Balancing Science and Practice in the PharmD Curriculum

Ralph J. Altiere, Ph.D., Dean
University of Colorado
School of Pharmacy
Aurora, CO USA

2011 Pharmacy Education Symposium
Prato, Italy
General Outline & Learning Objectives

General Outline
Evolution of the pharmacy curriculum
  Baccalaureate to PharmD program
Basic science and therapeutics in the curriculum
Emerging curriculum

Learning objectives
Describe outcomes of clinical education in PharmD programs
Discuss the value of integration of science and therapeutics coursework
Stimulate ideas for improving contextual relationships between science and clinical education
BS Pharmacy Curriculum 1995-1996

Outcomes
Ability to:
- Apply clinical pharmacy knowledge and skills
- Apply pharmaceutical and general practice knowledge and skills
- Apply management and administrative knowledge

Competency Areas
- Monitor Therapies
- Provide Drug Information
- Patient Counseling
- Communication Skills in the Clinical Area
- Pharmacy Management
- Jurisprudence
- Compounding, Dispensing and Drug Delivery
BS Pharmacy Curriculum 1995-1996

Prerequisites

Two years and minimum 61 semester credit hours
General education
General chemistry, organic chemistry, general biology and microbiology all with laboratory
Calculus, English composition, public speaking, social science
No physics, physiology, biochemistry, statistics
BS Pharmacy Curriculum 1995-1996

Three-year program after two years of prerequisites
Baccalaureate Curriculum 1995-96
(Years in Professional Program)

<table>
<thead>
<tr>
<th>BS PROGRAM (current)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1ST YEAR - 32 credit hours</strong></td>
<td></td>
</tr>
<tr>
<td><strong>FALL (15 HOURS)</strong></td>
<td></td>
</tr>
<tr>
<td>PHPR 3200 Pharmacy &amp; Health Care</td>
<td>3</td>
</tr>
<tr>
<td>PHPR 3090 Medical Terminology</td>
<td>2</td>
</tr>
<tr>
<td>PHSC 3100 Pharmaceutics I</td>
<td>3</td>
</tr>
<tr>
<td>PHSC 3400 Physiology &amp; Pathology I</td>
<td>3</td>
</tr>
<tr>
<td>PHSC 3611 Biochemistry &amp; Biotechnology</td>
<td>4</td>
</tr>
<tr>
<td><strong>SPRING (17 HOURS)</strong></td>
<td></td>
</tr>
<tr>
<td>PHPR 3070 Pharmacy Communications</td>
<td>3</td>
</tr>
<tr>
<td>PHSC 3110 Pharmaceutics II</td>
<td>3</td>
</tr>
<tr>
<td>PHSC 3111 Pharmaceutics Lab &amp; Calcs</td>
<td>3</td>
</tr>
<tr>
<td>PHSC 3410 Physiology and Pathology II</td>
<td>4</td>
</tr>
<tr>
<td>PHSC 3510 Cellular Pathology</td>
<td>2</td>
</tr>
<tr>
<td>PHSC 4720 Medicinal Chemistry</td>
<td>2</td>
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</tbody>
</table>

| **2ND YEAR - 33-35 credit hours**        |         |
| **FALL (17 HOURS)**                      |         |
| PHSC 4520 Pharmacology I                 | 4       |
| PHPR 4600 Pharmacotherapeutics I         | 3       |
| PHSC 4730 Medicinal Chemistry II         | 4       |
| PHPR 4680 Pharmacy Management            | 3       |
| PHPR 4300 Non-prescript. Drugs           | 3       |

| **SPRING (16-18 HOURS)**                 |         |
| PHSC 4530 Pharmacology II                | 5       |
| PHPR 4610 Pharmacotherapeutics II        | 5       |
| PHPR 4790 Biopharmaceutics & P'kinetics  | 4       |
| PHSC 4740 Toxicology                     | 2       |
| (PHXX xxxx Elective - optional)          | 2       |

| **3RD YEAR - 30-31 credit hours**        |         |
| **FALL (12-13 HOURS)**                   |         |
| PHPR 4400 Intro Externship               | 2       |
| PHPR 4500 Pharmacy Law & Ethics          | 3       |
| PHSC 3520 Immunology                     | 3       |
| Elective                                 | 2       |
| Elective                                 | 2-3     |

| **SPRING (18 HOURS)**                    |         |
| PHPR 4910 Ambulatory Externship (6 wks)  | 6       |
| PHPR 4912 Institutional Externship (6 wks)| 6       |
| PHPR 4938 Elective Externship (6 wks)    | 6       |

Total credit hours - Prof - 95; Pre & Prof - 156 minimum
### BS Pharmacy Curriculum 1995-1996

Percentage of coursework devoted to basic sciences and clinical courses

<table>
<thead>
<tr>
<th></th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic science</td>
<td>75%</td>
<td>58%</td>
<td>10%</td>
<td>48%</td>
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<tr>
<td>Clinical (total)</td>
<td>16%</td>
<td>33%</td>
<td>83%</td>
<td>42%</td>
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<tr>
<td>Therapeutics</td>
<td>0%</td>
<td>33%</td>
<td>15%</td>
<td>9%</td>
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<tr>
<td>Other</td>
<td>9%</td>
<td>9%</td>
<td>10%</td>
<td>9%</td>
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</tbody>
</table>

Types of delivery methods
- Mostly didactic lectures
- Modest skills development
- Experiential
PharmD curriculum

Started 1999-2000 academic year

Foundational principles:
- General practice competency
- Abilities-based education
- Integration of subject matter
- Longitudinal experiential programming
- Active learning
- Patient focus
PharmD curriculum

Abilities Based Outcomes*

General Ability-Based Outcomes
- Communicate using various modes of communication including people, text, media and technology
- Think critically, solve problems and make decisions
- Make value judgments and independent decisions
- Integrate information derived from theory, concepts and factual evidence
- Demonstrate effective interpersonal and professional interactions
- Self-assess and engage in self-directed learning

Pharmacy Specific Ability-Based Outcomes
- Integrate knowledge, skills and attitudes gained in basic, clinical and socio-behavioral sciences to provide pharmaceutical care to individuals, families and diverse patient populations in various practice settings
- Apply the principles of economic and administrative sciences to address the pharmacy-related needs of contemporary society
- Engage in activities to provide drug information and education and to promote public health
- Demonstrate professional and social responsibility

*ABOs derived from national outcomes documents
PharmD curriculum

2009 Revisions

Curriculum Mission Domains
- Patient Care
- Systems Management
- Public Health
- Professionalism and Communication
- Scholarship
PharmD curriculum

2009 Revisions
New ABOs – The Colorado 14
1. Collect appropriate patient data to make an assessment
2. Conduct a patient-centered assessment
3. Design, implement, evaluate and adjust a patient-centered pharmacy care plan
4. Process medication related orders
5. Provide population-centered care
6. Manage aspects of pharmacy operations using appropriate data and procedures
7. Manage a successful patient-centered practice
8. Retrieve, evaluate, and utilize basic science, professional, and lay information in a critical and scientific manner that enhances the practice of pharmacy
9. Manage medication use systems to optimize patient and population outcomes
10. Develop and participate in health promotion, disease prevention, and public health policy
11. Exhibit the highest standards of professional and ethical behavior in pharmacy practice
12. Maintain professional competency and professional stewardship
13. Apply basic and clinical scientific principles and methods to identify and solve problems
14. Communicate effectively using multiple strategies to improve health outcomes
PharmD curriculum

Prerequisites - 1999
Same as for BS program
Plus: anatomy or anatomy & physiology; general physics 1;
macro or microeconomics

Prerequisites - 2009 revision
Same as above plus
Biochemistry
Human Physiology
Additional General Education credit hours
Recommended courses: cell biology and immunology
Total = 90 credit hours = 3 years
### PharmD curriculum

#### Four-year professional program

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Grade</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Fall</td>
<td>PHRD 3600</td>
<td>Science Fundamentals</td>
<td>3</td>
<td>2.5</td>
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<tr>
<td>P1</td>
<td>PHRD 3650</td>
<td>Principles of Drug Action</td>
<td>4</td>
<td>3.0</td>
</tr>
<tr>
<td>Spring</td>
<td>PHRD 3760</td>
<td>Integrated Org Sys 1</td>
<td>4</td>
<td>3.0</td>
</tr>
<tr>
<td>Fall</td>
<td>PHRD 4750</td>
<td>Clinical Science Fundamentals</td>
<td>4</td>
<td>3.0</td>
</tr>
<tr>
<td>P2</td>
<td>PHRD 4760</td>
<td>Integrated Org Sys 2</td>
<td>4</td>
<td>3.0</td>
</tr>
<tr>
<td>Spring</td>
<td>PHRD 4770</td>
<td>Integrated Org Sys 3</td>
<td>4</td>
<td>3.0</td>
</tr>
<tr>
<td>Fall</td>
<td>PHRD 5700</td>
<td>Integrated Org Sys 4</td>
<td>4</td>
<td>3.0</td>
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<tr>
<td>P3</td>
<td>PHRD 5710</td>
<td>Integrated Org Sys 5</td>
<td>4</td>
<td>3.0</td>
</tr>
<tr>
<td>Spring</td>
<td>PHRD 5720</td>
<td>Integrated Org Sys 6</td>
<td>4</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Note: The table above outlines the curriculum for the PharmD program, detailing the courses, grade points, and credits for each semester.
### PharmD curriculum

<table>
<thead>
<tr>
<th>Curriculum Area</th>
<th>1995 vs. 2011 Credit Hours</th>
<th>1995 vs. 2011 Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic sciences</td>
<td>46 vs. 33.5</td>
<td>48% vs. 22%</td>
</tr>
<tr>
<td>Clinical total</td>
<td>40 vs. 99</td>
<td>42% vs. 65%</td>
</tr>
<tr>
<td>Pharmacotherapeutics</td>
<td>[9 vs. 31]</td>
<td>[9% vs. 20%]</td>
</tr>
<tr>
<td>Other</td>
<td>9 vs. 23</td>
<td>9% vs. 15%</td>
</tr>
</tbody>
</table>

**Types of courses offered**
- Increased active learning
- Increased skill development
- Increased experiential
- Reduced didactic
- Integrated coursework
- Emphasis on EBP and problem solving
- Increased technology
PharmD curriculum

**Integrated coursework**

**BS program**
- Discipline specific courses

**PharmD program**
- Fewer discipline specific courses
- More integrated coursework
- Integration of sciences within science courses
- Integration of science with pharmacotherapeutics
- IOS – integrated organ systems courses
- Integration with skills and experiential
PharmD curriculum

Basic sciences

SF 1 = Science Foundations 1: pharmaceutics
SF 2 = Science Foundations 2: biochemistry and cell biology introduction
PDA = Principles of Drug Action: principles of pharmacology and medicinal chemistry
CSF = Clinical Science Foundations: PK and ADME; PG; toxicology
IOS 1 = Physiology
Pathophysiology and pharmacology – IOS courses
PharmD curriculum

**IOS/Terapeutics courses**
- Primarily pharmacotherapeutics
- Pathophysiology, pharmacology
- Minor pharmaceutics and medicinal chemistry
- Lectures and case studies

IOS 1 = physiology (no therapeutics)
IOS 2 = pharmacology of ANS and anti-inflammatory agents

IOS 3, 4, 5 = renal, CV, pulmonary systems
IOS 6 = immunology and oncology
IOS 7 = GI, liver, nutrition
IOS 8 = CNS, neurology
IOS 9 = endocrine
IOS 10, 11 = infectious diseases
Total of 37 credit hours
PharmD curriculum

IOS 3 and 4 (5 cr)

Renal: pharmacology of diuretics; acid/base and fluid/electrolytes; pathophysiology and therapeutics of acute and chronic renal diseases
CV: HTN pathophysiology; pharmacology and therapeutics of anti-HTN drugs
CV: dyslipidemia including angina pathophysiology; pharmacology/med chem.; and therapeutics of dyslipidemia drugs

Pathophysiology = 26%
Pharmacology = 21%
Therapeutics = 53%
PharmD curriculum

IOS 5 (4 cr)

- Anti-coagulation
- Heart failure
- Acute coronary syndrome
- Dysrhythmias
- Pulmonary - allergic rhinitis; asthma; COPD; CF

Pathophysiology = 21%
Pharmaceutics = 4%
Pharmacology = 21%
Therapeutics = 54%
PharmD curriculum

**Pharmacotherapeutics** covers:

- Drugs
- Dosages
- Indications and use (drug of choice; second choice; combination, etc.)
- Combinations where appropriate
- Clinical guidelines and EBP
- Side effects and toxicities
- Monitoring drug therapy
- Interactions
- Contraindications
- Case studies
- Clinical controversies
PharmD curriculum

Active learning courses
P1-P3 skills development
- Patient interviews, counseling and education; communications with HC professionals
- Physical assessment skills, health screening skills
- Application of IOS/therapeutics and other (e.g., DI, primary literature) material
- Case studies, simulated patients, MTM skills
- Verbal and written assessments; PBEs and OSCE type assessments
- Increasing complexity and difficulty P1 to P3 years
- Aligned with other components of the curriculum, e.g., in P1 year emphasis on OTC products and patient counseling aligned with IPPE activities and expectations

Comprehensive Patient Care (CPC)
- Capstone course
- Application of all learned material, primarily pharmacotherapeutics
- Case studies
- Primarily PBL type course and OSCE type assessments
P3 Professional Skills Development

Outcomes
1. Collect appropriate patient data to make an assessment
2. Conduct a patient-centered assessment
3. Design, implement, evaluate and adjust a patient-centered pharmacy care plan
4. Process medication related orders
5. Retrieve, evaluate, and utilize basic science, professional, and lay information in a critical and scientific manner that enhances the practice of pharmacy
6. Communicate effectively using multiple strategies to improve health outcomes

Competency based course
Must demonstrate competency in each skill in order to pass each exercise and the course
Verbal and written assessments
Simulated patient exercise, PK calculations, medication review, chart review, communications skills (in person or telephone), case studies, health screenings, etc.
PharmD curriculum

P3 Professional Skills Development

Active learning
All active learning (no lectures) through
In class activities (e.g., group discussion; think-pair-share; simulations; role-playing; debates; sample cases; standardized patient interviews) and
Self-learning activities (e.g., textbook and literature materials, Powerpoint and video demonstrations)

Two examples of course activities
Clinical recommendations in a dispensing role with limited information
Student given Rx medication profile and patient provided OTC meds only
Student must determine medical conditions, identify drug related problems, formulate recommendations to physician(s), determine what lab values are needed to fully assess patient conditions and needs

Self learning and demonstration of specific skills, e.g., assessment of patients with diabetes including glucometer training, insulin training and foot exam
Student assessed on ability to perform each activity according to a standard rubric.
Students given multiple chances to demonstrate competency

Pharmacotherapeutics
All exercises require application of pharmacotherapeutics knowledge
PharmD curriculum

Comprehensive Patient Care (CPC)

Capstone course in P3 spring just before full year of clinical APPEs
100% active learning, self-learning course
Various activities related to patient centered care
All exercises involve patients with multiple, complex medical conditions (less complex conditions used in skills courses)
All require application of prior learning – focused mainly on pharmacotherapeutics but also science knowledge, skills development, literature evaluation, etc.
Students are expected to evaluate patient conditions, medications, other relevant information and develop specific pharmacy care plans with high, medium and low priority issues to be addressed
Assessment by in class patient case presentations, EBM sessions requiring student evaluation and application of primary literature to patient cases, and individual written and verbal exams and case presentations
PharmD curriculum

Experiential

A major component of the curriculum = approximately one-third of curriculum, P1-P3 IPPEs; P4 APPEs

Utilizes all learning in other parts of curriculum

Provides real life experience in all aspects of practice – dispensing, patient counseling, direct patient care (immunizations, health screenings, anti-coagulation monitoring, HTN, asthma, DM clinics, etc.), management, research opportunities, etc.
PharmD curriculum

Contextual Learning and Basic Sciences*

Learning a disease from a basic science vs. epidemiologic perspective leads to greater learning and application to clinical cases. (Woods et al, The Value of Basic Science in Clinical Diagnosis. Acad Med. 2006; 81(10 Suppl):S124–S127)

Contextual knowledge leads to increased learning and application.

*Dr. Kari Franson
PharmD curriculum

Learning in context
- A newspaper is better than a magazine
- The coast is better than the street
- First it is better to run than to walk
- You will have to try it several times
- Some skill is required but it is easy to learn
- Even small children can enjoy it
- Once successful the chance for complications is minimal
- Birds seldom get too close
- Rain soaks in very fast
- A rock can be a good anchor
- Once it is broken loose you won’t get a second chance
PharmD curriculum

Learning in context – flying a kite

- A newspaper is better than a magazine
- The coast is better than the street
- First it is better to run than to walk
- You will have to try it several times
- Some skill is required but it is easy to learn
- Even small children can enjoy it
- Once successful the chance for complications is minimal
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- A rock can be a good anchor
- Once it is broken loose you won’t get a second chance
PharmD curriculum

Learning in context

What does this mean for the role of basic sciences in education?

Basic sciences are not the foundation
Basic sciences are essential
  To support hypothetical-deductive reasoning
  To provide meaningfulness to cases
  To provide a scaffold for deeper understanding

Basic sciences are relevant if they
  Relate to real life problems
  Are taught and assessed in relation to actual practice
  Are used to de-contextualise and re-contextualise
Learning in context

What does this mean for the role of basic sciences in education?

Assessment of basic sciences in the curriculum:
  Is preferably problem or vignette-related
  Context, meaningfulness, encoding specificity
  Has a clear relationship with practice
  Relevance, context, meaningfulness
  Stimulates transfer
  Understanding of deep structure
Learning in context

Dual Roles
Science should be taught within the context of human health and disease and for us within the context of pharmacy practice

Clinical sciences and therapeutics should to be taught in the context of the scientific basis for understanding the disease state and its treatment

Question – how does our curriculum - or your curriculum – measure up?
PharmD curriculum

Changing Practice and Emerging Curriculum

Need for greater contextual learning

Dispensing role diminishing
Technology use in practice increasing
Patient-centered clinical roles emerging
Increased focus on health outcomes for reimbursement

“No longer go to pharmacy school to secure a job
Go to pharmacy school to help create your future”
PharmD curriculum

Changing Practice and Emerging Curriculum

Basic sciences
   Prerequisites
   Pharmacy curriculum – more contextual, more application

Clinical sciences and therapeutics
   Greater use of science in context of diseases and therapies

IPE
PharmD curriculum

Contextual Learning in the Curriculum

Historical perspective
Hopkins model
University of Colorado 1911 - 1998

Knowledge

Experiential
Assessing student levels of competence

Modified Miller model
University of Colorado 1999 - 2012

Knowledge

Skills practice

Experiential
Knows how

Does

Shows how

Knows how

Knows

Teaches what is possible

What is already known and can be done

How to create professionals ready for life-long learning
# Interdependency model translated into courses

<table>
<thead>
<tr>
<th>P1 Fall</th>
<th>P1 Spring</th>
<th>P2 Fall</th>
<th>P2 Spring</th>
<th>P3 Fall</th>
<th>P3 Spring</th>
<th>P4 Summer</th>
<th>P4 Fall</th>
<th>P4 Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease States</td>
<td>Pharmacology</td>
<td>Pharmacokinetics</td>
<td>Pharmacogenomics</td>
<td>Advanced Informatics</td>
<td>Informatics</td>
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<tr>
<td>Applied biological chemistry</td>
<td>Communication Foundation</td>
<td>Medicinal Chemistry</td>
<td>Public Health &amp; Outcomes</td>
<td>Pharmacy Management</td>
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<td>Communication Foundation</td>
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<td>Pharmacy Law Regulations</td>
<td>Introduction Drug Information</td>
<td>Public Health &amp; Outcomes</td>
<td>Integrated Clinical Sciences</td>
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<tr>
<td>Practice &amp; Informatics Fundamentals</td>
<td>Self-Care Nutrition</td>
<td>Integrated Clinical Sciences</td>
<td>Principles of Research</td>
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<tr>
<td>Self-Care Nutrition</td>
<td>Integrated Clinical Sciences</td>
<td>Integrated Clinical Sciences</td>
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</tbody>
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**Professional Development Portfolio**

[University of Colorado Anschutz Medical Campus School of Pharmacy]