The Future of Medical Education

The Translational Discipline

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Medical Education of the Future

*The Translational Discipline*

- Input: Philosophy and Content
- Output: Clinical Quality and Assessments
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Biomedical Publications in the Age of Information Overload

![Graph showing the growth of different databases over time](image)

- PDB
- Swiss-Prot
- TrEMBL
- PubMed
- EMBL

- Structures
- Sequences
- Publications
- Sequences
• **Current Taxonomy**
  • Based on signs & symptoms
  • Information overload

• **New Taxonomy** based on *Precision Medicine*:
  • **Information Commons**
    • Data repository on all patients
  • **Knowledge Network**
    • Integration of data from all levels of biology
Information Commons analogous to a layered Geographical Information System (GIS)

Google Maps: GIS Layers
Organized by Geographical Positioning

Transportation
Land Use
Census Tracts
Structures
Postal Codes
Raster Imagery

Information Commons
Organized Around Individual Patients
Medical Education: ...translating the bench to the bedside...
Genes-to-Society Principle I:
Phenotype is determined by internal and external factors

- Society
- Environment
- Organ physiology
- Cell biology
- Genomics

45 y.o. w/ bone pain
75 y.o. w/ no symptoms, ↑PSA
60 y.o. w/ urinary dysfunction
Genes-to-Society Principle II:
Disease expression segregates along a continuum depending on risk.

Asymptomatic-Latent  Risk factors:

• Genotype
• Post-transcription events
• Environment
• Behavior

Symptomatic-Sick
The Genes to Society Curriculum

**Years I and II**
- Scientific Foundations
- GTS Systems Biology
- Longitudinal Clerkship
- Scholarly Concentrations
- Intersessions

**Years III and IV**
- Basic Clerkships in Year 3
- Electives
- Preclerkship Educational Exercise (PRECEDE)
- Translational Science Intersessions
- Required Advanced Clerkships
  - Physiology and technology (ICU)
  - Chronic care (Palliative Care, Geriatrics, Rehabilitation Medicine)
- Capstone course: Transition to Internship, Residency and Life (TRIPLE)
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Educationally Sensitive Patient Outcomes
from Kalet, Acad Med 2010
Barriers to linking medical education to patient outcomes

• Short-term focus
  – Test scores

• Inadequate sample size
  – Studies confined to single institutions

• Disconnected research teams
  – Medical education vs. from health services researchers

• Inadequate methodologies
  – Confounding variables
  – Long time course
Emerging Solutions for Outcomes Assessment

• eFolio:
  – National longitudinal data commons of medical learning

• Case-control studies
Aliki: Decreased heart failure readmission rate
(Record, Arch Int Med 2011)
What makes learning stick?

• Spacing Effect
  – Repeated exposures $\rightarrow$ longterm memory (Pagani MR, Cell 2009)

• Vividness effect
  – Vividness $\rightarrow$ hippocampal activation and episodic memory (Moscovitch, Curr Opin Neurobiol 2006)

• Stress effect
  – Mild acute stress $\rightarrow$ neuronal survival. Chronic stress $\rightarrow$ neuronal survival. (Snyder JS, Hippocampus 2006)

Ruge H, Cerebral Cortex 2010
Technology-Enhanced Simulation for Health Professions Education
A Systematic Review and Meta-analysis

Cook DA, JAMA 2011

• 609 studies

• 35,226 trainees

Conclusion:

“Technology-enhanced simulation training is associated with improved outcomes … across a range of clinical topics, including large effects on clinician behaviors and moderate effects on patient care.”
The Medical Education Translation Cycle

**The Assessments**
- Practice
- Knowledge
- Quality
- Performance

**The Learning**
- Systems biology
- Simulation
- Bedside

**The Outcome**
- Patient health
- Team performance
- Practice efficiency

**The Competency**
- Graduation
- Licensure
- Certification
- Credentialing
A Dean’s Legacy

“Today’s medical students are the seed corn for tomorrow’s medicine. For the sake of the future of healing, we must help them flourish.”

Edward D. Miller, M.D.
Summer 2000

3,414 Graduates