BASIC SCIENCE EDUCATOR

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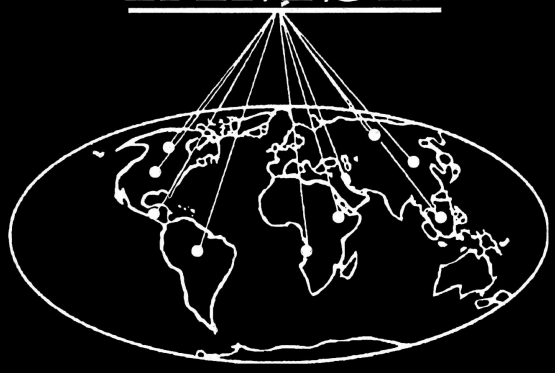

Standardized Patient Assessment Exam

Student Case Discussion Leaders

Attitude Towards Neuroscience PBL

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MISSION STATEMENT

The mission of the International Association of Medical Science Educators is to advance medical education through faculty development and to ensure that the teaching and learning of medicine continues to be firmly grounded in science. We strive to achieve this by:

- sharing current and innovative means to teach the sciences fundamental to medicine and health,
- providing a multidisciplinary forum for discussion of issues affecting medical science education and educators,
- serving as an international voice to enhance the public's appreciation of the crucial role of medical science education in health and health care.

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MESSAGE FROM THE MANAGING EDITOR

J. CHARLES ELDRIDGE, PH.D.

We are excited and pleased to announce that, beginning with this issue of Volume 10, ***The Basic Science Educator*** is being published on line, at the website of the International Association of Medical Science Educators (IAMSE).

It had become painfully apparent to the IAMSE Board of Directors, and to the Publications Committee, that the costs of printing and mailing journal issues to every IAMSE member (many living outside the United States) had moved beyond the financial means of the Society. Our last printed issue appeared in 1999.

IAMSE is now prepared to resume publication of the BSE with a very attractive and convenient electronic system. Issues will be accessible from the journal home page. Clicking on Volume 10 will bring up a Table of Contents and abstracts of each article. IAMSE members can then read or download the complete text of each article in PDF format. Previous volumes of BSE, including full text, are also available to members from the journal home page.

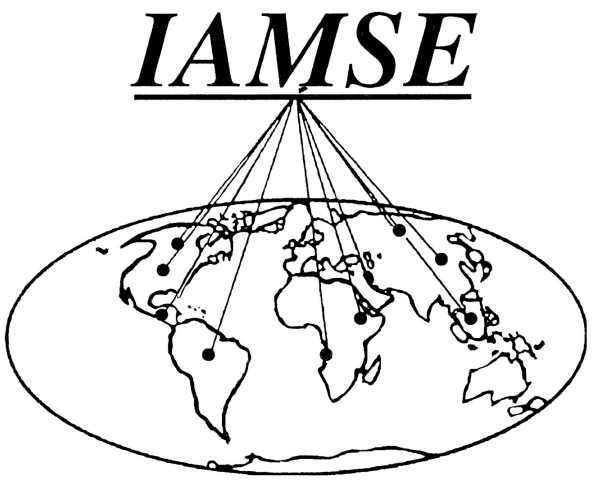
We believe this new format provides a much better, as well as less expensive, means to publish the high quality articles that our field is calling for. Pictures, figures and appended materials can be more easily attached than in print copy, article and issue size is no longer a severe restriction, and readers will have a permanent, easily retrievable resource of all materials published in the journal.

The basic format of the journal remains unchanged: peer-reviewed articles, plus articles, columns, and information prepared by or with our Associate Editors. We are still the only publication dedicated solely to issues of education in basic medical science. Volume 11, due to appear later in 2001, will be the proceedings of the recent IAMSE meeting in Rochester, MN. It will have text from the plenary speakers, discussion of issues from the focus sessions, and abstracts of the posters.

Manuscript submissions are being accepted for Volume 12, which will be in the regular format. Original articles can be submitted to the Managing Editor (Word document, by email only, at **eldridge@wfubmc.edu**). Articles for columns should be arranged with the respective **Associate Editor**.

Personally, I wish to thank the BSE Editorial board, and the IAMSE Publications Committee, for working diligently on this transition to an electronic publication. A particular acknowledgement is due Edward (Pat) Finnerty, Chair of the committee, who helped create and install the new website for BSE. It's an exciting moment for the journal, its authors and its readers.

J. Charles Eldridge
Wake Forest University



The Standardized Patient Assessment Examination: Integration with the Basic Sciences Curriculum

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ABSTRACT

The standardized patient assessment examination (SPA) is an integral part of the new Prescription for Excellence: A Physicians Pathway to Lifelong Learning curriculum at Wake Forest University School of Medicine (WFUSM). It consists of two parts: Part I is an exercise in which the student takes a complete history and performs a physical examination on a standardized patient. In Part II the student gives a 2-hour oral presentation of his/her clinical reasoning process and presents a basic science discussion on a topic related to the case. Although WFUSM had been doing standardized patient assessments since 1987, they involved only 25% of the medical school class. In 1998 the exercise was expanded to include the entire medical school class of 108 students. This created logistical challenges related to facilities, cost, recruitment of standardized patients, and faculty to supervise the exercises. In addition, changes were made in the process to allow more integration of the clinical cases with the basic science curriculum. Although these exercises are extremely time consuming and labor intensive for faculty and staff, they are felt to measure reasoning skills not examined in other parts of the curriculum, and emphasize the importance of relating clinical situations back to the basic sciences.

INTRODUCTION

In August of 1998, Wake Forest University School of Medicine (WFUSM) initiated a new curriculum: *Prescription for Excellence: A Physician's Pathway to Lifelong Learning.* This curriculum incorporated the best aspects of the traditional lecture-based and problem-based learning tracks that existed since the creation of the problem-based curriculum in 1987. The goals of the new curriculum are to foster:

- the development of professional attitudes and behaviors
- core biomedical science knowledge
- clinical skills
- problem solving/clinical reasoning skills
- communication skills
- self-directed learning/lifelong skills
- information management skills

The development of the new curriculum occurred over a three year time period. Each of the components of the two existing curricula tracks were scrutinized for the ability to assist students in achieving the above stated goals. The IPA, or Individualized Process Assessment, utilized in the Parallel Curriculum, was one such component. Its development into the SPA (Standardized Patient Assessment) exam, an integral part of the Prescription for Excellence curriculum, is the focus of this report.

History of the IPA

The Parallel Curriculum (PC), a problem-based learning, educational program during the first two years of medical school, started at WFUSM in 1987.[1.] One essential component of the curriculum was a performance-based assessment entitled the Individualized Process Assessment (IPA). The IPA was a two-part exercise designed to assess a student's physical examination and interviewing skills, clinical reasoning, basic science knowledge acquisition, and oral presentation skills.

The IPA consisted of two parts: Part I and Part II, which were conducted at two different times during one week examination periods. Part I was a Standardized Patient (SP) encounter in which the student had 1 hour and 15 minutes to conduct a thorough history and physical examination. The student was observed by a clinical faculty member through a one-way mirror using a standardized

checklist. Oral feedback was presented to the student after completion of the exercise. Following the completion of Part I, the student had two hours to write up the case, develop a problem list with mechanistic hypotheses, and construct a preliminary list of learning issues. The student was then given two days to do library research, revise their hypotheses, log his/her clinical reasoning process, and prepare a basic science presentation. In Part II of the IPA, the student met with two faculty members, a clinical and basic science faculty team, for approximately 2 hours. In this time, the student gave a brief oral case presentation, discussed his/her clinical reasoning process, presented basic science learning issues, and reviewed a self-assessment.

PC students completed five IPA exercises in the first two years of medical school-three in the first year (October, January, and April) and two in the second year (December and May). These exercises were deemed successful for the 24 students of the student body each year who matriculated through the Parallel Curriculum, but the question was asked "what about the rest of the class?"

Should We Do It?

"What about the rest of the class?" was a guiding question when restructuring the curriculum. The curriculum committee encouraged the use of IPA-like examinations for assessment and program evaluation, but recognized that expanding the exercise to the entire medical school class would be a logistical challenge. Ultimately, the assessments were seen to provide information regarding the achievement of all seven goals for the Prescription for Excellence curriculum. It was also noted that these exercises would provide useful assessment data for other courses in the curriculum such as the Foundations of Clinical Medicine (FCM) course, the Basic and Clinical Sciences Problem-based learning course, and the basic science core courses.

Creation of the SPA

The Standardized Patient Assessment (SPA) resulted from the decision to incorporate performance-based assessments for all students into the new curriculum. The SPA is similar in structure to the IPA examinations, but with a different administrative schedule. Part I remains a 1 hour and 15 minute history and physical exam of a SP encounter with a clinical faculty observer through a one-way mirror, and Part II a written and 2 hour oral presentation of clinical and basic science reasoning to a basic science/clinical faculty member team. To accommodate a full class and fit into the new curriculum, the exam structure was redesigned to build upon each experience for the student and end with a complete Part I and Part II by the middle of the second year. Considerations about facilities and staff, student preparation, faculty recruitment, and SP recruitment and training all guided the design process.

Facilities and Staff

The first question was whether there were sufficient facilities and staff to conduct the exam for the full class of 108 students. WFUSM has ten fully equipped examination rooms and six small group tutorial rooms. Each room has one-way viewing windows, wall-mounted video cameras, microphones, and whiteboards. A SPA staff was assembled which included a volunteer medical director, a full-time administrative director who doubles as the SP Coordinator, and six support-staff team members.

The Medical Director oversees all activities pertaining to the SPA. The director works with the SPA coordinator to orient new faculty and students, to develop and/or revise student documentation forms, and collaborates with content expert faculty to develop the clinical cases.

During the SPA itself, the Medical Director is available on-site during the exam to supervise, fill in for last minute faculty vacancies, and to participate in grading and evaluation of students. After the SPA exam, the Medical Director reviews videotapes of students with substandard performance on the examination and makes recommendations for remediation.

Student Preparation

Student preparation was the second challenge. Students are prepared for these examinations in a variety of ways. First is the Foundations of Clinical Medicine (FCM) course, which is a weekly course with two components – Physical Examination (PE) and Doctor/Patient Relationship (DPR) teaching. In 24 weeks, all students are taught the components of conducting a complete

adult physical examination. In that same 24-week period, students are also receiving training in the Doctor/Patient Relationship on alternate weeks. Five to six students meet with two faculty facilitators to learn the intricacies of both the interpersonal relationship between doctor and patient, as well as how to conduct a thorough adult patient interview.

In order to prepare students specifically for each SPA examination, all information is posted on the Intranet several months prior to the examination period and videotapes of outstanding previous performances are on file in the library. One month before the exam, an orientation session is offered by the medical and administrative directors to explain the process and answer questions.

Faculty Recruitment

With 108 medical students, faculty recruitment was the biggest concern when determining whether or not the SPA could be accomplished. With increasing demands on clinical and research time, could we actually get enough faculty to volunteer two hours or more of their time to this exercise?

Over the summer, a memo was sent to all faculty regarding educational opportunities available for the upcoming year. Three months prior to the examination a recruitment letter was sent to all full-time, part-time, and emeritus faculty. One month before the examination, a recruitment letter was sent to all house officers. Throughout the three months leading up to the exam, memos were sent to the Department chairs updating them on their department's participation. Faculty are asked to give a "block" of time, either a morning or afternoon if possible, yet any volunteered time is accepted. The block of time reduces the actual number of different faculty required for the exercise, safeguards against "no shows" for the second slot, and reduces the number of faculty who need training in this process. This exercise has the full support of the Dean of the medical school who, himself, participates in the SPA.

Standardized Patient Recruitment & Training

WFUSM has a 100 person strong, on-going SP program that actively recruits from the nine local colleges and universities, the North Carolina School of the Arts (a fine arts and performance art school), the nine major hospitals, and the medical school.

A three-day examination process requires anywhere from 16-28 SP's depending upon scheduling. Existing SPs train, in groups, for two to three hours with the trainer and often a clinical faculty member. New SPs spend four to five hours on touring the facility, checklist training, question practice, and physical exam preparation.

Cost

A final consideration when designing the SPA was cost. The actual number of SP examination encounters dropped from five to three in the MS I and MS II years. However, the cost of using SP's increased from approximately $600 per exam ($3,000 per two years) to nearly $2,800 per exam ($8,400 per two years). A full-time standardized patient trainer was hired to support this and other curricular processes.

Scoring and Grading

The evaluation process for the SPA consists of the following grades – Honors, Pass, Low Pass, Fail. Descriptive criteria for each grade are reviewed with faculty participants and are also available to the students. Table 1 indicates the cumulative SPA grade distribution for December 1999.

Table 1. Percentage Grade Distribution for December 1999 SPA

SPA		Honors	Pass	Low Pass	Fail
Part I	History & Physical Exam	25.2	72.8	1.9	0
Part II	Clinical Reasoning Process	22.3	76.7	1.0	0
Part II	Basic Science Discussion	24.3	72.8	2.9	0

RESULTS

The First SPA (Formative Part I) - November

PC students, because of the small size of the group (24 students), had covered all 12 sessions of physical examination by the first SP exercise in November. The students in the new curriculum had covered only five sessions of physical examination by the first examination week.

Therefore, it was decided that this initial assessment (SPA Part I) would be a "practice exercise" focused primarily on the provision of formative feedback, and counting for only five percent of the FCM course grade.

Students completed a one hour and 15 minute interview as well as a physical examination covering the parts of the exam they had reviewed in class. Upon completion of the SP encounter, students were required to submit a write-up of the patient within 24 hours.

MS II's were used as "graders" for this exercise. This was done for several reasons: 1) having second-year student graders would lower the anxiety of first-year students; 2) this avoided any unintentional comparison on the part of faculty of the skills of the former PC students and the new curriculum students; 3) it was a maturing experience for the MS II's who received the benefit of "being on the other side of the one-way mirror." The second-year students wrestled with grades and feedback, which increased their understanding of faculty graders in other activities. The MS II's attended a "faculty" orientation and were trained to use the standardized checklist and provide appropriate feedback. Faculty supervision of the second-year students during the exam was provided by the medical director.

The Second SPA (Part I and Formative Part II) – February

A complete Part I was administered including a one hour and 15 minute comprehensive adult interview and physical examination with a clinical faculty member observing through a one way mirror. Each faculty member graded the student based upon a standardized, case-specific checklist, which included elements that were ■ Critical, □ Important, or ..... Optional. After the student completed the history and physical examination, the faculty observer joined the student in the exam room to elicit feedback from the SP. The faculty member then reviewed the checklist with the student, provided feedback, and assigned a grade for the exercise. The grade constituted 25% of the first year FCM grade. The total time commitment for faculty was two hours.

Following the completion of the Part I exercise, students had four hours to write-up the case, develop a problem list with mechanistic hypotheses, and a brief list of learning issues. The write-up was submitted electronically and graded by the faculty member who observed the student performing the history and physical exam. Once this information was submitted, students were given laboratory data on the patient and were expected to answer an essay question related to this case within 24 hours. A protocol answer was created by faculty from the Department of Biochemistry and the discussion question was graded by faculty with content expertise in this subject matter. This experience provided practice in Part II of the SPA examination as well as formative feedback on students' clinical reasoning and independent learning skills. The grade constituted 5% of the final grade for the Cellular and Subcellular Processes course.

The Third SPA (Part II) – May

The third SPA in May is designed to measure the student's clinical reasoning process. In this exercise, a correct diagnosis is less important than the student's ability to collect and analyze data in a systematic manner, be able to explain underlying mechanisms, and support his/her hypotheses.

Three individual but related neurological cases were written to correspond with the teachings from the previous eight-week Systems Pathophysiology block of neuroscience and musculoskeletal systems. Each case was electronically released by computer to a previously assigned group of students 48 hours prior to the oral presentation. The students had two hours from the case release time to electronically submit a problem list, mechanistic hypotheses, and a preliminary list of learning issues. The remaining 46 hours were spent with students researching the case, revising initial hypotheses, keeping a well-documented clinical log of the reasoning process, ordering lab tests, and preparing a basic science presentation on three learning issues.

On the oral examination day, the student met with a 2 member, clinical/basic science faculty team in the following format:

- 20 minutes: Evaluator preparation time
- 5 minute: Oral presentation of the case
- 30 minutes: Student discusses the patient's major problems through problem identification and hypothesis formulation

- 30 minutes: Basic science learning issues
- 30 minutes: Self-assessment process and grading

The clinical reasoning assessment constitutes 10% of the Basic and Clinical Science Problems small group grade from the first year and the basic science presentation counts for 10% of the eight-week Systems Pathophysiology block grade.

The Fourth SPA (Part I and Part II) – December

The fourth and final SPA takes place in December; three months prior to students beginning the clinical ward rotations. The students are expected to "put it all together," by performing a complete Part I and Part II in one week. Again, cases were scripted to correspond with the Systems Pathophysiology phase teachings from the previous 12-week block. This exam was seen as the culmination of two years of physical examination, doctor-patient relationship, and basic science reasoning skill development. The Part I grade counted for 25% of the second year FCM grade. Part II, the clinical reasoning process, counted for 10% of the Basic and Clinical Science Problems small group grade and the basic science discussion of Part II for 15% of the Systems Pathophysiology grade (see Table 2).

Table 2. The SPA Framework

	Part I	**Part II**	**Grade Distribution**
SPA I – November-Phase I	• 1 hour and 15 minute partial H&P (history, head/neck/peripheral-vascular/cardiac/ abdomen • Student feedback	None	• 5% of FCM grade
SPA II – February-Phase I	• 1 hour and 15 minute complete H&P • Faculty feedback	• Written H&P • Written problem list and mechanistic hypotheses for each major problem • Written inquiries, basic science learning issues, and self-assessment • Written faculty feedback	• 25% of FCM grade 5% of Basic Science course grade
SPA III – May-Phase I	None	• 48 hours of self-directed learning, pursuit of diagnosis, and case related basic science learning • 2 hour oral clinical reasoning and basic science learning issue presentation • Faculty feedback	• 10% of Small Group grade (clinical reasoning process) • 10% of Systems Pathophysiology Grade (basic science presentation)
SPA IV– December-Phase II	• 1 hour and 15 minute complete H&P • Faculty feedback	• 48 hours of self-directed learning, pursuit of diagnosis, and case related basic science learning • 2 hour clinical reasoning and basic science learning issue presentation • Faculty feedback	• Part I – 25% of FCM grade • Part II – 10% of Small Group grade (clinical reasoning process) and 15% of Systems Pathophysiology grade (basic science Presentation)

Integration of the SPA with the Basic Science Curriculum

Another goal of the SPA was to integrate clinical cases with the basic science curriculum. For example in the February SPA, a patient with diabetic ketoacidosis was used for the Part I examination (history and physical examination). The students were then required to answer essay questions on fatty acid metabolism and ketogenesis related to this case. In Part II of the SPA the student makes a basic science presentation relevant to the clinical case to a clinical/basic science faculty team. In previous years, the grade for this exercise was combined with the clinical reasoning process grade. However, starting in December 1999, to emphasize the importance of the basic sciences, the basic science presentation became a separate grade for Part II of the SPA. Having the basic science component count as a substantial part of the grade for Part II of the SPA emphasizes to the student the importance of learning basic concepts of pathophysiology, anatomy, pharmacology, etc. and relating these issues back to the clinical case.

The relationship of student performance in the basic science core courses and the May 2000 and December 1999 SPA basic science discussion was examined. Correlational analyses of the overall core course percent scores (calculated without any SPA components) and the SPA basic science discussion grades revealed modest to weak relationships.

Pearson correlation coefficients for the May 2000 SPA grades and the first year core course percent scores ranged from .266 to .394 (n=107) as shown in Table 3. All were statistically significant ($p < .01$) but slight to modest in magnitude. The nature of case may have contributed to the strength of the relationship to the Systems Pathophysiology course because the case used related to a topic the students had been tested on earlier in the week.

The relationships of the December 1999 basic science SPA grades and all the core basic science courses were somewhat weaker, r ranging from .139 to .359 (n=103) as shown in Table 4. The case used was related to a topic that students had completed 4 weeks prior to SPA.

Table 3. Correlation of May 2000 SPA grades and final overall percent scores in first year basic science courses

Course	r
Human Structure and Development	.266
Cellular and Subcellular Processes	.304
Systems Pathophysiology A	.394

The strengths of SPA and core course relationships were somewhat greater overall for the May 2000 than the December 1999 SPA. This may reflect differences in the educational level or abilities of the students, in the nature of the case, or it may indicate that basic science knowledge development and basic science knowledge assessment in SPA are becoming more integrated as the curriculum becomes more refined.

Table 4. Correlation of December 1999 SPA grades and final overall percent scores in first and second year basic science courses

Course	r	p <
Human Structure and Development	.224	.05
Cellular and Subcellular Processes	.139	
Systems Pathophysiology A	.294	.01
Systems Pathophysiology B	.312	.01
Systems Pathophysiology C	.359	.01

Use of Computers

The implementation of the new curriculum brought new technology to WFUSM. Each student, upon matriculation, is provided with a laptop computer with network access, Internet access, and on line curriculum delivery through the Intranet. The Office of Academic Computing was created to service the needs of the computerized curriculum and provide technical support to students and faculty.

Curricular Feedback

The SPA also serves as a vehicle for curricular feedback and the first year brought forth a number of curricular issues that needed to be addressed. Time constraints limited the students from completing a patient-centered interview.

Therefore, changes were made in the FCM course to incorporate the need for patient-centered interviewing coupled with efficient and effective history taking methods. The SPA also highlighted redundancies or missing components of the interview/examination within the teaching process.

SPA performance feeds into the small group case course that occurs weekly. Students who perform poorly on Part II, the clinical reasoning process and mechanistic thinking, are referred to their small group leader for additional attention during small group. Not only does this reinforce SPA concepts, but it strengthens a student's performance within the small groups.

Finally, SPA tapes and performances have been evaluated for the Promotions Committee when decisions about a student's behavior, communication skills, or clinical reasoning are in question.

DISCUSSION

The goals of the SPA experience are to develop:

- Competence in the technical skills of performing a physical examination.
- Problem solving and clinical reasoning skills.
- Skills in interviewing and communications.
- Professional attitudes and behaviors such as the ability to admit mistakes and lack of knowledge.
- Presentation skills and self-assessment.
- Self-directed learning skills.

Students have reported increased confidence in their ability to conduct histories and physical examinations and have shown progress in clinical reasoning and presentation skills. Faculty, after observing students, report increased confidence in the skills these students will bring with them to the third and fourth year clinical rotations. Faculty also expressed the belief that this type of examination process is producing a more well-rounded, prepared medical student.

A concern with the increased number of students is the subject of cheating. How could we control intentional or inadvertent speaking about the exam in the halls with 108 students? To control for this issue we sacrificed some standardization by utilizing male and female SP's for the same case, and in other exercises by changing the case presentations or laboratory values to lead students toward different diagnostic conclusions. Students also operated under the WFUSM Honor Code and Policy during the examination.

The recruitment of faculty for this process was another major concern when designing the SPA. The first year proved to be a challenge in terms of faculty participation. Faculty were recruited up to the time of the SPA exam and some faculty simply did not show for the assigned time slot(s) or left early. The SPA Medical Director and Associate Dean for Medical Education were "on call" to fill in as were residents who could not block out scheduled time, but agreed to be called at the last minute.

Fear of the unknown has been reported as a reason for faculty not participating in these types of activities. SPA exams and SP's were not a part of medical school 20 years ago. Increased exposure to SP's and alternate assessment methods has increased faculty participation at WFUSM. In addition, a plan for departmental participation based upon the number of faculty members in each department was developed. This has helped SPA recruitment efforts for the 1999-2000 academic year in faculty participation and medical education overall.

There is a continuing call for structured observation of students' clinical skills by faculty. A recent summary from the LCME database sources[2] documented the infrequent use of structured observation of students' clinical skills. There was a positive trend of an increase from 19.1 to 48% in the number of schools using standardized patients in comprehensive fourth-year clinical assessments: however, there was no mention of how many schools use faculty observers of first- and second-year students' interviewing and physical diagnosis skills.

The underlying justification for performance-based assessment of clinical skills using multiple station clinical encounters with standardized patients (OSCE - Objective Structured Clinical Examination) is the difficulty in getting faculty to systematically observe students in structured clinical settings.[3] In studies of the validation of standardized patient ratings, faculty observations

and ratings are used as the criterion standard.[4] Some authors have gone so far as to say that faculty rating is the gold standard for the validation of standardized patient ratings.[5] Even though there are legitimate concerns regarding the inter-rater reliability of faculty ratings of students' clinical skills,[6] the use of structured encounters and standardized patients reduces some of the sources of reliability error.

Students were asked to complete an evaluation of the May 2000 SPA experience. The overall response rate was 86%. Students overwhelmingly agreed with statements that the SPA allowed adequate demonstration of their clinical reasoning ability (83.5% agreed or strongly agreed) and adequate demonstration of their relevant basic science knowledge (84.4% agreed or strongly agreed). Almost 71% of the students also agreed or strongly agreed that the skills and attributes upon which they were evaluated were appropriate.

CONCLUSIONS

More formalized research needs to be conducted on the actual benefits of this type of examination over smaller more focused OSCE exams. However, the National Board of Medical Examiners (NBME) plans to implement an SP examination as part of the USMLE (United States Medical Licensing Examination) step 2,. This will be a required element of the step 2 licensing process. Therefore, in addition to being an integral part of the *Prescription for Excellence* curriculum, the SPA also serves to better prepare WFUSM students for the Step 2 examination.

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LIST OF ABBREVIATIONS

IPA	Individualized Process Assessment
SPA	Standardized Patient Assessment
PC	Parallel Curriculum
SP	Standardized Patient
FCM-	Foundations of Clinical Medicine
WFUSM	Wake Forest University School of Medicine
MS I-	1st year Medical Student
MSII-	2nd year Medical Student
H&P	History and Physical Examination
DOS	Disk Operating System
VB Script	Visual Basic Script
ODBC	Open Database Connectivity
DSN	Data Source Name
URL	Uniform Resource Locator
CGI	Common Gateway Interface
GI	Gastroenterology
HTML	Hypertext Markup Language
MRI	Magnetic Resonance Imaging
CT	Computed Tomography
OSCE	Objective Structured Clinical Examination
NMBE	National Board of Medical Examiners
USMLE	United States Medical Licensing Examination

APPENDIX

Forms and documents used by students and evaluators in the SPA are appended here:

APPENDIX A	*Evaluation Overview for Faculty Conducting SPA Part I*
APPENDIX B	*Evaluation Overview for Faculty Conducting SPA Part II*
APPENDIX C	*Part I Evaluation Form – Observed Patient Encounter*
APPENDIX D	*Part II Evaluation Form – Clinical Reasoning & Oral Presentation*
APPENDIX E	*Student Initial Report of Standardized Patient Encounter*
APPENDIX F	*Student Initial Report of Problem Identification and Proposed Hypotheses*
APPENDIX G	*Student Initial Report of Hypothesis Testing & Proposed Learning Issues*
APPENDIX H	*Student Log of Clinical Reasoning Activity During SPA*
APPENDIX I	*Student Summary Report in Preparation for Oral Exam (SPA Part II*
APPENDIX J	*Student Summary Report of Learning Issues Prepared for Part II*
APPENDIX K	*Student Self Assessment of SPA Performance*

APPENDIX A

The Standardized Patient Assessment (SPA): An Overview - Part I
December 2000
Faculty Orientation

I. Introduction

SPA part I: **Standardized patient Assessment**. The student will perform a 1 hour and 15 minute (maximum) videotaped History and Physical Examination of a standardized patient under the observation of a clinical faculty member. The evaluator will critique the student's bedside manner, interviewing style, physical examination technique skills, and the completeness of the student's history and physical examination using a checklist (enclosed for your review) covering the areas of history, physical exam, interviewing and interpersonal skills, patient education (if applicable) and closure. The student is graded on a scale of:

Honors **Pass** **Low Pass** **Fail**

Students are expected to include all critical elements and the vast majority of important elements, but should not be penalized for including the nonessential elements.

Standardized patients expect students to treat them as they would treat real patients in the clinic or hospital. Students should ask any questions that they would ask of a real patient. The only exceptions are:

(1) Refrain from performing breast, genital or rectal exams; if these exams are relevant to the exploration of the patient's problem, the student should **say** that he/she is deferring that exam for the present.

(2) Many (but not all) relevant physical exam findings can be simulated or patients can be recruited who have the relevant findings. For findings that cannot be simulated, index cards with relevant information are given to the student at the end of the encounter.

II. Format

A. Faculty Preparation

Report to the Central Area on the E floor of the Hanes Building a few minutes prior to your assigned evaluation time. Beverages and/or snacks will be provided.

B. History - the student should

- Introduce him/herself to the patient and establish eye contact and rapport
- Take the history in an organized approach.
- List the chief complaint or complaints.
- Get all information about **each** major problem (duration, severity, location, etc.)
- Obtain relevant past medical history
- Obtain relevant family history
- Review of systems - ask a few screening questions about each major organ system. Go into more detail on organ systems related to complaints.
- Ask if there are other concerns, questions, or problems.

C. Physical Examination - the student should:

- Pull the blinds (patient may do this) and leave the room while the patient undresses. The patient will let the student know when he/she is ready by opening the door.
- Return, open the blinds, and again establish rapport with the patient.
- Wash hands prior to beginning physical examination. Take vital signs.
- Complete the physical examination in an organized manner.
- Use judgment on whether to perform a mental status examination.
- After completing the physical examination the student should pull the blinds and leave the room while the patient dresses. The patient will open the door when ready for the student to return.

D. Closure

The student should return to the room and summarize with the patient what he/she perceives as the major problem or problems and any significant physical findings. The student should also discuss plans for the work-up and tell the patient that the attending physician will be consulted to discuss the case. Finally, the student should ask if there are any further questions and let the patient know how to reach the student if they have any questions.

E. Evaluation

After closure with the patient, the student will leave the room and wait in the hallway. The faculty evaluator should join the student and re-enter the room to receive feedback from the patient. The evaluator may then ask the student to leave the room for a few minutes (if more time is needed) while they review the checklist and fill out the evaluation form. The student will then return to the room and review the evaluation. The student and evaluator may discuss how the student felt during the examination, issues about the student's performance of History and Physical Examination, or general questions about the performance of skills, but **the student may not ask questions about the case.**

F. Grading Forms

After the feedback session with the student is completed, the faculty evaluator should ask the student to sign the grading form. The grading form and the checklist should be handed in to the staff in the central area.

APPENDIX B

The Standardized Patient Assessment (SPA): An Overview - Part II
December 2000
Faculty Orientation

The Standardized patient Assessment (SPA) is a comprehensive exercise designed to give each student an opportunity to be evaluated on the full range of activities expected of a physician. It is not designed to be a quantitative, mathematically precise evaluation instrument. Instead it is more sensitive to measuring broad areas of growth in mastery of the clinical reasoning process. It is also a means of identifying students who are in need of additional help with the reasoning process.

This exercise is a "process" evaluation. Therefore, a correct diagnosis is less important than the student's ability to collect and analyze data in a systematic manner, to be able to explain underlying mechanisms, and to support his/her hypotheses.

Details of SPA Part II:

The student will perform a complete history and physical examination of a standardized patient two days before this exercise. The student will then have 4 hours to write-up the case history and physical exam, develop a differential diagnosis (problem identification and hypothesis formulation), list diagnostic studies they wish to obtain, and develop a preliminary list of learning issues. After submitting this information electronically, the student may order and obtain results on diagnostic tests. They will spend the remainder of the 2 days keeping a detailed log of the clinical reasoning process, revising the differential diagnosis (hypothesis revision), keeping a list of resources used, developing a final list of learning issues, and preparing a basic science discussion on topics related to the clinical case.

On the day of the examination, the student will meet with a basic science/clinical faculty team to give a brief oral presentation of the case, review the log and forms documenting the clinical reasoning process, and present the basic science discussion. The student will then give a self-assessment and receive an evaluation from the faculty team.

The role of the faculty team is to:

1) critique the student's oral presentation
2) facilitate the discussion of hypotheses, learning issues, and underlying mechanisms
3) critique the student's clinical reasoning abilities, self-assessment, and learning strategies

The time allotted for this exercise is 2 hours (see time schedule enclosed).

APPENDIX C

Standardized Patient Assessment Evaluation Form
February 2001 - Observed Patient Encounter

Student:_____ Date: _____

Evaluator:_____ Time: _____

Please provide a DESCRIPTIVE NARRATIVE and GRADE ASSESSMENT of the student's performance in each of the following categories as well as an OVERALL ASSESSMENT.

Scale for evaluation:

Fail= unacceptable	**Low Pass= some cause for concern**	**Pass=competent**	**Honors= superlative**

General impression of student's performance:

Assessment	**Descriptive Narrative**
_____	History (30%)
_____	Interview Skills (15%)
_____	Interpersonal skills (including psychosocial issues) (15%)
_____	Physical examination (30%)
_____	Patient education (if applicable) (5%)
_____	Closure (5%)

OVERALL EVALUATION:_____

Suggested performance categories and a description of the grading scale are provided above.

Suggestions for improvement:

Observer _____ Student _____
(Signature) (Signature)

APPENDIX D

STANDARDIZED PATIENT ASSESSMENT EVALUATION FORM
PART II -- ASSESSMENT OF CLINICAL REASONING PROCESS
May SPA 2001

STUDENT**: «Student»** DATE**: «SPA_Presentation»** Room: **«Room»** Hour: **«PresentationTime»**

EVALUATORS**: «Eval_1_First» «Eval_1_Last», «Title_1»** and **«Eval_2_First» «Eval_2_Last», «Title_2»**

I. GENERAL IMPRESSION OF STUDENT'S PERFORMANCE:

II. ASSESSMENT BY PERFORMANCE AREA

In each of the following areas, please record a ***descriptive assessment*** for each performance category. Use the evaluation criteria printed below the category label along with the grading guidelines to determine the *assessments*. Write the *descriptive assessment* in the space after the criteria for that category.

GRADING GUIDELINES FOR PERFORMANCE AREAS

H **Nearly flawless** performance in the category; student satisfies **all criteria** (the criteria representing ideal or perfect performance); **superlative** *(exceeds expectations)*

P: **Competent**; acceptable performance on **most** of the criteria in most categories but had sub-optimal or deficient performance in some categories *(meets expectations)*

LP **Minimal performance** in most categories or, satisfactory in only a small number of the categories; **some cause for concern**

F **Sub-optimal** performance on **most** criteria; **Unacceptable Performance**

Grade

CLINICAL REASONING PROCESS (6 components)

_____ 1. Oral case presentation (note there is **no form A-1** /patient write-up used in the May SPA, but students do present the case they received)

Criteria: Calm, confident, authoritative; concise yet included pertinent positives and negatives; finished within 5-6 minutes; presented with minimal notes; organized; accurate; proceeded logically; used accepted format; accurate use of medical terminology

_____ 2. Problem identification (**form A-2**)

Criteria: Problems are relevant to case; comprehensive (including major and minor problems noted, psychosocial issues, previous diagnoses)

_____ 3. Hypothesis formulation (**form A-2 process presentation**)

Criteria: Comprehensive for <u>each</u> problem; appropriate and relevant to stated problems; prioritized, ranked; using mechanistic terms rather than diagnostic labels

_____ 4. Hypothesis testing (**forms A-3, hypothesis testing and B-4, log**)

Criteria: Logical sequencing of tests and queries (seeking additional historical or physical exam data, and laboratory/diagnostic studies); justification for tests clear from hypotheses given; prioritized (least expensive/invasive to most expensive/invasive, focused on most likely hypothesis first)

_____ 5. Hypothesis revision (**Summary (Form B-1) and log form, process presentation**)

Criteria: Logical, understandable; appropriate integration of negative and positive test results and new information from studying to consider adding new hypotheses or dropping inappropriate hypotheses; appropriately re-ranked hypotheses

continued on reverse

CLINICAL REASONING PROCESS (continued)

Grade

_____ 6. Acquisition and integration of new information (**log form B-4Log of application of clinical reasoning process**)

Criteria: Related basic science knowledge and mechanisms back to patient; explained clinical signs, symptoms and treatments by invoking basic science mechanisms; demonstrated ability to reason with new information and to apply new information to related situations

_____ Summary Grade of Clinical Reasoning (note: you should 'average' the 6 components)

DEVELOPMENT OF KNOWLEDGE BASE DURING THE SPA

Basic Science Presentation (**Form B-2, summary report-learning issues)**: Understanding of basic mechanisms. The primary determinant of the grade for this section is the Basic Science Presentation. *Criteria: Depth, accuracy, clarity, breadth, mastery of asterisked learning issues. Relates basic science learning back to the patient (integration of basic science and clinical knowledge).* **This category should be the major determining factor for the grade in the category "Development of Knowledge Base During SPA"** but you should also take into consideration the additional criteria below:

1. The breadth & depth of learning issues *Criteria (Summary-**Form B-2**): Clearly and logically related to problem(s) and hypotheses; focused, well-defined and achievable (not too general or global); primarily focused on basic science rather than clinical issues; comprehensive, including multiple disciplines and psychosocial issues.*

2. Use of resources: *Criteria: (summary-**Form B-2**): Appropriate to learning issues; used multiple and appropriately balanced resources (e.g., review texts, reference works, journal articles); resources of appropriate quality.*

_____ Grade for Development of Knowledge Base

SELF ASSESSMENT

Self assessment of strengths and weaknesses (**Form B-3, self assessment**)
Criteria: Accurate; confident in areas of strength; open to critique; responded appropriately to feedback; demonstrated insight into plans for improvement

_____ Grade for Self Assessment

III. SUGGESTIONS FOR STUDENT'S IMPROVEMENT:

Evaluator Signature: _____ **Evaluator Signature: _____**

Student Signature: _____

APPENDIX E

STANDARDIZED PATIENT ASSESSMENT
POST-PATIENT ENCOUNTER - FORM A-1
DECEMBER 2000

Evaluators:	**This documentation is completed within 4 hours of the patient encounter. It is related to the process step "Perceived Initial Data."**

Student: _____ Date:_____ Patient: _____

Directions to Student: Write a **complete patient narrative** based on your interview and examination of the patient. **Copy this form as a Word Document** and begin writing your narrative below. The write-up should be approximately 2 pages in length. Attach additional pages as needed, numbered to indicate order and include your name at the top of each page. Electronically submit one copy of the write-up **within 4 hours** of completing your patient encounter to: decspa@wfubmc.edu and keep one copy for your records.

APPENDIX F

STANDARDIZED PATIENT ASSESSMENT
POST-PATIENT ENCOUNTER ----- FORM A-2
DECEMBER 2000

Evaluators: This documentation is completed within 4 hours of the student receiving the written patient history and physical examination information. It is related to the process steps "Problem Identification" and " Hypothesis Formulation."

STUDENT: _____ DATE: _____ PATIENT: _____

Problem Identification	Hypothesis Formulation
What are the patient's **major <u>problems</u>**? Provide a comprehensive list of problems (not diagnoses) that you identified from the written <u>history and physical examination.</u>	What are the **probable mechanisms** for **<u>EACH</u>** of the patient's problems (i.e., **<u>mechanistic hypotheses</u>**)? Rank your hypotheses from MOST (#1) to LEAST (#xx) LIKELY, based on the information and understandings you have at this point.

<u>V</u>ascular **<u>I</u>**nfectious/Inflammatory **<u>N</u>**eoplastic **<u>D</u>**egenerative **<u>I</u>**ntoxication **<u>C</u>**ongenital/Hereditary
<u>A</u>utoimmune **<u>T</u>**raumatic **<u>E</u>**ndocrine **<u>M</u>**etabolic/Nutritional **<u>P</u>**sychologic/Psychiatric

APPENDIX G

STANDARDIZED PATIENT ASSESSMENT
POST-PATIENT ENCOUNTER ----- FORM B
DECEMBER 2000

Evaluators: This documentation is completed within 4 hours of the student receiving the standardized patient history and physical examination information. It is related to process step "Hypothesis Testing".

Student: _____ Date: _____ Patient: _____

Hypothesis Testing

What **additional information** would you like to have at this point (e.g., from the history & physical exam, which diagnostic studies you would order)?	For each piece of information you would like, what are you trying to **rule out or in**? What question(s) do you expect to answer?

Preliminary list of learning issues:

After forms A-1, A-2 & B are submitted electronically within 4 hours, the student can order lab studies through a list of studies available on the computer.

APPENDIX H

STANDARDIZED PATIENT ASSESSMENT
LOG OF APPLICATION OF CLINICAL REASONING PROCESS
DECEMBER 2000

Student: _____ Date: _____ Patient: _____

Evaluators: This document is related to process steps "Hypothesis Formulation", "Hypothesis Testing", "Hypothesis Revision" and Identification of Learning Issues. It is an ongoing record of the student's work to stimulate reflection and discussion by evaluators and the student.

Directions to Student: Use this form to **document your use of the clinical reasoning process** as you work towards a better understanding of the patient's problem(s). Begin your Log with your hypothesis list as it stands after reading the standardized patient history and physical exam. Then keep an **ongoing record of all changes to your hypothesis list**, including adding, ruling out, or re-ranking hypotheses. For each change, record **WHY** you made it. Attach additional pages as needed, numbered to indicate order.

APPENDIX I

STANDARDIZED PATIENT ASSESSMENT
SUMMARY REPORT
FORM C - 1
DECEMBER 2000

Evaluators: This Summary Report is completed as the last step before the student turns in all documentation before meeting with you. It is related to process step "Hypothesis Revision".

Student:_____ Date: _____ Patient: _____

Directions to Student for Summary Report: The Summary Report is the last document you complete before you meet with your evaluators. It allows you to document **where you are in your thinking** as you prepare to talk with them. On the first page you report where you are at this moment with your thinking about and understanding of the patient's problems. On the second page you record your comprehensive list of learning issues and resources. The third page is for recording your comprehensive self-assessment.

(1) **Hypothesis Revision:** What are your **current hypotheses** about the patient's problems and your **rationale** for those hypotheses?

(2) What **other inquiries, exams or investigations** (if any) would you still like to explore? Why?

APPENDIX J

STANDARDIZED PATIENT ASSESSMENT
SUMMARY REPORT
FORM C - 2
DECEMBER 2000

Student: _____ Date: _____ Patient:_____

(3) Provide a **comprehensive list of learning issues** (i.e. 5-10 LI's from areas such as anatomy, physiology, pharmacology, clinical) that you developed during the course of your work. Star (*****) the issues that you actually studied. For each issue that you studied, provide a list of the **resources** you used (e.g., books, articles).

APPENDIX K

STANDARDIZED PATIENT ASSESSMENT

SUMMARY REPORT

FORM C - 3

Student: _____ Date: _____ Patient:_____

(4) Write a **detailed self-assessment**. Address your **strengths** and **weaknesses** in each of the following areas, along with (if appropriate) a **plan** for addressing your weaknesses:

(a) Use of the clinical reasoning process (including problem identification, hypothesis formulation, hypothesis testing, hypothesis revision)

(b) Development of knowledge base during the SPA (including your identification of learning issues, use of resources, understanding of basic mechanisms, acquisition and integration of new information).

Fourth Year Medical Students are Effective Case Discussion Leaders

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ABSTRACT

Medical seniors have been used extensively as discussion leaders in small group settings for sophomore Medical Microbiology students. There is a benefit for both the seniors and the sophomores. In addition, this obviates the need for faculty discussion leaders.

INTRODUCTION

Clinical case presentation is an integral part of medical education from the preclinical years to clinical studies and postgraduate rounds. We have found that clinical case presentation can be enhanced in the second year Medical Microbiology and Immunology course by bridging the medical education experience between fourth year students and second year students. Fourth year students were used as discussion leaders for small groups of second year students. There is educational value for both student groups.

METHODS

A straightforward, effective way was instituted to bring fourth year medical students to a basic science setting and develop a mutual learning experience for fourth and second year medical students. Our course in Medical Microbiology and Immunology has extensive clinical correlation by featuring numerous clinically relevant activities throughout the course. In fact, our course only has 58% formal lectures. We do not use a classical problem-based learning (PBL) format. To initiate the 8 clinical case discussions each year, volunteers from the senior class are sought to be leaders for these discussion groups. The response has been excellent and universal. From a class of 142, about 40 volunteered immediately and rarely will anyone refuse if asked later, even without volunteering. A valuable inducement is an agreement with the Associate Dean for Students, whereby a sentence is inserted into every participating senior's residency application letter stating that this student helped in teaching second year students.

The mechanics for running these sessions are straightforward. Each senior received an envelope with the case to be discussed (see sample case Figures) and instructions for the session, a few days prior to their session, to facilitate preparation. The second year students received the case to read and review the day prior to discussion. The seniors each had a group of 24 students and went through the case in detail, making sure the sophomores understood all the clinical terms, implications of the physical findings, as well as an appreciation for what should be done initially for the patient. Then, through discussion, they helped the group develop a differential diagnosis of each case, not necessarily with microbiology and immunology in mind initially, even though all cases were ultimately course-related in nature. Once the differential diagnosis was finished, more data on the case were provided to the students (either freely or having the sophomores ask for specific tests) to narrow the differential, and the students were ultimately led to the cause of the medical problem. As a variation, the seniors in some of the cases acted as the patient, and the sophomores had to elicit relevant history to reach conclusions about the cause of the medical problem. Next, treatment was discussed and any unique clinical information available to the seniors was introduced. Often, the seniors can relate the development of the case to questions they had

seen in the United States Medical Licensing Exam (USMLE) Part 1. Finally, the second year students separated into smaller groups of 4-6 for discussing 3-4 questions relevant to the case and the senior student was a much used facilitator for this exercise. The seniors were also provided a key of preferred answers to these questions. At the end, the second year students turned in their question sheets for course credit. The entire exercise takes about one hour.

Sample case

The sample case is presented in Figure 1 (adapted from Underground Clinical Vignettes[1]) and the informational material on the case provided for the senior discussion leaders is shown in Figure 2. Figure 3 represents the questions used for discussion on this case. This particular case was deliberately misleading to show the sophomores that clinical findings should not be prejudged. The case was presented when the sophomores had finished immunology in our course and had received a correlation on *Streptococcus pyogenes* infection and its sequela-induced rheumatic fever and glomerulonephritis.

Figure 1. Discussion Case #3

A 12-y/o female is brought to her pediatrician and complains of headache, chest palpitation, and ringing in her ears, and is found to have generalized edema. She denies any dyspnea, sore throat, skin infection, or fever. On extended and very careful questioning, she admits she had hematuria. On physical exam, her BP is found to be 140/110, she has generalized (including periorbital) pitting edema; jugular venous pressure is normal; the lung base is clear; neither kidney is palpable; there is no evidence of pleural effusions or ascites.

What would you do initially?

Their first inclination during discussion was that this case could be lupus, or glomerulonephritis. On that basis, they ordered from the senior the results for anti-DNA antibody, streptolysin O antibody, as well as bacterial cultures and antibody titers for some viral infections, just to be sure. However, as you can see in Figure 2, all those were negative. The critical finding is serum hypocomplementia. They were also provided with results from the urinalysis as well as micropathology. They then, ultimately, arrived at the diagnosis of idiopathic membrane proliferative glomerulonephritis. This interfaced strongly with pathology, which our sophomores were just beginning, but the seniors knew well. So, there was also correlative, course-bridging teaching that can take place in these types of exercises. A "hidden agenda" in this process is that the seniors also have to review basic sciences to function as "effective" leaders. The seniors often bring clinical material (X-rays, literature) to illustrate cases and provide further integration with the clinical sciences. The questions shown in Figure 3 allow the sophomores to compare the results from this case to diseases they have already learned about in our course, introduce an ethical question on value and necessity of biopsies as well as information on how to do them, and then specifically center on the problem that this patient is experiencing.

DISCUSSION

An added benefit to this methodology was the interaction between the fourth and second year students. First, the seniors used clinical terminology and intuitive analysis skills, which gave the second year students a look at their own future development. Second, the seniors rapidly realized that the terminology was relatively foreign to the second year students, and they had a look at their future interaction with patients and how they will need to talk to them. Third, the seniors received valuable practice in case presentation before an audience which will help them in future grand round presentations and in teaching, if they choose an academic career. In addition, our medical school has historically sent very few graduates into academic medicine careers and this exposure to teaching may influence more students to consider an academic future.

Both groups of students benefited and moreover, thoroughly enjoyed the exercise. The only difficulty came in arranging the final schedules with the seniors. Some had to drop out because their fourth year rotation would not let them take the time.

Figure 2. Discussion Case #3
(Session Leader Copy)

(Seniors-make sure they understand the symptoms, the medical terms, and the nature of the physical)

A 12-y/o female is brought to her pediatrician and complains of headache, chest palpitation, and ringing in her ears, and is found to have generalized edema. She denies any dyspnea, sore throat, skin infection, or fever. On extended and very careful questioning, she admits she had hematuria. On physical exam, her BP is found to be 140/110, she has generalized (including periorbital) pitting edema (seniors-go over this); jugular venous pressure is normal; the lung base is clear; neither kidney is palpable; there is no evidence of pleural effusions or ascites. *(Seniors-go over these to make sure sophomores understand the examination and findings)*

What would you do initially?

(Get blood chemistries and check for antibody titers for possible bacterial, or even viral infections; think of immunological problems)

Ask them what they would like to order. If they order:

Urinalysis- fatty casts and oval bodies in addition to heavy *proteinuria (explain what this means)*
Immunology-

- antinuclear antibody-negative,
- Anti-streptolysin O antibody – normal
- Complement-serum hypocomplementia

(if they don't order, give this result after discussion)
No antibodies to expected infections with bacteria or viruses
Chemistries-

- High BUN and serum creatinine
- Decreased serum albumin;
- Elevated serum triglycerides

Ask them if they would want to order anything else? If they don't come up with this, suggest it.

Micropathology- Light microscopy reveals a diffuse glomerular involvement with thickening of capillary walls and enlargement of glomerular tufts, many times in a lobular pattern. Thickening of the capillary wall comes from interposition of mesangial matrix between GBM and endothelial cells which results in a splitting or double contour of the capillary wall, also known as "railroad tracks". Staining with periodic acid- Schiff reagent or silver stain visualizes this. Immunofluorescence shows coarsely granulated deposits of complexes with complement components. *(Seniors: make sure they understand the pathology report)*

Identification: membrane proliferative glomerulonephritis, idiopathic.

The clinical diagnosis of this disease cannot be differentiated from other glomerular diseases and may require renal biopsy to diagnose definitively. Membrane proliferative glomerulonephritis should be strongly considered in young patients who demonstrate nephrotic syndrome and hematuria, as did this patient, and whose serum is shown to have hypocomplementia.

Treatment: *(They most likely have no idea so discuss this with them).* No immediate response to oral steroid therapy, though prolonged therapy may be beneficial in preserving renal function in children. Renal transplant may be necessary though the disease can recur in transplanted kidneys. Within 6-10 years 1/3 of untreated patients progress to chronic renal failure, 1/3 have persistent nephrotic syndrome, 1/3 have persistent non-nephrotic proteinuria or hematuria

An additional variability comes from the seniors themselves. Not all are great teachers, however that does not seem to impede the value of the sessions to the sophomores. Most seniors arrived ahead of time and could not wait to run their session. They all said they would do it again. This year one wanted to participate in all the discussion sessions. For the first time, the second year students were unanimously satisfied with their discussion groups and put high educational value on the exercise. Prior to the use of seniors, our discussion groups rated at 2.8-3.2 on the scale of 1(best) to 5 (worst). For the three years we have used seniors for clinical discussion the rating is consistently between 1.4-1.8. In the yearly course evaluation for the Fall 2000 session a student wrote: "I hope someday I'll have the knowledge those 4th years have, so I can teach 2nd year students!" The use of seniors to lead discussion for sophomores is self-propagating for future discussion leaders. Also, it is difficult to recruit faculty with the experience and freshness of knowledge that the senior possesses.

CONCLUSIONS

This method for using fourth year students in basic science instruction should be equally applicable to other basic science courses, where discussions on clinical material are presented in

either PBL or non-PBL formats. Also, this type of presentation allows the instructor to alter the exercise in whatever way is most suitable for the course, while still maintaining the benefits of this direct interaction among the students for mutual learning.

References

1. Bhushan, V., Amin, C., Nguyen, H., Fierro, J., Pall, V. and Grimm, A. Case 89. In: *Underground Clinical Vignettes: Pathophysiology*, Vol. II. Student to Student Medical Publishing, distributed by Blackwell Science, Malden, MA, 1999.

Figure 3. Discussion Case #3

Name_____

DISCUSSION QUESTIONS
TURN IN ANSWERS FOR CREDIT

1) How is this case similar or different from:

   a) a case where the findings would have revealed a positive antinuclear antibody?

   b) a case where the findings would have revealed a positive antistreptolysin O antibody with high titer?

2) Would you want to take a biopsy of this girl's kidney? Why or why not?

3) How does the lack of complement components contribute to this disease?

Idiopathic membrane proliferative glomerulonephritis is an inherited deficiency of complement components. This girl could be C2 minus and cannot clear immune complexes. This would be most common. Complement would be absent under these conditions. She could also be C4 minus- there are two allotypes that make different proteins. If deficient in one, then there would be immune complex disease and hypocomplementia. This is probably what this girl has.

Student and Faculty Attitudes Towards a Neurosciences PBL Pilot in a Traditional Curriculum

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ABSTRACT

This paper describes a Neurosciences PBL pilot project at The University of Oklahoma College of Medicine. It is noteworthy in that it describes how, with few resources a PBL experience was successfully infused into a conventional discipline-based curriculum. The authors describe assessment and logistical challenges. Student and facilitator attitudes and faculty effort are discussed.

INTRODUCTION

Problem-based learning (PBL) is a student-centered approach to teaching and learning that emphasizes in-depth understanding, critical reasoning, teamwork, and contextual learning. During a typical two-part PBL session, a small group of students systematically uncover a clinical case through the help of an instructor who takes on the role of facilitator rather than an expert lecturer. In the first session students identify concepts they do not know and assign these among themselves to research. During the subsequent session, students return to discuss what they learned and integrate these ideas around the problems of the patient.

The evidence base surrounding PBL is abundant and varied. While there is much disagreement and debate regarding basic sciences academic achievement, problem solving, and clinical performance, it is generally agreed that student satisfaction is superior in the PBL model.[1,2,3] The disparity is further evidenced by the ways in which some authors interpret the equivocal body of literature ranging from "the results generally support the superiority of the PBL approach over more traditional methods"[2] to "PBL curricula provides no convincing evidence that PBL improves knowledge base and clinical performance".[1] A recent study comparing USMLE Step1 and Step 2 exam outcomes following a PBL implementation found that PBL "[does] not compromise the performances of medical students. . . in fact, they may have contributed to higher scores".[4] Others suggest that PBL methods may be more effective at helping students minimize the rote learning required to navigate traditional medical school curricula.[5] While many advocates claim that PBL can improve generic problem solving abilities, some have found problem solving not to be a generalizable skill.[6,7] Most studies do assert that current outcome measures are not sufficient to understand the true effect of PBL.

Despite national discussions regarding measurement and outcomes, many educators have found PBL to be an attractive and enjoyable alternative to conventional educational modalities. Studies of faculty satisfaction with the PBL technique reveal no major frustrations once they have had an opportunity to experience the process as a facilitator.[3] Many instructors have experimented with PBL variants by altering the case structure and logistics. Others have used technology to develop, deliver, and evaluate PBL activities.[8]

The resource-intense nature of PBL is commonly cited as a drawback. A five-year study at The University of Sherbrooke found that teaching loads can increase as much as thirty percent.[9] An analysis of the use of PBL in a pathology course estimated that PBL activities require an average of 17.4 faculty hours per year per student compared to 4.8 for traditional lectures.[10] Class size also appears to be an important factor. PBL may be resource prohibitive for class sizes greater than 100.[3]

At The University of Oklahoma College of Medicine, many faculty had followed the PBL trend with interest but struggled with a way to feasibly adopt it into the moderately large classes

of 150-160 students. Nonetheless, several instructors in the Neurosciences course were interested in piloting this technique. With little experience in problem-based learning and few volunteers for facilitators they developed a pilot project to determine student and faculty reception to problem-based learning and compare faculty effort with traditional techniques.

METHODS

All 153 first-year medical students were required to participate in the pilot as part of the Spring 2000 Neurosciences course. To accommodate the pilot PBL activities, the course director decided to cut five hours (out of eleven total) of lecture from his personal section of the course on motor systems. Students were informed early in the semester that the course was going to implement a PBL pilot and that attendance was mandatory.

Two cases were developed for the pilot. One case was selected to integrate content previously covered in the classroom. This case concerned a lesion in the lateral portion of the caudal pons. The students had previously covered the anatomy and physiology of the brainstem, and were taught all of the classic lesions involving the brainstem. The second case was chosen to present a novel situation that could be addressed using previous material. This case presented a thalamic lesion. Although the students had been taught the basic anatomy and physiology of the thalamus, they were not taught any thalamic lesions. For this case, the students had to use information previously taught to localize a type of lesion they had not seen before.

Learning objectives were pre-identified and outlined on instructor's version of case. To reduce the group size each instructor was asked to repeat the experience by facilitating two separate groups of students. Each group covered the two cases over three 1-hour sessions (roughly 1.5 hours spent on each case). There were two to three days between sessions during which students were asked to research their learning issues.

Eight faculty, a combination of experts and non-experts, were recruited to act as facilitators for the cases (roughly one facilitator per ten students, with each facilitator supervising two groups). A role-playing training session was conducted to familiarize the instructors to the traditional PBL approach. During this session one of the authors acted as the facilitator to the rest of the instructors who played the role of students. After role-playing the exercise each instructor was given the actual cases for study.

As with the traditional PBL method of teaching and learning, students identified learning objectives during the first session and reported on these during the second session. Students were given the freedom to allocate learning issue responsibilities as they saw fit.

Student attendance and participation were assessed during each of the three sessions using a simple checklist system. As long as a student made some effort to contribute they were given full participation credit (a total of 11 points for the three sessions, out of 360 possible for the entire course). Students who were not able to attend one of the sessions were able to make up credit through a PBL exercise held later in the semester.

Student attitudes were assessed using a post-exercise Likert scale survey. In addition, students had space to write written comments. Faculty attitudes were assessed with individual interviews that asked their perception of the interaction and how it affected their teaching workload.

RESULTS

Ninety-seven percent (149/153) of students responded to the survey. Table 1 reveals that an overwhelming majority of students found the experience useful and desired more PBL sessions in the curriculum. Slightly fewer felt like they were evaluating a real patient by working through the problem. Written comments were equally favorable. Of the fifteen written comments (see Table 2) most described the experience with positive language. The students of one facilitator were noted to have received less enthusiastic ratings and comments from students.

Most facilitators experienced a teaching time increase of 7 hours (6 contact hours plus one preparation hour). However, for the instructor that cut lecture hours the increase of time was 5 hours (-5 lecture, +7 hours as described for other faculty, +3 hours developing the case). When instructors were interviewed individually they noted that they enjoyed the personal interaction with students; even though total teaching time increased, it was

Table 1. Student Attitudes Regarding the Neurosciences PBL pilot.

Survey Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1) I found this problem-based learning experience useful	66%	33%	1%	1%	0%
2) I would like more of these sessions in the curriculum	61%	28%	9%	2%	0%
3) By going through this case I felt like I was evaluating a real patient	40%	43%	14%	2%	1%
4) This kind of format provided a clinical context that helped me learn basic science concepts	63%	33%	3%	1%	1%

not prohibitive because the preparation time was minimal compared to traditional lectures

The PBL experience had no obvious effect on student grades relative to the written exams. However, students still believed that the cases helped them prepare for the exams because case presentations are a significant proportion of the exams; up to 50% of the exam questions (fewer on the first exam, more on the final exam) involved clinical situations.

An unexpected impression occurred to many faculty. As noted previously, several students did not participate in the discussions to the extent that other students did. We expected this to occur, but we thought that it would be more related to personality or being uncomfortable in a group setting. After the case discussions were completed, and the names of some of these students were mentioned to the course director, it became evident that many of these students were performing poorly in the course.

Table 2. Student Attitudes Regarding the Neurosciences PBL pilot (Comments)

Written Comments
✓ *I thought these were helpful in evaluating our knowledge of the systems we have talked about. PBLs integrate our knowledge and make us think.*
✓ *It is very helpful to learn with this problem solving/case study concept.*
✓ *This should definitely be a BIGGER part of the curriculum!*
✓ *This is an excellent integrative tool. Let's do more of them.*
✓ *Please include radiograms, etc., next year.*
✓ *Rarely attend lecture -- just confuses me; Love this! I like the active learning!*
✓ *A combination of clinical correlations & case-based learning would be helpful! (50/50)*
✓ *Please include more of these interactive & integrative learning seminars in the curriculum. I found this experience to be a dynamic and unique approach to understanding Neurosciences.*
✓ *I already feel fairly taxed in terms of sheer class load & this tends to add more time required for school that I could use for studying.*
✓ *More, more, more!! We should have PBL for ALL classes!!*
✓ *How about switching [meeting] times for groups? This group ALWAYS had to get here early. All in all, very good exercise!*
✓ *This was very enjoyable, and more helpful than some clinical correlations.*
✓ *I think it might be helpful to have more case studies for the amount of time we spend on this project. Three hours is a lot of time and I would like to get through more cases.*
✓ *This was great. I would actually prefer more of these small group sessions even if it means more time outside of regular lecture.*
✓ *One PBL exercise each week or every other week would be an appropriate time spent.*

DISCUSSION

The Neurosciences PBL experience was a successful pilot for several reasons. Students found that this method gave them a clear application of basic sciences to clinical situations and in most cases considered this similar to evaluating a real patient. The increased faculty-student interaction and small group setting likely contributed to positive ratings as well. Faculty also reported a positive experience. This effect on faculty and students attitudes is consistent with the literature. However, the faculty effect may have been due to the novel nature of the pilot and may not be sustained if many more PBLs were included in the curriculum without reducing other teaching responsibilities (e.g., lectures).

We feel the grading system could have been improved. Because the students were essentially awarded 11 points for just attending and minimally participating in the discussions, they were given 3.1% of their final course grade for relatively little effort. This problem became evident at the end of the course when several students passed the course without having passed any of the individual written exams. When we planned the PBL exercises, we felt that the exercises should be graded for two main reasons. First, since this was the first time that PBL-like cases would be used in this course, we wanted to encourage student attendance. Second, we felt that students should receive some reward for working on the problems during class time as well as between sessions. The grading system could have been more rigorous. We intend to continue to examine this issue for the next occurrence of the course.

The overall impact of non-expert facilitators was minimal. One of the non-experts was rated slightly below the other facilitators, which did slightly detract from overall positive review. However, other non-experts were reviewed as favorably as the expert facilitators. It was noted that this particular facilitator was not quite as enthusiastic about the process.

The course director would like to explore alternatives to assessing student contribution and performance during PBL sessions. While other medical schools have had success with reflective narrative assessment, it is difficult to accomplish this *de novo* in a class size of 153 students. Standardization of assessment will be an important issue. Of particular interest is an assessment approach for early identification of students who will have difficulty in the course.

Because of the success of the Neurosciences PBL pilot, more cases will be infused into the curriculum during the upcoming academic year. The course director is interested in developing more interdisciplinary cases to integrate and reinforce concepts from multiple courses. Convincing additional faculty that this method can replace lecture hours will continue to be a challenge.

CONCLUSIONS

Our specific plan for the coming year is to present the results of this experiment to other course directors in the first year of our curriculum, with the hope that they will incorporate some cases into their courses. At the same time, we will use faculty who facilitated the cases this year to help recruit additional faculty, partly by emphasizing how much fun it was to interact this directly with students. For the Neuroscience course specifically, we plan to expand to three cases. We do not plan to grade the student participation in each case. Rather, they will be required to attend the case studies, and questions based on the cases will appear on the exams. We hope that this system will reward the students adequately for participation in the case studies.

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Computerized Testing and the United States Medical Licensing Examination

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MANAGING EDITOR'S NOTE: *The following is from an oral presentation given on July 20, 1999 during the Fourth IAMSE Association Meeting held at Georgetown University School of Medicine in Washington, DC.*

INTRODUCTION

I will first address the current status of Computer-Based Testing (CBT) for United States Medical Licensing Examination (USMLE) Step 1, which is always of interest to audiences like this, and second will describe the testing software that we are developing at NBME which has the code name FRED. From the outset, let me state that this word is not an acronym with a definable meaning. In fact, it has absolutely no significance at all other than being a convenient reference name for the program. Third, I would like to speak about the National Board of Medical Examiners (NBME) Subject Tests since we are about to computerize those also. I believe this is an area where your input will be crucial. With the USMLE, we are fairly constrained with what changes can be made since this is an exam which must satisfy state licensing boards. However, there is much more latitude with the Subject Test program since it is essentially designed as a service to medical schools. With your comments and suggestions, it could be made even more helpful.

CBT for USMLE

We will begin with progress in the implementation of the USMLE Step 1. To reiterate, this involves seven 50-item blocks taken over an eight hour period. Virtually all items are in single-best answer format (A-type), and there are typically five options, the number can vary from three up to a dozen or more. Content coverage is parallel in each block. Originally, we had planned to do adaptive testing because it will actually help us to retain as much accuracy and reliability as possible, given that we're shortening the exam. However, we eventually decided for various reasons to delay adaptive testing, and currently each block is equivalent in mean item difficulty. There will be about 18,000 U.S. medical students taking the USMLE Step 1 during 1999. To date, over 17,000 of these have been tested. To summarize progress to date, there has been a deafening silence from medical schools in terms of problems. We assume that means everything is functioning more or less as planned. In terms of reported problems, the rate is approximately 0.5%. Whether that is good or bad depends on if you are one of the small number of students who encountered a problem.

Problems in the Examination Process

It is important to consider just what types of problems occur. For convenience, these are split into three groups. The first group has been software time-out problems. For the USMLE Step 1, the session clock allows seven hours of testing in an eight-hour period. However, if there is a power failure, we have found that the session timer may not stop, in which case students may be "shorted" time when the computer is rebooted. Similarly, on a few occasions, Sylvan personnel in trying to be helpful turned on workstations before students had logged in to start the exam. Since this could result in the timer starting, some students were again timed out. It is NBME policy (for many complex reasons) that students may not restart the same test on a different day. Students who had timed out because of this problem were

required to sit the test again. Not surprisingly, they were very unhappy about this. This timing software "bug" has now been remedied, and fortunately in the grand scheme of things, this problem had a serious impact on only a few students.

The second group relates to the occasional occurrence of scheduling problems. In one incident we received a phone call from an anxious candidate who thought he had scheduled to take the exam in East Chicago when in actuality, he was scheduled for West Chicago. This candidate suffered the anxiety of navigating Chicago rush hour traffic to arrive barely in time to begin the exam. There have been a few such similar incidents.

Perhaps the largest numbers of diverse problems have occurred in the third group, which is related to the quality of the testing experience. These are problems such as the room environment being too warm or too noisy, the proctor being rude, or the bathrooms being dirty. Some of these issues are real, but our problem is that, we cannot know for certain after the fact how warm it was, or how noisy it was, and what constitutes an unreasonable problem with the exam environment. Many anecdotes have been circulated within the examinee community. There was for example an individual who complained that the computer was bouncing up and down on the desk because there was a jackhammer in operation next door. We checked into this and sure enough, there was a jackhammer in operation. There was another candidate who for inexplicable reasons (at least to us), removed clothes down to his underpants while he was taking the exam! While he did not actually complain, another candidate in the center did. There are many such interesting and sometimes humorous stories. Our main purpose in investigating these incidents is to be certain that they did substantially affect candidate performance. Obviously, some of this is in the eye of the beholder. For example, many will remember in the early days of preparing for CBT, there was enormous reaction to the concept of examinees being unable to return to questions and change their answers; most felt that this would seriously impact their scores. Consequently, during one of the field studies, we conducted a relevant study that indicated the ability to change answers made. However, it made a great difference to the comfort level of the examinees just knowing that they could change answers, and in the end, NBME relented and allowed examinees to change answers. Although we have not specifically studied other potentially "hot-button" issues, I suspect this is likely true for a wide variety of other options, such as underlining questions, striking out words, scribbling on the book, etc. These are issues more of importance to examinee comfort and most likely would not significantly affect overall performance.

Quality Assurance

At present, we are still collecting information about the testing environment and are using the following methods. First, a series of surveys are sent to candidates who have completed the exam. As far as quality assurance is concerned, all students are asked to complete at least one survey concerning their test experience. Some have also been queried by telephone as to the testing process, others have been queried by e-mail and some have received paper and pencil surveys. Questions ask about what was good and what was bad.

A second mechanism we are using to assess environmental conditions during the USMLE is to employ what the corporate world refers to as "Secret Shoppers". Essentially, these are individuals sent as exam candidates, but whose function it is to monitor and report back on exam conditions. This is not a new technique, and Sylvan already does this in test centers to ensure that the quality of the testing experience is adequate. However, the NBME wanted its own Secret Shoppers in addition to those employed by the Sylvan Centers. In a few cases, we actually tested the security of the exam by attempting deliberate breeches of security. Some of our staff turn out to be quite proficient at being dishonest! One example of what we have attempted are to have two individuals exchange places. Needless to say, this really stresses the Sylvan system, but we wish to observe how the proctor will respond. Through these efforts we hope to obtain a broader picture of the actual examination environment both in the United States and at the 300 Sylvan sites worldwide where the USMLE is administered.

Practice Examinations

The next issue that I would like to address concerns practicing for computer-based testing. In the initial phases of development of the computerized USMLE, many faculty members expressed concerns about the computer literacy of their students. Students had somewhat less concern since many used computers on a daily basis. Nonetheless, faculty members were concerned about the level of preparedness of their students. To address this concern, NBME developed means to permit students to take practice exams. Initially, 150 sample items were distributed on a compact disk (CD) that utilized the same driver as in the Sylvan Centers. This parallels the system so closely that individuals can take a timed exam with exactly the same pacing as the real USMLE. At present we are collecting data on how these CDs are being used and whether they found it helpful, etc. My guess is that most exam candidates will look through it. At a minimum, they can at least acquaint themselves with the interface experience. The NBME is interested in hearing from you if you have any comments, suggestions, or information as to how these are being used by the exam candidates. In addition to the CD, these materials are available on the USMLE website (http://www.usmle.org/**),** and practice materials are also available at all Sylvan Centers. Occasionally a candidate may request to take the practice exam at the actual site where they are scheduled to take the "real" USMLE. This can be arranged, although there is a nominal fee of $42.00, which is charged for "seat time" since during this time, that Sylvan site cannot be used for other purposes.

Examination Score Reporting

Reporting of examination scores is always an important issue! The first necessity was to collect a sufficient number of students so that the items could be recalibrated. This is because it is possible that the difficulty of some questions might change because of the transition from paper and pencil to CBT. Recalibration requires a relatively large group. It was decided to hold back the first 10,000 scores, do the recalibration on them, and then report all 10,000 scores together during August 1999. The net result would be that everyone should have received their score by approximately the time of which they received it with the former paper and pencil exam, i.e. around the middle of August. Following this first group of 10,000, scores will likely be reported on a weekly basis. That means one day each week all scores for the examinees since the previous week will be reported. On that day, each school will be able to access student scores by means of their secured website.

I should emphasize that we will no longer be reporting percentiles, but we will continue to report school specific performance. These reports to the dean's office will continue to show your school scores in each discipline as a function of national means. Our reporting format has been slightly modified because in the past there have been instances where data has been misinterpreted. For example, if anatomy is compared with pharmacology, most schools will exhibit a difference. This reflects a nationwide difference in the mean score between anatomy and pharmacology. Thus, it is invalid to compare anatomy and pharmacology scores. What should be compared are anatomy scores of your students with anatomy scores nationally, and pharmacology scores of your students with pharmacology scores nationally.

Secure Websites

In each school someone in the dean's office will have authority to view one or more of the functions offered. The system requires a "smart card" for access. This is about the size of a credit card upon which the user must enter their name and personal identification number. A special number is also contained within this card, which must be entered at the prompt. This number will be verified within the records at the NBME before access is granted to that user. These precautions help ensure that only the correct person will achieve access to records of an individual school. This is most important, as NBME does not want schools to be accessing each other's data without proper authorization. If a school wishes to share their data they certainly may, but to do so must be under their control. Initially, each website will offer three functions:

- Reporting of scores
- Confirming eligibility of students to sit for the USMLE

- Student status report. This includes dates for registration, mailing of eligibility permit, scheduling and taking the exam, and whether or not that score was pass or fail.

This information provides the dean or other individuals at the medical school with an opportunity to instantly track an individual student, and provide counseling if appropriate.

Overall, CBT for the USMLE seems to working well for the majority of students that have sat thus far. The USMLE has now therefore joined a number of other health care professionals, particularly the nurses, in computerizing their high stakes examination.

FRED - The NBME's New Testing Software

I have a demo to show of the driver, which runs the test items through, puts them up on the screen and records the answers. This particular driver is quite a bit different from the current Sylvan driver, and includes several new features. For example, examinees may underline words or strike them out. Examinees may also add annotation comments if they wish. We will take a look at one of the exam modules. The items are on the right hand side, and on the left hand side there is a summary of what is going on. Examinees may either type, or point and click with a mouse. Note that if I select an option, say C, and then change my mind to D, then C un-selects itself. This illustrates that only one answer can be selected at a time. This differs from the paper-and-pencil exam where students who change their answer may incompletely erase the previous answer, in which case no score can be given.

The right mouse button brings up a menu and you can see the words "highlight", "strikeout" or "annotate". On the left side, there is a summary of what is going on. It tells me I am on question one. It also tells me I have just added an annotation to that question so that I may navigate back to it and see the annotation. I can also place a "bookmark" on the question. Thus, between the summary area, the annotation, and the bookmark features, we have a strategy that allows instant, random access to any question in the order that we would like to view and/or answer it. The other feature we have is an exhibit, e.g. for items where we have pictorials. If we wish to bring that exhibit up we may, but it does not clutter up the screen unnecessarily if we do not want it. Finally, I should emphasize that this is just the driver. FRED does not yet include components that do scoring and scheduling and all the other tasks that we require to be regarded as a comprehensive software package.

Our plans call for substituting FRED for the current Sylvan software when development is complete and adequate testing has occurred. This will allow the use of more innovative item types, for example including multiple pictorials, sound, and moving pictures in multi-media approaches. We could even explore the feasibility of problem-solving or information-gathering exercises, e.g. with use of the Internet.

Subject Tests (Shelf Exams)

We at NBME are also making a number of changes in relation to the Subject Test program, following a strategic plan that was developed a year or so ago. The two main thrusts I would like to mention are computerization and customization. What is the rationale for computerizing a perfectly good paper and pencil exam? Possible reasons include:

- practicing for USMLE with exams that have the look and feel of CBT USMLE
- diagnostics (including prediction of USMLE score)
- greater flexibility in timing
- richer interface (sound, moving pictures, multi-media, simulations)
- enhanced security
- testing laboratory for new ideas and approaches to assessment

However, I must stress that regardless of when or how fast we develop a CBT alternative for Subject Tests, paper and pencil tests will remain as a viable alternative for the foreseeable future for those schools that do not wish to use CBT. I believe it would even be reasonable to use CBT and paper-and-pencil testing for different courses at the same school, although it is probably unwise to mix them for a single course, simply because students may not believe that they yield completely comparable grades.

The second major new thrust for the Subject Test program is Customization. Probably many of you are involved in the current rich period of

curricular development and evolution that is occurring both in this country and to some extent in Europe. To this point we have produced only discipline-based subjects. However, this appears to contribute to a creeping dissidence between what we offer in the Subject Test and what instructors would like to see in such an exam if used for the course actually being taught. This leads to the idea that we should begin the process of customizing Subject Exams for individual courses and individual schools. To do so, we likely will need some new exams. These would probably be more interdisciplinary in nature, e.g. Genetics, Cell Biology, or even Comprehensive Year 01 or year 02 exams. Second, we should consider customizing blueprints by building more modular exams along the lines of our current Physiology exam, which comes with or without Neurophysiology. Third, a parallel customization can occur at the level of scoring. With the proviso that the number of relevant items may be small, we may be able to give some idea of performance in each different subsection or content categories in comparison with the total. Fourth, and this is conjectural and several years down the road, we might just make our entire Subject Test item pool available to schools. Individuals could build their own examinations and NBME would score them. However, the difficulty with all these approaches is the possibility that multiple different exams attuned to different schools would make national comparisons very difficult. And, of course, this could involve added expense. Our next step is likely to survey schools to determine the level of interest in these various options.

Actually implementing CBT for Subject Tests in medical schools will require much careful thought since there are several significant impediments. First we require comprehensive testing software, i.e. FRED, both to serve the particular needs of this testing program and to avoid dependence on Sylvan software. We have already spent a significant amount of time and money developing the driver part of FRED to beta test version.

Second, we must be certain that the performance on a paper and pencil test is the same on a computer-based test.

We have done that analysis for the USMLE and found absolutely no difference. We are assuming the same would also apply for Subject Tests, but those studies must be done to be certain.

Third, we must have medical school centers of adequate size. When we computerized the USMLE, many schools expressed interest in opening center in their schools, and as of July we have eight fully operational centers. These USMLE Centers have a seat capacity which is only a fraction (10% or less) of the total class size. Assume that we have 100 students and that a testing center has five seats. During the month of June, with 20 working days, 100 students could take the USMLE. On the other hand for Subject Tests, typically instructors wish to test the group today, move them on and start the next course or the next clerkship tomorrow. Thus, we would need much larger centers to accommodate Subject Tests. Development of larger dedicated centers to the same level of security as for USMLE would require large amounts of space and be very expensive. Even with a large capacity center (e.g. 25% of class size), four sequential sessions would be needed to test a full class in a single topic in a single day. Because of this, we must consider other innovative ways of configuring test centers for Subject Tests, i.e. large temporary centers in shared space with proctoring but without video monitoring.

CONCLUSIONS

In summary, I believe that computerized testing is here to stay. It is not “just a phase” though which medical education is transitioning, but rather a benefit that technology offers to better train and evaluate our students. This trend will continue to be reinforced with every medical school that experiments with its own computerized course examinations.

COMPUTER APPLICATIONS IN BASIC SCIENCE EDUCATION

ASSOCIATE EDITOR: Marshall Anderson, Ph.D.

Problem-Based Learning (PBL) has been the 'buzz word' in medical education for some time now. Many medical schools throughout the world have revised their curriculum to include more problem-solving sessions and active learning type formats. Basic scientists are often skeptical of PBL because of their perceived lack of clinical knowledge. In the following article, Joseph Goldfarb describes a 'low stakes' method of incorporating both technology and problem-solving into a basic science course. It is a good first step in venturing into the realm of both problem-solving and involving technology in the teaching of a basic science course to medical students.

An Electronic Mail Tutorial to Teach Problem Solving in Pharmacology

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INTRODUCTION

Over the past few decades medical schools in both the United States and Great Britain have been urged to decrease lecture hours and use formats that foster problem solving and self-learning.[1-4] One response has been the increased use of small group exercises in which students are provided with a case description, a journal article, a data set, or a numerical or analytical problem to solve. During the exercise, students are encouraged to discuss the case or problem with faculty guidance, and to raise any issues that they need clarified. Depending on the instructional model, the faculty member may provide information and/or extract it from the students. Alternatively, the issues raised by students and faculty may form the basis for independent student inquiry, the results of which are discussed at a subsequent group meeting.

The transition to increased reliance on small group sessions raised many problems, including the recruitment of sufficient faculty during regularly scheduled class time; wide disparities in the level of student (and often faculty) facility with the material being discussed; student (and faculty) inhibitions about publicly admitting to lack of knowledge or understanding; and the difficulty, during group sessions, of extended one-on-one student-faculty interaction tailored to the needs of individual students.

The Pharmacology Course at Mount Sinai includes 31 hours of small group conference, performance in which contributes 20% to the final course grade. To facilitate evaluation of students, faculty members spend at least eight conference hours with a single group often covering diverse drug classes. The wide range of subject matter and the small number of faculty permit us to field 7 groups of 15 students each, so significant attention to individual student needs is difficult.

An e-mail tutorial was initiated in 1997 as a supplement to the Pharmacology course in an attempt to overcome some of the limitations of our small group teaching, while retaining the focus on problem solving and case discussion. All students have e-mail accounts at Mount Sinai and there are electronic mailing lists for each of the classes. Student participation in the e-mail tutorial is voluntary and is not part of the evaluation that contributes to the course grade. This paper

describes the tutorial, and discusses it in relation to small group conference.

METHODS AND RESULTS

Description

Problems similar to those included in small group conference are sent via the class electronic mailing list on Thursdays. Problems are sent weekly save for the last two weekends before exams and weekends during holidays. In the 1998 course, 9 e-mail problems were sent, six before the midterm examination during the first 9 weeks of the course and 3 during the remaining 6 weeks. Students must reply by e-mail no later than 11:59 PM the following Monday to initiate the tutorial. In their replies, students are expected to explicitly describe their reasoning, not just to provide a numerical answer or a list of drugs. If they do not know how to approach the problem they are asked to be specific about what they don't understand. Individualized responses are sent to each student. If the student answers appropriately and it appears that the student has good command of the material, this is noted and, when applicable, supplemental information that would generally be considered beyond the general course requirements might be offered. If the student evinces minor difficulties or has made an easily correctable mistake, the correction is made and the student is invited to continue the e-mail conversation if any uncertainty remains. If, on the other hand, there seems to be some basic deficit in either knowledge or reasoning, then rather than simply providing an answer, the basic principles necessary to solve the problem would be provided, and the student asked to try the problem again. In this case, the student still retains the option of doing no further work and just requesting a correct solution. Although there is a time limit for the first student response to an e-mail problem, once the student-faculty conversation has begun, there are no time constraints and the conversation could theoretically continue until the student is satisfied.

The first e-mail tutorial problem from the 1998 series is shown below as an illustration of the format:

Welcome to the Pharmacology E-Mail Tutorial.

In answering the following problem, please briefly explain the rationale for your answers; don't just give numbers for the numerical parts of the problem. Also please make sure all your numerical answers have correct units.

If you don't know how to get an answer to a particular part of the problem try to verbalize your concerns. What information do you think you need, but haven't been given? What is confusing you? Remember, there are no "dumb" questions.

Problem 1:

At therapeutic concentrations, Drug X is eliminated with ZERO ORDER KINETICS. It also obeys a one compartment model (that is, its distribution after intravenous injection is so rapid it can be considered to be instantaneous).

A 200 mg bolus IV injection of X administered at noon yielded an initial plasma concentration of 10 mg/L. Plasma concentration of X measured at 3:00 PM was 8 mg/L.

a) At what time would plasma concentration reach 4 mg/L?

b) if you gave this 200 mg bolus dose as a loading dose, and then immediately started an IV infusion of Drug X, what IV infusion rate of X would you have to give to maintain the plasma concentration of X constant at 10 mg/L?

c) What would happen if you used an IV infusion rate higher than the one you calculated in part b?

d) Under what circumstances, in real life, would you expect a drug to exhibit zero order kinetics? Given this circumstance, what would normally occur as the drug's plasma concentration decreased?

Remember, for you to receive an answer to your e-mail, I must receive it no later than Monday, January 12.

Although figures or tables can be scanned and attached to the e-mail so that students can work from real data, this was not done because there was no assurance that all students would have the appropriate software for handling these. It was possible, however, to mimic graphical data as part of the text of the e-mail message. This was used in the e-mails to display drug-induced changes in heart rate and blood pressure, and to draw simple line graphs.

Student Participation

In 1997, the year this exercise was initiated, 25 students participated at least once. In 1998, out of a class of 110 students, 51 participated at least once in this exercise. The number of students replying to each of the 9 e-mail problems is shown

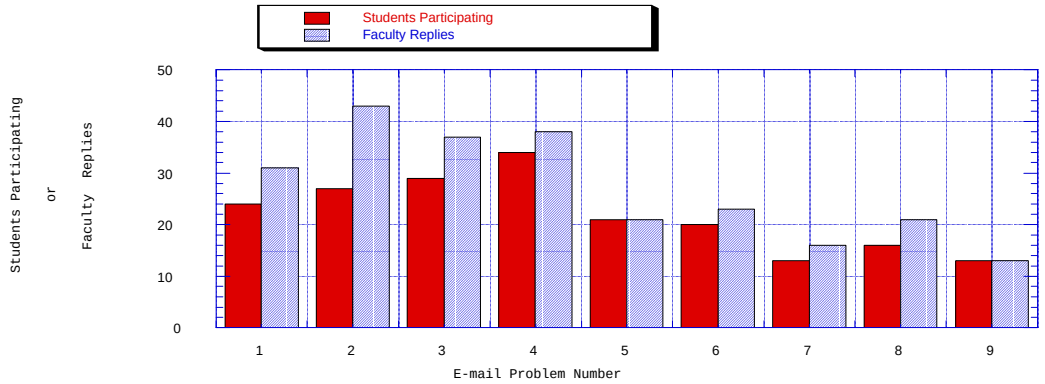

Figure 1. Degree of participation in the 1998 e-mail tutorial over the course of the semester. Problem numbers 1 to 6 were e-mailed during weeks 1 to 7 of the course, before the midterm exam, problems 7 to 9 during the second half of the course. The graph shows the number of students who replied to each problem (solid bars) and the number of faculty feedback e-mails. The larger number of faculty e-mails reflects continuing discussion of the problem beyond the first iteration of student reply and faculty feedback. Note that the number of student respondents for problems 2, 3 and 4 were greater than the number of e-mails received because in problems 2 and 3 there was one group of three students who collaborated on a single reply, and in problem 4 there were two groups of two students.

in Figure 1, along with the number of faculty responses. The differences in the numbers of faculty replies and student participants reflect both continued e-mail conversations and a few instances in which two or three students elected to do the problem as a group. Overall, about one quarter of the initial responses were continued for at least one additional iteration. On two of the nine problems, no students continued the e-mail conversation beyond the initial response and faculty feedback. On the other problems, from 15% to 64% of the initial respondents were asked to redo the problem or had comments about the feedback that prompted them to respond with an additional e-mail. Participation peaked during the middle of the first half of the course, and was lower after the mid-term exam. Only 5 students did all 9 problems. Figure 2 shows the degree of participation by individual students. Data are shown for the entire course.

It should be noted that students may use the problems even if they don't take part in the tutorial. In response to a request for feedback on the tutorial, one student who had answered only one problem during the course indicated, "I have been saving the [problems] to use as review for the exam, even though I don't have 'official' answers."

Nature of Student Responses

Almost all students who used the tutorial were explicit in their reasoning. One of the motivating factors for starting the e-mail tutorial was the perception by many of our faculty that some students were hesitant to participate in conference because they were reluctant to explicitly state their ignorance about a particular area, or to inadvertently reveal it in an attempt to answer a question. Students who used the tutorial were certainly explicit about their uncertainties. Following are two quotes from initial responses to problems:

> "I am rather confused about how to attack these problems. Although I understand the concept behind the formulas, I was uncertain as to how to integrate them to solve this problem. Here is my attempt: ..."
>
> "I tried to work on this problem, but I really don't have an idea where to start. Can you give me a feedback in which way is best to approach this problem. Thank you"

Students sometimes raised questions when they recognized that there was something illogical about their answer or when they considered doing the problem a different way. This often revealed a lack of understanding that would have gone undetected had the problem been assigned as a written exercise to be turned in, rather than as the first stage in what could develop into an extended conversation.

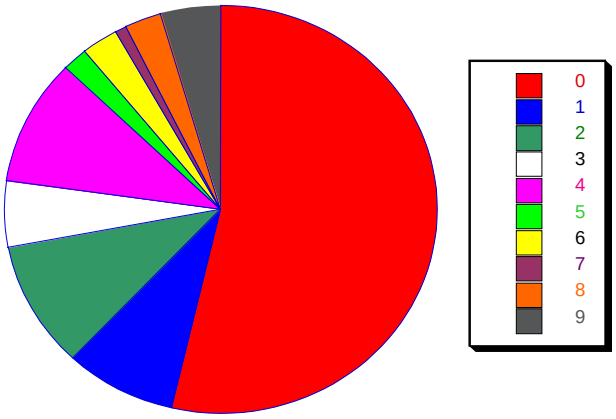

Figure 2. Fraction of the class who participated in the 1998 e-mail tutorial and the number of problems they worked on. Data includes all 9 e-mail problems. Each segment of the circle represents the fraction of the class that did the number of problems indicated.

For example a student answering a multi-part problem about a dosing regimen ended up predicting that the highest concentration attained was lower than the mean concentration, an impossible result. She recognized this and asked what error she had made. Analysis of her answer and explanations revealed that she was using equations in a rote way without fully understanding their meaning. However, she was not blindly plugging numbers into equations because she was aware that her answers to two parts of the problem were incompatible.

Timing of Student Replies

The e-mail format permits the students to answer problems at their convenience, so it is not unusual to have initial replies to the problems posted well after school hours and throughout the weekend. But the time of e-mailing may not indicate when students worked on the problems, because many students told me that they made a hard copy of the problem on Thursday or Friday, worked on it over the weekend and e-mailed the answer on Monday.

Faculty Response to Participants

Faculty feedback to students was sent in the order their e-mails were received, often within 24 hours, sometimes sooner. Virtually all student e-mails received by Sunday evening were answered by Monday evening.

As this suggests, the major disadvantage of the tutorial was that it was time intensive. On weeks when the response rate was 20 or more students, it took from 12 to 20 hours to answer all the e-mails, depending on the difficulty of the problem and the number of students who continued with a second or third iteration of the process. In part, this reflected the fact that many of the problems had multiple sections. The length of feedback on the initial student responses varied widely. For tutorials number 3, 4, and 5, for example, replies to students averaged about 300, 350 and 130 words respectively with a range of about 40 to 680 words. At the expense of covering less ground, the problems could be simplified so that the length of the feedback to students and the faculty time commitment would be decreased. Another alternative would be to have the initial faculty recipient distribute the student replies to a number of designated faculty who would share the workload. The most obvious way to reduce time expenditure would be to use pre-composed boilerplate answers for the bulk of the feedback, but this would be in direct conflict with the objectives of the exercise.

Examination Performance

Because 6 of the 9 e-mail tutorial problems occurred before the midterm exam, and because participation was higher during the first section of the course, only midterm exam performance was analyzed. The midterm consisted of 70 multiple choice questions. The mean score for the entire class was 71.2% with a standard deviation of 10.9%. The median score was 73.6%.

Figure 3 compares the distribution of exam scores of students who participated in the e-mail tutorial, and those who did not. Students who participated were more likely to have total examination scores above the median. This primarily reflected students who did at least half the e-mail problems (24 of 28 such students had grades above the median grade for the entire class), but not those who did 1 or 2 e-mails (only 10 of 21 such students had grades above the class median grade). These data, of course, do not reveal whether the e-mail tutorial just attracted the students who had less trouble mastering the material, and who, therefore, felt they had the time

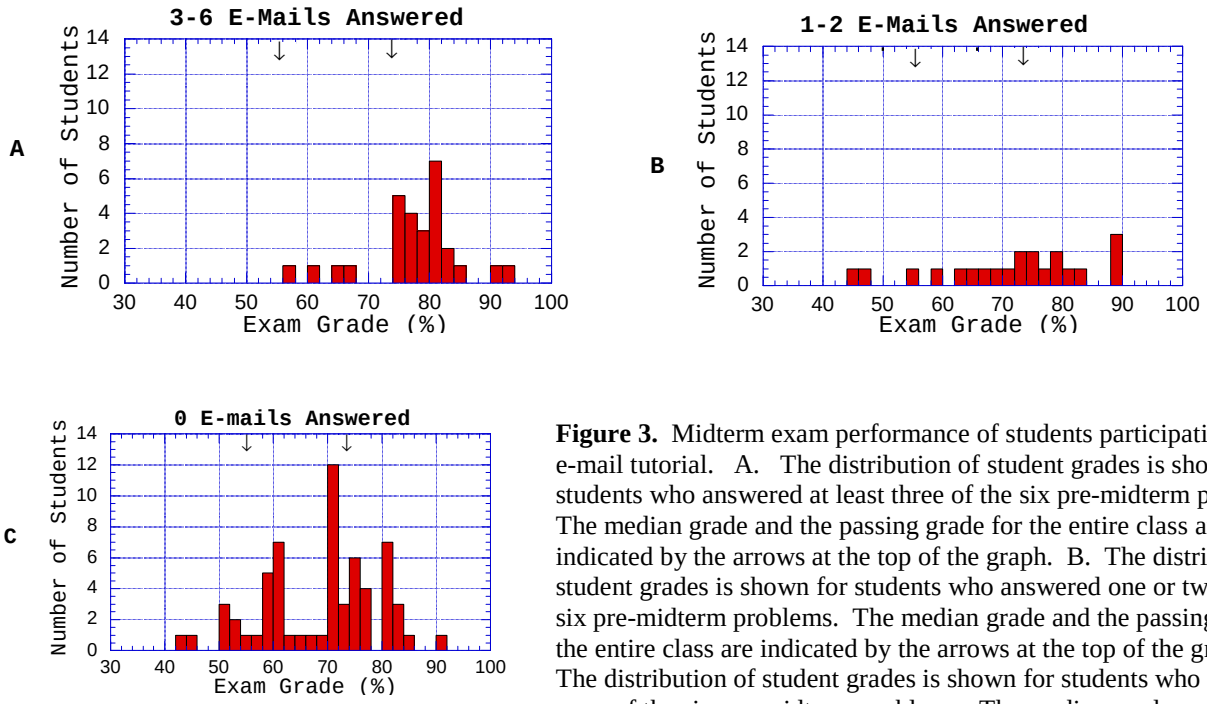

Figure 3. Midterm exam performance of students participating in the e-mail tutorial. A. The distribution of student grades is shown for students who answered at least three of the six pre-midterm problems. The median grade and the passing grade for the entire class are indicated by the arrows at the top of the graph. B. The distribution of student grades is shown for students who answered one or two of the six pre-midterm problems. The median grade and the passing grade for the entire class are indicated by the arrows at the top of the graph. C. The distribution of student grades is shown for students who answered none of the six pre-midterm problems. The median grade and the passing grade for the entire class are indicated by the arrows at the top of the graph

to participate in a supplemental voluntary exercise, or whether participation in the tutorial was instrumental in improving performance. Because our goal was to offer the tutorial to all students, that prohibited a prospective design in which the intervention was offered to only part of the class in a randomized, controlled experiment.

However, it is possible to assess the contribution of the tutorial by analyzing students' performance on the midterm questions that were most closely related to the tutorial problems, compared to the remainder of the exam. Twelve of the 70 exam questions were directly related to problems presented in the e-mail tutorials. Based on the grade distribution shown in figure 3, the class was divided into two groups: students doing 3 or more of the 6 pre-midterm problems, and those who did not participate or did only 1 or 2 problems.

As shown in Table 1, the 28 students who did 3 or more problems performed better than the remainder of the class on both related and unrelated questions. A 2-way ANOVA comparing the performance of the two groups of students on the two subsets of exam questions showed an overall difference between the two groups of students (F = 19.228,

Table 1. Examination Performance as a Function of E-Mail Tutorial Participation

	E-mail participants (3 or > of 6)[b] (n = 28)	Remainder of Class (n = 82)	Difference (in %)
Entire exam	77.7 ±1.4%)[c]	69.0 ±1.2%	8.6
12 e-mail related questions [a]	67.6 ±3.1%**c,d**	53.1 ±1.7%**d**	14.5
Remaining 58 questions	79.7 ±1.5%**c,d**	72.3 ±1.3%**d**	7 .4

Mean grades (%) + SEM

a. Sub-exam more difficult, ANOVA, F = 176.841, df =1, P ≤ 0.0001
b. Exam performance better, ANOVA, F = 19.228, df = 1, P ≤ 0.0001
c. Different from performance of remainder of class. t test, P≤ 0.05
d. Significant interaction, ANOVA, F = 5.382, df = 1, P ≤ 0.02

$P \leq 0.0001$), between the difficulty of the two sub-exams ($F = 176.841$, $P \leq 0.0001$), and a significant interaction ($F = 5.382$, $P \leq 0.02$). This suggests that, while the e-mail tutorial may have attracted the better students as frequent participants, it also contributed to knowledge acquisition (at least as measured by examination performance).

Student Evaluation of the Tutorial

Students were asked by e-mail, to comment on the strengths and weaknesses of the tutorial as compared to small group conference. Two of the comments follow.

> "I also appreciate you taking time to answer us individually because, as opposed to small group where there are too many of us, my thought processes could be picked apart. On the same token, it was a useful exercise for me to have to verbalize my thought process because it helped me identify my weaknesses for myself."
>
> "The only way it's [the e-mail tutorial] worse than conference is that there is more of a delay in feedback. Otherwise it's great b/c I'm a lot more likely to attempt to answer a question w/ "I don't know exactly but I think the answer might be...." in a one-on-one situation instead of in a group of 20. Also, the feedback is more focused to my individual weaknesses vs. a group as a whole where different people may have different problems and not all are addressed."

Students varied in their opinions about the consequences of the delay noted above between a student's answer and the faculty feedback:

> "The dialogue succeeding the original question--most importantly the depth and care of the responses from you...is a chance to get one on one attention with intricate problem solving and have individual problems addressed. The speed of replies keeps the dialogue fresh and valuable."

Students also had the opportunity in the end-of-course narrative evaluations to comment on this exercise. Of 97 students who wrote narrative evaluations, 12 cited the e-mail tutorial as one of the strengths of the course.

DISCUSSION

E-mail is an extremely common communication medium in academia and elsewhere, but there are few reports of its use as a stand-alone educational tool. Latting[5] introduced e-mail in a graduate social work class with use of electronic communication itself (rather than its use as a teaching and learning tool) being a major goal. Letterie, et al.[6] report the use of an e-mail system for didactic teaching in an Obstetrics and Gynecology residency program. In this instance e-mail was used to distribute questions, and residents replied by e-mail. However, rather than individual feedback keyed to the resident's response, stock answers and references were distributed by e-mail and the questions discussed in later group meetings.

Coulehan, et al.[7] used e-mail to supplement a small group curriculum in ethical and social issues in medicine. Students formed small e-mail(NET) groups with a tutor. Problems were distributed by e-mail every 3 weeks and students had a week to respond with an initial analysis that was distributed to the tutor and to the other students in the group. This was followed by student critiques of at least one of their colleagues' initial submissions. All students received an open copy of at least one tutor's critique of the student submissions and a discussion summary. In addition faculty could, and sometimes did, post individual private critiques to students. In this model the NET group was also a small-group conference group and so there was spillover from the e-mail exercise into the class meetings.

Perhaps the closest parallel in format to the current Pharmacology tutorial model is that of Todd[8] who used e-mail in an undergraduate Child Health Nursing course. Students were required to do 10 "critical thinking exercises" in which a scenario was distributed by e-mail along with four possible courses of action. Students were given 5 to 7 days to select an answer to the question and to present the rationale for their answer. The goal was for students to read the relevant material before the issues were discussed in class. Faculty feedback to the students consisted of a "generalized feedback response" which was "personalize[d] as needed." Performance in this exercise was evaluated and contributed to the course grade.

Some of the advantages of the use of e-mail cited by Coulehan, et al.[7] include giving voice to students whose personalities militated against full expression during small group discussions and permitting students to consider problems at their convenience with fewer time constraints than with in-class discussions. Similar advantages have been recognized by other faculty who have used e-mail in various ways in the classroom[9,10] and

appear to be at work as well, in the Pharmacology tutorial. A specific advantage of using regularly scheduled e-mail problems that was evident in our course and that has been recognized by others,[8,11] is that it often enables faculty to recognize deficits in a student's basic fund of knowledge or in their thought processes early on, and correct them immediately. Because such gaps are rarely restricted to a single student, this also allows faculty to review these areas with the entire class during lectures or small group sessions, or to use e-mail to alert the class to a possible widespread misconception.

The Pharmacology tutorial differs from previously described models in many respects. First, it is totally voluntary. Not only do students have the option of participating or not participating, but participating students have no continuing obligations during the course of the semester. One can enter the process at any problem and can pick and choose from week to week whether or not to participate in the tutorial. While this presents maximal flexibility to students, it also means that participation is likely to wane as other factors take precedence. Thus, participation dropped as the Pharmacology midterm exam (as well as the final exams in Endocrine and GI-Liver Pathophysiology) approached. Participation also remained low during the second half of Pharmacology, when many students were starting their review for Step I of the USMLE exams. Second, participation in no way contributed to the course grade, not even as a supplement for those students who were borderline. That is not to say that student responses were not evaluated. In fact, the quality and quantity of the evaluative comments was probably higher than for any other aspect of the course, in both expressions of praise for jobs well done and constructive criticism when responses are less than satisfactory.

Third, improving computer literacy was not one of the goals of the program; ability to use e-mail was assumed. Fourth, this model was focused entirely on faculty-student interaction, as opposed to the student-student interaction described for the NET groups of Coulehan, et al.[7] Notwithstanding this, a few students elected to do some of the tutorials in groups of 2 or 3, which shows that the model does not prohibit cooperative interactions among students.

CONCLUSIONS

This exercise is, at its core, a one-on-one interaction between student and faculty with faculty feedback intimately dependent on the student's particular response, and with the possibility for an extended student-faculty conversation. Unlike almost all the examples in the literature, the Pharmacology tutorial has no feedback component that is "boilerplate." Except for the fact that each week's exercise is based on a different faculty-chosen problem, it is the electronic equivalent of the classic model of weekly meetings between a student and tutor.

As an elective component of the course, it provides an opportunity for students who want to extend their understanding by engaging in sophisticated dialog with faculty in a problem based setting, while simultaneously affording students who need remedial work a private tutorial where they can ask any questions and feel free to openly voice uncertainty and ignorance.

Overall exam grades were higher for students who were the most active tutorial participants and performance, relative to that of non-participants, was even better on questions directly related to tutorial content. This suggests that even if higher achieving students self-selected to participate, the tutorial could improve performance even in this group.

The major disadvantage of this model is the immense faculty time commitment required. But despite the time invested, the e-mail tutorial is, at least to this faculty member, one of the most satisfying endeavors in large group teaching.

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An Effort/Quality Based Program For Documenting Teaching Contribution In A Clerkship Setting

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INTRODUCTION

In 1994 the Josiah Macy, Jr. Foundation sponsored a conference on the financing of medical schools in an era of healthcare reform and concluded that "the rapid expansion in medical schools' revenues over the past 30 years is at an end, and medical schools can no longer depend on the continued growth of past sources of income, especially the highly specialized practices of their faculties."[1] While previous excesses from clinical practice were adequate to cross subsidize the educational mission, the current mismatch between core mission and core business is now an unacceptable mismatch because of poor margin. These emerging fiscal constraints have prompted re-evaluation of the methods for distributing limited resources both at the medical school level and within departments. At the departmental level, the teaching mission has suffered the greatest under these economic pressures since it is perceived as non-income producing and seldom a major factor in promotion and tenure decisions. In light of these new restraints, this paper describes an effort/quality based program designed for a surgical clerkship to assure that the educational mission is kept intact with a fair and equitable educational contribution by all faculty members and a basis for rewards for those whose contributions are significant in both amount and quality.

METHODS -THE EFFORT/QUALITY BASED PROGRAM

The program was designed to provide both quantitative and qualitative evaluation of faculty contribution. During a faculty retreat all faculty teaching activities were identified that would allow achievement of the surgical clerkship goals and objectives. Presentation of a one hour student core curriculum case based session was assigned the relative value of one teaching credit. Through faculty consensus, appropriate teaching credits were agreed on for all of the other activities noted in Table 1. All components were clearly defined. In addition, instruments were developed to provide ongoing qualitative evaluation of faculty teaching with forms completed by students at the end of each core curriculum session, and at the end of the Clerkship providing an overall evaluation of teaching effectiveness as well as an evaluation for all faculty serving as student mentors for a group of four students throughout the six week Clerkship.

Over the subsequent five years, faculty received an annual report for the quantity and quality of their teaching contribution to the Clerkship Program. This report was generated using social security numbers so that faculty could identify their ranking relative to peers with regard to quantity and quality of teaching. This information was annually provided to the Department Chair for discussion during annual evaluation for salary negotiation and promotion

and tenure planning. The generated data was readily available and used by the Clerkship Director to provide teaching support letters for all faculty being considered for promotion and/or tenure. It should be noted that a very similar program for quantitative and qualitative evaluation was implemented simultaneously for teaching in the residency training program.

RESULTS

Over the five year interval there was a high level of satisfaction by both department leadership and faculty with the effort/quality based program. At each annual faculty retreat faculty were identified that ranked highest for quantity of teaching in the Clerkship. At the beginning of each academic year a surgical education grand rounds was devoted to honoring faculty with teaching awards based on data accumulated in this program over the previous twelve months.

Table 1. The Quantitative Component of the Effort/Quality Based Program

Teaching Activity	Teaching Credits
Core Curriculum	1
Problem-Based Learning Tutor (2 sessions)	3
Clinic Supervision	1
Bedside Tutorial (clerks only)	1
Review Student Generated Patient Write-Ups	0.25
Faculty Mentor for One Clerkship	8
Supervise Student Research Project	5
Student Advisor (1 academic year)	1
Faculty Development Workshop	1/hour

DISCUSSION

The traditional economic model for U.S. Medical Schools has been described by Reinhardt as a black box with financial resources entering the system with the three outputs of education, research and patient care.[2] Utilizing surpluses in clinical practice income, most medical schools have managed to maintain excellence in the three missions over past decades. However, new economic pressures threaten this balance with education suffering the impact because of its poor reimbursement and perceived minor role in promotion and tenure decisions. Furthermore, healthcare insurers have been reluctant to allow healthcare premiums to reimburse any activity other than direct patient care.[3] In an effort to counter this trend, the 1992 ACME Tri report recommended that ". . . deans and department chairmen should elevate the status of the general profession education of medical students to assure faculty members that their contributions to this endeavor will receive appropriate recognition."[4] However, only six of the 55 responding schools reported using educational accomplishments in tenure decisions, five used educational dossiers to document teaching and only five utilized rewards for educational accomplishments.

A number of medical schools have sought to define a rational distribution of limited resources by unbundling income and expenditures in programmatic budgeting. With a goal of developing a revenue allocation system for the sole purpose of supporting teaching, the Yale School of Medicine created a system with both a quantitative and qualitative component.[5] Cumulative totals for each department were used to calculate percentages reflecting teaching commitment, which was then used to determine appropriate allocation of tuition dollars. Similarly Dalhousie University has developed a model of "desired academic outputs" using contact hours for the first two years of medical school and the number of students for clerkships and senior electives.[6] All of these programs enhance the educational mission by support of an effort based system that defines faculty teaching expectations, provides program and faculty evaluation incentives, and assures accountability for tuition dollars.

The departmental model described in this paper seeks to maintain accountability to the educational mission at the third year student clerkship level. The quantitative component considers all contributions to achieving the educational goals and assigns them a relative value. The qualitative component assures clerkship leadership that faculty are effective in their assigned or selected teaching roles. Such a system can assume a baseline level of faculty involvement in teaching activities regardless of clinical practice volume or basic science research commitment. For those who make educational activities the major focus of their scholarly work,

this system provides for public recognition and reward. The system allows for added incentive to activities of greatest value to the educational mission such as faculty development and supervising student research. The annual ranking of faculty by quantity and quality of teaching compared to peers appeals to the competitive nature of physicians and virtually eliminated the need for the Clerkship Director to coerce faculty to participate in student teaching activities. More frequently, faculty made requests for additional teaching assignments, particularly after the annual distribution of ranking. Such a system, particularly when paired with a similar arrangement in a departments' residency training program, assures that all faculty are provided with opportunities to contribute to the educational mission according to their perceived teaching abilities. For example, the faculty member who is reluctant to participate as a lecturer in a student core curriculum with documented poor teaching evaluations may find that she is uniquely effective in the setting of one on one student mentoring. Finally, although this system was not linked directly to faculty reimbursement, the system provides such an opportunity if desired.

CONCLUSIONS

The current mismatch between core mission and core business is a major problem facing medical school leadership as well as clinical department leadership. Systems such as the effort/quality-based program we have described assure continued focus and accountability for the core mission. Similar systems designed for accountability in research may help to provide further balance between the core business of clinical practice and the educational and research mission.

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THE MEDICAL EDUCATOR'S RESOURCE GUIDE

ASSOCIATE EDITOR: John R. Cotter, Ph.D.

The beauty of the Web is that information on any subject can be easily obtained without leaving the office or home. Anyone who has used a search engine however understands that searching the Internet for information often leads to the hundreds, perhaps thousands of "hits" and that culling and identifying the most useful sites from so many "hits" is laborious and time consuming.

The goal of the Medical Educator's Resource Guide is to assemble in one place a list of basic science websites that contributors to the Guide have identified as being useful in the teaching and learning of the basic sciences. In this issue, several basic science educators and medical students offer their perspective and insight into the structure and utility of sites dealing with biochemistry, embryology, hematology, histology, and neuroanatomy.

If you are aware of a site that has the potential for being used by educators and students of the basic sciences, please consider contributing to the Guide. Once published by the journal, the sites and their reviews will be posted in hyperlink form on the IAMSE website under our "Educational Resource" branch.

Please send all submissions to jrcotter@buffalo.edu. *Please include the URL and a short critique of between 100 and 200 words.*

Atlas of Hematology. Nagoya, Nagasaki and Hamamatsu Schools of Medicine and Kyoto University College of Medical Technology.

http://pathy.med.nagoya-u.ac.jp/atlas/doc/atlas.html

This is an extremely good collection of normal and abnormal blood and hematopoietic bone marrow cells as observed in May-Grunewald-Giemsa stained dry film smears. A complete spectrum of hematopoietic diseases is also included. Typically, several examples of a given disease are presented, thereby making the "lesson" useful and effective. Many of the illustrations are unsurpassed in quality for an electronic format. The illustrations of the peripheral blood, variations of erythrocyte morphology and normal bone marrow cells are useful for an entry-level student. Since the images are not labeled or accompanied by explanatory text, the clinical cases are of optimal use only to individuals with experience in hematopoietic morphology. *(Reviewed by Chester A. Glomski, M.D., University at Buffalo)*

Blue Histology. The University of Western Australia

http://www.lab.anhb.uwa.edu.au/mb140/

Users who visit this site have several options. The backbone of the site "Lectures and Lab Notes" summarizes and illustrates the basic histology of tissues and organs. Since it is designed for local use, the content is course specific. For outsiders, who are looking for ways to evaluate learning at their institutions, this site provides a multiple choice question quiz with crystal clear images of tissue types, cells and organs that download quickly. The user determines the field of study using a quiz engine to hone a certain subject area or test a diverse field of knowledge. The quiz is mostly identification, yet does contain some function and theory questions as well. The site also serves as an atlas as it contains over 370 images of slides that are efficiently organized. There is "VScope" available as well that simulates and explains the use of a microscope with a microscope slide. Links to other histology web sites, mostly belonging to universities, are listed on this Web page. *(Reviewed by Brenda C. Boggs, B.S., University at Buffalo)*

HemoSurf: An Interactive Atlas of Hematology. University of Bern.
http://www.aum.iawf.unibe.ch/VLZ/BWL/HemoSurf/IndexE.htm

This program offers a comprehensive collection of circulating blood and hematopoietic bone marrow cells as seen in typical Wright's stained dry film blood and bone marrow smears. It introduces the user to the subtleties of clinical blood and marrow smear interpretation. The task of learning to identify individual cells is divided into three or four exercises. The first presents specific, identified cells. Subsequent formats are challenging and interesting to pursue. One "exercise" allows the viewer to select and display the identity of cells. Conversely, a prompt "correct/wrong answer" may be displayed as the user identifies cells. The number of images is numerous thereby offering many variations of a given cellular line/stage of maturation. Both the novice and the more experienced who wishes to increase their knowledge or test their proficiency in cellular recognition will find HemoSurf useful. *(Reviewed by Chester A. Glomski, M.D., University at Buffalo)*

Main Histology Index. Texas Tech University Health Science Center.
http://www.ttuhsc.edu/courses/cbb/histo/index_frame.html

This site presents a fairly comprehensive collection of 961 images and accompanying text that provide a survey of human cell biology and tissue and organ histology. A uniform screen format is used throughout, making movement through the material very simple. The list of topics permanently occupies a frame on the left of the screen. Movement between topics is as easy as leafing through a text and can be done at any time. General instructions and learning objectives introduce each major topic. All images selected are accompanied by a short explanatory text with highlighted links to test the viewer's understanding of the material. A series of text images with linked identifications/answers is provided at the end of each major topic for self-testing. This site is a useful adjunct to microscope-based laboratory study and is a source of supplemental images for computer-based laboratory study of cell biology and histology. *(Reviewed by Roberta J. Pentney, Ph.D., University at Buffalo)*

Medical Neuroscience. Loyola University Medical Education Network (LUMEN).
http://www.lumen.luc.edu/lumen/meded/Neuro/

This site offers helpful visual aids for learning the cross sectional anatomy of the brainstem, diencephalon, and basal ganglia. There is an abundance of sectioned materials, all of which have pertinent structures labeled with brightly colored overlays on one side of a black and white photomicrograph. The overlays help one to clearly define the areas/structures/fibers that are vaguely defined on stained sections. The authors use frames to squeeze all the necessary information for a particular slide onto one screen. There are four frames for each screen in the atlas. Two of the frames show the specimen: one contains an unlabeled stained specimen, and the other contains the color labeled specimen. Another frame lists the labeled structures and contains some important notes about that particular slide as well as; and a fourth frame has links to other slides in the atlas that offer different views of the labeled structures. In addition to images of the brainstem, there are axial and coronal MRI scans that are fully labeled and a neurovascular tutorial that is excellent but under construction. *(Reviewed by Daniel M. Cotter, B.A., University at Buffalo)*

Metabolic Pathways of Biochemistry.
http://www.gwu.edu/~mpb/

This site summarizes all of the major pathways of intermediary metabolism. The material is well organized and presented in neat flow charts that contain both text and molecular formulas (structures). The charts are in full color

for ease in following the complexities of the pathways. The site also features an option that allows one to view reactions in 3-D provided one has a newer version of either Netscape or Internet Explorer and a compatible video card. *(Reviewed by Christopher M. Foresto, B.A., University at Buffalo)*

Microscopic Anatomy. Gold Standard Multimedia.
http://www.imc.gsm.com/integrated/

This site contains several sections, which correspond to subjects taught in the first and second year of medical school. It is a useful resource for students who want to review histology, anatomy, physiology, cross sectional anatomy, immunology, radiology and/or pharmacology. The microscopic anatomy section contains images that can be displayed in two sizes. There is also a self-test that can be taken in either quiz or flash card modes. The quiz tests general histological knowledge using multiple choice questions. While the questions are accompanied by images, they are not directly related to the image. The flash card mode tests the user's ability to identify structures. Since a choice of answers is not given, the flash card mode is more difficult and therefore helpful in preparing for practical examinations. The site is free (until Aug. 1, 2001) but users must register before accessing materials. Registration is quick and consists of providing your e-mail address and deciding on a user name and password. The site does send out occasional e-mails promoting new sections or improvements to existing sections but these are not very long. *(Reviewed by Timothy Pardee, Ph.D., University at Buffalo)*

Neuroscience Tutorial. The Washington University School of Medicine.
http://thalamus.wustl.edu/course/

This site is highly recommended as an introductory guide to the basic sensory and motor pathways of the brain and spinal cord, and the organization of the brainstem, basal ganglia, cerebellum, hypothalamus, and limbic system. The treatment of each topic is concise and the main points are illustrated with uncluttered line drawings and slide specimens that make the practical aspects of the subject easier to grasp. This site is particularly helpful for understanding the details of the trigeminal, somatosensory, and auditory pathways. *(Reviewed by Christopher M. Foresto, B.A., University at Buffalo)*

Texas Tech Neuro Atlas. Texas Tech University Health Science Centre
http://www.ttuhsc.edu/courses/neuro/wygrt/index.html

This is a great site for testing one's knowledge of brain and spinal cord structure. It consists of 27 images of spinal cord and brain sections (nearly all myelin stained) and thumbnail diagrams that orient the user to the position of each section and angle of cut relative to the gross structure of the central nervous system. Once an image is chosen for study, the user can roll over the image with a cursor and choose specific regions to identify. The location of tracts and nuclei are outlined but they are not pre-labeled. This is a powerful feature of the application because the user can attempt to identify structures before the identity of the structure is revealed. *(Reviewed by Jennifer DelBroccolo, B.A., University at Buffalo)*

The Human Brain: Dissections of the Real Brain. Virtual Hospital.
http://vh.radiology.uiowa.edu/Providers/Textbooks/BrainAnatomy/BrainAnatomy.html

The authors present an extensive collection of central nervous system materials, many of which are in color. The materials include dissected specimens "the nature and quality of which" as pointed out in the introduction "would be virtually impossible for teachers or students to achieve in the teaching lab." Illustrative materials are labeled and annotated and the positioning of specimens and drawings of the specimens side by

side for comparison is effective. A wealth of detailed anatomical information is provided so much so that this site is recommended to more advanced students or those wishing to a review of the neuroanatomy of the brain and spinal cord. *(Reviewed by Harold Brody, M.D., Ph.D., University at Buffalo)*

UNSW Embryology. University of New South Wales.
http://anatomy.med.unsw.edu.au/CBL/Embryo/Embryo.htm

This image intensive site draws on the power of the Internet to integrate several aspects of embryology and reproductive biology, and several informational resources. It is comprehensive and can be used by undergraduates, and professional and graduate students who are involved in studying basic embryology either with or without the benefit of a laboratory experience. The images of human material are especially valuable considering the paucity of human embryonic material that is available for coursework. Sections on early development and organ systems provide easy access to difficult topics including heart development. Developmental abnormalities are presented with each system that will interest medical students and underscore the need for understanding developmental processes. Another section on animal models describes the development of various tissues, organs, and systems in commonly used animal models, such as the rat. *(Reviewed by Cynthia Dlugos, Ph.D., University at Buffalo)*

Basic Science Educator
Instructions for Contributors

General

Contributions to the Basic Science Educator are encouraged from all who seek to have their information reach an audience of basic science course directors, members of the basic science faculty, clerkship directors, attending physicians, curriculum planners, residency directors, and all those involved with the teaching or administration of the medical sciences throughout the continuum of health professional training. With the exception of Letters and Commentaries, all articles must begin with an **Abstract**, have an **Introduction**, which clearly indicates the purpose for the paper, and end with **Conclusions**. Appropriate section headings for the body of the text, such as **Background**, **Commentary**, etc. are at the discretion of the author(s) and the Managing Editor. All articles must cite appropriate **References**. The Managing Editor and two other members of the Editorial Board will review articles. Unless otherwise noted, send all submissions to J. Charles Eldridge, Ph.D., Managing Editor.

The Basic Science Educator has an international staff of Associate Editors and Manuscript Reviewers, and thus it is preferable we receive all materials electronically. These may be in any word processing program and submitted as e-mail attachments to eldridge@wfubmc.edu. Gels and other illustrations may be included as high quality scanned images. If electronic submission is not possible, please contact Dr. Eldridge by phone (336-716-8570) or fax (336-716-8501) to discuss alternate methods. This is also true when submitting articles for consideration to an Associate Editor. For their contact information, see individual listings below.

Articles

Submission is encouraged of articles relating to all aspects of teaching and learning in the medical sciences throughout undergraduate and graduate medical education, continuing medical education, and all aspects of faculty development. Examples include, but are not limited to, integration of science throughout the continuum of medical training; experiments in individual course or curriculum design; creation of methods which stimulate thinking, problem-solving skills, and foster independent student learning; methods to encourage student integrity, humaneness, and team-building characteristics; and programs directed toward medical science faculty development**.**

Innovations In Basic Science Teaching And Learning

The purpose of this column is to share new approaches to the teaching of medical sciences that will enhance the student's ability to learn. Submissions to: **Harold Traurig, Associate Editor.**

Computer Applications In Basic Science Education

The purpose of this column is to explore means by which computer technology may be used to aid both faculty and students in the teaching and learning of medicine. Submissions to: **W. Marshall Anderson, Associate Editor.**

Social Issues In The Basic Sciences

The purpose of this column is to present articles that stimulate basic science faculty to consider their role in all aspects of medicine and society. Submissions to: **David Bolender, Associate Editor.**.

International Perspective

The purpose of this column is to demonstrate both the diversity and yet commonality of how the fundamental medical sciences are taught throughout the world. Submissions to: **Roger Koment**.

The Educator's Portfolio

The purpose of this column is to disseminate techniques currently in use, or under development, for the documentation of the educational activities of medical school faculty members. Submissions to: **Jay Menna, Associate Editor**.

The Medical Educator's Resource Guide

The purpose of this column is to present critical reviews of educational materials on the worldwide web. Submissions to **John Cotter, Associate Editor**.

In My Opinion... (Debates)

Debates on issues of timely interest to medical science educators are welcome, and may actually be arranged with help from the Editorial Board. The purpose is to present readers with common arguments on each side of a controversial issue to help us better understand different views. To discuss your ideas, to volunteer as one side of a debate, or to suggest a topic you would like to see debated, please contact **J. Charles Eldridge**.

Commentary

The Editorial Board encourages submission by individuals of their views on timely topics in medical education, especially those which relate to teaching and learning of the medical sciences. These essays may be up to 1,500 words in length. Please contact **J. Charles Eldridge**.

In The Literature...

This column features reference citations and brief excerpts from articles in medical science education, which are published in other journals, or sources. Your submissions are encouraged. Please contact **J. Charles Eldridge**.

Afterthoughts…

These are anecdotal accounts, original poetry, or commentary that are reflections on the process and meaning of medical education and the practice of medicine. Your submissions are encouraged. Please contact **J. Charles Eldridge**.

Letters To The Editor

Reader response to articles in the Basic Science Educator is encouraged in the spirit of dialogue, and will be published as space permits. Letters may be up to 500 words. Please contact **J. Charles Eldridge**.

Announcements

Announcements and news of interest to medical science educators are published in each issue. All topics may be considered. Please contact **J. Charles Eldridge**.

Calendar Of Events

Notices of upcoming conferences, workshops, and other events of interest to medical science faculty are listed chronologically in each issue. Please send information regarding your event as soon as possible to ensure inclusion in the next available issue. Please contact **J. Charles Eldridge**.

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