even w/o federal incentives</td>
</tr>
</tbody>
</table>
“This Davies award enterprise application would not have been possible without the efforts of thousands of people throughout the MHS and our partners over the last two decades. These individuals (past and present) share a vision for health information technology. They have worked and continue to work together to enable the MetroHealth System to use health information technology to help achieve the MetroHealth System’s vision to “be the most admired public health system in the nation, renowned for our innovation, outcomes, service and financial strength.” We dedicate this Davies enterprise application to all the individuals who have helped make the accomplishments documented in the application possible and to our patients and community whose health we are continuously working to improve.”

- Davies Enterprise Award Dedication/Acknowledgement
Questions

• Dr. David Kaelber (dkaelber@metrohealth.org)