Quantifying Clinical Rotation
Patient Encounters: Variations In
Student Experiences

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Declaration of Potential Conflicts-of-Interest, Consulting and Corporate Collaborators
Abstract

• Using an in-house developed “app” third- and fourth-year students at VCOM capture their clinical patient encounters by entering diagnoses and procedures using universal ICD-10 codes.

• These entries can be used to quantify the depth and breadth experienced by each student for each rotation at each of many distributed training sites.

• This has enabled us to use this information to optimize the clinical rotation experiences of our students and measure the site-to-site variability.

The “app” is called CREDO, Clinical Rotation Evaluation and Documentation Organizer,

A Clinical Learning Management System

https://credo.education/info
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Entries are used to fulfill Learning Objectives for each student for each rotation via qualifying ICD-10 diagnosis and procedure codes that are associated with each Learning Objective.

ICD-10 codes are the central index used throughout CREDO.
Abstract

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Within CREDO there are a variety of administrative and research tools which provide real-time information to assess progress of students, and aid in quantifying accreditation requirements.
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• This has enabled us to use this information to optimize the clinical rotation experiences of our students and measure the site-to-site variability.

Element 6.11: Comparability across Clinical Education Sites:

A COM must ensure that the curriculum includes comparable educational experiences and equivalent methods of assessment across all core clinical educational sites where students learn, ensuring all students achieve similar outcomes based on core educational learning objectives.
Who are the stakeholders and what do they get?

• Medical students – A quantitative portfolio, review information, automated Procedure Logs.
• Preceptors – Enhances communication with students/chairs and documents experience when applying for privileges
• Administration – An assessment tool to identify the best and those that may need help, and a reporting tool to make documenting student performance on clinical rotations easier and more efficient
• VCOM – Demonstrate uniformity in clinical experience as per accreditation bodies’ new requirements
• Faculty – A database that is a tremendous source of research topics
• Public – A public health surveillance tool that collects across all VCOM clinical sites, especially Appalachia and the South
What is CREDO?

• A web-based “app” available on computers and smart phones/devices
  – Used by 3rd and 4th year students to record and track their clinical experiences
  – Used by 1st and 2nd year students in standardized patient and simulated patient encounters
  – Used by all students who go on an International Medical Mission trip (60%) to track their patient encounters

• CREDO has multiple instances of the app and database on the Google Cloud, with CloudFlare synchrony.
  – HIPAA compliant
  – Multiple redundancies and backup
  – 99.9% uptime
  – Each campus is independent, but data is integrated
  – Extensible and with sufficient power to handle all medical schools and all students

• CREDO has been in operation for 2 years, with functionality being added/refined continuously
What is CREDO?

Common Vocabulary - ICD codes & descriptions
- Performance improves as more data is logged
- ICD codes are key index that enables quick expansion of connections
- Track student progress and identify learning gaps
- Real-time performance metrics and statistics display
- Match review questions to clinical encounters
- Automate identifying learning objectives
- Portfolio db
- Experience db
- Growing connections knowledge base
- Public Health db mining
- Smart Search
- Experience db
- Portfolio db
- Learning Synonym db
- Advanced multi-modal search strategies
- Search engines - MYSQL and Lucene; growing synonyms
What is CREDO?

>200,000 diagnostic and procedure codes, drugs and synonyms

Updated at least monthly
USING CREDO
Navigate everywhere from the Welcome page

- Change your Account Settings, including Rotation and Site
- Confirm/change your Rotation and Site in the greeting
- Enter new Patient Encounters
- See what is being logged now
- Click here to access:
  - Quick Start Guide video
  - Instructions
  - About
  - Support (email developers)
  - FAQs
  - Statistics
- Access Procedure Logs
- Review Patient Encounters
LOGGING A PATIENT ENCOUNTER
For each Patient Encounter, patient demographics are entered once...

Enter Notes and History information, as well as hints to recall specific patient.

No PII allowed, names, phone #s, SSNs blocked

See a list of previous patients
...then the Primary Diagnoses is entered...

Multiple diagnosis selection modalities

Quickly review and select from among the most frequent diagnoses seen in each rotation
...then the Primary Diagnoses is entered...

Easily search for diagnoses, procedures and drugs
...then the Primary Diagnoses is entered...

Smart Suggest most frequent diagnoses seen in Family Medicine rotation
For each Patient Encounter you can quickly enter new or review and edit all diagnoses, procedures and drugs.

Click to add
Procedures or Drugs are coupled to Diagnosis entries...

Use Notes to capture precise data, such as drug dose

The most frequent procedures for each diagnoses can suggest quick entries
All recent Patient Encounters are available for review and editing, coupled via unique patient ID for future continuity of care entries.
Students must see value to really use the system

- Must be very intuitive, easy and fast
  - Students don’t read instructions
  - No need to memorize actually ICD-10 codes
  - Entry should be faster than hand notes
- Rotation Primer so they know exactly what to expect at a new rotation
- Review information, board-relevant facts and questions
- Automated Learning Objective fulfillment based on diagnoses and procedures entered, which is done through Procedure Logs that are reviewed by preceptors and administration
Rotation Primer

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encounter for general examination without complaint, suspected or reported diagnosis</td>
</tr>
<tr>
<td>Essential (primary) hypertension</td>
</tr>
<tr>
<td>Type 2 diabetes mellitus</td>
</tr>
<tr>
<td>Disorders of lipoprotein metabolism and other lipidemias</td>
</tr>
<tr>
<td>Gastro-esophageal reflux disease</td>
</tr>
<tr>
<td>Other anxiety disorders</td>
</tr>
<tr>
<td>Dorsalgia</td>
</tr>
<tr>
<td>Acute sinusitis</td>
</tr>
</tbody>
</table>

System is aware of most frequent diagnoses, procedures, drugs for each rotation from accumulated data

Family Medicine rotation most frequent diagnoses
Review information in SOAP format for top 20 diagnoses for every rotation.
Factoids are presented to students, triggered by specific ICD-10 code entry.

36,000 slides from first 2 years of classes were reviewed to identify opportunities to link to a diagnoses, procedure or drug code.

~3,000 Factoids created, each linked to one or multiple ICD-10 codes.
Review Facts, SOAP notes editor allows quick updating

FACTOID MANAGER

This interface allows you to manage system factoids, which are shown to users when they log a relevant code. Create a new factoid using the 'Add' button or select a row to edit an existing factoid. Factoids are triggered by code expressions; simply enter the exact code (i.e. A01.1) or append a trailing percent symbol to act as a wildcard (i.e. 201% will match Z01.1, Z01.11, Z01.110, etc...). Be aware that each code expression must be bound to a single type of code (i.e. diagnostic) and that an improper selection will result in it being shown for unintended codes or not at all.

FACTOIDs (GLOBAL)

<table>
<thead>
<tr>
<th>ID</th>
<th>Area</th>
<th>Fact</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Respiratory Failure/ARDS**

ARDS = secondary disorder from inflammatory process ie, sepsis, aspiration, severe trauma/fractures, pancreatitis, massive transfusion, drug OD, intracranial HTN, cardiopulmonary bypass

**2005 SOAP**

ARDS = acute onset, hypoxemia refractory to O2, b/l infiltrates on chest imaging, non cardiogenic pulmonary edema (no evidence of CHF aka PCWP <18), abnormal PaO2/FiO2 ratio.

Acute Respiratory Failure (J96.0)

ARDS Ventilator Strategy: HIGH PEEP, LOW tidal volumes, AVOID high FiO2. Use PEEP and RR to oxygenate vss. FiO2 and TV.
Latest activity display refreshed every 10 seconds

**CREDO: WHAT STUDENTS ARE LOGGING NOW ON CLINICAL ROTATIONS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Patient</th>
<th>Rotation</th>
<th>Location</th>
<th>Time Ago</th>
</tr>
</thead>
<tbody>
<tr>
<td>[48.0]</td>
<td>Paroxysmal atrial fibrillation</td>
<td>65-90</td>
<td>Geriatrics</td>
<td>Aiken Regional Medical Center</td>
<td>a few seconds ago</td>
</tr>
<tr>
<td>[116]</td>
<td>Essential (primary) hypertension</td>
<td>65-90</td>
<td>Family Medicine</td>
<td>Piedmont Family Practice</td>
<td>a minute ago</td>
</tr>
<tr>
<td></td>
<td>(C06A40) Antihypertensive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(C06A40) Lisinopril</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[209]</td>
<td>Encounter for follow-up examination after completed treatment for conditions other than malignant n.a.</td>
<td>19-44</td>
<td>Family Medicine</td>
<td>Piedmont Family Practice</td>
<td>a minute ago</td>
</tr>
<tr>
<td>[F43.0]</td>
<td>Acute stress reaction</td>
<td>19-44</td>
<td>Family Medicine</td>
<td>Piedmont Family Practice</td>
<td>2 minutes ago</td>
</tr>
<tr>
<td></td>
<td>(N01A802) Fluoxetine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(N01A802) Fludrocortisone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[116]</td>
<td>Essential (primary) hypertension</td>
<td>43-94</td>
<td>Geriatrics</td>
<td>Aiken Regional Medical Center</td>
<td>2 minutes ago</td>
</tr>
<tr>
<td></td>
<td>(C06A40) Lisinopril</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[F43.0]</td>
<td>Acute stress reaction</td>
<td>19-44</td>
<td>Family Medicine</td>
<td>Piedmont Family Practice</td>
<td>2 minutes ago</td>
</tr>
<tr>
<td></td>
<td>(N01A802) Fluoxetine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**STUDENTS LOGGING**

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,027</td>
<td>Past 30 Days</td>
</tr>
</tbody>
</table>

**PATIENTS CARED FOR**

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>330,443</td>
<td></td>
</tr>
</tbody>
</table>

**DIAGNOSTIC CODES**

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>499,397</td>
<td></td>
</tr>
</tbody>
</table>

**PROCEDURAL CODES**

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>62,213</td>
<td></td>
</tr>
</tbody>
</table>

**PRESCRIPTION CODES**

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>148,778</td>
<td></td>
</tr>
</tbody>
</table>

**AVERAGE ENTRY TIME**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>18.3 seconds</td>
<td>Past 160 Days</td>
</tr>
</tbody>
</table>

Displayed outside all MS1/MS2 lecture rooms, student can see what they can expect in rotations.
As of 4/9/2019
NAVIGATION AND FUNCTIONS
Navigate all user functions from the System Dashboard page

View system status:
- Real-time student entries, summaries, map
- Time graph of entries and statistics
- Time graph of students who are active

View/access what students see

For Preceptors, DSME and Site Coordinators

Explore the data

Many functions for Administrators

Functionality in Development
Student pages

- Information to prepare you for each Rotation
- Edit/review Entries
- Review your Rotation Statistics
- Review automated fulfillment of Procedure Logs
- Secure link to school health records
- Find research opportunities
Preceptor evaluation form:
Sent automatically to Preceptor for ease and security
Access to each student’s entries and Procedure Log
Electronic sign-off and submission

DSME and Site Coordinator summaries
of site’s students and their activities
Administrator pages

- Automated email for certain entries
- Request Preceptor Evaluations
- Edit/enter review information
- Add/edit new Rotation Sites
- Create/send messages in CREDO
- Create/edit user accounts
- View any user data as if you were them
- View/analyze all user Entries
- View any user/rotation Procedure Log
- View/analyze all user Entries over time

Valuable for COCA requirement for site comparison
MEASURING STUDENT AND SITE PERFORMANCE
Automated Procedure Logs

- Review Procedure Log for any user for each rotation
- Summary of History, Physical, Assessment and Plan activity
- Summary of fulfillment of items (Clinical Presentation, Clinical Skills, Procedures) in Procedure Log
- Checklist of all Procedure Log items (which are fulfilled automatically as student makes entries that qualify for each item, or student can manually enter lecture/reading information to fulfill item)
Automated Procedure Logs

Review Procedure Log for any user for each rotation

Summary of History, Physical, Assessment and Plan activity

Summary of fulfillment of items (Clinical Presentation, Clinical Skills, Procedures) in Procedure Log

Checklist of all Procedure Log items (which are fulfilled automatically as student makes entries that qualify for each item, or student can manually enter lecture/reading information to fulfill item)
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Summary of History, Physical Assessment and Plan activity

Summary of fulfillment of items (Clinical Presentation, Clinical Skills, Procedures) in Procedure Log

Checklist of all Procedure Log items (which are fulfilled automatically as student makes entries that qualify for each item, or student can manually enter lecture/reading information to fulfill item)

FAMILY MEDICINE OBJECTIVES

As you make entries, they are used to automatically fulfill objectives (below number of entries accumulated in all other rotations which qualified to fulfill in Procedure Log).

In addition to this automated quantification, you can manually make an entry (lecture, reading, or other activity).

Clinical Presentation

- OMM
- Allergy and Asthma
- Common Adult Gastrointestinal Disorders
- Coronary Artery Disease (CAD) Stable Angina
- Crystal Arthropathies
- Dermatology
- Diabetes Mellitus
- Dyslipidemia
- Headache
- Hypertension
Automated Procedure Logs

Review Procedure Log for any user
Automated Preceptor Evaluations

- Monitor status of eEvaluation completion
- Generate/send bulk email to Preceptors

Request for Preceptor Evaluation

Dear Dr. Garner,

As the Preceptor of record for the medical student under your tutelage, it is necessary that you complete this electronic Evaluation. Please click on the link below to begin your e-Evaluation. To aid in your thorough evaluation, you can now review the Procedure Logs and entries made by your student.

This link is valid for two days. Please complete your review before it expires.

Contact the CREDO team with any questions: Araba Wubah, arabawubah@gmail.com, (540) 449-5533

Student: Garner, Skip
Rotation: Internal Medicine
Link: Click Here to Evaluate

Thank you.

— VCOM Administration
## Rotation Performance Statistics

This table shows statistics for each rotation in the system with data on-file. The 'Students' column shows the count of users having logged for a given rotation; 'Patients' shows the number of unique patients encountered, regardless of how many codes were entered for the patient. The remaining columns give a breakdown of entries by code type. Tap or click any row to see the Top 25 codes for that rotation; hover over a code to see its description. The Top 25 is updated hourly and based on entries from the past 180 days.

### GLOBAL ROTATION PERFORMANCE METRICS

<table>
<thead>
<tr>
<th>Year</th>
<th>Rotation</th>
<th>Students</th>
<th>Patients</th>
<th>DIAG</th>
<th>PROC</th>
<th>DRUG</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>All System Data</td>
<td>648</td>
<td>78.5±107.3</td>
<td>185.8±222.3</td>
<td>16.4±16.7</td>
<td>59±145.3</td>
</tr>
<tr>
<td>1st</td>
<td>General Logging</td>
<td>6</td>
<td>30.3±29.8</td>
<td>42.7±176.7</td>
<td>No Data</td>
<td>No Data</td>
</tr>
<tr>
<td>2nd</td>
<td>Clinical Skills Interns</td>
<td>1</td>
<td>No Data</td>
<td>No Data</td>
<td>No Data</td>
<td>No Data</td>
</tr>
<tr>
<td>2nd</td>
<td>General Logging</td>
<td>7</td>
<td>11.6±12.6</td>
<td>25±39.1</td>
<td>11.5±10.5</td>
<td>28.4±43.5</td>
</tr>
<tr>
<td>3rd</td>
<td>Family Medicine</td>
<td>133</td>
<td>73.8±73.5</td>
<td>156.3±209.3</td>
<td>8.5±11.8</td>
<td>60.3±131.5</td>
</tr>
</tbody>
</table>

Click on any line to open up Top 10 list

Mouse over any code to see definition

Average and standard deviation
Site Accreditation Statistics for March, 2019, 3rd year rotations

<table>
<thead>
<tr>
<th>ID</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>214</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>274</td>
<td></td>
</tr>
<tr>
<td>674</td>
<td></td>
</tr>
<tr>
<td>552</td>
<td></td>
</tr>
<tr>
<td>111</td>
<td></td>
</tr>
<tr>
<td>565</td>
<td></td>
</tr>
<tr>
<td>605</td>
<td></td>
</tr>
<tr>
<td>791</td>
<td></td>
</tr>
<tr>
<td>109</td>
<td></td>
</tr>
</tbody>
</table>

Showing 1 to 10 of 179 entries
Site Accreditation Statistics for March, 2019, 3rd year rotations

<table>
<thead>
<tr>
<th>Rotation/Role</th>
<th>Rotation Period</th>
<th>Campus</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Filter</td>
<td>[02/25-03/22] March 2019</td>
<td>No Filter</td>
<td>No Filter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Count, Users</th>
<th>Count, Patients</th>
<th>Count, Codes</th>
<th>Average, Codes/User</th>
<th>CPL µ</th>
<th>CPL σ</th>
<th>OMM µ</th>
<th>OMM σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>55</td>
<td>60</td>
<td>30.0</td>
<td>100%</td>
<td>0%</td>
<td>2.13%</td>
<td>0%</td>
</tr>
<tr>
<td>1</td>
<td>43</td>
<td>142</td>
<td>142.0</td>
<td>100%</td>
<td>0%</td>
<td>25.53%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Showing 1 to 10 of 179 entries
Site Accreditation Statistics for March, 2019, 3rd year rotations

• Out of the 700 3rd year rotation sites we found that:
  – 12 sites were more than 1 standard deviation above average for number of entries and fulfillment of Learning Objectives
  – 6 sites were more than 1 standard deviation below
PUBLIC HEALTH AND EDUCATION RESEARCH TOOLS
Filtering and mapping from User Entry Page

Click on Filter to select what you want to study

Then click Map to view your filtered entries on a world map

Two views – heat map and flags. Mouse over flag to see the ICD code details; click to view all entries at that location.

4,058 entries for diabetes
Public Health Alerts

Set to check hourly, and send me an email if Zika, MRSA or if a Malignant neoplasm of the lung is logged.

Email is delivered to user who set the alert.
EXTENDED FUNCTIONALITY AND THE FUTURE
CREDO offshoots

• emr.credo.education – EMR/EHR system in use in VCOM’s 4 International Clinics (Honduras, El Salvador, Dominican Republic)
• qborg.credo.education – Question and Case builder
• WEMCAT.credo.education – real-time mass causality victim and first responder tracking app
**Recent Activity / Actividad Reciente**

Daily Log Totals (Grey) and Patient Encounters (Green) from All Users

Registro Diario Total (Gris) y Consultas (Verde) por Todos los Usuarios.

Time Period / Período de Tiempo

Past Quarter / Último Trimestre

**Sites / Sitios**

6

**Patients / Pacientes**

1,079

**Female Patients / Pacientes Femeninos**

70%

**Pediatric Patients / Pacientes Pediátricos**

39%
WEMCAT First Responder User Interface

- **How to log**
  - Select patient status, needs, demographics information
  - Click on Scan Barcode, which opens camera, take a close up of the barcode (i.e. zoom with 2 fingers in camera view). Returns to app and shows message to confirm successful scan
  - Submit the entry. This goes to the central database.

- **Re-log a victim as many times as desired, for change in status or to show victim movement**

Enter victim status (same as wrist band tear-off)

Enter victim needs

Scan opens camera to take picture of bar code

Enter victim demographics and any optional notes

Submit entry
WEMCAT Live Tracking

- Each time a victim is scanned, their position and status are updated.
- Responders are continuously tracked.

Click to navigate to different parts of the dashboard.

Each victim is marked, color indicates status.

Click and grab to move map.

Zoom.
CASE DETAILS

Name
Skip Astronaut Accident

Case Presentation
A 33 year old male astronaut crashed. Presented at ER with a blue foot.

History H1.0
No prior foot problems
CASE DETAILS

Name
Skip Astronaut Accident

Case Presentation
A 33 year old male astronaut crashed. Presented at ER with a blue foot.

History H1.0
No prior foot problems

CASE QUESTIONS

What is the most probable diagnosis?
Skip Astronaut Accident

Case Presentation
A 33 year old male astronaut crashed. Presented at ER with a blue foot

History H1.0
No prior foot problems

Question Text
What is the most probable diagnosis?

External Link
https://www.youtube.com/watch?v=Nxz5JJ0DJtk

What is the most probable diagnosis?
Thank You

QUESTIONS, COMMENTS?