Curriculum Innovation at the Warren Alpert Medical School of Brown University

Luba Dumenco, MD, Paul George, MD, Julie Scott Taylor, MD, MSc, and Richard Dollase, EdD

Over the last six years, the Warren Alpert Medical School of Brown University (AMS) has developed an integrated, patient-centered curriculum. Students are now engaged in a dynamic interdisciplinary learning process that provides a foundation of basic science and clinical knowledge, as well as clinical skills and clinical experiences that promote and enhance their professional development. The Medical School's strong central oversight helps to provide a high-quality curriculum. Ongoing quality improvement efforts are focused on enhancing all aspects of the teaching and learning environment. These curriculum initiatives are informed by and responsive to faculty and students' needs and aspirations. In addition to their preclinical and clinical training, students have a broad range of options to pursue interdisciplinary scholarship and traditional research. They have the opportunity to work toward becoming physician-scientists, patient and community advocates, and/or academic leaders.

In providing an overview of the Medical School curriculum, we focus on seven major educational innovations that we developed or refined over the last six years: the Nine Abilities; the Integrated Preclinical Curriculum; the Academic Support Program; Inter-Professional Team Learning; the Scholarly Concentration Program; the Clinical Skills Clerkship; and the Individual Education Plan.

The Nine Abilities

In 1996, AMS designed *MD2000*, a competency-based curriculum, which was named after the year of its initial implementation in academic year 2000-01.[1,2] As the first medical school in the nation to establish a competency-based curriculum, we pioneered the development of competency standards and assessment protocols to evaluate students' progress. Working groups of faculty, students and administrators, under the leadership of the Medical Curriculum Committee, developed the nine competency standards.

In 2011, the Medical Curriculum Committee appointed a new working group to revise the standards to reflect national trends and recent developments in medical education. In the process, we retitled our competency-based curriculum *The Nine Abilities*. A major goal of the revision was to clarify the domains of our curriculum that focus on patient-centered care, advocacy, and professional development. The Nine Abilities are as follows:

I. Effective Communication
II. Basic Clinical Skills
III. Using Basic Science in the Practice of Medicine
IV. Diagnosis, Prevention and Treatment
V. Lifelong Learning
VI. Professionalism
VII. Community Health Promotion and Advocacy
VIII. Moral Reasoning and Clinical Ethics
IX. Clinical Decision Making

Our competency-based objectives inform our major educational planning initiatives and our student and program evaluation systems. The Nine Abilities are seamlessly integrated into each of the required preclinical courses and core clerkships. All student evaluation forms that faculty complete, in either the preclinical courses or the core clerkships are based on the Nine Abilities framework.

Assessing the Nine Abilities

The Nine Abilities are substantively assessed in our required preclinical courses and core clerkships. Students who demonstrate successful fulfillment of the competencies by satisfying course and clerkship requirements receive a grade of Satisfactory or Honors in each preclinical course and core clerkship. Students who do not pass a medical school course must remediate the course before competency credit is realized.

A variety of traditional methods of evaluation and performance assessment measures are employed in assessing students' competence, including multiple choice examinations and performance-based assessments such as **Objective Structured Clinical Examinations (OSCEs)**. A fuller description of the Nine Abilities appears in Table 1.

Preclinical Interdisciplinary Curriculum

Our interdisciplinary preclinical curriculum is composed of Integrated Medical Sciences, a two-year basic science course, and Doctoring, a two-year clinical skills course. The latter course is designed to teach the knowledge, skills, and attitudes of a competent, ethical, and humane physician.

Year I

Integrated Medical Sciences I (IMS-I)

IMS-I provides students with foundations of cell biology, cell physiology, biochemistry, nutrition sciences, immunology and genetics, all of which are integrated with gross and microscopic anatomy. IMS-I also includes general pathology in which students are introduced to concepts underlying the mechanisms of disease. This foundation forms the basis for the subsequent systems-based blocks of IMS II through IV.

Integrated Medical Sciences II (IMS-II)

Brain Sciences, the first interdisciplinary IMS-II course integrates head and neck anatomy with neurobiology, brain and behavior, neuropathophysiology, neuropathology, and neuropharmacology. In the second IMS-II course, microbiology is integrated with infectious diseases and relevant pharmacology. Endocrine Sciences is the final IMS-II course. It incorporates endocrine physiology with endocrine pathophysiology, pathology and pharmacology.

Doctoring I & II

In Year I, Doctoring focuses on basic communication skills including

Table 1. Nine Abilities

The Nine Abilities constitute a competency-based curriculum that defines the knowledge, skills and personal and professional values we expect of all of our graduates. Students are evaluated in the Nine Abilities by multiple methods of assessment: Written exams; in labs and small-group discussions; on performance-based methods of assessment such as ***Objective Structured Clinical Examinations (OSCEs)*** *in Doctoring, a preclinical clinical skills course, and in a number of core clerkships. A description of these abilities and a table depicting where in the curriculum the abilities are addressed and assessed follow:*

Ability I. Effective Communication.
The competent graduate demonstrates effective verbal, nonverbal and written communication skills in a wide range of activities, including patient care, consultation and teaching. The graduate has the communication skills to establish rapport with and the ability to counsel patients and their families.

Ability II: Basic Clinical Skills
The competent graduate develops the skills to obtain a comprehensive history, conduct a thorough physical examination, perform basic clinical tests and interpret data in a spectrum of patient care settings.

Ability III: Using Basic Science in the Practice of Medicine
The competent graduate logically applies basic scientific principles and concepts in evaluating, identifying, treating and preventing illness.

Ability IV: Diagnosis, Prevention and Treatment
The competent graduate is able to diagnose, manage and prevent a spectrum of health problems. This competency involves formulating an assessment and care plan for individuals and extending it to families and communities.

Ability V: Lifelong Learning
The competent graduate understands the need to continually expand and enhance one's knowledge and abilities to best serve patients. The graduate is intellectually inquisitive and competent. The graduate seeks out and evaluates information from the full spectrum of resources continually updating one's knowledge of best practice guidelines.

Ability VI: Professionalism
The competent graduate displays a deep and ongoing commitment to the care of patients while ably attending to professional and personal responsibilities

Ability VII: Community Health Promotion and Advocacy
The competent graduate practices medicine in a broader context by understanding the many factors that influence health, disease and disability. The graduate advocates for the patient's well-being and works with community partners to identify and address environmental, social and behavioral factors and health system policies which alter the opportunities to be healthy.

Ability VIII: Moral Reasoning and Clinical Ethics
The competent graduate recognizes the ethical dimensions of medicine and health policy. The graduate formulates, defends and effectively carries out a course of action that takes into account the ethical complexity of the health care setting. The graduate respects patients' values and beliefs, and is able to reconcile them with alternative options while maintaining ethical integrity.

Ability IX: Clinical Decision Making
The competent graduate demonstrates an understanding of and reflects on the complex processes involved in the evaluation and treatment of a patient. The graduate can incorporate the previous eight competencies into a holistic approach to medical care.

the patient-centered medical interview, behavior change counseling and oral and written case presentations. Students participate in lectures and small group sessions led by multi-disciplinary faculty teams. Students practice their skills a half-day a week in an outpatient setting working under the guidance of a community-based physician-mentor and in several visits to a resident of an Assisted-living Facility. Through writing exercises called "field notes," students reflect on their community mentoring experiences and assess their strengths and weaknesses in developing their clinical skills and professional competence.

Year II

Integrated Medical Sciences III & IV

Students continue with a systems-based approach in Year II: The seven course sections are cardiovascular, renal, human reproduction , pulmonary, supporting structures (comprised of orthopedics, dermatology and rheumatology), hematology, and gastroenterology. Epidemiology is incorporated into year II courses, along with a journal club component in several problem-based learning small-group sessions that helps prepare students to interpret the medical literature. In addition, students have self-directed learning time in the second-year schedule to accommodate participation in the Scholarly Concentrations Program.

Doctoring III & IV

In Year 2, Doctoring builds upon the skills covered in Year I with an emphasis on mastery of the physical examination, the oral presentation, the application of physician-patient communication skills and critical thinking/clinical problem solving. Students continue to work with their community-based physician-mentor a half-day per week throughout the year.

Academic Support Program

The **Office of Medical Education** (**OME**) provides preclinical students with a very effective and robust peer-tutoring program and ample learning resources. The OME also has formal mechanisms

Table 2. Inter-professional Workshops (Medical Students, URI Nursing and Pharmacology Students)

Fall Workshop	Didactic Content	Standardized Patient Case: Pneumonia
Goals: Acquire knowledge of each other's role & professional training Practice working together as a health care team	Asthma paper case COPD paper case	Patient interview Physical examination Diagnosis Drug Therapy Patient Counseling
Spring Workshop	**Didactic Content**	**Standardized Patient Case: Lacerations**
Goals: Gain understanding of how a team works together effectively Practice working together as a health care team	Team Building Exercise: Seeing the Big Picture	Patient interview Physical examination Suturing Wound dressing Patient counseling

in place for student feedback and direct curriculum input.

PEER TUTORING

Tutorial assistance is provided principally by our peer tutoring program. Each academic year, second-year tutors offer first-year students assistance with studying for examinations and developing their clinical skills. In addition, second-year students are tutored in content areas by third- and fourth-year students. The four preclinical peer tutoring programs at the Medical School are the Doctoring Teaching Academy, Content Tutoring Program Teaching Assistant Program, and the USMLE Step I Tutoring Program.

1. Doctoring Teaching Academy

Each year 25-35 second-year medical students who demonstrated both excellent clinical skills and exemplary professional attitudes and behavior during the first year of Doctoring are selected by Doctoring course faculty to serve as peer mentors to first-year students in Doctoring I. The duties of the peer-mentors include: (1) working with first-year students individually or in pairs to help develop their history-taking and physical examination skills; (2) serving as peer-advisors to first-year students, especially in regard to their professional development as medical students.

2. Content Tutors

Each year, twenty-five to thirty second-year students who received Honors in their course work offered tutoring for first-year students. The tutors are selected by the OME based upon their outstanding academic performance in particular courses and their interpersonal skills. The tutors meet regularly with first-year students who requested tutoring services, providing one-on-one or small-group instruction tailored to the individual needs of students. The tutoring program is coordinated by two or three second-year Medical Education Scholarly Concentrators (the scholarly concentration program is described below). Workshops are held for content tutors to provide them with appropriate tutoring and teaching strategies.

3. Teaching Assistants

Second-year medical student who are chosen from the group of Content Tutors are selected to serve as Teaching Assistants for several first-year courses (Histology, **Scientific Foundations of Medicine (SFM)**, General Pathology and Brain Sciences). Before each first-year exam, the Teaching Assistants hold an afternoon or evening optional session to review important basic science concepts and principles, provide mnemonics and tips for addressing content, and answer questions from the first-year students.

4. USMLE Step 1 Tutoring Program

In addition to serving as Content Tutors for second-year students, a number of third- and fourth-year students also serve as Step 1 tutors who help prepare second-year students for the board examination. A number of the Step 1 tutors in their roles as Teacher Assistants hold optional content review sessions open to the whole class. They also provide tutoring sessions for individual students and help students develop board study plans and monitor their progress.

CURRICULUM DEVELOPMENT

First- and second-year medical students play an active role in ongoing curriculum improvement initiatives. In addition to individual feedback to the Directors of the Preclinical Curriculum, students participate in formal focus groups and in summer curriculum development work.

1. Focus Groups

Course evaluations are reviewed after each preclinical course is completed, and focus groups of first- or second-year students are held to determine the strengths and weaknesses of the course or block. Students are selected randomly to participate in one or two focus groups during the year In addition, a small num-

Table 3. Scholarly Concentrations Program

Concentration Areas:

- Advocacy and Activism
- Aging
- Caring for Underserved Populations
- Contemplative Studies
- Disaster Medicine & Response
- Global Health
- Health Policy
- Informatics
- Integrative Medicine
- Medical Education
- Medical Humanities & Ethics
- Medical Technology & Innovation
- Physician as Communicator
- Women's Reproductive Health, Freedom & Rights

ber of medical education concentrators also participate in each focus group, in order for them to learn how to lead focus group discussions. Student recommendations are discussed with Course Leaders, and, whenever possible and appropriate, changes are incorporated into the course curriculum the following academic year. The focus group initiative is, in reality, a needs-assessment that enables us to plan for the continual quality improvement of our curriculum, which is in large part carried out by students who serve as curriculum developers working with the Directors of the Preclinical Curriculum.

Table 4. Fourth-Year Individual Educational Plan (IEP)

Student proposes a the fourth-year academic schedule with a faculty advisor who must sign off on the IEP.

IEP Components

- Completion of graduation requirements
- Preparation for residency and for the student's chosen discipline
- Scholarship

Example 1: Primary Care Specialty

Goal: Preparing for a Family Medicine Residency

Students choose clinical experience in specialties such as:

Neurology, Emergency medicine, Orthopedics, Community health
Dermatology, Obstetrical or Surgical sub-specialties

Graduation Requirements:
Four-week Sub-internship in Family Medicine, Internal Medicine or Pediatrics
Two-week Longitudinal Ambulatory Clerkship (1/2-day per week over 6 months)
Six-week Community Health Elective Clerkship

Recommended Electives:
Four-week Emergency Medicine elective
Four-week Orthopedics (in the community) or Dermatology elective
Neurology elective
Independent study (to complete either Scholarly concentration research or community health research)

Example 2: Surgical Specialty

Goal: Preparing for a General Surgery Residency

Students select course work in:

Anatomy, Pathology, Neurology, ICU, Surgical sub-specialties (such as Orthopedic surgery, Urology, Neurosurgery)

Graduation Requirements:
Four-week Subinternship in Surgery
Two-week Longitudinal Ambulatory Clerkship (1/2-day per week over 6 months)
Six-week Community Health Elective Clerkship

Recommended Electives:
Four-week surgical sub-specialty elective (Orthopedic surgery, Urology or Neurosurgery)
Four-week Neurology Elective
Four-week Emergency Medicine Elective
Four-week Independent Study Research Project to complete scholarly concentration research or basic science article for publication

2. Medical Education Curriculum Developers

Based on the needs-assessments, during ten weeks each summer, selected students undertake curriculum-development initiatives. Curriculum projects during the summer of 2012 included revising anatomy dissectors, developing new lecture materials in SFM, and Brain Sciences, helping to re-structure Doctoring sessions and preparing a handbook to help first-year students utilize their iPads in lectures and small groups. Fourth-year students also served as curriculum developers creating Problem-Based Learning cases and fourth-year OSCE stations.

Inter-professional Team Learning

During Year II, two inter-professional workshops bring together AMS medical students and nursing and pharmacy students from the University of Rhode Island and Rhode Island College to learn about their respective roles as future health-care professionals, and to work together as a health-care team in examining standardized patients and developing a plan of care. The goal of these workshops is to promote greater team work and collaboration among health-care professionals in order to improve patient care locally and nationally. Feedback from students at each institution involved has been overwhelmingly positive. See Table 2 for more details on the inter-professional workshop experiences.

Scholarly Concentration Program

In addition to the integrated preclinical courses, the medical school also offers an elective **Scholarly Concentrations** (**SC**) Program that runs throughout the four years of medical school. During the summer between the first and second year of medical school, students have ten weeks to undertake a Scholarly Concentration project, perform basic science research, undertake curriculum development projects, or engage in clinical experiences in this country or abroad.

The Scholarly Concentration Program promotes interdisciplinary scholarship and research and has five major components:

- Cross-disciplinary inquiry
- Independent project work
- Faculty-student mentorship
- In-depth summer research experience
- Submission of a scholarly product in Year IV

Approximately one-third of our students participate in a formal Scholarly Concentration Program each year. Students actively undertake self-directed learning projects that often lead to publication of one or more journal articles. A number of the Scholarly Concentrators also engage in collaborative research, curriculum development or patient advocacy projects. Almost 90% of our students who completed the 2012 AAMC Graduate Questionnaire Survey report engaging in a research project with faculty by the time of graduation. Over 79% of these students report they also engaged in a community-based research project. See Table 3 for list of current Scholarly Concentrations.

Clinical Skills Clerkship

For the first time this year, in mid-April 2012, students completed a second-year **Clinical Skills Clerkship** (**CSC**), a three-week transitional clerkship. The goal of this clerkship is to prepare rising third-year students for the core clinical clerkships that begin in early May. One hundred twenty faculty members from a wide variety of medical specialties provided more than 90 hours of instruction. There are three major components to this innovative course:

Virtual Family Curriculum

The Virtual Family Curriculum is designed to build clinical competence by providing students with a holistic understanding of the longitudinal aspects of health care and family dynamics as well as a set of advanced clinical skills essential in the clinical setting.

Utilizing a three-person, three-generation virtual family, students follow Barbara Garcia, a 69-year-old woman, from the outpatient setting (Family Medicine) to the Emergency Room to a hospital admission (Internal Medicine), and then to the operating room (Surgery). After discharge from the hospital she enters a rehabilitation unit where she gets depressed (Psychiatry). Her daughter, Samantha Garcia, has a baby named Joseph (Obstetrics and Gynecology) who gets sick (Pediatrics) and requires hospital admission and a specialty consultation.

Table 5. National Examination Results (Academic Year 2010-2011)

USMLE Step 1 (2010)

Year	Brown Mean	National Mean
2010	226	222

USMLE Step 2 CK (2010-2011)

Year	Brown Mean	National Mean
2010-2011	237	233

USMLE Step 2 CS (2010-2011)

Year	Percent Passing	National Percent Passing
2010-2011	99	98

NBME Subject Examination (SHELF Exams)

	MEDICINE SHELF EXAM	Total Test Mean
2010-2011	AMS Students	77.9
	National Average	77.1
	OBSTETRICS AND GYNECOLOGY SHELF EXAM	Total Test Mean
2010-2011	AMS Students	75.6
	National Average	74.7
	PEDIATRICS SHELF EXAM	Total Test Mean
2010-2011	AMS Students	75.9
	National Average	77.4
	PSYCHIATRY SHELF EXAM	Total Test Mean
2010-2011	AMS Students	83.3
	National Average	79.9
	SURGERY SHELF EXAM	Total Test Mean
2010-2011	AMS Students	76.6
	National Average	74.7

Brown Students' performance on AMS 4th year OSCE and USMLE Step 2 CS

Year	AMS 4th Year OSCE Passing Percentage	USMLE Step 2 CS Passing Percentage
2010	99%	96%

Clinical Skills Training

Advanced clinical skills addressed in the course include:

- Effective oral presentations, written documentation (history and physicals, admission orders, daily progress notes, discharge paperwork).
- Interpretation of diagnostic tests, including **electrocardiograms** (**EKGs**), and **chest x-rays** (**CXRs**); management of intravenous (IV) fluids and blood sugars; dosing medications.
- Searching for evidence: formulating clinical questions and accessing practice guidelines.
- Lumbar punctures; IVs; subcutaneous/intramuscular injections; venipuncture/ phlebotomy; arterial blood gases; nasogastric tube insertions; male/female catheterization.
- Basic suturing; operating room procedures in scrubing in including gloving and and gowning/sterile fields; stapling/ wound care vacuums; ABCs for trauma; **advanced cardiac life support** (**ACLS**) certification; and medical student roles during codes.

Professional Development

A final component of the course addresses clerkship expectations related to students working effectively in the clinical environment (*e.g.* attendance, work hour

and evaluation policies). An inter-professional workshop (in conjunction with students from University of Rhode Island and Rhode Island College pharmacy and nursing schools) is held to further effective health care team training and interaction. Students also acquire **Occupational Safety and Health Administration (OSHA)** certifications; they become familiar with various **electronic health records (EHRs)**; and participate in workshops focusing on scholarship in the clinical years.

Clinical Skills Clerkship Teaching Fellows Program

In the new Clinical Skills Clerkship, 12 fourth-year students serve as small-group leaders. The Teaching Fellows have a number of teaching responsibilities that include facilitating small group sessions, supervising procedure stations, giving mini- lectures and demonstrations, providing peer counseling, and grading the Objective Clinical Skills Exams (OSCEs under the supervision of the course leaders). To prepare for their teaching roles, Teaching Fellows spend a week before the clerkship begins developing the teaching materials and preparing for the course under the guidance of the clerkship faculty.

Clinical Curriculum

In the third year, students take six core required clinical clerkships. They vary in length: the Family Medicine, Ob/Gyn, Pediatrics, and Psychiatry Clerkships are all six-week rotations. The Surgery Clerkship is an eight-week rotation and the Internal Medicine Clerkship is a 12-week rotation. At the end of the third year in June, students take the Fourth-Year OSCE, a summative performance evaluation that both assesses student mastery of the Nine Abilities and helps prepare students to successfully complete the USMLE Step 2 Clinical Skills examination.

In the fourth year, students are required to take a six-week Community Health clerkship, a four-week subinternship, and a Longitudinal Ambulatory Clerkship. The latter involves working for one half-day per week with an attending physician for 6 months, often in the specialty in which the student is applying to residency programs. In total, students must complete 80 weeks of course work in the clinical years—56 weeks of required courses and 24 weeks of electives. There are over 150 clinical electives at the Medical School that students may select from in the fourth year. Students may also take electives at other medical schools.

Individual Educational Plan

With the help and guidance of faculty career advisors and administrators, fourth-year students develop an **Individual Education Plan (IEP)** that is designed to prepare them for their residency of choice. Students have a variety of advanced electives and independent study options from which to tailor a fourth-year curriculum based on their career goals and aspirations. In developing the IEP, students need to justify their fourth-year curriculum. A faculty advisor provides oversight and advises students on their course selections. See Table 4 for examples.

Curriculum Effectiveness

The four-year curriculum is designed to provide our students with an excellent foundation that promotes and enhances student acquisition and utilization of medical knowledge and clinical skills. The medical school experience also provides opportunities for students to undertake self-directed learning and self-reflection, and to continue to utilize these resources for developing their professional identity and career pathways. Students are exposed to a range of medical specialties and physician roles as physician-scientist, patient advocate and medical educator. Assignments in hospitals and outpatient settings and Assisted Living Facilities enable our students to experience diverse practice environments that help them in selecting a specialty.

The redesign of the curriculum that began to be implemented in 2006, is an ongoing and dynamic process that is responsive to perceived student and faculty needs as well as to changing national trends and federal and state policy initiatives in medical education. Evidence of success of our general professional education is indicated by our students' successful performance on USMLE Steps 1 and 2 and Clerkship Shelf Examinations, and by their demonstration of clinical and professional competence on the summative fourth-year OSCE. (See Table 5 for national examination results for academic year 2010-2011.) Data from the recent 2012 residency match, in which our students placed in 17 different clinical specialties across the nation, strongly suggests that our curriculum initiatives enable our students to build upon their general education foundation in diverse ways. In the AAMC 2012 Graduate Questionnaire, students report that they are highly satisfied with their educational experience and preparation for residency. In 2012, 96.1% of our students (as compared with 93.3 % for all US medical schools) "agreed or strongly agreed" that they "have the fundamental understanding of common conditions and their management encountered in the major clinical disciplines" and 94.3% of our students (88.2% for all schools) "agreed or strongly agreed" that "overall, I am satisfied with the quality of my medical education;" 48.1% of our students (42.2% for all schools) "strongly agreed" with the statement.

References

1. Smith SR, Dollase, R, Boss J. Students' performance in a competency-based curriculum. *Acad Med*. 2003 January; 78: 97–107.
2. Smith, SR, Dollase R. Outcome-based education: Part 2: Planning, implementing and evaluating a competency-based curriculum. *Med Teach*. 1999; 15–22.
3. Rougas, S, Rusley, J, Young, B, Romain, C ,Lambrese, J, Dollase, R. Development of a student-based teaching academy. *MHRI*. 2008; 252–4.

Luba Dumenco, MD, is Director of the Preclinical Curriculum at the Warren Alpert Medical School of Brown University.

Paul George, MD, is Director of the Second-Year Preclinical Curriculum at the Warren Alpert Medical School of Brown University.

Julie Scott Taylor, MD, MSc, is Director of the Clinical Curriculum at the Warren Alpert Medical School of Brown University.

Richard Dollase, EdD, is the Director of Medical Education at the Warren Alpert Medical School of Brown University.

Disclosure of Financial Interests

The authors and/or their spouses/significant others have no financial interests to disclose.

Correspondence

Richard Dollase, EdD
The Warren Alpert Medical School of Brown University
222 Richmond Street
Providence, RI 02912
phone: 401-863-9609
fax: 401-729-2923