Health Care as a Platform for Discovery

Building blocks:
• Scale
• Personalization as standard of care
• NLP-enriched EHRs
• Integrated diagnostics

VUMC’s Health Care Delivery System

• Annual operating budget > $3.3B
• 4 Hospitals (1,105 beds) – Children’s, Adult, Psychiatric, Rehabilitation
• Annual volumes
  • 62,000 inpatient discharges
  • 2.1 M ambulatory visits
  • 62,000 surgical operations
• 2425 faculty (MDs, PhDs) – all medical disciplines and sub-sub-specialties
• Market leading quality and cost trends
  • Quality: Thompson Reuters top 20 hospital for 13 yrs
  • Health plan 3-yr trend 1% PMPY (US trend 5%, $25M saved)
VUMC Affiliates

Jennie Stuart Medical Center
Baptist Health

- Affiliates

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Vanderbilt Health Affiliated Network
Consumer Facing

10 Health Systems from Memphis to Johnson City
- 47 Hospitals

222 Practices (excluding Baptist and Mountain States)
- 3,441 Total Participating Providers
- 1,354 Primary Care Providers
- 2,088 Specialists

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Personalization as Standard of Care

Early Vision of Personalized Medicine

"Here's my sequence…"

New Yorker, 2000
VUMC’s Strategy for Bringing the Vision to Reality

Excellence in biomedical sciences
Commitment to informatics and phenomics
Harnessing the healthcare system for discovery
Ability to nimbly adapt a healthcare system to evolving evidence
High value healthcare

"Here’s my sequence…"
New Yorker, 2000

VUMC’s Personalized Medicine Capabilities

Excellence in biomedical sciences
Commitment to informatics and phenomics
Harnessing the healthcare system for discovery
Ability to nimbly adapt a healthcare system to evolving evidence
High value healthcare

- Top ranked basic science departments
- Largest Department of Biomedical Informatics
- DNA bank linked to EHR-derived phenotype
- Phenome-wide association methods
- eMERGE coordinating center
- PCORI clinical data research network
- Precision medicine initiative pilot cohort
- Predictive pharmacogenomics
- Diagnostic management team
- MyCancer genome
- Affiliate network
NLP-enriched EHRs

Informatics Principle: Decouple Data from Interpretation

- Measure at multiple scales
- Triangulate signals for robustness

Satellite

Rain Gauge

Doppler Radar
Informatics Principle: Match Computation Method to Scale of Problem


VUMC’s NLP-enriched EHR

Sources ➔ Externalize content as documents ➔ Compute patient chart views

Systems (ADT, lab, rad…)
Dictation/transcription
Note capture tools

Assemble “documents” by patient
“Tag” clinical concepts for decision support
Index each word or number for cross-patient queries

Image (PACS, EKG…)
Fax/scan

Text reports
Report header plus pointer to Image

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### VUMC’s EHR Strategy

<table>
<thead>
<tr>
<th>Conventional</th>
<th>VUMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>One integrated set of data</td>
<td>Sets of data from multiple sources</td>
</tr>
<tr>
<td>Capture data in standardized terminology</td>
<td>Capture raw signal and annotate with standard terminology</td>
</tr>
<tr>
<td>Single source of truth</td>
<td>Current interpretation of multiple related signals</td>
</tr>
<tr>
<td>Seamless transfer among systems</td>
<td>Visualization of the collective output of relevant systems</td>
</tr>
<tr>
<td>Clinician uses the computer to update the record during the patient visit.</td>
<td>Clinician &amp; patient work together with shared records and information.</td>
</tr>
<tr>
<td>The system provides transaction-level data.</td>
<td>The system provides cognitive support.</td>
</tr>
<tr>
<td>Work processes are programmed and adapt through non-systematic work around.</td>
<td>People, process and technology work together as a system.</td>
</tr>
</tbody>
</table>


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### VUMC’s Discovery Platform

**Electronic Health Record**
- Clinical notes
- Physician orders
- Billing codes
- Patient and staff messaging
- Labs, Radiology, test results

**VanderbiltBioVU**
- De-identified DNA repository
- >186k adult samples
- >26k pediatric samples
- >56k with genetic data

- Discarded blood samples from routine testing
- If eligible, extract DNA
- De-identification

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VUMC’s Phenomics Ecosystem

Discovery platform → Executable knowledge → Clinical trials & Standard of Care

- Structured/unstructured personal, health, health care & community data sources
- Feature selection & extraction algorithms
- Phenotype classifiers
- Clinical Decision Support & Patient Portal “apps”

Curated cohorts

Integrated Diagnostics
The Challenge of Integrated Diagnostics

Sets of facts per decision

Human cognitive capacity

Structural genetics: e.g. SNPs, haplotypes

Functional genetics: Gene expression profiles

Proteomics and other effector molecules

Decisions by clinical phenotype

Questions?

Suggestions?