Roles of Basic Sciences in Clinical Reasoning Education

W. Cary Mobley, R.Ph., Ph.D
University of Florida College of Pharmacy
July 13, 2010
The Basic Sciences - A Broad Perspective

Basic Sciences
- Pathophysiology
- Pharmaceutics
- Med. Chemistry
- Pharmacology
- Pharmacokinetics
- Epidemiology
- Statistics
- Informatics
- Pharmacoeconomics
- Biochemistry
- Microbiology
- Psychology
- Sociology
- Communications
- Medical Chemistry

The Clinical Reasoning Spectrum

Diagnostic Reasoning
Therapeutic Reasoning
General Reasoning Processes

Analytical
- Induction,
- Hypothesis,
- Deduction

Nonanalytical
- Automatic
- Patterns

Solutions and decisions

General Values of Basic Sciences for the Health Care Practitioner

- For understanding
- For communication
- For furthering knowledge
- For translating knowledge
- For debunking
- For demystifying
- For valuing the whole patient
Roles of the Basic Sciences in Clinical Reasoning Processes

Preventing and resolving DRPs
- Obtaining patient information
- Organizing patient information
- Establishing cause and effect
- Developing a care plan
- Preventing premature closure
- Reflecting & integrating

Important Concept Attributes for the Education of the Clinician
- Integration
- Hierarchy
- Automatization
Integrating the Curriculum to Support Conceptual Integration

A Range of Possibilities
(The Integration Ladder)

- Trans-disciplinary
- Multi-disciplinary
- Complimentary
- Correlation
- Sharing
- Coordination
- Harmonization
- Awareness
- Isolation

RM Harden. The integration ladder: a tool for curriculum planning and evaluation. Medical Education 2000;34:551-557

An Approach to Curricular Integration:
Weaving the Training Around the Curriculum

Integrated Case Studies (ICS)

Year 1
Biochemistry, Physiology, Pharmaceutics, Microbiology, Intro Courses: to Pharmacy, to Medicinal Chemistry, to Pharmacology, to Pharmacotherapy

Year 2
Medicinal Chemistry, Pharmacology, Pharmacokinetics, Communications, Statistics, Pharmacotherapy...

Years 3 and 4
Evidence-Based Med., Law, Pharmacoeconomics, Drug Therapy Mon., Skills Labs, Pharmacotherapy, APPEs...
An Approach to Conceptual Integration:
ICS - Weaving the Curriculum Around the Patient

Intro to Healthcare
Biochemistry
Pathophysiology
Microbiology
Dosage Forms
Intro to Med Chem

General Description of the Integrated Case Studies Courses

- Using patient cases to integrate and apply curricular knowledge
- Facilitated, small-group sessions
- 3 to 4-week sequence: Case overview > Learning issue presentations > Practical applications and integrations
- Learning issue order: Pt/disease background > diagnosis and monitoring > patient care
Next Stage: Developing Clinical Reasoning Skills

• Integration alone is not enough

• Cognitive aids are multiplying

• For the “future of the profession”

Developing Clinical Reasoning Skills: Some General Considerations

• For the generalist
• Hierarchy and integration
• Basic sciences from beginning to end
• Analytical & non-analytical reasoning skills
• Independent rational thought
• Personal responsibility
• Habits of mind
Habits of Mind
(Costa and Kallick)

- Listening with Understanding and Empathy
- Gathering Data Through all Senses
- Managing Impulsivity
- Thinking and Communicating with Clarity and Precision
- Deferring Viability
- Applying Past Knowledge to New Situations
- Remaining Open to Continuous Learning
- Persisting
- Thinking Flexibly
- Creating, Imagining and Innovation
- Thinking about Thinking (Metacognition)
- Responding with Wonderment and Awe
- Taking Responsible Risks
- Striving for Accuracy
- Questioning and Posing Problems
- Humor

Developing Clinical Reasoning Skills: Some Important Themes

- The integrated patient
- Common illnesses, common DRPs
- Patient assessment
- Important basic science concepts
Developing Clinical Reasoning Skills: General Course Sequence

- Semester 1 - Understanding the patient and clinical reasoning processes
- Semester 2 - Differential assessment of patients' medical needs
- Semester 3 - Differential assessment and therapeutic reasoning of the prototypical patient
- Semester 4 - Differential assessment and therapeutic reasoning of prototypical and complex patients

Developing Clinical Reasoning Skills: Understanding Reasoning Processes

- Induction, hypothesis, deduction, and patterns
- Example: Include logical fallacies as causes of clinical error e.g., “post hoc, ergo propter hoc”
Developing Clinical Reasoning Skills: Exercises for Analytical Reasoning Processes

Mapping Examples:
- Integration
- Logical Pathways
- Patient Care Planning
- Pharmacotherapy Consults
If active renal resorption capacity exceeded

Sandra's breath odor

Formation of advanced glycation end products

Increased infection risk

Ketoacidosis

Increased ketones

Ketosis

Ketoacidosis

Vomiting

GI effect

Ketone bodies

Acetone

Dehydration

Increased hepatic gluconeogenesis

Increased glucagon

Increased fatty acid oxidation

Polyphagia

Decreased insulin

Protein catabolism

Insulin resistance

 increased glucose

Decreased bicarbonate

Increased serum glucose

Increased serum ketones

Increased anion gap metabolic acidosis

DKA

Increased hepatic glucose output

Increased hepatic gluconeogenesis

Increased hepatic ketogenesis

Increased hepatic ketone disposal

Increased hepatic glucose disposal

Insulin deficiency

Decreased insulin action

Decreased glucose uptake

Decreased glucose synthesis
Mapping for Patient Care Planning

Key Problem: Hypertension
136/84
Left ventricular hypertension

Key Problem: Hyperkalemia
K = 5.6 mEq/L

Reason for Needing Health Care:
Staph aureus Endocarditis

Key Assessments:
fever, chills, worsening shortness of breath,
past skin abscess
WBC = 15.4 x 10^3, Bands ~9% (Left shift)

I don't know how this fits with the problems
lesions on feet
spinter hemorrhages on right thumb

Key Problem: Renal Insufficiency
SCr = 1.9 mg/dL
BUN = 15 mg/dL
Alb = 2.6 g/dL
K = 5.6 mEq/L
Na = 133 mEq/L
Cl = 91 mEq/L

Key Problem: Valvular abnormalities
Past fenfluramine use
S3 sound present
III/VI holosystolic murmur
severe mitral regurgitation
Increased QTc interval
non-specific T-wave changes

Key Problem: Acidosis
Cl = 91 mEq/L
CO2 = 17 mEq/L
RR = 24

Key Problem: Diabetes
128 kg
Glucose = 185 mg/dL

Created by 2PD Integrated Case Studies Session Group 1 Students. Spring 2010
Mapping for Pharmacotherapy Consults

Title of Specific Disease State that will be managed

- PMH
- Social Hx

Consult Specifics

Patient interview/assessment data

- Assessment of Disease State from Consult

Specific drug therapy options and considerations

Plan

- Labs
- Med Review

1. D/C Amitriptyline
2. Lyrica 25mg qhs may increase to max 150mg daily if tolerated

Patient Ed

PMH

- Current Meds
- Med Review

Robin Moorman Li, Pharm.D.
Clinical Assistant Professor-JAX Campus
University of Florida, College of Pharmacy

Diabetic Peripheral Neuropathy

78 y/o f with severe DPN; possible drug induced confusion

1. Lisinopril 10mg daily
2. Amitriptyline 75mg qhs
3. Glargine 20 units qhs
4. Novolog 5 units tid

Amitriptyline improper due to pt age; anticholinergic SE can cause confusion

Negative for Tobacco, ETOH, Substance Abuse

Labs: WNL except CrCL calc: 23.3ml/min
AIC: 6.8%

Robin Moorman Li, Pharm.D.
Clinical Assistant Professor-JAX Campus
University of Florida, College of Pharmacy

1. Pain 7/10
2. Heat and rest improves pain
3. Only has been prescribed amitriptyline for DPN
4. C/O excessive daytime sedation/ dry mouth, confusion

1. DPN uncontrolled; improper drug selection

1. Pregabalin: renal dosage possible effective agent
2. Gabapentin: as above but possible tid dosing vs bid

1. D/C Amitriptyline
2. Lyrica 25mg qhs may increase to max 150mg daily if tolerated
Developing Clinical Reasoning Skills: Exercises for Non-analytical Reasoning Processes

- Patterns
e.g., of signs and symptoms

- Scripts
Goal-directed [automatized] knowledge structures

Illness Scripts

Problem list generation and processing

- Predisposing (Enabling) Conditions
  - Age >40 yr
  - Male sex
  - Alcohol use
  - Diuretics use

- Pathophysiological Insult (Fault)
  - Abnormal uric acid metabolism
  - Crystals in joint
  - Joint inflammation

- Clinical Consequence
  - Acute pain
  - Single joint (usually the first metatarsophalangeal)
  - Recurrent

Assessment of Clinical Reasoning Skills

- Need for Cognition Scale
- Diagnostic Thinking Inventory
- Rational-Experiential Inventory
- Health Sciences Reasoning Test
- Script Concordance Test

Script Concordance Test: Example

Clinical Vignette: “A 50-year-old pre-menopausal woman shows up for a routine visit in the Department of Occupational Medicine. Her body mass index is 28; she is sedentary. Glycosuria is found at screening urine analysis.”

<table>
<thead>
<tr>
<th>If the hypothesis is</th>
<th>And you know that</th>
<th>The hypothesis becomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Her glycosuria results from early-stage type 2 diabetes</td>
<td>Her FBG is 126 mg/dL, plasma insulin level was high</td>
<td>-2 Much less likely</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1 Less likely</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 Not affected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+1 More likely</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+2 Much more likely</td>
</tr>
</tbody>
</table>

Carrying Basic Science Education Forward

Basic Science Education
• Find the right depth
• Clinical correlations
• Critical concepts / automatizations / working knowledge

Clinical Science Education
• Integrate basic science
• Feedback to basic science educators

Curricular Coordination

Acknowledgements

Robin Moorman-Li, Pharm.D.
Ann Snyder, Pharm.D.
Ken Sloan, Ph.D.
Victoria Montoya
Doug Ried, Ph.D.
Larry Lopez, Pharm.D.
Tom Munyer, M.S.

Bill Riffee, Ph.D.
Vimla Patel, Ph.D.
Heather Hardin, Pharm.D.
Teresa Roane, Pharm.D.
Anna Hall, Pharm.D.
Shimaa Gonim, Pharm.D.
Diane Beck, Pharm.D.
Selected References


KW Eva. What every teacher needs to know about clinical reasoning. *Medical Education* 2004; 39: 98–106


