LEARNING ANALYTICS

“Learning analytics refers to the interpretation of a wide range of data produced by and gathered on behalf of students in order to assess academic progress, predict future performance, and spot potential issues.”

- DOE 2012

How is Big Data Different?

<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>Big Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Collection</td>
<td>Purposeful</td>
<td>Incidental / Opportunistic</td>
</tr>
<tr>
<td>Intrusiveness</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Data Acquisition Cost</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Frequency</td>
<td>e.g. Quarterly</td>
<td>Continuously</td>
</tr>
<tr>
<td>Temporality</td>
<td>Static Reports</td>
<td>Dynamic Dashboards</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>Causal</td>
<td>Associations</td>
</tr>
<tr>
<td>Sample Size</td>
<td>Small biopsies</td>
<td>Large swaths</td>
</tr>
</tbody>
</table>
Outline
NYU Approach to Learning Analytics:

“The Football Field” – Listeners everywhere
“The Blade of Grass”
  – Insights at a Fine Level
“The New CME” – Action Oriented

NYU Education Data Warehouse

NYU Practice Network
NYU Education Data Warehouse
Clinical Data Warehouse
Epic EMR
Epic EMR

Activity Logging

iOS 7
iBeacons
New “Listeners”

- iPads
- Point-of-care digital forms
- Immediate Lecture evaluations
- Learning interactions with EHR
- Anything a Smartphone can do

**LEARNING ANALYTICS**

- **Descriptive Analytics:** $Y = \text{Counts, averages, } \%, \text{ min/max}$
  
  Understand what happened in past

- **Diagnostic Analytics:** $y = mx + b$
  
  Understand what influences what
  Why did this happen?
  Focus is on group level coefficients

- **Predictive Analytics:** $y = mx + b$
  
  Knowing something sooner
  Early warning system
  Focus is on individual level prediction

- **Prescriptive Analytics:** IF $Y$ THEN WHAT?
  
  Adjustment on the fly (uses the prediction)
  Supports Individualization
LEARNING ANALYTICS

Descriptive Analytics: Y: Counts, averages, %, min/max
Understand what happened in the past

Diagnostic Analytics: \( Y = f(X) \)
Understand what influences what
Why did this happen?
Focus is on group level coefficients

Predictive Analytics: \( Y = \beta_0 + \beta_1 X \)
Knowing something sooner
Early warning system
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Prescriptive Analytics: IF-THEN-WHAT?
Adjustment on the fly (uses the prediction)
Supports individualization

NYU Medical Knowledge Report

Path Diagram for the Class of 2014
LEARNING ANALYTICS

Descriptive Analytics: Y: Counts, averages, %, min/max
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Predictive Analytics: Knowing something sooner
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Prescriptive Analytics: IF-THEN-BEAUSE?
Adjustment on the fly (uses the prediction)
Supports Individualization

Gartner Model

NEW TARGETS for the PREDICTIONS

Created a data mart with several combined sources, all linked via the NPI
- AMA Masterfile data for NYU UME/GME graduates
- CMS Physician Compare: Directory and Quality
- Medicare Part D Prescribing Data
- CMS Utilization and Payment Data
- NPI Database
- New York State SPARCS
Create a database of your graduates with their NPI numbers

Our Approach at NYU Langone

Physician Quality Reporting System (PQRS) Qualified Clinical Data Registry (QCDR) measure performance rates

<table>
<thead>
<tr>
<th>Measure</th>
<th>NYU GME Graduates</th>
<th>NYU Med School</th>
<th>Non-NYU Med School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast Cancer Screening</td>
<td>89.7%</td>
<td>76.2%</td>
<td>66.7%</td>
</tr>
<tr>
<td>Case Plans</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemoglobin Cytometry Screening</td>
<td>93.1%</td>
<td>84.5%</td>
<td>87.5%</td>
</tr>
<tr>
<td>Determination of Current Medications in the Medical Record</td>
<td>93.4%</td>
<td>87.3%</td>
<td>86.8%</td>
</tr>
<tr>
<td>Hemoglobin Variations for Older Adults</td>
<td>93.4%</td>
<td>90.1%</td>
<td>93.6%</td>
</tr>
<tr>
<td>Body Mass Index (BMI) Screening and Follow-up Plan</td>
<td>78.5%</td>
<td>87.8%</td>
<td>71.7%</td>
</tr>
<tr>
<td>Screening for High Blood Pressure and Follow-up Documented</td>
<td>74.8%</td>
<td>74.0%</td>
<td>69.0%</td>
</tr>
<tr>
<td>Use of High Risk Medications in 48 Hours*</td>
<td>11.4%</td>
<td>3.5%</td>
<td>4.8%</td>
</tr>
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2015 Physician Quality Reporting System and non-PQRS Qualified Clinical Data Registry measures

Dreyfus Model of Expertise Development

Compound Interest Model of Expertise Development

Master Adaptive Learning compared with Linear Learning
LEARNING ANALYTICS

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Counts, averages, %, min/max
Understand what happened in past

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y = bx + t
Knowing something sooner
Early warning system
Focus is on individual level prediction

Prescriptive Analytics:
IF THEN WHAT?
Adjustment on the fly (uses the prediction)
Supports Individualization

Individualized Report

Example | Text | Color
--- | --- | ---
<25th percentile | "A predictive model based on your quantitative data available to the 18th month point of medical school suggests you are on track to pass the USMLE" | Green
25-50th percentile | "A predictive model based on your quantitative data available to the 18th month point of medical school suggests you will pass the USMLE in 90% of cases." | Yellow
>50th percentile | "Students with your profile of quantitative data up to the 18th month point of medical school have gone on to score between xx and yy on the USMLE Step 1 in 90% of cases." | Red

A 10% improvement in your score on each of these 3 medical knowledge report categories would have resulted in the maximum USMLE Step 1 Score improvement, based on our statistical models. Your mileage may vary.

- Neuroanatomy
- Physiology
- Histology

Gartner Model

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- Neuroanatomy
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- Histology
“The Blade of Grass”

The Atomic Unit of Emergency Medicine

DECISION

Item Bank

Case 1

Item Bank

Case 1  Case 2
Item Bank

Case 1  Case 2  Case 3  Case 4  Case 5  Case xx

Sensitivity

Cumulative Accuracy

Number of Cases Completed

Cumulative Averaged Sensitivity for 12 Fellows

Number of Cases Completed

Sensitivity

Number of Cases Completed

Time Based
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- DOE 2012
Door to Needle Time

Radiology Pilot Project

UK National Audit: Satisfaction with Surgeon

Adjusted mean scores for “Satisfaction with Surgeon” for hospital organisations based on women's responses on the 3 month post surgery questionnaire

The New CME “Listeners”

- Un-Announced Standardized Patients
- In-Situ Simulations
- Patient Reported Outcome Measures
- Process Metrics
  - E.g. Door to Needle Time in Stroke Activations
  - E.g. Surgical Video

LEARNING ANALYTICS

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- DOE 2012
Quality Improvement

“Quality improvement refers to the interpretation of a wide range of data produced by and gathered on behalf of clinicians in order to assess progress, predict future performance, and spot potential issues.”

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Feedback

The New CME

- More, better data about individuals
- Learning data and Quality data will overlap
- Shift from time-based to performance-based metrics
- Shift from outcome to process metrics
- Shift from measures of knowing to measures of doing

Limitations

- Big Brother aspect of this needs to be worked out
- Physician “safety” will be a necessary component of any system
- Implies resource re-alignments
Education Data For Innovations Committee

The Research on Medical Education Outcomes (ROME) Registry: Addressing Ethical and Practical Challenges of Using “Bigger,” Longitudinal Educational Data


Discussion