Health Informatics: How can information technology help improve quality?

Patricia Dykes, PhD, RN, FAAN, FACMI – Sr. Nurse Scientist, Brigham and Women's Hospital
Doug Fridsma, MD PhD FACMI FACP - President and CEO, AMIA

Session Code
This presenters has nothing to disclose

Sunday, December 5
1 - 4:30 PM

#IHI27FORUM

Presenters

Doug Fridsma

Doug Fridsma, MD, PhD, FACP, FACMI, is the President and Chief Executive Officer of AMIA, a membership society representing 5000 professional and student informaticians and their interests and activities in academe, industry, government and nonprofit organizations. Prior to joining AMIA, Dr. Fridsma was the Chief Science Officer for the Office of the National Coordinating for Health Information Technology, responsible for the portfolio of technical resources needed to support the meaningful use program and health information technology interoperability. He was engaged in key initiatives involving the Federal Health Architecture, the Patient Centered Outcomes Research Trust Fund (PCOR-TF) and the Standards and Implementation Framework.

Patricia Dykes PhD, RN, FAAN, FACMI

Patricia Dykes is Senior Nurse Scientist and Program Director for Research in the Center for Patient Safety Research and Practice and the Center for Nursing Excellence at Brigham and Women's Hospital. Dykes' program of research relates to the use of technology to promote communication, care coordination, and patient safety. She has published and presented widely on these topics. Dykes is past Chair of American Medical Informatics Association (AMIA) Nursing Informatics Working Group and a member of AMIA Board of Directors. She is an elected fellow of the American Academy of Nursing and the American College of Medical Informatics.
Session Objectives

- Define scientific concepts, core principles and purposes, and application areas of biomedical and health informatics
- Illustrate the links between informatics and patient safety
- Describe the uses of precision medicine and big data to tailor interventions and treatments for patients
- Develop a plan for leveraging informatics to improve core quality and safety processes at your organization while contributing to a learning healthcare system (interactive exercise)

What is Health Informatics?

- Define scientific concepts, core principles and purposes, and application areas of biomedical and health informatics.
WHAT IS HEALTH INFORMATICS?

Describing Biomedical and Health Informatics

Source: Joseph W. Hales, PhD Christopher Cimino, MD,
Describing Biomedical and Health Informatics

Source: Joseph W. Hales, PhD Christopher Cimino, MD,

Describing Health Informatics

Source: Joseph W. Hales, PhD Christopher Cimino, MD,
Biomedical Informatics

Basic research

Biomedical informatics methods, techniques, and theories

Applied research

Bioinformatics
Imaging Informatics
Clinical Informatics
Public health Informatics

Molecular and cellular processes
Tissues and organs
Individuals (patients)
Populations and society

Source: Joseph W. Hales, PhD Christopher Cimino, MD,

INFORMATICS AND QUALITY IMPROVEMENT: IT ISN’T JUST WHAT WE KNOW. IT’S WHAT WE DO.
The Learning Healthcare System

- Draw research closer to clinical practice
- Build knowledge development and application into healthcare delivery
- Improve today’s care
- Address the growing demands in the future


The Learning Healthcare System: Why Now?

Quality – persistent shortfalls

- Patient harm – One-fifth to one-third of hospital patients are harmed during their stay, largely preventable.

- Recommended care – Only about half of the recommended preventive, acute, and chronic care is actually received.

- Outcome shortfalls – If all states matched care quality in the highest-performing states, 75,000 fewer deaths would have occurred in 2005.

From Best Care at Lower Cost: The Path to Continuously Learning Health Care in America, IOM, 2012
The Result?

The U.S. health care system today

The Learning Healthcare System: The Vision

From Best Care at Lower Cost: The Path to Continuously Learning Health Care in America, IOM, 2012
Adopt best practices already in use in other industries to achieve healthcare system goals.

**Healthcare system goal:** Clinicians and patients should have real-time access to medical record and use technology to streamline administrative tasks.

**Best practice:** Use information technology more efficiently.
The Promise of Health IT

- The Health Information Technology for Economic and Clinical Health (HITECH) Act:
  - Provides $30 billion in Medicare and Medicaid incentive payments
  - For the meaningful use of health information technology by clinicians and hospitals,
  - Estimated to yield savings of $93 billion between 2011 and 2019.

Meaningful Use as a Building Block

- Utilize technology
- Access to information

Enhanced access and continuity
Data to improve delivery and outcomes
Patient self management
Patient engaged, community resources
Patient centered care coordination
Team based care, case management
Registries to manage patient populations
Privacy & security protections

Improved population health
Data utilized to improve delivery and outcomes
Evidence based medicine
Registries for disease management
Privacy & security protections

Basic EHR functionality, structured data
Privacy & security protections

Care coordination
Privacy & security protections

Structured data utilized
Privacy & security protections

Transform health care

The Promise of Health IT
The Promise of Health IT

Projections are for 90 percent of providers to have access to fully operational electronic health records by 2019, up from 3.4 percent in 2014.

United States EMR Adoption Model

<table>
<thead>
<tr>
<th>Stage</th>
<th>Cumulative Capabilities</th>
<th>2009</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 7</td>
<td>Complete EMR; CCD tran</td>
<td>17.8%</td>
<td>63.9%</td>
</tr>
<tr>
<td>Stage 6</td>
<td>Data warehousing; Data exchange; ED, OP</td>
<td>60.4%</td>
<td>66.9%</td>
</tr>
<tr>
<td>Stage 5</td>
<td>Physician documentation (structured templates), full CDSS (variance &amp; compliance), full PACS</td>
<td>2.80%</td>
<td>16.50%</td>
</tr>
<tr>
<td>Stage 4</td>
<td>Closed loop medication administration</td>
<td>3.70%</td>
<td>29.50%</td>
</tr>
<tr>
<td>Stage 3</td>
<td>CPOE, Clinical Decision Support (clinical protocols)</td>
<td>10.30%</td>
<td>14.50%</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Nursing/clinical documentation (flow sheets), CDSS (error checking), PACS available outside Radiology</td>
<td>49.70%</td>
<td>23.90%</td>
</tr>
<tr>
<td>Stage 1</td>
<td>CDR, Controlled Medical Language, may have Document Imaging; HIE capable</td>
<td>36.1%</td>
<td>8.70%</td>
</tr>
<tr>
<td>Stage 0</td>
<td>Ancillaries - Lab, Rad, Pharmacy - All Installed</td>
<td>6.70%</td>
<td>2.50%</td>
</tr>
<tr>
<td>Total Hospital 5,233</td>
<td>All Three Ancillaries Not Installed</td>
<td>10.5%</td>
<td>4.40%</td>
</tr>
</tbody>
</table>

Secure Clinical Communication And Notification of Results

Automatic Reminders

Summary Flowsheets

Intuitive Chart Summary

Coded Clinical Data

Customizable Desktop
The Learning Healthcare System: The Path

- **Healthcare system goal:** Create systems to manage complexity
- **Best practice:** Prompts, technologies, and delivery systems should help clinicians manage the growing complexity of medical knowledge and care required.

The Promise of Health IT

- **BWH MICU Patient Safety Checklist**

From *Best Care at Lower Cost: The Path to Continuously Learning Health Care in America*, IOM, 2012
The Promise of Health IT

- BWH MICU Patient Dashboard: Touch-screen device on unit allows clinicians to quickly identify actionable safety risks

The Promise of Health IT

- Patient-Level Dashboard: Data from Safety Checklist and EHR used to describe high-risk states alerted in unit-level dashboard
The Learning Healthcare System: The Path

- **Healthcare system goal:** Make healthcare safer
- **Best practice:** Hospitals and providers should constantly assess performance and learn from experience to reduce errors and harm.

**IN HEALTH CARE...**

1/3 of hospitalized patients are harmed during their stay.

**IN OTHER INDUSTRIES...**

1/5 of Medicare patients are re-hospitalized within 30 days.

**THE AVIATION INDUSTRY**

learns from past performance and adjusts operations to ensure safe flights.

From Best Care at Lower Cost: The Path to Continuously Learning Health Care in America, IOM, 2012

---

The Promise of Health IT

- **BWH MICU Safety Checklist Reporting Tool**
Impact on Process Efficiency

- Massachusetts General Hospital Site: Revere
- Measure:
  - Time for a diabetes nurse manager to identify whether a reminder letter should be sent

<table>
<thead>
<tr>
<th></th>
<th>Without RPM</th>
<th>With RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process rate (patients/h)</td>
<td>10-30</td>
<td>300</td>
</tr>
<tr>
<td>Total number of patients reviewed</td>
<td>200</td>
<td>73</td>
</tr>
<tr>
<td>Total time to complete task</td>
<td>1.5 months for 2 nurses working 0.5 days per week</td>
<td>15 min with 1 nurse</td>
</tr>
</tbody>
</table>
The Promise of Health IT

- Public reporting

![Hospital Compare](image)

The Official U.S. Government Site for Medicare

**Healthcare system goal:** Improve transparency

**Best practice:** Patients and clinicians should have easy access to the prices of tests and procedures and to reliable information about care outcomes and quality.

The Learning Healthcare System: The Path

- **Healthcare system goal:** Improve transparency
- **Best practice:** Patients and clinicians should have easy access to the prices of tests and procedures and to reliable information about care outcomes and quality.

From Best Care at Lower Cost: The Path to Continuously Learning Health Care in America, IOM, 2012
The Promise of Health IT

- Clinical decision support to improve transparency and decrease cost of care
  - Provider order entry
    - Medications
      - Generic equivalent
      - Cost effective alternatives
    - Lab and radiology tests
      - Indications
      - Costs
      - Prior results
      - Probability of abnormal result
  - Consumer decision support related to costs of medical care
    - Does knowledge of costs change behavior?

The Learning Healthcare System: The Path

Healthcare system goal: Promote teamwork and communication.

Best practice: Clinicians and hospital staff should communicate to provide seamless, coordinated care within and across different settings.

From Best Care at Lower Cost: The Path to Continuously Learning Health Care in America, IOM, 2012
Promise of Health IT and Team Care

- Dramatic progress has been made in identifying patient safe practices.
- These five practices alone have been shown to significantly reduce medication errors and adverse outcomes at a minimum of cost.

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provider order entry</td>
<td>81% decrease in medication errors</td>
</tr>
<tr>
<td>Pharmacist Rounding</td>
<td>78% reduction in preventable ADE’s</td>
</tr>
<tr>
<td>Rapid response teams</td>
<td>15% decrease in cardiac arrests</td>
</tr>
<tr>
<td>Team training in labor and delivery</td>
<td>50% reduction in adverse outcomes</td>
</tr>
<tr>
<td>Reconciling medications upon hospital discharge</td>
<td>90% decrease in medication errors</td>
</tr>
</tbody>
</table>


The Learning Healthcare System: The Path

- **Healthcare system goal:** Partner with patients
- **Best practice:** Clinicians should fully incorporate the needs and preferences of patients into care decisions.

In Health Care...

- LESS THAN HALF of patients receive clear information on the benefits and trade-offs of treatments for their conditions.
- ALMOST HALF of patients are not satisfied with their level of control in medical decision making.

In Other Industries...

- GENERAL CONTRACTORS work with customers to build homes tailored to fit their needs and meet their specifications.

From Best Care at Lower Cost: The Path to Continuously Learning Health Care in America, IOM, 2012
Promise of Health IT

- Patient portals accessed via iPad devices at the bedside.

  Patient engagement in:
  - Recovery plan
  - Medication reconciliation
  - Risk reduction
  - Discharge plan
  - Care team communication

Brigham and Women’s Hospital

Discrepancy

Details
The Learning Healthcare System: The Path

- **Healthcare system goal:** Decrease waste and increase efficiency.
- **Best practice:** Money should not be spent on unnecessary administration, inefficiencies, and care that doesn’t improve health.

The Promise of Health IT

- **Cost and Revenue Goals of Meaningful Use**
  - Increased productivity
  - Improved billing and reimbursement rates
  - Faster turnaround for accounts
  - Lower medical record costs
  - Improved revenue cycle
  - Enhanced regulatory requirement compliance

Are we there yet?
Using Health IT to Improve Team Communication, Patient Engagement, and Patient Safety

- **PROSPECT** *(Promoting Respect and Ongoing Safety through Patient-centeredness, Engagement, Communication and Technology)*
- **Fall TIPS** *(Tailoring Interventions for Patient Safety)*
BWH PROSPECT* Project

Goal: To transform the acute care environment through implementation of a patient-centered intervention

- Focus on patients and care partners

*Promoting Respect and Ongoing Safety through Patient Engagement Communication and Technology

BWH PROSPECT Project

- Cluster randomized control trial (June 2014-May 2015)
  - Medical intensive care and oncology

- Goals:
  - Optimize the overall experience of patients (and care partners) by
    - facilitating engagement
    - improving care plan concordance
    - promoting dignity and respect
    - enhancing satisfaction
  - Minimize preventable harms
    - *VAP, DVT/PE, CLABSI, CAUTI, Falls, Pressure ulcers*
  - Reduce unnecessary healthcare resource utilization and associated costs.

*VAP = Ventilator associated pneumonia; DVT = Deep vein thrombosis, PE = Pulmonary embolism, CLABSI = Central line associated blood stream infection, CAUTI = Catheter associated urinary tract infection
PROSPECT Preliminary Work

- Collaborative approach to designing and implementing a structured team communication program enabled by health information technology.
  - Focus on physicians, nurses, patients and care partners
  - Methods:
    - Interviews, workflow observations, focus groups
    - Participatory, iterative design of the communication model and a suite of shared documentation and communication tools

PROSPECT Intervention

- Patient SatisfActive® Model
  - A proactive, structured intervention that aims to improve patient experience and satisfaction in real-time

- Web-Based Patient-Centered Toolkit (PCTK)

“Patient-facing” Tools

“Provider-facing” Tools
PATIENT FACING TOOLS

Prospect

• Improve respiratory status
• Prevent skin breakdown
• Free of pain
• Adequate nutrition

Be comfortable
Get out of bed

I would like my sister to be involved in my care

Care Team Goals:
- Improve respiratory status
- Prevent skin breakdown
- Free of pain
- Adequate nutrition

My Overall Goal:
Be comfortable

My Daily Goal:
Get out of bed

My Care Team is helping me to meet my goals:

My Preferences related to my care:
I would like my sister to be involved in my care
My Care Team
My Safety Concerns

My Medications
Safety Checklist

<table>
<thead>
<tr>
<th>Item</th>
<th>Safety Screen (MD w/RN present at rounds)</th>
<th>RN Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient/Family Toolkit</strong></td>
<td>We have given the RN an opportunity to present any new patient or family input (from the Patient Satisfactory model, Toolkit, or Microblog).</td>
<td>Yes/No</td>
</tr>
<tr>
<td><strong>Vent Bundle</strong></td>
<td>Is the patient on mechanical ventilation?</td>
<td>Yes/No</td>
</tr>
<tr>
<td><strong>HOB elevation</strong></td>
<td>Indicated</td>
<td>Last documented HOB angle</td>
</tr>
<tr>
<td><strong>Spontaneous Awakening Trial</strong></td>
<td>Indicated</td>
<td>Performed this calendar day passed</td>
</tr>
<tr>
<td><strong>Spontaneous Breathing Trial</strong></td>
<td>Contraindicated: Hemodynamic instability (up titration of pressors)</td>
<td>Performed this calendar day passed</td>
</tr>
</tbody>
</table>
Multidisciplinary Plan of Care Platform

Nursing Plan of Care
Clinical Care Classification System Problems and Outcomes

Patient Plan of Care
Problems With Infobuttons
Patient Educational Content

Nursing Plan of Care Documentation

Patient and Care Partner Quotes Related To The Patient-centered Toolkit

- “It’s a really great idea. We’re always asking questions so this way we won’t have to chase anyone down”

- (In response to “My Care Team page) “These are my friends! I’ve known them for 7 years. It’s nice to see their pictures here”

- “With something like this, you know what’s going on”

- “This is great! Patients need more info about risks, safety, medications, ‘who is my doctor’ …”
PROSPECT Lessons Learned

- Clinical outcomes and patient/care partner experience improved
- More work needed re:
  - Clinical workflow integration and clinician buy-in
  - Communicating value of using technology to partner with patients and care

- Many patients want to be engaged but still challenges
  - Incapacitated, elderly, disabled, less “tech-savvy”, variably “activated” patients
  - Access to content for non-English speaking patients
  - Identifying and providing access to caregivers can address these challenges

PROSPECT Team

BWH Research Investigators
David Bates - PI
Sarah Collins - Co-Investigator /Nursing Informatics Specialist
Anuj Dalal - Co-Investigator
Jacques Donze - Co-Investigator
Patricia Dykes – Project Director/Co-Investigator
Priscilla Gazarin - Co-Investigator
Jaeho Lee – Graphical Design
Lisa Lehmann - Co-Investigator
Stuart Lipsitz - Biostatistician
Kelly McNally - Research Assistant
Conny Morrison - Research Assistant
Kumiko Ohashi - Project Manager
Ronen Rozenblum - Co-Investigator
Lipika Samal - Co-Investigator
Diana Stade - Research Assistant
Orly Tamir - Co-Investigator
Deborah Williams – Database Programmer
Cathy Yoon - Data Analyst

Clinical Leadership
- Oncology
  - Ted Alyea – Medical director
  - Eddy Chen - Medical Oncologist
  - Katie Fillipon – Nursing Director
  - Marsha Malone - Nursing Director
- MICU
  - Kathleen Leone - Nursing Director
  - Anthony Massaro - Medical Director

Technology Development and Patient Engagement Collaborators
- Frank Chang - Developer
- George Getty - Developer
- Maureen Fagan - Executive Director Center for Patients and Families
- Martie Carnie - Patient/Family Advisor
- Care Thread Inc.
Fall TIPS (Tailoring Interventions for Patient Safety)

- 2 year mixed methods study funded by Robert Wood Johnson Foundation:
  - Qualitative phase:
    - why hospitalized patients fall?
    - what interventions are effective and feasible in hospital settings?
  - Randomized control trial: to test a fall prevention toolkit designed to address issues identified during qualitative phase.

Fall TIPS Qualitative Results Summary

- Communication related to fall risk status and the plan to prevent falls is highly variable.
- Inconsistent communication across team members is a barrier to collaboration and teamwork.
  - Non-nursing team members do not view fall risk assessment/plan in medical record.
  - Inadequate, incomplete, or incorrect information at the bedside (i.e., generic “high risk for falls” signs are not useful).
- All stakeholders (care team members, patients and family members) must work together to prevent patient falls.
The Fall TIPS Toolkit Requirements

Leverage Existing Workflows

Surveillance

Tailoring

Teamwork

Communication

The Fall TIPS Toolkit: Fall Risk Assessment/Tailored Plan
There were fewer falls in intervention units than in control units.

Patients aged 65 or older benefited most from the Fall TIPS toolkit.

No significant effect was noted in fall related injuries.
Fall TIPS (Tailoring Interventions for Patient Safety)
Research Team/Funding Support

- **Investigators**
  - Patricia C. Dykes, PhD, RN
  - Diane Carroll, PhD, RN
  - Ann Hurley, DNSc
  - Stuart Lipsitz, ScD
  - Blackford Middleton, MD, MPH, MSc

- **Support/HIT Team**
  - Angela Benoit, BComm
  - Frank Chang, MSE
  - Jan Horsky PhD
  - Seth Meltzer
  - Lana Tsurikova, MSc, MA
  - Luba Zuyev, MA

**Conclusions**

- **Making care better:**
  - Will require health IT as a tool
    - Clinical decision support
    - Checklists
    - Registries
  - Will involve partnering with patients.
  - Will require high-tech and low-tech solutions
    - Team care is foundational
    - Clinician attitudes still have a ways to go
  - Will be highly multidisciplinary
    - Roles of nurses and other clinicians will change

- **Health IT is opening new doors and we need to take advantage!**
  - Need to begin to leverage social, mobile, big data, cloud
Health Informatics: How can information technology help improve quality?

BREAK

PRECISION MEDICINE
President Obama

“Tonight, I’m launching a new Precision Medicine Initiative to bring us closer to curing diseases like cancer and diabetes — and to give all of us access to the personalized information we need to keep ourselves and our families healthier.”
— President Barack Obama, State of the Union Address, January 20, 2015

- $215 M in 2016 budget
  - $130 million to NIH for 1M volunteer national research cohort

P* Medicine?

- Personalized medicine
- P4: predictive, preventive, personalized, and participatory (Hood)
- Aka stratified, genomic, individualized…
- Precision medicine
- Each a different emphasis, but fundamentally: use more data to deliver
  - the right intervention
  - for the right person
  - at the right time
What do you mean more data?

- More data types
  - Clinical
  - Molecular
  - Environmental
  - mHealth...

- More data points
  - Genomic
  - Proteomic
  - Metabolomic
  - Epigenetic...

Precision medicine is an emerging approach for disease prevention and treatment that takes into account people’s individual variations in genes, environment, and lifestyle. The Precision Medicine Initiative® will generate the scientific evidence needed to move the concept of precision medicine into clinical practice.
**WHY NOW?**

The *time is right* because of:

- Sequencing of the human genome
- Improved technologies for biomedical analysis
- New tools for using large datasets

**NEAR-TERM GOALS**

Intensify efforts to apply precision medicine to *cancer*.

- Innovative *clinical trials* of targeted drugs for adult, pediatric cancers
- Use of *combination therapies*
- Knowledge to overcome *drug resistance*
**WHY NOW?**

The time is right because of:

- Sequencing of the human genome
- Improved technologies for biomedical analysis
- New tools for using large datasets

**LONGER-TERM GOALS**

Create a research cohort of > 1 million American volunteers who will share genetic data, biological samples, and diet/lifestyle information, all linked to their electronic health records if they choose.

Pioneer a new model for doing science that emphasizes engaged participants, responsible data sharing, and privacy protection.

Research based upon the cohort data will:

- Advance pharmacogenomics, the right drug for the right patient at the right dose
- Identify new targets for treatment and prevention
- Test whether mobile devices can encourage healthy behaviors
- Lay scientific foundation for precision medicine for many diseases
Anticipated data sources for the PMI Cohort

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Example Data Provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self report measures</td>
<td>Diet, substance use, self-report of disease and symptoms (e.g., cognitive or mood assessment)</td>
</tr>
<tr>
<td>Structured clinical data (EHR)</td>
<td>ICD and CPT codes, medication history, laboratory results, vitals, encounter records</td>
</tr>
<tr>
<td>Unstructured clinical data (EHR)</td>
<td>Narrative documents, images, EKG and EEG waveform data</td>
</tr>
<tr>
<td>Biospecimens</td>
<td>Blood sample for DNA collected in CLIA fashion. Anticipate microbiome, nail and hair for environmental exposures over time.</td>
</tr>
<tr>
<td>mHealth and sensor data</td>
<td>Passively-collected data (e.g., location, movement, social connections), wearable sensor data (activity, calories expended, hours and quality of sleep, time sedentary).</td>
</tr>
<tr>
<td>Healthcare claims data</td>
<td>Billing codes as received by public and private payors, outpatient pharmacy dispensing</td>
</tr>
<tr>
<td>Geospatial and environmental data</td>
<td>Weather, air quality, environmental pollutant levels, food deserts, walkability, population density, climate change</td>
</tr>
<tr>
<td>Other data</td>
<td>Social networking e.g., Twitter feeds, over-the-counter medication purchases</td>
</tr>
</tbody>
</table>

EXAMPLE: EMERGE NETWORK
eMERGE goals

- To perform genomic studies using EMR-derived phenotypes
- Implement actionable variants in the EMR

Source: Josh Denny, VUMC

Discovery science in eMERGE

Table 1. Evaluation of Primary Hypothyroidism Algorithms at the Five eMERGE Sites

<table>
<thead>
<tr>
<th>Site</th>
<th>Primary Phenotype</th>
<th>Total Genotyped Subjects</th>
<th>Primary Hypothyroidism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Health</td>
<td>dementia</td>
<td>2532</td>
<td>397</td>
</tr>
<tr>
<td>Methodist</td>
<td>cataracts</td>
<td>4315</td>
<td>314</td>
</tr>
<tr>
<td>Mayo Clinic</td>
<td>peripheral arterial disease</td>
<td>3063</td>
<td>331</td>
</tr>
<tr>
<td>Northwestern</td>
<td>type 2 diabetes</td>
<td>1217</td>
<td>92</td>
</tr>
<tr>
<td>Vanderbilt</td>
<td>normal cardiac conduction</td>
<td>2712</td>
<td>81</td>
</tr>
</tbody>
</table>

Genotype counts represent all subjects who were found by the hypothyroidism algorithm at each site and who were genotyped. Counts are limited to those classified as “valid” in the electronic medical record of each site. PPV = positive predictive value.

Average weighted for number of samples contributed to the total.

Source: Josh Denny, VUMC

Algorithms can be deployed across multiple EMRs

Analyses can be performed using extant data
Hypothyroidism algorithm

**Case medications**
- Levothyroxine, synthroid, levoxyl unifilm
- Armour thyroid, desiccated thyroid, cytomel, tristar, lothrytone, synthetic triiodothyronine, liofex, thyrolar

**ICD-9 codes for hypothyroidism**
- 244, 244.8, 244.9, 245, 245.2, 245.8, 245.9

**Abnormal lab values**
- TSH > 5 OR FT4 < 0.5

**ICD-9 codes for secondary causes of hypothyroidism**
- 244.9, 244.1, 244.2, 244.3, 244.5

**Case Definition**
- All three conditions required:
  - ICD-9 code for hypothyroidism OR abnormal TSH/FT4
  - Thyroid replacement medication use
  - Require at least 2 instances of either medication or lab with at least 3 months between the first and last instance of medication and lab

**Case Exclusions**
- Exclude if the following information occurs at any time in the record:
  - Secondary causes of hypothyroidism
  - Post surgical or post radiation hypothyroidism
  - Other thyroid disease
  - Thyroid altering medication

**PREDICT:** Pharmacogenomic Resource for Enhanced Decisions In Care and Treatment

"Here's my sequence..."

*New Yorker, 2000*

"...the right drug, the first time."

Source: Josh Denny, VUMC
Genotype $\rightarrow$ Enzyme Phenotype

**CYP2C19 - Clopidogrel**

*17 = CYP2C19 Gain of Function Variant

<table>
<thead>
<tr>
<th>CYP2C19 Genotype</th>
<th>Drug Metabolism Phenotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>*X/*X</td>
<td>Poor metabolizer</td>
</tr>
<tr>
<td>*1/*X</td>
<td>Intermediate metabolizer</td>
</tr>
<tr>
<td>*X/*17</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>*1/*17</td>
<td>Normal (Extensive) metabolizer</td>
</tr>
<tr>
<td>*1/1</td>
<td>Rapid metabolizer</td>
</tr>
<tr>
<td>Other</td>
<td>Uncharacterized genotype</td>
</tr>
</tbody>
</table>

Source: Josh Denny, VUMC

Genetic results visible passively in EHR

Drug Genome Interactions in the Patient Summary
<table>
<thead>
<tr>
<th>Medication</th>
<th>Does your genetic test result affect your response to medicines?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clopidogrel/Plavix®</td>
<td>No</td>
</tr>
<tr>
<td>Simvastatin/Zocor®</td>
<td>No</td>
</tr>
<tr>
<td>Tacrolimus/Prograf®</td>
<td>No</td>
</tr>
<tr>
<td>Thiopurine Therapy</td>
<td>Yes</td>
</tr>
<tr>
<td>Warfarin/Coumadin®</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**The Clopidogrel Test**

Clopidogrel (sounds like "kloh-PID-oh-grel") is a blood thinner used to prevent clots that can cause a heart attack or stroke. Your genes can affect how well the drug works. This genetic test identifies how well you may respond to clopidogrel.

**Your Risk**

Sometimes clopidogrel does not prevent harmful strokes or clots as well as it should because of your genes. Your provider, often with the results of a lab test, can determine if clopidogrel is the right medicine for you.

Based on the results of your test, your genes do not put you at increased risk for this negative outcome.

**More About Clopidogrel**

**More About Your Risk**

Source: Josh Denny, VUMC
Interactive Exercise

Develop a plan for leveraging informatics to improve core quality and safety processes at your organization while contributing to a learning healthcare system.

1. Select an IHI improvement map that you would like to implement at your organization: [http://app.ihi.org/imap/tool/](http://app.ihi.org/imap/tool/)
2. Describe how informatics can be used to improve performance of the improvement map elements.
   - What components of the improvement map can be automated?
   - What data elements are needed?
   - Where can clinical decision support help?
3. Discuss the socio-technical aspects of implementing the improvement map at your organization.
   - Describe the process for integrating the informatics enhancements into your organization's EHR system.
   - What leadership support is needed to implement the improvement map?
   - What clinical support is needed to implement the improvement map?
   - What aspects of the workflow will be affected?
   - What stakeholders need to be involved?
Exercise

Thank you!