

Teaching Biochemistry to Students of Medicine, Dentistry & Pharmacy

3rd Conference of the Association of Biochemistry Course Directors (ABCD), Myrtle Beach SC, USA, April 30-May 4, 2011

Introduction

Ninety faculty educators representing 77 institutions from North America and the Caribbean met to discuss the teaching of biochemistry to students of medicine, pharmacy, and dentistry. Plenary sessions and workshops are summarized below.

Plenary session I: Student-centered teaching

Drs. Richard Sabina (Oakland University William Beaumont School of Medicine, Rochester, MI) and Edward McKee (Indiana University School of Medicine-South Bend, IN) introduced this mode of teaching during the welcome dinner by facilitating a Team-Based Learning[©] (TBL) session on hot peppers that was designed to both simulate an exercise and acquaint conference attendees with each other. The plenary session on the next day featured:

- **Concept-Mapping in Team-Based Learning (TBL):** Drs. Kathryn Thompson and Renée LeClair (University of New England College of Osteopathic Medicine, Biddeford, ME) led the audience through a TBL session on hypoglycemia in an alcoholic patient. The entire biochemistry curriculum at their school is taught in a TBL format. Students have access to brief video lectures on every major pathway. Readings for TBL are taken from references that clinicians use. During a TBL session, students are given a list of concepts and each group is asked to create a map that connects biochemistry to the clinical domain. Groups trade maps and grade them according to a detailed rubric that includes overall presentation, content, understanding of facts and concepts, and links between metabolism, clinical problems, and treatments.

- **Problem-Based Learning (PBL):** Dr. W. Marshall Anderson (Indiana University School of Medicine - Northwest, Gary, IN) presented a PBL case on phenylketonuria. This case and material for 13 others is available from MedEdPORTAL: http://services.aamc.org/30/mededportal/servlet/s/segment/mededportal/find_resources/browse/?su_bid=210. Dr. Anderson includes 6 PBL cases in his 6-week course. Twenty-six students in four groups meet for 2-hour PBL sessions three to five times per week and are asked to learn about biochemical processes, rather than be content with making a correct diagnosis of the case.

- **A 3-quiz paradigm:** Dr. Steven King (Oregon Health & Science University School of Dentistry, Portland, OR) reported giving students a 6-question quiz, then asking groups of 7-8 students to answer the same quiz, and finally testing individual students with a new, closely related quiz. Each student's grade depends on the two individual quiz grades and the group's quiz grade. Students have an incentive to come well prepared, and to learn from their group.

- **Simulation:** Dr. David Pederson (Ross University School of Medicine, Roseau, Dominica) stated that a typical simulation is about 15 min long, multidisciplinary, and matters with regard to patient safety. Cases take approximately one year to develop, which includes trial runs on faculty and students. In simulations, testing occurs before learning and also drives learning that follows the session. Hence, providing students with feedback is extremely important.

Dr. Mary Wimmer (West Virginia University School of Medicine, Morgantown, WV) reported on using simulation of congestive heart failure and gunshot trauma as an introduction to PBL cases in the first year. Students learn to interpret monitors in the

E.R., operate a hospital bed, administer oxygen or IV saline, and work in a team.

Dr. Ralph Keil (Penn State Hershey Medical Center, Hershey, PA) reported on a simulation of diabetic ketoacidosis (published in *Simulation in Healthcare* 2009; 4: 232-236), which is a part of a PBL case. Students learn about monitors in the E.R., cannulas and masks for giving O₂, infusions, glucometers, and insulin.

Plenary Session II: Assessment and Remediation

This session focused on student assessment, student remediation in integrated curricula, and guidance of self-directed learning.

• Predicting At-Risk Students Using a Diagnostic Proficiency Examination:

Dr. Neil Osheroff (Vanderbilt University School of Medicine, Nashville, TN), reported on a fifty-item multiple choice proficiency exam administered to students prior to the start of a first-semester interdisciplinary course in biochemistry, molecular biology, and genetics. Scores predicted performance in the course in each of the three years studied. This information has helped guide intervention and academic support for at-risk students.

• Just in Time Teaching (JiTT):

Dr. David Franklin (Tulane University School of Medicine, New Orleans, LA) described JiTT, a mode of teaching that adjusts to students' needs. Students receive a lecture or reading assignment (e.g., lipoproteins in the blood). The results of a subsequent online exam (including an essay question about issues the students do not understand) guide the instructor in the design of the next lesson. Dr. Franklin indicated that students feel this method gives them greater control of how they are taught. The method also leads to higher class attendance.

• NBME Examination Services:

Dr. Agata Butler (National Board of Medical Examiners, Philadelphia, PA) described the Comprehensive Basic Science Self Assessment (CBSSA) exam, which allows students to assess their level of preparation for the USMLE Step 1 exam (for outcome data, see *Academic Medicine* 2010; 85 (Oct.): S98-S101, 2010). Six different testing forms are available. After most exams, students can access incorrectly answered questions but are not provided with correct answers. Dr. Butler concluded with an overview of customized services. The NBME retires questions from the USMLE question bank yearly.

After review, some questions are reused for customized subject exams, and new questions are written for this purpose as needed.

• Remediation in an Integrated Curriculum:

Dr. Tracy Fulton (University of California, San Francisco, CA), reported on remediation of biochemistry within UCSF's integrated medical curriculum. Performance in 18 individual disciplines is tracked through the first two years by tagging exam questions in one or more categories. Students are informed at regular intervals of their longitudinal performance and encouraged to consult relevant discipline representatives regarding areas of weakness. Few students have done so, although many subsequently asked for additional discipline-specific support to prepare for the Step 1 board exam.

• Activating Self-Regulated Learning (SRL):

Dr. Ryan Brydges (Department of Medicine and The Wilson Centre, University of Toronto, Toronto, Ont.), presented research on adult SRL. Dr. Brydges emphasized that faculty must share the responsibility in helping students learn how to study optimally. They also must encourage students to improve their study habits through self-reflection. To this end, faculty should consider ways to support students in their efforts to self-regulate learning.

Plenary Session III: New Curricula

This session focused on innovative curricula in medical schools.

• Molecular Foundations of Medicine: An Interdisciplinary Biochemistry Based Course:

Dr. Neil Osheroff reported on creating a ~150-hour integrated course of biochemistry, cell biology, tissue biology, and genetics. The course leadership consists of a biochemist, a cell biologist, and a geneticist, who work together. Thereby, one person serves as a clear leader. Integration occurred mostly along a backbone of biochemistry. Advantages of integration are increased support from the school, increased student interest and satisfaction, and higher board scores.

• Biochemistry in an Integrated M1/M2 Organ-System Curriculum:

Dr. Richard Sabina presented an overview of the integrated curriculum that will be implemented at this new school in 2011. Students will receive biomedical foundations in the first semester and organ-based courses during the remainder of the pre-clinical curriculum. Basic science concepts will be reinforced in the clinical

curriculum. Full-time basic science educators serve as discipline directors and each organ-based course has clinical and basic science co-directors.

• **Teaching Biochemistry in an Integrated First-Year Medical School Curriculum:** Dr. Clive Slaughter (Georgia Health Sciences University-University of Georgia Medical Partnership, Athens, GA) reported on the first year of an integrated, organ-system-based curriculum at this new campus. Repetition is thought to be key to learning, whereby depth and breadth are increased with each visit of a topic. Content is organized into weekly themes. Case-based learning in small groups focuses on a case written by a team of basic and clinical scientists that unfolds over 6 hours during the week. Between sessions, students pursue and report on learning assignments. In addition, 6-8 hours of large-group sessions focus on background or difficult topics related to the week's theme. Building genuinely integrated learning materials and sessions has been very challenging, yet the students truly appreciate the clinically relevant instruction, and basic science faculty find new working relationships with clinicians rewarding.

• **Using Clinical Case Conferences as a Means of Delivering Basic Science Content in the Clerkship Years:** Dr. Steven Ellis (University of Louisville School of Medicine, Louisville, KY) proposed to increase the presence of basic scientists in clinical conferences, such as Grand Rounds, in an attempt to increase exposure of 3rd- and 4th-year medical students to basic science.

• **Curriculum integration or differentiation?** Dr. Chin-To Fong (University of Rochester School of Medicine, Rochester, NY) reported on an exercise during the basic science block in the third year. Groups of 3 students are given a picture along with 1-2 sentences about a real patient. The students have to find dysmorphic features, establish a leading diagnosis, delineate the causative developmental pathway abnormality, determine possible intervention, conceive counseling, and generate a 30-min group presentation.

• **Integration of a Basic Science Assessment into a Clinical Performance Exam:** Dr. Katherine Hyland (University of California, San Francisco, CA), reported on a pilot program that incorporates five case-based genetics questions into a 4th year clinical performance exam. Initial outcomes indicate that students perform rather poorly, thus reinforcing the need for greater integration of genetics into the clinical years.

• **Integration of Genetics and Basic Science into the 4th Year of Medical School Using Clinical Cases:** Dr. Darrel Waggoner (University of Chicago, Chicago, IL) reported on a basic science elective late in the 4th year. If, e.g., Marfan syndrome is the course topic, individual students are given questions that relate to their future field of residency training (e.g., obstetric care and delivery, surgical repair of pectus excavatum). Students research the underlying science and prepare a presentation that includes a basic science paper.

Plenary Session IV: Nutrition

This session included information about a network of nutrition educators, on-line resources, and examples of instruction in nutrition.

• **Resources for Nutrition Education:** Dr. Martin Kohlmeier (University of North Carolina at Chapel Hill, Chapel Hill, NC) show-cased the Nutrition in Medicine online curriculum for healthcare professionals (www.nutritioninmedicine.org). There are 29 curated modules that contain lessons, tools, interactive learning, case studies, and review questions. Faculty who are interested in joining a budding network of nutrition educators can send an e-mail to mkohlmeier@unc.edu

• **Nutrition Curricula:** Dr. Janet Lindsley (University of Utah, Salt Lake City, UT) described weaving nutrition education throughout the entire medical school curriculum. In addition to studying on-line nutrition modules, her first-year students do a variety of activities including a body composition and 3-day diet analysis, blood glucose laboratory with different breakfasts, and efficacy analysis of dietary supplements.

Dr. Alan Diekman (University of Arkansas for Medical Sciences, Little Rock, AR) described nutrition education in an integrated first-year curriculum. Among the fun activities is a supermarket tour, whereby students focus on macro- and micronutrients.

Dr. Clive Slaughter emphasized that nutrition can easily be built into an integrated curriculum, and he showed several examples of this.

Dr. Chin-To Fong described an experiential culinary laboratory that involves faculty, dietetic interns, and hospital nutritional support staff. Groups of 5 students prepare meals that would be suitable for patients with disorders such as hyperlipidemia, hypertension, obesity, or celiac disease. Pre-class preparation includes nutritional assessment, recipe selection, and feedback from dietetic interns. Following meal consumption, groups analyze food

choices and meal quality, and they also propose improvements.

Plenary Session V: Continuing Education

This session has become a staple at ABCD meetings. Members identify topics that are controversial or difficult to teach. Presentations included the following topics:

- **Regulation of phosphofructokinase** (Dr. Eric Niederhoffer, Southern Illinois University School of Medicine, Carbondale, IL).
- **Serotonin as a growth factor** (Dr. Brad Jameson, Drexel University College of Medicine, Philadelphia, PA).
- **De novo fatty acid synthesis in overfed humans** (Dr. Jim Shoemaker, Saint Louis University School of Medicine, St. Louis, MO).
- **B12 and folate deficiency and neurological changes** (Dr. Michael Lieberman, University of Cincinnati College of Medicine, Cincinnati, OH).
- **Dyslipidemic triad in the metabolic syndrome and type 2 diabetes mellitus** (Dr. Richard Sabina).

Workshops

• **Working Sessions to Create Biochemistry Competencies & Objectives for Undergraduate Medical Education:** To support improvements in curricula, ABCD is developing competencies and learning objectives in biochemistry for students. This process started at the 2009 meeting with the production of lists of topics that should be included in medical curricula. The importance of each topic in medical, pharmacy, and dental curricula was evaluated in member surveys shortly before the 2011 meeting. At the 2011 meeting, ten working groups of 8-19 faculty each produced a set of learning objectives from existing topics lists and sample objectives. The resulting lists of learning objectives represent the consensus opinion of each working group. The entire group of conference attendees specifically approved a short document of overarching competencies that map to the six ACGME domains of competency. The ABCD will next appoint a small working group to review, refine, and link the existing topics, competencies, and learning objectives. The combined document will be distributed to the ABCD membership for review and approval to disseminate publicly.

• **Multiple Choice Questions and Assessment:** The objective of this workshop was to improve the

participants' ability to write quality NBME-style multiple-choice questions that assess specific learning objectives. Conducted in a TBL format, this session was led by Drs. Janet Lindsley, Eric Niederhoffer, and Clive Slaughter, who have experience writing for the NBME.

• **Resource Exchange:** This workshop was designed to allow faculty to share educational activities. The following presentations were made:

- **Jigsaw:** Cooperative Learning: Dr. Emine Abali (Robert Wood Johnson Medical School, New Brunswick, NJ) described the jigsaw concept: n diverse groups of n students (e.g., n=5) are formed, and each group becomes an expert on one of n topics that relate to a common clinical problem (e.g., diarrhea). After appropriate remixing of groups, each group member teaches the other group members about the topic learned in the first group. The second set of groups then solves a problem that requires knowledge of all topic areas. Afterwards, the instructor can highlight important points and administer a test.

- **Faculty Development for Biochemists and Beyond:** Dr. Tracy Fulton described workshops she has developed and facilitates for faculty development, such as training small-group facilitators, or developing learning objectives (the latter topic was also taught to conference participants before they were asked to participate in working sessions to write biochemistry objectives). Such workshops can be published for a wider audience via MedEdPORTAL. Dr. Fulton led the audience through a brief simulation of a workshop on "Giving an Effective Lecture".

- **Peer-Facilitated Break-out Discussions in Biochemistry:** Dr. Gemma Geslani, (St. Louis College of Pharmacy, St. Louis, MO) described a method to add active learning to a 2-hour lecture period. Small groups of students are given a brief assignment, case, or problem. The exercise concludes with a whole-class discussion.

- **Vitamin-Jeopardy:** Dr. David Franklin described an active mode for learning about vitamins in friendly competition. Students are given pre-session resources and come to class ready to compete. Dr. Franklin uses Jeopardy and an audience response system from Turning Point. Usually, women compete with men. Answering times and correct answers are used to determine the most valuable players, who then compete in the final jeopardy question. Category topics for the game include water- and fat-soluble vitamins, vitamin sources and RDAs, metabolic functions of vitamins, vitamin deficiencies, and vitamin toxicities. In Dr. Franklin's course this active

learning tool has replaced two rather dry hours of lecture.

- **Case Studies for the Study of Medical Nutrition:** Dr. John Swaney (Drexel University College of Medicine, Philadelphia, PA) explained how students are instructed to read a case study and identify salient features of the case to relate basic nutrition and biochemistry concepts. The case studies come from Hark and Morrison's Medical Nutrition and Disease: a Case-based Approach (Wiley-Blackwell, 4th edition, 2009). Dr. Swaney then led the audience through the analysis of a case involving a diabetic patient.

- **Independent Explorations of Biochemistry:** Dr. Denise Ferrier (Drexel University College of Medicine, Philadelphia, PA) demonstrated a way to periodically foster independent acquisition of information in a lecture-based course. Students were given a 1-paragraph description of a topic, along with learning objectives and a sample answer. Topics included mucopolysaccharidoses, the hypoxia response pathway, and CYP proteins. The students' learning was assessed in an exam through 1-2 MCQs.

• **Simulation:** This workshop was led by Dr. Pederson and allowed him to expand upon his introduction to simulation given in Plenary Session I. Participants were provided with prompts and worked in small groups to discuss ideas for simulation scenarios that are relevant to biochemistry.

Further information about ABCD

The next ABCD meeting is scheduled for April 20-24, 2013. The organization's website is at:

<http://abcd.wildapricot.org>.

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