CTSI Module 8 Workshop
Biomedical Informatics, Data Standards & Practical Tools

Introduction to Biomedical Informatics, Part II

Coordinators: William Hsu, PhD & Corey Arnold, PhD
Medical Imaging Informatics Group
Dept of Radiological Sciences
UCLA School of Medicine
Module Objectives

**Objective:** Provide basic and clinical translational scientists with a working understanding of biomedical informatics principles and their applications in biomedical data collection, standardization, representation, and analysis.

<table>
<thead>
<tr>
<th>Intro to Biomedical Informatics</th>
<th>Data Standards &amp; Terminologies</th>
<th>Practical Tools in Informatics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarize participants with the basic principles of biomedical informatics demonstrated by ongoing projects and services across the CTSI sites.</td>
<td>Describe the use of data standards for representation and exchange of clinical information in the context of electronic health records and clinical decision support.</td>
<td>Provide a demonstration of CTSI-specific applications and resources that facilitate the management and analysis of clinical and experimental data.</td>
</tr>
</tbody>
</table>

- Introduce the foundational concepts of biomedical informatics and its subfields
- Understand the role of informatics in evidence-based medicine
- Distinguish the different types of health information
- Learn about UCLA CTSI efforts related to this area and whom to contact for expert consultation
- Describe the use of standards for data coding, knowledge representation and exchange of clinical information
- Discuss the importance of controlled terminologies as a specific class of standards
- Learn about health information system architecture
- Demonstrate data collection using REDCap
- Discuss software tools and resources for data collection, extraction and representation, and analysis
- Showcase resources available through the CTSI, member campuses, and the UC system
Lecture Outline

- **5/7 Part I: Informatics in healthcare and translational research (D. Bell, 1.5 hrs)**
  - Introduce the fundamental concepts of biomedical informatics and its subfields
  - Learn about UCLA CTSI efforts related to this area and whom to contact for expert consultation

- **5/9 Part II: Community-based informatics research (O. Ogunyemi, 1.5 hrs)**
  - Summarize the role of informatics in public health and addressing health disparity issues
  - Define disease registries, their implementation and applications, and considerations
  - Discuss development towards a national learning health care system

- **5/14 Part III: Electronic health record systems (R. Jenders, 1.5 hrs)**
  - Introduce principles of health information system architecture and design
  - Describe the use of standards for data coding, knowledge representation and exchange of clinical information

- **5/16 Part IV: Clinical decision support (R. Jenders, 1.5 hrs)**
  - Enumerate techniques for clinical decision support (e.g., alerts, infobuttons)
  - Present standards for clinical decision support

- **5/23 Part V: Practical tools in biomedical informatics (W. Hsu/C. Arnold, 3 hrs)**
  - Demonstrate data collection using REDCap (Martin Lai, UCLA CTSI)
  - Services provided by the biostatistics core (David Elashoff, UCLA Biostatistics)
  - Discussion of advanced tools and services available (William Hsu/Corey Arnold, UCLA Medical Imaging Informatics)
Recap from Part I

• **Biomedical Informatics**
  – Interdisciplinary field that studies and pursues the effective uses of biomedical data, information, and knowledge for scientific inquiry, problem solving, and decision making, motivated by efforts to improve human health -- AMIA

• In **healthcare**
  – Adoption of EHRs at hospitals is at ~**44%** as of 2012
  – EHRs have had a positive impact on various outcome measures (efficiency/effectiveness of care) (Buntin et al, 2011)
  – BUT, EHRs have also been implicated in complications (Han, 2005) → challenges in functionality/workflow integration

• In **translational research**
  – Providing informatics tools to support translation from basic science to clinical practice
  – CTSI offers a variety of services for investigators
    • Cohort discovery (UC ReX, LADR)
    • Data management (REDCap)
    • Clinical trial data management, statistical consultation
Module Resources

• Recorded webcast & materials
  – http://www.ctsi.ucla.edu/education/training/webcastmodules

• CTSI virtual home
  – http://www.ctsi.ucla.edu
  – Biomedical Informatics Program
    http://www.ctsi.ucla.edu/about/pages/bip2

• Other resources
  – Agency for Healthcare Research and Quality
    http://www.ahrq.gov/
  – CDC Public Health Informatics Fellowship Program
    http://www.cdc.gov/PHIFP/
  – Health People 2020
    http://www.healthypeople.gov
  – National Institute on Minority and Health Disparities
    http://www.nimhd.nih.gov/
Informatics in community-based research

Omolola Ogunyemi, PhD
Director, Center for Biomedical Informatics
Charles Drew University of Medicine & Science
Introduction

• Overview of public health informatics
• Health disparities
• Electronic chronic disease registry
  – CEDRIC
• Infrastructure for screening in urban clinics
  – Teleretinal Screening
Goal: To use methods from computer and information sciences, networking and information technology to improve the public’s health
O’Carroll et al:

• Focus on preventive intervention when disease or injury causes are found
  – Vaccinations and vaccination registries

• Mostly reflects a governmental context rather than a private one
Key Public Health Information Systems:

• The National Vital Statistics System
  – Collection of births, deaths, marriages and other events on a national level

• Morbidity data
  – National Health Care Survey
  – National Health Interview Survey
  – State and Local Area Integrated Telephone Survey
Key Public Health Information Systems:

- Informatics of Toxicology and Environmental Public Health
  - National Library of Medicine provides services for chemical identification
    - Chemical Abstracts
    - Hazardous Substances Databank
    - Bibliographic databases
Key Public Health Information Systems:

• Knowledge-based Information and Systems
  • MEDLINE (NLM)
  • EMBASE
  • PsycInfo
  • National Technology Information Service
  • MedlinePLUS
Resources

Books:


• **Definition:** Set of technologies, standards, applications, systems, values, and laws that support all facets of individual health, health care, and public health with the goal of delivering information to individual stakeholders when and where they need it to make informed decisions
  
  – First proposed under Bush administration, 2003
  – Evolved to become the Nationwide Health Information Network (HITECH Act 2010)
Key Characteristics of the NHIN

- Use electronic medical records to capture all health information regardless of the setting
- Send and receive messages across health care settings and communities about a patient's health status whenever and wherever
- Enable automatic electronic reporting to public health for early detection and response to unusual health patterns (e.g., bioterrorism)
- Provide real-time clinical decision support to health care professionals allowing more rapid widespread application of research findings in routine patient care
- Aggregate of non-identified patient care information to provide evidence regarding the outcomes and efficacy of health interventions
- Monitor quality of health care services in an accurate and prompt manner
- Reduce the administrative burden on health care practitioners associated with filling out forms
Health Disparity

- **Definition**: Preventable differences in the indicators of health of different population groups, often defined by race, ethnicity, sex, education, socioeconomic status, and geographical location

- Several reports have examined this issue
  - Understanding the impact of health IT in underserved communities
  - National Healthcare Disparities Report 2011
  - Institute of Medicine Report 2012
Closing the Gap in Healthcare Disparities through Dissemination and Implementation of Patient Centered Outcomes Research (U18)

- Agency for Healthcare Research and Quality
- Posted May 1, 2013 (RFA-HS-13-010)
- Due July 31, 2013 (Letter of Intent June 14)
- Intent to fund 1-3 awards for up to $3 million for 3 years, budget not to exceed $500k annually

Purpose

- Identify strategies to engage stakeholders through shared decision making to effectively implement interventions specific to the reduction of racial/ethnic healthcare disparities
- Incorporate patient-centered outcomes research (PCOR) findings for racial/ethnic minority populations
- Demonstrate an ability to leverage the capacities of relevant and diverse stakeholders in their strategies to reduce healthcare disparities in under-resourced settings
### Impact of Health IT

<table>
<thead>
<tr>
<th>Current Disparities</th>
<th>Impact of Health IT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quality of care</strong></td>
<td>• Support the needs of special populations using clinical decision support tools</td>
</tr>
<tr>
<td>Disparities exist for underserved populations for measures of quality that include</td>
<td>• Facilitate quality improvement reporting</td>
</tr>
<tr>
<td>effectiveness, patient safety, and timeliness</td>
<td>• Increase access to a broader range of services</td>
</tr>
<tr>
<td><strong>Access to care</strong></td>
<td><strong>Health outcomes</strong></td>
</tr>
<tr>
<td>Disparities exist in health insurance coverage, patient perceptions of need, and</td>
<td>• Improve access through telemedicine to provide free or low-cost preventive health services</td>
</tr>
<tr>
<td>avoidable hospital admissions</td>
<td><strong>Patient engagement</strong></td>
</tr>
<tr>
<td><strong>Health outcomes</strong></td>
<td>• Improve health care delivery, safety, and patient engagement</td>
</tr>
<tr>
<td>Underserved populations are more likely to experience health outcome disparities,</td>
<td><strong>Chronic disease management</strong></td>
</tr>
<tr>
<td>which vary from differences in morbidity and mortality rates for cancer and other</td>
<td>• Facilitate improved coordination of care for individuals with chronic diseases</td>
</tr>
<tr>
<td>illnesses to other measures of health</td>
<td>• Promote active patient involvement through patient portals</td>
</tr>
<tr>
<td><strong>Patient engagement</strong></td>
<td></td>
</tr>
<tr>
<td>Lack of patient involvement in their own care can impact health, resulting in less</td>
<td>• Educate users about their condition and their treatment options</td>
</tr>
<tr>
<td>preventive care and poorer understanding of their conditions and care, among other</td>
<td>• Improve health literacy</td>
</tr>
<tr>
<td>impacts</td>
<td>• Provide more targeted care that addresses cultural and language needs</td>
</tr>
<tr>
<td><strong>Chronic disease management</strong></td>
<td></td>
</tr>
<tr>
<td>Data has shown that underserved populations are more likely to exhibit signs of</td>
<td>• Facilitate improved coordination of care for individuals with chronic diseases</td>
</tr>
<tr>
<td>poor management of chronic disease, such as higher rates of hospital admissions for</td>
<td>• Promote active patient involvement through patient portals</td>
</tr>
<tr>
<td>short-term complications associated with chronic diseases</td>
<td></td>
</tr>
</tbody>
</table>

Disease Registries
Chronic Disease Management

• Introduction
  – Wagner’s chronic care model
  – Electronic chronic disease registries

• CEDRIC System Overview

• Current Work
Introduction

Urban, medically underserved areas in the US have:

- a predominance of chronic diseases (diabetes, cardiovascular disease, etc.)
- a shortage of primary care providers and specialists
- a need for informatics solutions appropriate for settings with
  - high physician turnover
  - large uninsured/underinsured patient population
• Majority of healthcare research happens at large academic medical centers

• Academic medical centers treat less than 1% of US patients (Green, Fryer, et al. NEJM 2001)

• Research partnerships with primary care clinics & providers that provide bulk of patient care could help improve health outcomes generally
Wagner’s Chronic Care Model

The Chronic Care Model identifies the essential elements of a health care system that encourage high-quality chronic disease care (Bodenheimer et al, JAMA 2002)
Wagner’s Chronic Care Model

**Community**
- Resources and policies
- Patient self-management support

**Health System**
- Healthcare organization
- Design of delivery system
- Decision support
- Clinical information systems

**Informed patient**

**Prepared, proactive practice team**

**Improved Outcomes**
Wagner’s Chronic Care Model

Decision Support Goal: Promote clinical care that is consistent with scientific evidence and patient preferences.

Clinical Information Systems Goal: Organize patient and population data to facilitate efficient and effective care

Actions:
- Provide timely alerts & reminders for providers
- Identify relevant sub-populations for proactive care
- Facilitate individual patient care planning
- Monitor performance of practice team and care system
Electronic Disease Registries

• Help collect and manage data on chronic diseases

• Help assess effectiveness of a clinic’s quality improvement efforts

• Feasible for use in safety net clinics (Hanratty et al, J Health Care Poor Underserved. 2008.)

• Implementation more successful in clinics that already have some health information systems (Keyser DJ et al, Jt Comm J Qual Patient Saf. 2009)
Electronic Disease Registries

• Actual usage varies among clinics
  – 96% of California safety net clinics have a diabetes registry
  – Only 31% of physicians use registries at these clinics
    (California Healthcare Foundation; 2008)

• Existing solutions often don’t meet clinics’ unique needs

• Few safety net clinics have staff with the IT expertise to customize existing electronic registries
CDU Electronic Disease Registry to Improve Chronic Care

• CEDRIC initial project partners
  – CDU Center for Biomedical Informatics
  – Hubert H. Humphrey Comprehensive Healthcare Center

• Hubert Humphrey
  – L.A. County Department of Health Services ambulatory care center serving South L.A.
    – Caters to the uninsured/medically underserved
      • >70% of clinic population lacks public or private insurance
      • Has 12,749 annual patient visits
      • Patients: 55% Latino, 37% African American
**Goal:** Develop and evaluate a clinical information system for diabetes management that provides

- **Physicians & nurses**
  - summary of patient labs and preventive services,
  - self management goals and status, co-morbidities, & medications,
  - methods for assessing care continuity (broken appointments)
  - clinical practice guidelines (American Diabetes Assn plus locally tailored modifications) to produce alerts and reminders

- **Administrators**
  - tools for assessing clinic-wide care measures & care continuity
  - physician-specific care measures
CDU Electronic Disease Registry to Improve Chronic Care

Achieving goal requires

– involvement of clinical champions (e.g., MDs at Hubert Humphrey)

– socio-technical assessment of barriers & facilitators to system implementation and use

– integrating electronic data from disparate systems
  • patient scheduling & labs
  • referral
  • medication
CDU Electronic Disease Registry to Improve Chronic Care
CEDRIC System
Welcome to the CEDRIC System

Email Address: Nurse@x.com

Password:

Sign In

Forgot Password? Click here

33
### Today's Schedule of Patients

<table>
<thead>
<tr>
<th>Patients</th>
<th>MRUN#</th>
<th>DOB</th>
<th>Sex</th>
<th>Tel</th>
<th>Language</th>
<th>PCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi Ani</td>
<td>000235877</td>
<td>2/4/1971</td>
<td>M</td>
<td>310-123-4575</td>
<td>English</td>
<td>Dr. Dayrit</td>
</tr>
<tr>
<td>Daniel Ryan</td>
<td>000235875</td>
<td>5/2/1969</td>
<td>M</td>
<td>310-123-4571</td>
<td>English</td>
<td>Dr. Dayrit</td>
</tr>
<tr>
<td>Daryl West</td>
<td>000235879</td>
<td>4/25/1973</td>
<td>M</td>
<td>310-123-4579</td>
<td>English</td>
<td>Dr. Verma</td>
</tr>
<tr>
<td>David Hindman</td>
<td>000235873</td>
<td>2/25/1967</td>
<td>M</td>
<td>310-123-4567</td>
<td>English</td>
<td>Dr. Verma</td>
</tr>
<tr>
<td>James Smith</td>
<td>000235876</td>
<td>2/18/1970</td>
<td>M</td>
<td>310-123-4573</td>
<td>English</td>
<td>Dr. Verma</td>
</tr>
<tr>
<td>Keith Norris</td>
<td>000235881</td>
<td>9/23/1973</td>
<td>M</td>
<td>310-123-4583</td>
<td>English</td>
<td>Dr. Verma</td>
</tr>
<tr>
<td>Magda Shabteen</td>
<td>000235883</td>
<td>4/27/1977</td>
<td>F</td>
<td>310-123-4587</td>
<td>Spanish</td>
<td>Dr. Verma</td>
</tr>
<tr>
<td>Ogun Lola</td>
<td>000235878</td>
<td>3/26/1972</td>
<td>F</td>
<td>310-123-4577</td>
<td>English</td>
<td>Dr. Dayrit</td>
</tr>
<tr>
<td>Paul Robinson</td>
<td>000235882</td>
<td>6/21/1976</td>
<td>M</td>
<td>310-123-4585</td>
<td>English</td>
<td>Dr. Dayrit</td>
</tr>
<tr>
<td>Rick Baker</td>
<td>000235880</td>
<td>6/4/1974</td>
<td>M</td>
<td>310-123-4581</td>
<td>English</td>
<td>Dr. Dayrit</td>
</tr>
<tr>
<td>Sheba Goerge</td>
<td>000235874</td>
<td>3/24/1968</td>
<td>F</td>
<td>310-123-4569</td>
<td>Spanish</td>
<td>Dr. Dayrit</td>
</tr>
</tbody>
</table>
### Biometric Information

<table>
<thead>
<tr>
<th>Metric</th>
<th>Prev Value</th>
<th>Prev Date</th>
<th>Curr Value</th>
<th>Curr Date</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (in)</td>
<td>6 ft 0 inch</td>
<td>11/7/2008</td>
<td>5'10&quot;</td>
<td>5/27/2009</td>
<td>-5</td>
</tr>
<tr>
<td>BMI</td>
<td>34.6</td>
<td>11/7/2008</td>
<td>34.5</td>
<td>11/7/2008</td>
<td>-0.6</td>
</tr>
<tr>
<td>BP (Sys/Dia)</td>
<td>120/80</td>
<td>11/7/2008</td>
<td>120/80</td>
<td>11/7/2008</td>
<td>0</td>
</tr>
</tbody>
</table>

### Personal Information

- **LN:** Ani
- **FN:** Chi
- **DOB:** 2/4/1971
- **Sex:** M
- **Race:** AA
- **PCP:** Dr. Davis
- **Prev PCP:** 11/7/2003
- **Seen:** Dr. Hindman
- **Sub Use:** No
- **Homeless:** No
- **Smoke:** Yes
- **Alcohol:** No
- **Addr:** 2211 1st St, Palmdale, CA 90005

### SMBG

<table>
<thead>
<tr>
<th>SMBG</th>
<th>Prev Date</th>
<th>Prev Result</th>
<th>Curr Date</th>
<th>Curr Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg SMBG</td>
<td>11/7/2008</td>
<td>0</td>
<td>5/27/2009</td>
<td>25</td>
</tr>
<tr>
<td>Avg PM SMBG</td>
<td>11/7/2008</td>
<td>0</td>
<td>5/27/2009</td>
<td>185</td>
</tr>
</tbody>
</table>

### Self Management

- **Diet:** Yes
- **Exercise:** Yes
- **Blood Glucose Monitoring:** Yes
- **Smoking:** Yes
- **Alcohol:** No
- **Medication Adherence:** No
- **Visit Adherence:** Yes

### Labs

<table>
<thead>
<tr>
<th>Test</th>
<th>Prev Date</th>
<th>Prev Result</th>
<th>Curr Date</th>
<th>Curr Result</th>
<th>O</th>
<th>C</th>
<th>NC</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1C</td>
<td>1/2/2009</td>
<td>8.2</td>
<td>10/2/2008</td>
<td>6.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycated Al</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AST</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fasting Glucose</td>
<td>3/2/2009</td>
<td>230</td>
<td>10/2/2008</td>
<td>220</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wt Al/creas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Services

- **Dental:** 1/23/2007
- **Podiatry:** 1/23/2007
- **Eye Clinic:** 6/5/2007
- **Smile Cess:** 6/5/2008
- **Flu Vaccine:** 6/5/2007
<table>
<thead>
<tr>
<th>Patients</th>
<th>MRUN#</th>
<th>DOB</th>
<th>Sex</th>
<th>Tel</th>
<th>Language</th>
<th>PCP</th>
<th>Lab Date</th>
<th>Hba1C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi Ari</td>
<td>000235877</td>
<td>2/4/1971</td>
<td>M</td>
<td>310-123-4575</td>
<td>English</td>
<td>Dr. Dayrit</td>
<td>1/2/2009</td>
<td>8.2</td>
</tr>
<tr>
<td>Daniel Ryan</td>
<td>000235875</td>
<td>5/2/1969</td>
<td>M</td>
<td>310-123-4571</td>
<td>English</td>
<td>Dr. Dayrit</td>
<td>3/15/2009</td>
<td>6</td>
</tr>
<tr>
<td>David Hindman</td>
<td>000235873</td>
<td>2/25/1967</td>
<td>M</td>
<td>310-123-4567</td>
<td>English</td>
<td>Dr. Verma</td>
<td>3/12/2009</td>
<td>7.1</td>
</tr>
<tr>
<td>Paul Robinson</td>
<td>000235882</td>
<td>6/21/1976</td>
<td>M</td>
<td>310-123-4585</td>
<td>English</td>
<td>Dr. Dayrit</td>
<td>3/22/2009</td>
<td>10.2</td>
</tr>
</tbody>
</table>
Current Work

• Collaboration with Southside Coalition of community clinics to utilize CEDRIC methods for an electronic heart disease registry

• Patient’s ability to adhere to self management goals on diet & exercise is affected by local factors
  – Access to parks, recreation, fitness clubs
  – Neighborhood safety
  – Access to healthy nutritional outlets and grocery stores
Current Work

• Providing clinicians with information on patients’ local geographies can lead to
  – better understanding of potential barriers to patients achieving self-management goals
  – tailoring patient recommendations appropriately based on barriers identified through geographical information science
  – GeoCEDRIC plugin developed (Robinson PL, Mukherjee S, Ogunyemi O, George S. GEO-CEDRIC: Spatially Enabling a Chronic Disease Management System for Urban Safety Net Populations. AMIA Fall meeting, 2012)
Addressing Geography
Addressing Geography
Addressing Geography

Map showing locations of GROCERY STORES around 5850 South Main Street, Los Angeles, CA 90003:
Addressing Geography
Collaborators

• Chizobam Ani, MD
• Sukrit Mukherjee, MS
• David Hindman, PhD
• Sheba George, PhD
• Mary Verma, MD
• Melvin Dayrit, MD
• Paul Robinson, PhD

Reference

Teleretinal Screening in Urban Safety Net Clinics
Overview

• Background
  – Diabetic retinopathy
  – Pre-telemedicine screening process for diabetic retinopathy in inner city Los Angeles
• Teleretinal screening study goals
• Methods
• Results
• Discussion
• Recently Completed Work
• Future Work
Background

Diabetic retinopathy:

– Damage to blood vessels of the retina caused by diabetes
– Left untreated can lead to blindness
– Leading cause of blindness in US adults aged 20 to 74 years
– Risk factors include
  • poor blood glucose control
  • high blood pressure
  • high cholesterol
  • smoking
  • length of time a patient has had diabetes
Background

• General US screening rates for diabetic retinopathy: ~60%
• US Inner city safety net clinic screening rates: < 25%
• Factors impacting disparity in inner-city vs. national screening rates
  – Shortage of specialists for retinopathy screening
  – Large number of uninsured/underinsured patients
  – Patient misconceptions about utility of regular eye exams
Background

Process for retinopathy screening in South LA safety net setting in the absence of telemedicine

1. Diabetic patient seen at primary care clinic
2. Patient referred to county health facility for routine retinopathy screening
3. Patient screened at county health facility, returns if treatment necessary

LA County DHS Hospital

4–8 months after referral
Background

Teleretinal screening as a solution:

• Digital nonmydriatic camera images have been effectively used for retinopathy screening
• With retinal image uploads & secure, web-based image viewing software, off-site specialists can assess risk asynchronously
Background

Diabetic Retinopathy

- Vitreous
- Retina
- Abnormal blood vessels
- Microaneurysms
- Exudate
- "Cotton wool" spots
- Hemorrhages
Background

Normal retina

Diabetic retinopathy

Retina

Blood vessels

Proliferative Diabetic Retinopathy
Background

Diabetic Retinopathy
Study Goals

• Assess barriers to and facilitators of using teleretinal screening to detect diabetic retinopathy in 6 South Los Angeles safety net clinics (FQHCs)
  1. Image quality: what proportion of images are readable?
  2. How acceptable is teleretinal screening to patients and clinic staff?

• Determine proportion of diabetic patients at risk for retinopathy who
  – receive retinal screening in accordance with evidence based guidelines
  – require and receive ophthalmologic treatment
Methods

• MOU signed between clinics and CDU Center for Biomedical Informatics
  – CDU
    • Purchased 3 digital nonmydriatic cameras for use in screening
    • Retained 3 board-certified ophthalmologists as readers
    • Arranged photographer training/retraining and certification
    • Weekly monitoring of clinic sites and troubleshooting
    • Arranged with county and clinics to expedite treatment for potential cases of moderate or worse retinopathy
  – Clinics
    • Identified staff (medical assistants) to be trained on camera use
    • Photographers took and uploaded patient retinal images into software (EyePACS)
    • Made referrals to county health facilities
    • Provided access to medical records for abstraction
Methods

Patients screened for

– Mild non-proliferative diabetic retinopathy (NPDR)
– Moderate NPDR
– Severe NPDR
– Proliferative diabetic retinopathy (PDR)
– Clinically significant macular edema
– Other conditions (glaucoma, cataracts, non-diabetic maculopathy, etc.)
Methods

Photographer training

– Photographers were medical assistants already working at the clinics

– Received training on how to use cameras from collaborator, Dr. Jorge Cuadros (optometrist & informatician at UC Berkeley; creator of EyePACS software)

– Had to be certified before taking pictures of actual patients
  • 10 sets of retinal images of non-patients uploaded
  • Images graded satisfactory by EyePACS staff
Methods

Readers (3 board-certified ophthalmologists) Assessed retinal images through EyePACS web-based viewing system (6 – 8 images for both eyes)

• Checked boxes indicating presence or absence of microaneurysms, retinal hemorrhages, cotton wool spots, venous beading, new blood vessels, hard exudates, etc.

• Overall severity of retinopathy (or absence of retinopathy) computed by an algorithm based on boxes checked/left unchecked by reader

• Readers could override computer assessment and manually enter a different assessment
Readers (3 board-certified ophthalmologists) Graded the quality of the images taken by medical assistants/photographers by choosing from the following options

- Insufficient for Any Interpretation
- Insufficient for Full Interpretation
- Adequate
- Good
- Excellent
- Other (Specify in Comments)
- N/A
Methods

• Image taking (2010 – 2011)

• Retrospective data collection
  – Patient demographics
  – Medical visit history
    • Specialist referrals
    • Co-morbid conditions
  – Clinical values (at multiple time points)
    • Hemoglobin A1C
    • Blood pressure
    • Weight
Canon digital nonmydriatic camera
Canon digital nonmydriatic camera in clinic office
Study staff with camera
Study staff with camera
Methods: Clinic Characteristics (2010)

<table>
<thead>
<tr>
<th>Clinics</th>
<th>Clinic A</th>
<th>Clinic B</th>
<th>Clinic C</th>
<th>Clinic D</th>
<th>Clinic E</th>
<th>Clinic F</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of unique patients served</td>
<td>9,510</td>
<td>26,211</td>
<td>3,868</td>
<td>36,149</td>
<td>14,605</td>
<td>9,231</td>
<td>99,574</td>
</tr>
<tr>
<td>% of patient population that’s Hispanic</td>
<td>53.6%</td>
<td>88.3%</td>
<td>59%</td>
<td>85.4%</td>
<td>85.2%</td>
<td>27.9%</td>
<td></td>
</tr>
<tr>
<td>% of patient population that’s non-Hispanic black</td>
<td>4.7%</td>
<td>7.5%</td>
<td>26.1%</td>
<td>12.7%</td>
<td>4.4%</td>
<td>58.9%</td>
<td></td>
</tr>
<tr>
<td>% of patient population that’s Asian</td>
<td>0.7%</td>
<td>1.1%</td>
<td>2.8%</td>
<td>0.6%</td>
<td>0%</td>
<td>10.7%</td>
<td></td>
</tr>
<tr>
<td>Number of patients with type 2 diabetes</td>
<td>823</td>
<td>1,494</td>
<td>589</td>
<td>2,800</td>
<td>2,233</td>
<td>1,493</td>
<td>9,432</td>
</tr>
</tbody>
</table>
# Results

## Screenings and referrals (as of 9/25/2011)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of diabetic patients at 6 clinics</td>
<td>9432*</td>
</tr>
<tr>
<td>Total number of retinal image screenings 9/2010 – 9/2011</td>
<td>2876</td>
</tr>
<tr>
<td>Total number of unique patients screened 9/2010 – 9/2011</td>
<td>2732</td>
</tr>
<tr>
<td>Percentage of diabetic patients screened across 6 clinics</td>
<td>29%*</td>
</tr>
<tr>
<td>Total number of patients recommended for referral to a specialist</td>
<td>1035</td>
</tr>
<tr>
<td>Patients with proliferative diabetic retinopathy (PDR)</td>
<td>48</td>
</tr>
<tr>
<td>Patients with severe NPDR</td>
<td>115</td>
</tr>
<tr>
<td>Patients with moderate NPDR</td>
<td>247</td>
</tr>
<tr>
<td>Patients with mild NPDR</td>
<td>246</td>
</tr>
<tr>
<td>Patients with clinically significant macular edema &amp; no retinopathy</td>
<td>97</td>
</tr>
<tr>
<td>Patients with other conditions recommended for referral</td>
<td>282</td>
</tr>
</tbody>
</table>

*Note: The percentages are rounded to the nearest whole number.
Results

Image quality ratings (as of 9/6/2011)

<table>
<thead>
<tr>
<th>Image Quality</th>
<th>Clinic A</th>
<th>Clinic B</th>
<th>Clinic C/F*</th>
<th>Clinic D</th>
<th>Clinic E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient for any Interpretation</td>
<td>8%</td>
<td>4%</td>
<td>5%</td>
<td>13%</td>
<td>11%</td>
</tr>
<tr>
<td>Insufficient for full Interpretation</td>
<td>20%</td>
<td>11%</td>
<td>25%</td>
<td>36%</td>
<td>21%</td>
</tr>
<tr>
<td>Adequate</td>
<td>39%</td>
<td>49%</td>
<td>36%</td>
<td>35%</td>
<td>30%</td>
</tr>
<tr>
<td>Good</td>
<td>14%</td>
<td>17%</td>
<td>14%</td>
<td>6%</td>
<td>20%</td>
</tr>
<tr>
<td>Excellent</td>
<td>9%</td>
<td>12%</td>
<td>7%</td>
<td>1%</td>
<td>7%</td>
</tr>
<tr>
<td>Not rated</td>
<td>10%</td>
<td>7%</td>
<td>13%</td>
<td>9%</td>
<td>11%</td>
</tr>
</tbody>
</table>

*Clinics C and F share a camera

Insufficient for full interpretation – a diagnostic recommendation cannot be made.

Image rating of adequate or better desirable
Discussion

• Screening rate above the norm for inner-city clinics

• Teleretinal screening barriers
  – Clinics currently lack resources to integrate image taking for teleretinal screening into primary care visit
  – Patients sometimes didn’t understand the reason for their screening visit
  – Need for image quality rating cut off for photographers – (cut-off for future clinic use developed by ophthalmologist LPD)
  – Need to designate clinic staff responsible for coordinating camera refresher training and image quality control
Discussion

• Teleretinal screening facilitators
  – Proactive medical assistants (photographers)
  – Clinic environment that rewards photographer creativity for troubleshooting
  – Acknowledgment of importance of screening by staff not involved in study
  – Incentives for photographers to maintain/improve upon their skills

• Observations on image quality
  – In general, image quality improved over time
  – Clinics that screened patients several times a week saw greater improvements in image quality
Recently Completed Work

• Qualitative Assessment of Teleretinal Screening (Sheba George, Allison Fish, Erin Moran)
  - Impact on workflow
  - Patient perceptions (focus groups)
  - Clinic staff & medical director perceptions (in-depth interviews)
  - Ophthalmologist perceptions (in-depth interviews)

• Conducted in-depth interviews with
  - 6 chief medical officers
  - 4 mid-level clinic staff
  - 5 medical assistants
  - 3 ophthalmologists

• Held focus groups with 42 patients from 6 clinics who received teleretinal screening
Future Work

• Assess promotora impact on screening rate
  • Improve patient outreach

• Predictive model for patients at risk for retinopathy (machine learning)
  – Improve patient outreach
  – Identify and assist most vulnerable patients

• Identify biomarkers associated with diabetic retinopathy in different populations
  – Collaboration with basic scientists
Papers

- Ogunyemi O, Teklehaimanot S, Patty L, Moran E, George S. Evaluating predictive modeling's potential to improve teleretinal screening participation in urban safety net clinics. Medinfo 2013 (Accepted).

Abstracts

- George S, Moran E, Fish A and Ogunyemi L. Expanding the Digital Divide to the Clinical Setting: The Knowledge Gap Experienced by U.S. Safety Net Patients in Teleretinal Screening. Medinfo 2013 (Accepted)
Acknowledgments

- 6 South LA FQHCs
- Lauren Patty Daskivich, MD
- Miguel Unzueta, MD
- Michelle Banks, MD
- Sheba George, PhD
- Allison Fish, JD, PhD
- James Smith, MD
- Alicia Eccles, MPH
- Erin Moran, MS
- Senait Teklehaimanot, MPH
- Rao Ilapakurthi, MS
- Elizabeth Terrien, MA
- Otaren Aimiuwu, MPH,

- Kevin Lopez
- Richard Baker, MD
- David Martins, MD
- Keith Norris, MD
- Angela Nossett, MD (MLK MACC, Los Angeles County DHS)
- Jorge Cuadros, OD, PhD (UC Berkeley/EyePACS)
Summary

- Public health informatics
  - Opportunities: Capturing data in an accessible manner (rather than in silos), improving interoperability, advancing the speed and quality of health reporting

- Health disparity
  - Utilization of HIT to facilitate health care access and improve patient outcomes in historically underserved populations

- Electronic disease registry
  - Case study: CDU Electronic Disease Registry to Improve Chronic Care

- Impact of screening clinics in urban communities
  - Case study: Teleretinal screening
This work was supported in part by the US National Institutes of Health under grant U54 MD007598-01S2 (formerly U54 RR026138-01S2): Accelerating Excellence in Translational Science (AXIS).

AXIS webpage:
http://axis.cdrewu.edu

CDU Center for Biomedical Informatics webpage:
http://www.cdrewu.edu/research/cbi

Contact email: lolaogunyemi@cdrewu.edu