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)
Module Resources

- Recorded webcast & materials
  - [http://www.ctsi.ucla.edu/education/training/webcastmodules](http://www.ctsi.ucla.edu/education/training/webcastmodules)

- CTSI virtual home
  - [http://intranet.ctsi.ucla.edu/](http://intranet.ctsi.ucla.edu/)
  - Biomedical Informatics Program
    - [http://www.ctsi.ucla.edu/about/pages/bip2](http://www.ctsi.ucla.edu/about/pages/bip2)
UCLA CTSI
Clinical and Translational Science Institute

Introduction to REDCap

Presented by Martin Lai, MS
Informatics Core Manager
UCLA Clinical & Translational Research Center

www.ctsi.ucla.edu
What is REDCap?

- REDCap is a web based data collection tool developed by Vanderbilt University.
- No Web page or database programming experience needed.
- Currently used by 615 institutions in 55 countries on 66,000 projects with over 86,000 users.
Advantages of using REDCap

- **Fast Setup** - A simplified methodology for building databases quickly and easily.
- **Secure and web-based** - Input data from anywhere in the world with secure web authentication and data logging.
- **Multi-site access** - REDCap projects can be used by researchers from multiple sites and institutions.
- **Flexible** - Fully customizable. You are in total control of shaping your database.
- **Mid-study modifications** - You may modify the database at any time during the course of your study.
- **Easy in** - Data may be imported from external data sources to begin a study or to provide mid-study data uploads.
- **Easy out** - Export data to common data analysis packages - Exports raw data and syntax files for SAS, Stata, R, and SPSS for analysis.
- **Audit trails** - To track data manipulation and export procedures.
Overview of using REDCap

1. Get access to REDCap by requesting user accounts.
2. Create a new project – project will be in development mode.
3. Create data collection forms/surveys.
4. Test forms/surveys and make sure the data you have collected is sufficient for data analysis.
5. Move project to production mode in order to collect real data – IRB approval, CTRC application and project access request forms for members are required.
6. Export collected data for data analysis.
Getting started with REDCap


- Schedule a demo/training with Martin Lai
  [mylai@mednet.ucla.edu](mailto:mylai@mednet.ucla.edu)

- Explore the training and help resources inside REDCap.
Creating a new project in REDCap

Things to consider when creating a new project:

• Is the project longitudinal? (collection forms reused at various time points)
  - Longitudinal projects need to define Arms and Events.

• What collection methods are appropriate?
  - Data collection forms only. (Require user login and project, record selection in order to load data entry form)
  - Survey forms only. (User access data entry form by link inside email)
  - Data collection forms and Survey forms.

• Other options available
  - Randomization module.
  - Auto-numbering for records.
  - Scheduling module (longitudinal projects only)
REDCap project creation screen

Main project settings
- Use longitudinal data collection with repeating forms?
- Use surveys in this project?

Design your data collection instruments
- Add or edit fields on your data collection instruments. This may be done by either using the Online Designer (online method) or by uploading a Data Dictionary (offline method), in which you may use either method or both.

Enable optional modules and customizations
- Auto-numbering for records
- Scheduling module (longitudinal only)
- Randomization module
- Designate an email field to use for invitations to survey participants
Creating data collection forms in REDCap

Methods of creating data collection forms/surveys in REDCap:

1. Use the Online Designer
   - The Online Designer is the fast, easy way to build instruments entirely online. Customize existing instruments, and create new ones.
   - Search and download instruments from the REDCap library for commonly used forms instead of creating from scratch.

2. Upload a data dictionary csv file
   - The Data Dictionary method uses a spreadsheet to build instruments. Customize the file in Excel, and then upload it to make changes.
   - No need to recreate instrument if it has already been used in another project of yours.
Online Designer makes it easy to customize existing questions or add new ones.
The dictionary captures the same information as the Online Designer. Each row corresponds to a field.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Variable / Field Name</td>
<td>Form Name</td>
<td>Section Header</td>
<td>Field Type</td>
<td>Field Label</td>
</tr>
<tr>
<td>2 record_id</td>
<td>basic_demography_form</td>
<td>text</td>
<td>Study ID</td>
<td></td>
</tr>
<tr>
<td>3 first_name</td>
<td>basic_demography_form</td>
<td>Contact Information</td>
<td>text</td>
<td>First Name</td>
</tr>
<tr>
<td>4 last_name</td>
<td>basic_demography_form</td>
<td>text</td>
<td>Last Name</td>
<td></td>
</tr>
<tr>
<td>5 address</td>
<td>basic_demography_form</td>
<td>notes</td>
<td>Street, City, State, ZIP</td>
<td></td>
</tr>
<tr>
<td>6 telephone</td>
<td>basic_demography_form</td>
<td>text</td>
<td>Phone number</td>
<td></td>
</tr>
<tr>
<td>7 email</td>
<td>basic_demography_form</td>
<td>text</td>
<td>E-mail</td>
<td></td>
</tr>
<tr>
<td>8 dob</td>
<td>basic_demography_form</td>
<td>text</td>
<td>Date of birth</td>
<td></td>
</tr>
<tr>
<td>9 age</td>
<td>basic_demography_form</td>
<td>calc</td>
<td>Age (years)</td>
<td>roundup(datediff([d])...</td>
</tr>
<tr>
<td>10 ethnicity</td>
<td>basic_demography_form</td>
<td>radio</td>
<td>Ethnicity</td>
<td>0, Hispanic or Latino</td>
</tr>
<tr>
<td>11 race</td>
<td>basic_demography_form</td>
<td>dropdown</td>
<td>Race</td>
<td>0, American Indian/Ala...</td>
</tr>
<tr>
<td>12 sex</td>
<td>basic_demography_form</td>
<td>radio</td>
<td>Gender</td>
<td>0, Female</td>
</tr>
<tr>
<td>13 height</td>
<td>basic_demography_form</td>
<td>text</td>
<td>Height (cm)</td>
<td></td>
</tr>
<tr>
<td>14 weight</td>
<td>basic_demography_form</td>
<td>text</td>
<td>Weight (kilograms)</td>
<td></td>
</tr>
<tr>
<td>15 bmi</td>
<td>basic_demography_form</td>
<td>calc</td>
<td>BMI</td>
<td>round([weight]*10000</td>
</tr>
<tr>
<td>16 comments</td>
<td>basic_demography_form</td>
<td>General Comments</td>
<td>notes</td>
<td>Comments</td>
</tr>
</tbody>
</table>
Types of fields available in instruments:

- Text Box (Short Text)
- Notes Box (Paragraph Text)
- Calculated Field
- Yes – NO
- True – False
- Slider / Visual Analog Scale
- Dynamic Query (SQL)
- Matrix of fields
- Checkboxes (Multiple Answers)
- Multiple Choice – Drop-down List (Single Answer)
- Multiple Choice – Radio Buttons (Single Answer)
- File Upload (for users to upload files)
- Descriptive Text (with optional Image/File Attachment)
- Begin New Section (with optional text)
Textbox field can be used to collect a variety of data

Field Label = Question

Variable Name = Name of database field storing the element
Radio buttons easily created with online designer
Calculated Field

When a calculated value is needed, calculated field can help

Current Instrument: BMI

- Add Field
- Add Matrix of Fields

Variable: height

Height

(Meters)

Variable: weight

Weight

(Kilograms)

Variable: body_mass_index

Body Mass Index

Calculations: kg/m^2

Field Type: Calculated Field

Field Label

Body Mass Index

Calculation Equation

[weight]/[height]^2

How do I manually code the choices?

Save | Cancel
Dynamic SQL Field (part A)

Linking last name and study ID in Project A (Demographics) to Project B (Sample)
(Must be requested as it is only available for REDCap Administrators)

Project A with subject demographics data

Part of instrument

Testing Sample ID - Demographic Data

Add / Edit Records
You may view an existing record/response by selecting it from the drop-down lists below. To create a new record/response, click the button below.

Total records: 10
Choose an existing Study ID

Data Search
Choose a field to search (includes multiple choles fields)
Dynamic SQL Field (part B)

Project B with subject lab data

Sample instrument in Project B able to choose subjects from Project A

SQL Query within the studyid field linking subjects in Project A to be available as a drop down list in Project B
Matrix of Fields

Useful when having questions with the same answer choices.
Branching Logic is available to hide questions until the preceding questions are answered a certain way.
1. Define Arms and Events

- Arm 1
- Arm 2
- +Add New Arm

Arm name: Treatment

<table>
<thead>
<tr>
<th>Event #</th>
<th>Days Offset</th>
<th>Offset Range Min / Max</th>
<th>Event Name</th>
<th>Unique event name (auto-generated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>-0/0</td>
<td>Consent</td>
<td>consent_arm_1</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>-0/0</td>
<td>Phenotype</td>
<td>phenotype_arm_1</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>-0/0</td>
<td>Treatment</td>
<td>treatment_arm_1</td>
</tr>
</tbody>
</table>

Add new event

Arm name: Treatment

Begin Editing

<table>
<thead>
<tr>
<th>Data Collection Instrument</th>
<th>Consent (1)</th>
<th>Phenotype (2)</th>
<th>Treatment (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surveys</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demographics</td>
<td></td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>DEXA</td>
<td></td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>25-OH Vitamin D</td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Additional Lab Tests</td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Payment Status</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Location of Physical Samples</td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
Methods of sending out surveys

If first instrument of the project is a survey:

Can enable public survey

- A survey link is available for embedding inside an email to send to participants – no response tracking is available if this method is used.

- Use the participant list to send out survey invitations – this method embeds a unique survey link for each participant and can track if a particular participant has responded.
Methods of sending out surveys

If first instrument of the project is NOT a survey:

1. You will need to create a Textbox Field with validation type of Email within your instruments.

2. Use that field as the participant’s email by using Designate an email field to use for invitations to survey participants.
3. Define conditions for Automated Survey Invitations.
Testing your instruments – Import your test data

1. Manual Data Entry:

2. Using Data Import Template:

Template with records in rows

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>sid</td>
<td>consent_form</td>
<td>subject_initials</td>
<td>sex</td>
<td>dob</td>
<td>race_or_ethnic_group</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Template with records in columns

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Variable / Field Name</td>
<td>Record</td>
<td>Record</td>
<td>Record</td>
<td>Record</td>
<td>Record</td>
</tr>
<tr>
<td>2</td>
<td>sid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>consent_form</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>subject_initials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>dob</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>race_or_ethnic_group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
When sufficient test data have been entered, you can export the data to your analysis program to check the outcome and make any adjustments to your instruments.

<table>
<thead>
<tr>
<th>Software</th>
<th>Instructions</th>
<th>Download Syntax &amp; Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Excel</td>
<td>You may download the survey results in CSV (comma-separated) format, which can be opened in Excel. You have the choice of downloading the data either with the full headers and answer labels or just with the answer codes (i.e. raw data). NOTE: If you are using a version of Microsoft Excel prior to Excel 2007, due to limitations the data will only be read to 255 columns when opened.</td>
<td>Excel CSV Labels Excel CSV Raw</td>
</tr>
<tr>
<td>SPSS Statistical Analysis Software</td>
<td>Instructions: Download and save all 3 files on the right to a common location. First, double-click on the Pathway Mapper (.bat) file, which will run quickly and invisibly. (If you are not using a Windows operating system, such as Mac or Linux, please see the Additional Instructions.) Now double-click on the *spss file, which will open SPSS. When the file is loaded and displayed, choose Run---&gt;All from the top menu options. This action will launch the script that will automatically read in all data and manipulate data fields with labels, option values, etc.</td>
<td>SPSS DATA DATA CSV</td>
</tr>
<tr>
<td>SAS Statistical Software</td>
<td>Instructions: Download and save all 3 files on the right to a common location. First, double-click on the Pathway Mapper (.bat) file, which will run quickly and invisibly. (If you are not using a Windows operating system, such as Mac or Linux, please see the Additional Instructions.) Now double-click on the *sas file, which will open SAS. When the file is loaded and displayed, choose Run (or Run--&gt;Submit) from the top menu options. This action will launch the script that will automatically read in all data and manipulate data fields with labels, option values, etc.</td>
<td>SAS DATA DATA CSV</td>
</tr>
<tr>
<td>R Statistical Software</td>
<td>Instructions: Use command read.csv('filename') to read in data file.</td>
<td>R DATA DATA CSV</td>
</tr>
<tr>
<td>STATA Analysis and Statistical Software</td>
<td>Instructions: Download both files to common location and double-click on * .do file. This action will launch the script that will automatically read in all data and manipulate data fields with labels, option values, etc.</td>
<td>STATA DATA DATA CSV</td>
</tr>
</tbody>
</table>
**Logging - Audit Trail**

All activities within REDCap are logged

### 9999 CTRC Demo Study

#### Logging

This module lists all changes made to this project, including data exports, data changes, and the creation or deletion of users.

**Filter by event:** All event types (excluding page views)

**Filter by user name:** All users

**Filter by record:** All records

**Displaying events (by most recent):** 1 - 100

<table>
<thead>
<tr>
<th>Time / Date</th>
<th>Username</th>
<th>Action</th>
<th>List of Data Changes OR Fields Exported</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:28am 05/07/2013</td>
<td>mylai</td>
<td>Updated Record 1239 (Event 1)</td>
<td>second_id = 'testing 3', dob = '1999-05-04', demographics_complete = '0'</td>
</tr>
<tr>
<td>12:45pm 05/06/2013</td>
<td>mylai</td>
<td>Manage/Design</td>
<td>Edit project field</td>
</tr>
<tr>
<td>12:44pm 05/06/2013</td>
<td>mylai</td>
<td>Manage/Design</td>
<td>Edit project field</td>
</tr>
<tr>
<td>12:43pm 05/06/2013</td>
<td>mylai</td>
<td>Manage/Design</td>
<td>Edit project field</td>
</tr>
<tr>
<td>12:42pm 05/06/2013</td>
<td>mylai</td>
<td>Manage/Design</td>
<td>Edit project field</td>
</tr>
<tr>
<td>12:39pm 05/06/2013</td>
<td>mylai</td>
<td>Manage/Design</td>
<td>Designate data collection instruments for events</td>
</tr>
<tr>
<td>12:38pm 05/06/2013</td>
<td>mylai</td>
<td>Manage/Design</td>
<td>Edit project field</td>
</tr>
<tr>
<td>12:36pm 05/06/2013</td>
<td>mylai</td>
<td>Manage/Design</td>
<td>Upload data dictionary</td>
</tr>
<tr>
<td>12:27pm 05/06/2013</td>
<td>mylai</td>
<td>Manage/Design</td>
<td>Download data dictionary</td>
</tr>
<tr>
<td>12:26pm 05/06/2013</td>
<td>mylai</td>
<td>Manage/Design</td>
<td>Download data dictionary</td>
</tr>
</tbody>
</table>
REDCap provides an easy Report Builder for:

1. General overview of collected data.
2. Tracking of abnormal values in collected data.
3. Ability to go directly to a record within the report.

![Report Builder Screenshot]

**My Reports**

- **test report 1**

Create a New Report

You may create a new report by selecting the fields/variables below that you want to include in the report. You may add as many fields to your report as you wish. You will also need to provide a name for your report, which will then be displayed on the project's right-hand menu. When you have finished selecting the fields you wish to include in the report, click the Save Report button at the bottom. The new report will then be added to your list of reports above.

**Name of Report:** Too Tall

<table>
<thead>
<tr>
<th>Field Name/Label</th>
<th>Limiter (optional) Operator/Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>height (Height)</td>
<td></td>
</tr>
</tbody>
</table>

**Order the Results (optional):**

- First by: [selection options]
- Then by: [selection options]

**Download report as:**

- Microsoft Excel (CSV)
- XML

Number of results returned: **3**
Total number of records queried: **11** (records = total available data across designated Events)

**test report 1**

<table>
<thead>
<tr>
<th>Study ID (study_id)</th>
<th>Event Name (redcap_event_name)</th>
<th>Last Name (last_name)</th>
<th>Complete? (demographics_complete)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1234</td>
<td>Event 1</td>
<td>doe</td>
<td>Complete (2)</td>
</tr>
<tr>
<td>1237</td>
<td>Event 1</td>
<td></td>
<td>Complete (2)</td>
</tr>
<tr>
<td>1238</td>
<td>Event 1</td>
<td></td>
<td>Complete (2)</td>
</tr>
</tbody>
</table>
After sufficient tests are done and you are happy with the exported data, you can move your project to production status to start collecting real data by doing the following steps.

1. Use the Setup tab to request project be moved to production status.

2. Submit IRB approval notice of your project.

3. Submit CTRC application for your project.

4. Indicate whether you would like to have your test data completely erased.
Making Changes when project is in production Mode

- The Online Designer and Data Dictionary can still be used to modify instruments, but many changes are no longer immediate.
- Enter Draft mode to make and submit changes to the instruments.

NOTE:
The project is currently in PRODUCTION status, and thus changes cannot be made in real time to the project as when in Development status. However, changes to the project may be drafted in DRAFT MODE, after which such changes will be reviewed and approved by a REDCap administrator. Once those changes are approved, you will then receive an email confirmation informing you that those changes have taken effect on your production project.

Share your instruments with others via the REDCap Shared Library

Would you like to enter DRAFT MODE to begin drafting changes to the project?

Enter Draft Mode
Learn more about REDCap

To learn more about REDCap, please go to:

https://www.ctrc.medsch.ucla.edu/redcap

by watching a brief summary video (4 min) or see the Training Resources page. Please make sure you have TLS 1.0 or above turned on in your browser.