Revitalization of Small Group Pathology Teaching in a Medical School Curriculum Incorporating Informatics Tools

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Pathology instructional content is a cornerstone of the organ system-focused years 1 and 2 curriculum of the University of Colorado School of Medicine – 20 two-hour “small group” sessions
  • 156 medical students divided into 8 to 10 groups
  • Faculty and residents serve as preceptors
The small group sessions had gone essentially unchanged for approximately “ten” years
  – Materials were “old school”: Traditional pathology course orientation
  – There was lack of uniformity of content and instructional model of the sessions
  – Teaching materials were outdated
  – There was no synchronization or harmonization of content in small groups with content in lectures
  – There was no adjustment to the new curriculum
    • Implemented with 2005 – 2006 entering class
Impact
- Student scores in the pathology component of standardized examinations lagged behind scores in other disciplines
- Evaluation of the small group sessions by students
  • Highly variable among instructors
  • Ranged from high praise to disappointment to virulent diatribes
- Evaluation of the small group sessions
  • Widely derided
  • Considered by many students
    - “a waste of time”
    - “poorly organized”
    - “content varies at times extremely from that presented in lecture”
Goals / Objectives

• Case-based educational modules were developed for each of the 20 small group sessions,
  – Didactic content
  – Microscopic and gross photographs and specimens
• Compliment and supplement material covered in lectures
• Guided by
  – National Board of Medical Examiners (NBME)
  – United States Medical Licensing Examination (USMLE) topic lists.
Goals / Objectives

• Outcomes assessment
  – Tracking of student performance on pathology content of a
    • NBME Comprehensive Basic Science Exam, customized (CBSE)
      – taken after completion of the first year of medical school
    • Step 1 of the USMLE
      – taken after the second year
  – Evaluation of feedback from students
    • For each “block” of the curriculum
    • On Graduation Questionnaire (GQ) surveys.
Technology

- Distribution of the text- and image-based content of the curriculum
  - Microsoft Word and PowerPoint documents
  - Adobe Acrobat Pro PDFs
  - Standard HTML Web pages
- Content Management System
  - Blackboard
- Specimens used for macroscopic instruction
  - Surgical pathology and autopsy
  - To supplement the extensive but outdated teaching collection
New Curriculum: Overview

Phase I
August
- Human Body
- Molecules to Medicine
- Clinical Inteude
- Foundations of Doctoring

Phase II
August
- Nervous System
- Digestive, Endocrine, Metabolic Systems
- Foundations of Doctoring

Phase III
March
- Life Cycle
- Infectious Disease
- USMLE Step 1
- ICC-7001
- ICC-7002

May
- Infant-Adolescent Health
- Musculoskeletal Care
- Hospitalized Adult Care
- Foundations of Doctoring

July
- *Phase III Clerkship
  Blocks:
  Note: All six Clerkship
  Blocks are required but
  may be taken in any
  order.

Phase IV
August
- Women & Newborns
- Psychiatric Care
- ICC-7003
- ICC-7004
- Emergency Care
- Neurologic Care
- PeriOperative Care
- Adult Ambulatory Care
- Rural and Community Care

May
- ICC-8005
- ICC-8006
- Advanced Studies
- Graduated Questionnaire (GQ)

- ICC (Integrated Clinician Course)
  - Transition to the clerkships
  - Advanced clinical skills
  - Translational basic science
  - Advanced Threads material
  - Mentored Scholarly Activity presentations
  - Transition to the residency

Threads
- Humanities, Ethics and Professionalism
- Medicine and Society
- Cultural Competency and Diversity
- Informatics and Evidence Based Medicine
- Mentored scholarly activity

Scholarly activity
New Curriculum: Overview

Phase I
August
- Human Body
- Molecules to Medicine
- Clinical Introduce

Foundations of Doctoring

Blood & Lymph
- Disease & Defense

June
Cardiovascular, Pulmonary, Renal
- Foundations

Mentored scholarly activity

Phase II
August
- Nervous System
- Digestive, Endocrine, Metabolic Systems

March
- Life Cycle
- Infectious Disease

USMLE Step 1

Phase III
May
- Infant-Adolescent Health
- Musculoskeletal Care

July
- Hospitalized Adult Care

*Phase III Clerkship Blocks:
- Note: All six Clerkship Blocks are required but may be taken in any order.

Phase III
August
- Women & Newborns
- Psychiatric Care
- Neurologic Care

Emergency Care

Phase IV
May
- Adult Ambulatory Care
- Rural and Community Care

Advanced Studies

Phase IV
August
- ICC: 9004
- ICC: 9005

Advanced Studies

- Sub-internship
- Student electives
- Critical care

Graduate Questionnaire (GQ)

Threads
- Humanities, Ethics and Professionalism
- Medicine and Society
- Cultural Competency and Diversity
- Informatics and Evidence Based Medicine

Mentored scholarly activity

ICC (Integrated Clinician Course)
- Transition to the clerkships
- Advanced clinical skills
- Translational basic science
- Advanced Threads material
- Mentored Scholarly Activity presentations
- Transition to the residency

- Threads
- Scholarly activity
New Curriculum: Phases I and II

**Phase I**
- **August**: Human Body, Molecules to Medicine, Clinical Interlude
  - Foundations of Doctoring
- **June**: Blood & Lymph, Disease & Defense, Cardiovascular, Pulmonary, Renal
  - Foundations of Doctoring

**Phase II**
- **August**: Nervous System, Digestive, Endocrine, Metabolic Systems
  - Foundations of Doctoring

**Phase III**
- **March**: Life Cycle, Infectious Disease
- **May**: Infant-, Adolescent Health, Musculoskeletal Care
  - USMLE Step 1, ICC:7001
- **July**: Hospitalized Adult Care, ICC:7002

*Phase III Clerkship Blocks:
Note: All six Clerkship Blocks are required but may be taken in any order.*

**ICC (Integrated Clinician Course)**
- Transition to the clerkships
- Advanced clinical skills
- Translational basic science
- Advanced Threads material
- Mentored Scholarly Activity presentations
- Transition to the residency

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Threads
- Humanities, Ethics and Professionalism
- Medicine and Society
- Cultural Competency and Diversity
- Informatics and Evidence Based Medicine
- Mentored scholarly activity
New Curriculum: Phases I and II

**Phase I**

- **August**
  - Human Body
  - Molecules to Medicine
  - Clinical Interlude

- **June**
  - Blood & Lymph
  - Disease & Defense
  - Cardiovascular, Pulmonary, Renal

- **Foundations of Doctoring**

**Phase III (Thread Connections):**
- Humanities, Ethics and Professionalism
- Medicine and Society
- Cultural Competency and Diversity
- Informatics and Evidence Based Medicine
- Mentored scholarly activity

**Phase II**

- **August**
  - Nervous System
  - Digestive, Endocrine, Metabolic Systems

- **March**
  - Life Cycle
  - Infectious Disease

- **Phase III Clerkship Blocks:**
  - Note: All six Clerkship Blocks are required but may be taken in any order.

**Phase III**

- **May**
  - Infant, Adolescent Health
  - Hospitalized Adult Care

- **July**
  - ICC: 7002

**Highlights:**
- ICC (Integrated Clinician Course)
  - Transition to the clerkships
  - Advanced clinical skills
  - Translational basic science
  - Advanced Threads material
  - Mentored Scholarly Activity presentations
  - Transition to the residency

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* = Small Group Sessions
New Curriculum: Overview

Course Evaluations

Phase I
August
- Human Body
- Molecules to Medicine
- Clinical Interlude

Phase II
August
- Nervous System
- Digestive, Endocrine, Metabolic Systems

Phase III
March
- Life Cycle
- Infectious Disease
- USMLE Step I

May
- Infant-Adolescent Health

June
- Cardiovascular, Pulmonary, Renal

July
- Muscular-Skeletal Care
- Hospitalized Adult Care

*Phase III Clerkship Blocks:
Note: All six Clerkship Blocks are required but may be taken in any order.

Phase IV
May
- Adult Ambulatory Care
- Rural and Community Care

June
- Advanced Studies

August
- Advanced Studies
- ICC: 9005
- ICC: 8006

CBSE
- Threads
  - Humanities, Ethics and Professionalism
  - Medicine and Society
  - Cultural Competency and Diversity
  - Informatics and Evidence Based Medicine
  - Mentored scholarly activity

Course Evaluations

Data Points for assessing effectiveness of Small Group Teaching

Graduate Questionnaire (GQ)

- Threads
- Scholarly activity

- ICC (Integrated Clinician Course)
  - Transition to the clerkships
  - Advanced clinical skills
  - Translational basic science
  - Advanced Threads material
  - Mentored Scholarly Activity presentations
  - Transition to the residency
Small Group Organization: Before Improvements
Old: Man in a Bucket

CASE 62

The patient was a 24-year-old black female who presented to University Hospital on 10/26/91 with acute pain in the chest, abdomen and lower limbs. She was a known case of hemoglobin SC disease, with previous multiple episodes of sickling crises. She was treated with analgesics, hydration and oxygen. On her second hospital day, she had sudden cardiopulmonary arrest. Resuscitative efforts failed and she was pronounced dead at 2130 on 10/27/91.

Past medical history: The patient was diagnosed as having Sickle Cell trait at age four. Since then she has had multiple hospital admissions for sickling crises. Four years ago when she was pregnant, the pregnancy was complicated by a pain crisis at seven months gestation. Her baby was delivered by Cesarean section and the patient underwent exchange transfusion at that time.

The patient’s last hospital admission was in January of 1991 at University Hospital for a pain crisis. During this admission, she was treated for several things: pain crises, presumed pneumonia, pulmonary edema, and peripheral neuropathy. She was thought to have multiple organ failure at that time for which an immediate exchange transfusion was performed. This was followed four days later by ventricular fibrillation. Cor Zero was called, which was successful. Late CPK enzymes ruled out the presence of myocardial infarct. The cardiac arrest was thought to be secondary to hypoxia precipitated by the patient not wearing her oxygen mask. She also had peripheral neuropathy during that admission.

Family history: The patient did not have a clear history of hemoglobin disease in her mother or father. The father was a victim of leukemia. A younger sister also has Sickle trait. There was no history of bleeding diathesis, diabetes or hypertension.

Habits: The patient smoked one pack per day. She drank alcohol occasionally and used Marijuana and Cocaine. She denied IV drug abuse.

Social history: The patient was a single mother, separated from her former husband. She was unemployed.
CASE 112 92-119

This is a 62-year-old white male who was diagnosed with acute lymphoblastic leukemia in 6/92. The patient had an initial chemotherapy with Vincristine, Prednisone, L-asparaginase, and daunorubicin. The patient presented at University Hospital on 8/10/92 with complaints of weakness, especially in the legs, and also with increased pain in the left hip. On 8/13/92 the patient developed a left subclavian thrombosis and became hypertensive and required intubation. At that time he was also found to have positive cultures of his peripheral lines, hyperglycemia, increased LFT's and an upper GI bleed with hematemesis. The patient was also noted to have a coagulopathy probably secondary to the L-asparaginase, liver dysfunction, or perhaps DIC. The patient developed change in mental status with obtundation of unknown etiology. Blood cultures became positive with Staphylococcus (probably Methicillin-resistant) and Enterococcus. Later in the course of his disease, the blood cultures became positive for yeast forms. The patient continued to deteriorate with multi-organ failure including renal failure and uremia. The patient developed bilateral alveolar infiltrates, which was felt to be consistent with uremia edema. His bone marrow and peripheral blood showed continued pancytopenia secondary to the initial chemotherapy. The patient was to be supported therapeutically until his bone marrow could replenish. However, the patient continued to deteriorate with continued multi-organ failure with signs and symptoms of sepsis. He expired on 8/23/92 at 10:20 hours.
Old: Man in a Bucket
Inflammation and Repair - A

1. 36-year-old man with upper abdominal pain.

4. Teenager with foul-smelling stools and lung infections since childhood, (slide O).

6. 50-year-old woman with vague, past history of jaundice, final admission ascites and major hemoptysis, (slide T).

7. No history, (slide S).

8. 19-year-old man with abdominal pain.

9. 74-year-old man, incidental finding, (s)

11. 79-year-old man with rectal cancer 1 y

84-6566  28-year-old woman

VA-116-86  76-year-old man.

87-3459  49-year-old man. Anastomotic site.

87-1187  23-year-old woman

87-2713  40-year-old woman who drank Liquid.

90-93  42-year-old male with history of neuro
Findings at autopsy: Neurofibromas in carcinoid tumor.

91-138  91-year-old male with hypertension, chrc

S99-5089  33-year-old female with enlarged lymph

Inflammation and Repair - A

1. Acute gastric ulcer

4. Cystic fibrosis bronchioles

6. Cirrhosis - slide 79-3772

7. Old myocardial infarction

8. Acute appendicitis.


11. Bladder 1 year after rectal irradiation.

84-6566  Acute and chronic cholecystitis.

VA-116-86  Fat necrosis in and around pancreas.

87-3459  Peritonitis 3 weeks after perforation, subacute.

87-1187  Acute rejection at 29 days of renal transplant.

87-2713  Coagulative necrosis - esophagus.

90-93  Right lower lobe lung abscess with infarction, recent.

91-138  Advanced arteriosclerosis, bilateral. Chronic renal failure clinically.

S99-5089  Atypical follicular hyperplasia with plasma cell infiltrate consistent with Castleman’s disease, mixed type. Studies have shown that Castleman’s disease may be associated with subsequent development of neoplasms, particularly Kaposi’s sarcoma, Hodgkin’s disease, and non-Hodgkin’s lymphomas.
Old

- Great Specimens
- Each small group different
- No over-arching objectives / content / goals / outcomes
- No uniformity of experience among students
Small Group Organization: After Improvements
Pathology: Diagnosis and Study of Disease

Anatomic Pathology
- Surgical Pathology
- Cytopathology
- Autopsy Pathology
  - Forensic Pathology
- Molecular Pathology

Clinical Pathology ("Laboratory Medicine")
- Clinical Chemistry
- Toxicology
- Immunology
- Microbiology
- Hematology
- Blood Bank / Transfusion Medicine

What Should Be Taught:
- USMLE Step 1 Overview
  - Text Books
  - Robbins: Standard / Universal
- First Aid
- Group for Research in Pathology Education (GRIPE) lists
- Undergraduate Medical Education Section (UMEDS) of Association of Pathology Chairs content

Small Group Format

• **Attendance**
  – Required

• **Documents for Small Groups:**
  – Objectives
  – Instructor's Version: questions and suggested answers
  – Student's Version - no answers
  – Student's Version - with answers, for posting after session
  – Test Questions: for test; 3 questions per hour of teaching
  – Review Questions

• **Learning theory:**
  – Reinforce key concepts in several settings
    • Lectures
    • Small groups
  – Using questions and tests to challenge and refine knowledge base
Organization of Sessions

- Each session: 3 – 5 cases
- CPC Orientation
  - Objectives
  - History
  - Laboratory Data
  - Radiology Data
  - Anatomic Pathology Data
    - Gross:
      - Control
      - Patient specimen
    - Microscopic
      - Control
      - Patient specimen
- Clinical Correlations
  - Summaries / Tables / Diagrams
  - Treatment
  - Staging
  - Implications for future
- Pre-Test / Post-Test / Test preparation questions
Digestive System Component of DEMS Block

Case 1: 53-Year-Old Man with Intermittent Sublumbar Pain
GERD / Barrett Esophagus / Esophageal Adenocarcinoma

Subjective:
The patient is a 53-year-old man who is referred to the gastroenterology clinic because of an intermittent, burning gain behind his sternum. For 10 or more years he has experienced gastric distress in his chest 5-10 times per week lasting several hours, especially after meals or when he laid down. His symptoms are not relieved by exercise. The gain is associated with shortness of breath, nausea, vomiting, or radiation of pain to his back or arm. The gain is not controlled by taking a deep breath. His symptoms are worse if he eats spicy foods or drinks alcohol. He was seen short of breath by taking over the counter (OTC) heart medications (such as TMS or Madopar). He has not noted any swallowing difficulty or discomfort, weight loss, or change in appetite. His primary care doctor prescribed a proton pump inhibitor (PPI), which the patient usually takes once a day before he goes to bed. However, he still has gastrointestinal symptoms. He does not take any other medications. He smokes 1 pack of cigarettes daily and drinks 1-2 glasses of beer a week.

Objective:
A distinct gastro-esophageal disorder is present on examination. His physical examination reveals moderate obesity and a mild barrel chest appearance. There is no concomitant tendency to palpitation. On neurologic examination he has mild sensory deficits distal to the ankles bilaterally. Ears: otherwise normal.

Labs:
- Blood pressure (BP): 140/90 mm Hg
- Pulse: 62 / 115 mg/dL
- Hemoglobin (Hb): 95
- Platelets: 380,000
- SGOT: normal
- SGPT: normal

Clinical Questions:
1. Summarize the patient’s symptoms.
   - Burning substernal pain
   - Intermittent
   - Reflux of sublumbar food
   - Nausea
   - Not controlled by exercise

2. What organ systems need to be considered as possible causes of this patient’s symptoms? Which is most likely?
   - Gastrointestinal:
     - Gastroesophageal reflux disease (GERD) is likely given symptoms:
       - Consider ulcer
       - Consider esophageal cancer

   - Cardiovascular:
     - Heart disease is unlikely but must rule out
     - History of heart disease
     - Need to consider risk factors that could predispose him for cardiac disease

   - Pulmonary:
     - No significant change in breath

   - Neurologic:
     - No significant palpitation

3. Is he taking any proton pump inhibitors correctly? (he takes it once a day after he goes to bed “when I need it”)? If not, what schedule should be used and why?
   - No. He is not taking his medications correctly.

   - Proton pump inhibitors (e.g., Prilosec [omeprazole], Nexium [esomeprazole], etc.) should be taken 30-60 minutes prior to eating.
   - Active proton pumps: Substrates (e.g., gastric fundus) reside in the apical surface of the gastric cell membrane.
   - Basal pumps: “stored” in the membrane of specialized vesicles.
   - Translocated to the apical surface and fuse with the apical cell membrane
   - Influence of acid secretory signals (e.g., histamine, gastrin, and autonomic nervous system).
Digestive System Component of DEMS Block
Digestive System Component of DEMS Block
Supplemental “Gross” Materials
Test Preparation Materials
Results

• There has been an improvement in pathology component scores on the
  – NBME CBSE examination
  – NBME Step 1 examination

• Feedback: Course Evaluations / Exit Interviews
  – Strongly positive comments
    • Small group sessions
    • Practice questions on course evaluation
  – Far fewer complaints
Data Documents Impact of Changes: A Work In Progress
- I greatly enjoy the tables and mnemonics
- Dr. Boyer makes excellent study aids: by far the best we receive in CVPR
- He goes above and beyond the call of duty to provide students with detailed handouts and pretest practice questions
- Thanks for the mnemonics and review questions: they really help
- I’ll be using these to study for Step 1
- These were the most valuable materials I had to study for Step 1
## DEMS: A Work In Progress

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<td>Rate your opportunity to learn content through quizzes and/or practice questions.</td>
<td>4.1</td>
<td>3.8</td>
<td>3.9</td>
<td>-</td>
<td>-</td>
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<td>Rate the usefulness of the GI small group sessions.</td>
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<td>4.0</td>
<td>4.3</td>
<td>3.7</td>
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USMLE Step 1 Pass rate

COLORADO
NATIONAL
Exit Interviews

How well did study of following sciences prepare you for clinical experiences?

- Histology
- Microbiology
- Neuroscience
- Pathology
- Pharmacology

Bar chart showing the results of the survey.
Exit Interviews

Evidence Based Medicine
% Believe Instruction *Inadequate*

[Bar graph showing percentage of belief in inadequate instruction across different fields and years.]
Additional Data

• **Commencement Honors Ceremony**
  – Faculty Teaching Award – Nomination and Vote of Students
    • Basic Science
    • Clinical

• **“Master Educator” Funding by Medical School**
  – 0.20 FTE funding for 2012-2013 Academic Year
  – Previously 0.00 FTE funding by Medical School
Conclusions

• Work to date has met the primary objectives of improving and standardizing content.
• Advances during the 2012-2013 academic year
  – Incorporation of required Blackboard-based “pre-test” quizzes for each session
  – Further integration of content longitudinally within the course
  – Impute from clinicians on cases
  – Improvement of “Laboratory Medicine” component of the small groups and lectures
University of Colorado School of Medicine

Excellence in Education

Groundbreaking Research

(http://medschool.ucdenver.edu/)

Effort  Environment
Collaborators

- **University of Colorado**
  - Department of Pathology
    - Dana M. Grzybicki MD, PhD
    - Robert L. Low, MD, PhD

- **Department of Anatomy and Cell Biology**
  - Robin L. Michaels, PhD

- **School of Medicine**
  - Robin L. Michaels, PhD
  - Jennifer Gong
  - Gretchen Guiton, PhD