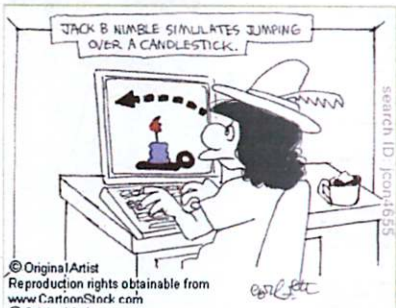
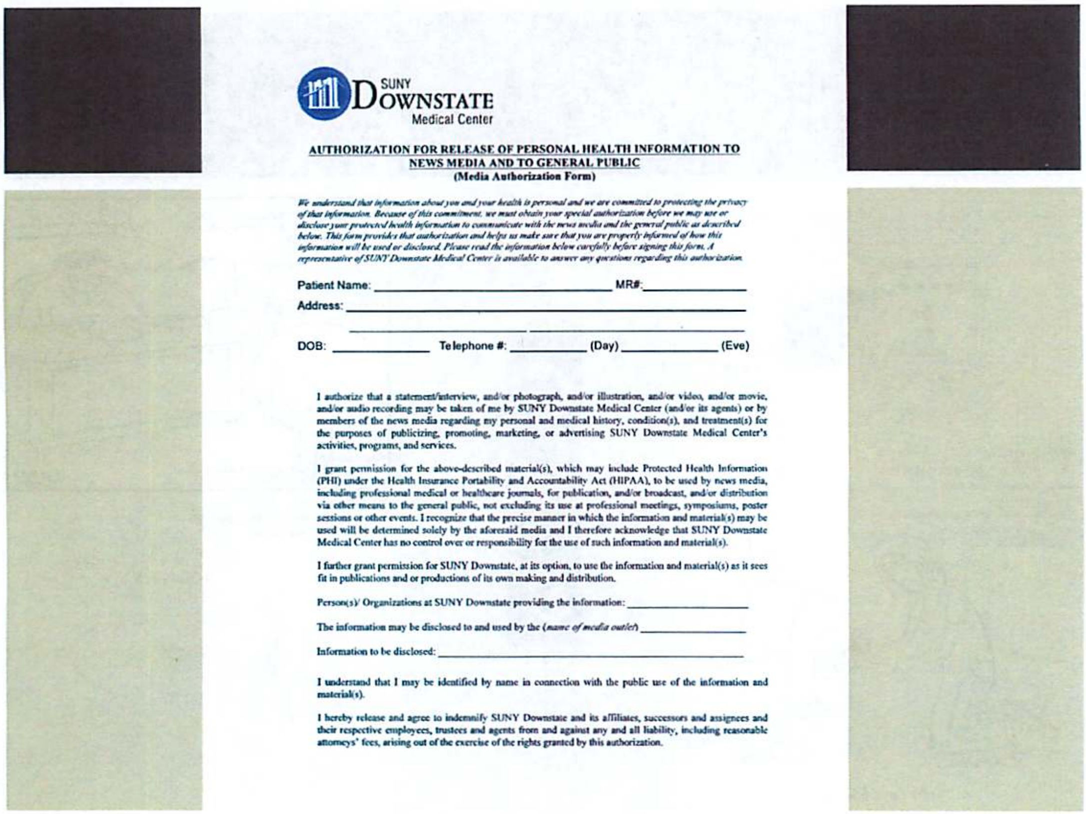
CENTER FOR HEALTHCARE SIMULATION



"There's an app for that."

C H S



SUNY DOWNSTATE Medical Center

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(Media Authorization Form)

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DOB: __________ Telephone #: __________ (Day) __________ (Eve)

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DATA MANIPULATION

- Cloud ? → Flash Drive, Portable drive, CD, DVD
- Editing → Purpose, Audience, Time
- Format → MOV, Quick time, WMV, Media Device
- Sharing → Email, Portable storage device, Web

- Consent

SUNY DOWNSTATE Medical Center (Consent Form)

Name: ______________________

Address ______________________________________

DOB: ____________ Telephone #: __________ (Day) ____________ (Eve)

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Signature: ______________________________ Date: __________
(Participant, Personal Representative or Legal Guardian)

Witness: ____________________ Print Name: ____________________

Personal Representative or Legal Guardian: [Print Name]

Authority: ____________________ Telephone: __________

Address:
____

HUSH HUSH

Quiet on the Set!!

Open mic

PERCEPTION INTERPRETATION

- Angles → What you need to see
- Audio → Who gets a microphone
- Focus → Areas with the exercise space
- Mark! → Scenario start and end time

FACILITY CAPABILITY

Multi Purpose Room

FACILITY CAPABILITY

- Edit → Basic Editing
- Record → Video + Audio
- Share → Portable Storage
- Storage → Facility Server or Local

APPLAUD GAUMARD

Gaumard®

FACILITY CAPABILITY

4

Debriefing

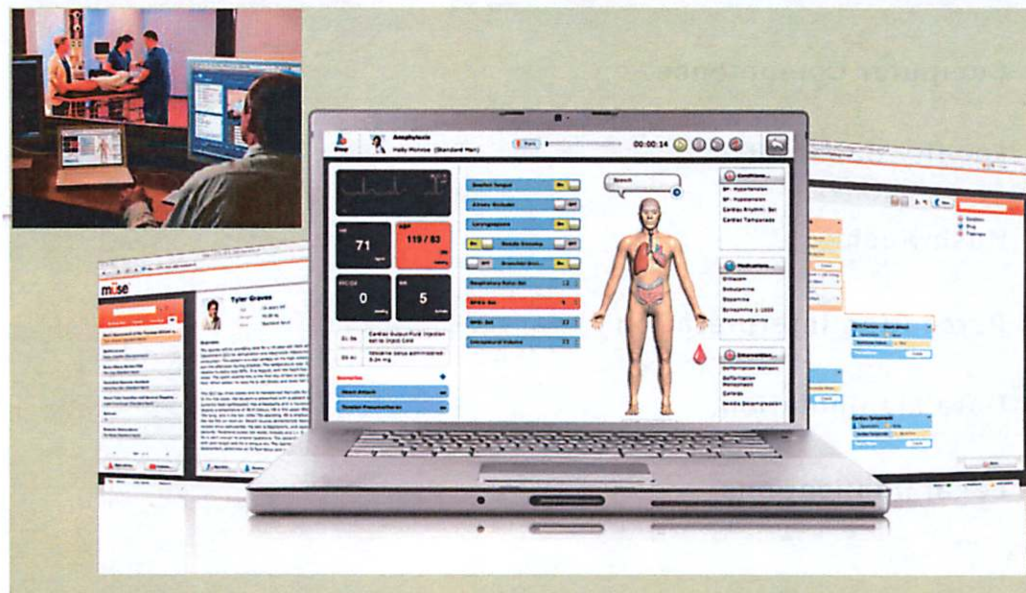
Rooms

COMPUTER COMPETENCE

- Are you a smooth Operator?
- Communicate your technical needs clearly
- Edit
- Know your Interface

HPS

CHOOSE USE MUSE



TECHNICAL CONSIDERATIONS

AV In Simulation

H. Erskine

FOR YOUR CONSIDERATION

- Computer Competence
- Facility Capability
- Hush Hush
- Perception Interpretation
- Data Manipulation
- Legal Implications

Advocacy/Inquiry

1. I observed "________" (an action)
2. I would have done "__________" (your personal feeling/opinion about how to manage situation)
3. Your thoughts on this?

Audience Exercise

Break into groups of 3

Please watch this video

Please debrief the team using either

advocacy/inquiry or plus delta

Please share

Audience Exercise

- Please think back on the case presented and write down an advocacy/inquiry for either the RN or the R1 in the prior case
- Please share with the group.

Prior Case- A/I for Resident

- I observed that you asked for Anesthesia straight away, but you did not take any steps to address the patients hypoxia

- I am concerned that you did not consider alternative means of oxygenating the patient

- Can you tell me your thoughts?

(I did not think of the BVM, I though that it would not help. I did not know that we had access).

A/I. Some useful vocabulary

<u>Advocacy</u>

I noticed

I observed

<u>Concern/Reinforcement</u>

I am concerned because ..

I am excited/glad that you did..

I am thinking I would have done….

<u>Inquiry</u>

Tell me how you see it

What are your thoughts

What's your take on that

What were you thinking

Advocacy/Inquiry

1. I observed "________" (an action)
2. I would have done "__________" (your personal feeling/opinion about how to manage situation)
3. Your thoughts on this?

Frames of Individual Participants

Patient needs a definite airway because he is hypoxic and not responding to Nasal cannula or face mask.

Did not consider BVM/OPA as possible interventions for oxygenating patient

Doctor is running the code
I can suggest alternate way of oxygenating but I am not running the code

Doctor knows whats in the Airway Kit

OBSERVABLE ACTIONS

Repeatedly asked for Anesthesia for Stat intubation

Repeatedly mentioned the presence of BVM and OPA but did not clearly communicate her recommendation

END RESULT: 10 MINUTE DELAY IN OXYGENATING PATIENT

Behaviors and Frames

R1

RN

Code 99 on Med Surg Floor. R1 is the first person on the scene. Delay in oxygenating patient.

Patient is hypoxic at 76% and unconscious, given recent surgery likely has a PE . we need to intubate now.

Call Anesthesia STAT. This patient needs to be intubated. He is not responding to NRB mask

Advocacy/Inquiry Molecule

- Assumption – People act/behave in certain ways (observable behavior) due to pre-existing frames (assumptions, knowledge, experiences based world views etc)

- What frames lead to certain observable actions?

- Uncovering the frames → self awareness, change in behavior/self-realization of knowledge gaps

- One-on-one feedback/critique
- Time intensive
- Behavioral impact

Plus/Delta

- brief, generic, team involvement
- Easy, short for time
- Superficial

"What went well...What could have been improved upon....what we can do to make this better in future.."

Two Debriefing Techniques

- Plus/Delta (+/Δ)
- Advocacy/Inquiry Molecule

Structure of a Debrief

Reactions

- Feelings – "How is every one feeling"

Understanding

- **Plus/Delta – What worked/what didn't work**
- **Advocacy/Inquiry Molecule***

Summary

- Take home points- "What did you learn from this experience"

Setting the Stage

DOs

- **Calm, collected approach**
- **Genuine Curiosity**
- **Goal is to help clarify what happened**
- **ALL ACTIONS OBSERVED WELL INTENTIONED**
- **Open ended questions**

DONTs

- Do not use debriefing as *personal venting space*
- Look to assign blame "teach him/her a lesson"
- Dive immediately into a debrief if you are upset
- Use GWIT (Guess what I am thinking) type questions

Debrief-able Incident Examples

- Errors/Near Errors
  - knowledge
  - medication
  - procedural
  - systems
- Unnecessary Delays in Patient Care
- Inefficient/lack of teamwork
- Improper/inefficient communication

Debriefing in Real Time: Critical Incident

- Pivotal Events
- Analysis reveals "systems errors, failures"
- Critical Incidents - Near errors and Errors

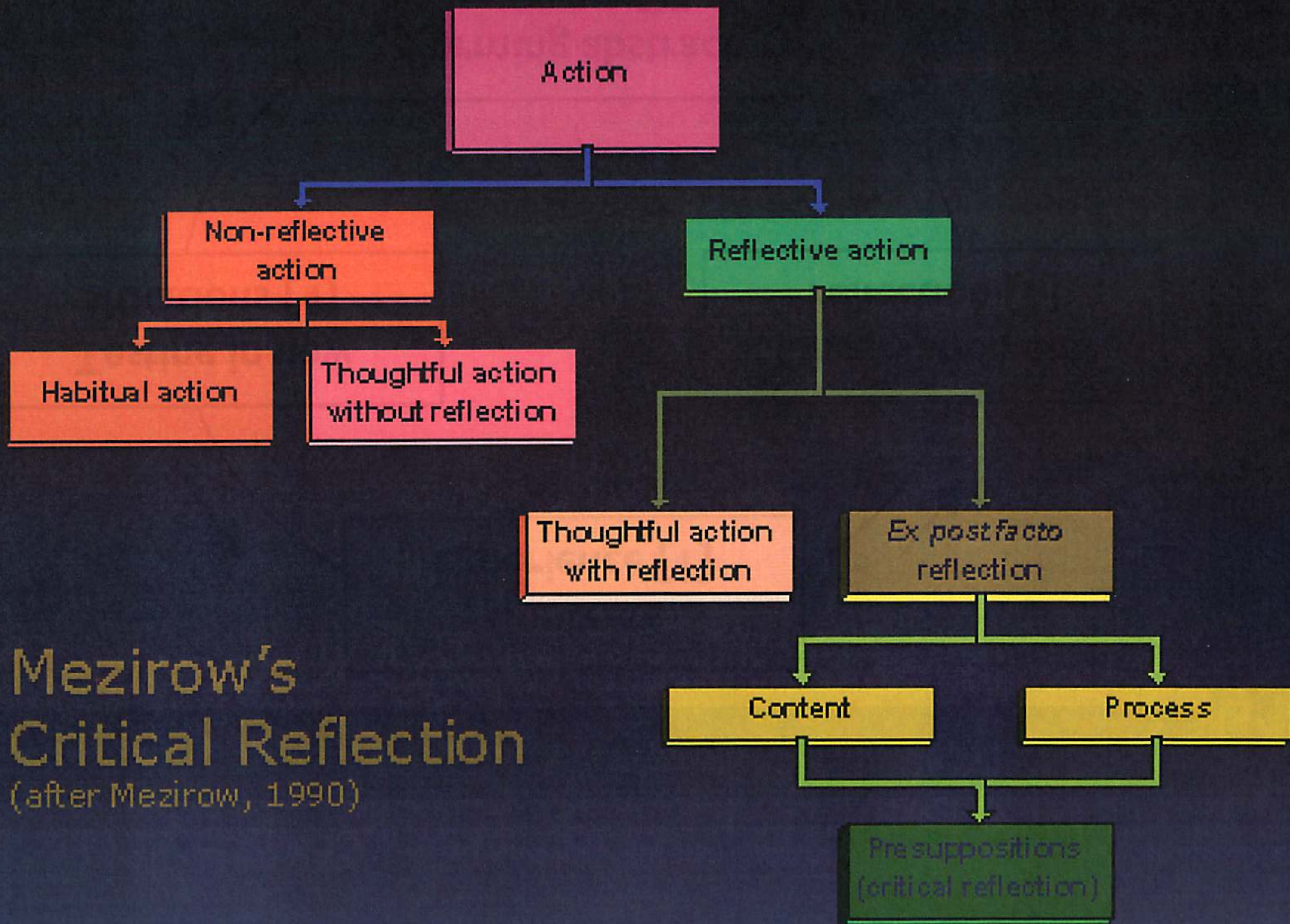
- <u>Why Debrief Critical Incidents?</u>

- Knowledge gaps → learning opportunity
- Improve communications → work relationships
- Medico-legal ramifications → shared mental model

Debriefing as Educational Tool

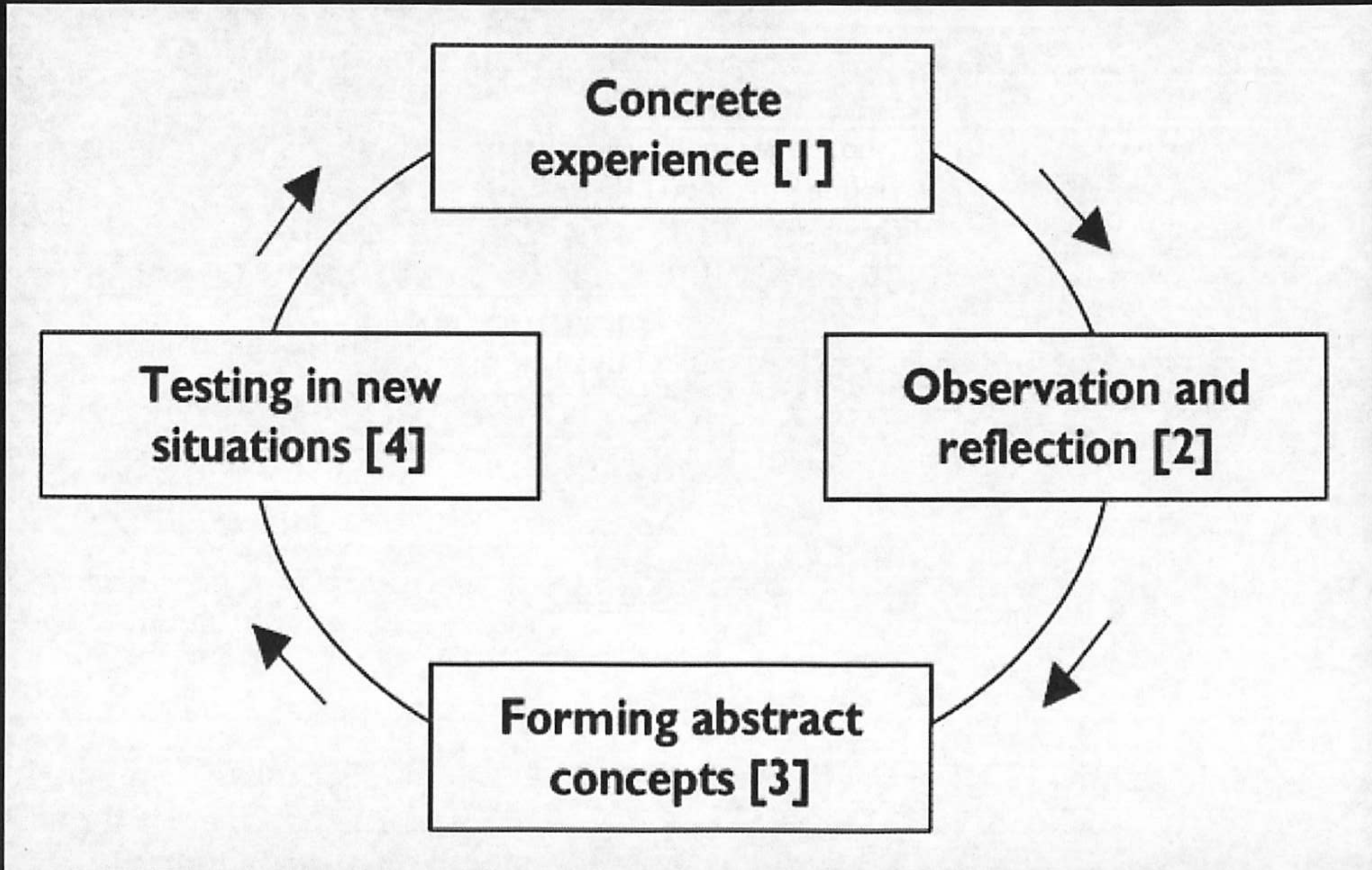
- Formative assessment
- Low stakes
- Mildly anxiogenic states optimize learning
- Useful for self analysis, reflection → behavior modification
- Typically sets out with clear set of objectives
- Can be modified for use *in vivo*
- Video playback of Simulated Session

Mezirow's Transformative Learning Theory



Mezirow's
Critical Reflection
(after Mezirow, 1990)

Kolbs Experiential Learning



Debriefing – Basis

- Adult Learning Theory/Androgogy
- Adults learning is different from children
- Adults learn what they perceive as important to them
- Kolbs experiential learning, Mezirow's Transformative Learning

Debriefing

- A conversation/dialogue/self-reflection
- To review a real or simulated event
- Participants analyze their actions
- Reflect on Thoughts Processes, Psychomotor Skills and Emotional States
- To improve or sustain performance in future

A Historical Perspective

- Conversational sessions that revolve around the sharing and examining of information after a specific event has taken place

- Originated in WWII - exploring combat events in a supportive group context

- Not strictly intended as a psychological intervention- has been perceived as beneficial for sharing experiences i.e. venting and defusing → Mitchells Model of Stress Debriefing

Activity

- Take 2 minutes
- Collect your thoughts on "debriefing" as you know them
- Think of the last time you experienced one
- What stood out?

Objectives

1) Define phenomenon of educational debriefing
2) Understand the importance of debriefing in formative assessment
3) Become familiar with some current debriefing techniques
4) Gain a basic understanding of some of the major adult learning theories behind debriefing

Debriefing : A new (?) educational tool?

Nur-Ain Nadir. MD.

SUNY Downstate Medical Center

Institute for Medical Simulation and Advanced Learning

an annual meeting linked to the AAMC meeting, which is an opportunity for dissemination. No curricular material is available on the web site.

5. Society of Directors of Research in Medical Education (SDRME) http://www.sdrme.org.

Membership here is open only to directors of office of education-type units that are responsible for educational research, program development, and evaluation. There is an annual call to the members for written reviews of topics of interest in medical education. Four of these are available from the web site under "sponsored scholarship." Informs the evaluation and dissemination steps especially.

6. Slice of Life. http://medstat.med.utah.edu/sol/.

A nonprofit-based project based at the University of Utah devoted to the development of educational multimedia applications in health sciences education. A variety of multimedia resources are available on order from the web site. The project hosts an annual workshop to share developmental efforts in multimedia and interactive computer software. Particularly useful for educational methodology using technology.

7. World Federation for Medical Education (WFME) http://www.sund.ku.dk/wfme/.

A global organization interested in medical education. Not much on the web site; links to *Medical Education*.

General Educational Resources Beyond Medicine

1. American Education Research Association (AERA) http://www.aera.net.

This is an international professional organization with the primary goal of advancing educational research and its application at all levels. The division most helpful to medical educations is Division I: Education in the Professions. The organization sponsors several journals in educational research, which may be helpful in the dissemination step (available from the web site). The AERA also has a funding program for research proposals. There is no curricular information directly available from the web site.

2. American Association of Higher Education (AAHE) http://www.aahe.org.

This is a professional body of educators in higher education who are concerned with a variety of issues as well as the body of knowledge related to teaching and learning. The association sponsors a number of publications that could relate to medical education including, Communication: Learning Climates that Cultivate Racial and Ethnic Diversity; Assessment, Teaching, and Learning; and Educational Technology. Publishes *Change*. Potentially informs the GNA, educational methodology, faculty development, and evaluation steps.

3. Educational Reference Desk. http://www.eduref.org.

Formerly the Educational Resource Information Center (ERIC), maintained by the US Department of Education, this is a resource guide and searchable database for educators. Can be used to provide background on effectiveness of an educational approach.

Supported in part by the following grant: Faculty Development Program in General Internal Medicine, Johns Hopkins University, 2000–2003. USPHS, Health Resources and Services Administration, Bureau of Health Professions, 1D14 HP 00049-01 to 03.

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1. Glassick CE, Huber MT, Maeroff GI. Scholarship Assessed: Evaluation of the Professoriate. San Francisco: Josey-Bass Publishers; 1996.
2. Kern DE, Thomas PA, Howard DM, Bass EB. Curriculum Development for Medical Education: A Six-step Approach. Baltimore: Johns Hopkins Press; 1998.
3. Medical School Objectives Writing Group. Leaning objectives for medical student education—guidelines for medical schools: report I of the Medical School Objectives Project. Acad Med. 1999;74:13–8.
4. Informatics Panel and the Population Health Perspective Panel. Contemporary issues in medicine—medical informatics and population health: report II of the Medical School Objectives Project. Acad Med. 1999;74:130–41.

practice guideline on population-based medicine available by mail order from the web site. Addresses evidence-based medicine, health disparities, and cultural competence; a good resource for ideal approach in the newer competencies. Informs the problem identification and GNA, learning objectives, and potentially, the educational strategies steps.

Preventive Medicine. Association for Teachers of Preventive Medicine (ATPM) http://www.atpm.org.

This web site includes curricular materials, including an interactive course in immunization, curricular guidelines, and case studies for use in teaching preventive medicine. Partners with CDC for funding in projects with ultimate goal of achieving Healthy People 2010 goals. Informs the GNA, learning objectives, and educational strategies steps.

Psychosocial Behavioral Medicine. 1. American Academy on Physician and the Patient (AAPP) http://www.physicianpatient.org.

This society is devoted to research and education in doctor-patient communication and fosters a strong faculty development component. The society publishes *Medical Encounter.* There is not much directly available from the web site, but the society maintains a videotape library, and a directory of educational resources on doctor-patient communication that can be ordered. Informs the GNA, educational strategies, and implementation through faculty development steps.

2. Association for Behavioral Sciences and Medical Education (ABSAME) http://www.absame.org.

ABSAME is concerned with behavior science curricula in medical school and residency programs. It publishes the *Annals of Behavioral Science* and *Medical Education.* There is a curriculum guide for behavioral sciences in the medical profession, which lists knowledge, attitudes, and skills objectives in each of the subject areas, including clinical reasoning and interpersonal skills. The outline of the curriculum guide is available from the web site. Informs GNA and learning objectives, and potentially evaluation steps.

3. Association of Directors of Medical Student Education in Psychiatry (ADMSEP) http://www.admsep.org.

This site contains published learning objectives for the junior psychiatric clerkship. Under resources is a list of films demonstrating disorders. In addition, there is an annotated list of cultural video material and lectures related to cross-cultural interviewing and counseling. Informs the GNA, learning objectives, and educational methods steps.

Subspecialty Medicine. Association of Subspecialty Professors (ASP) http://www.im.org/asp.

These are the internal medicine fellowship program directors and subspecialty division chiefs; there is a page for curriculum, which will eventually link to published subspecialty fellowship curricula, but has no content posted as yet. If interested in a particular subspecialty, curriculum developers should go directly to the subspecialty organization. For instance, the American College of Rheumatology has published its medical student, residency, and fellowship educational resources in rheumatology on its web site http://www.rheumatology.org. Some specialties, such as ACR, fund faculty awards in education.

Surgery. The Association for Surgical Education (ASE) http://www.surgicaleducation.com.

The web site contains an Educational Clearinghouse of curricula, videotapes, faculty development, and a host of other useful resources for needs assessment. Although not necessarily generalist content, there are helpful examples that may apply to generalist curricula, such as Resident Teaching Skills, Teaching in Outpatient Clinic, and Ethics Curriculum for Residents. The site also links to non-ASE educational and faculty development materials. Informs the GNA, educational strategies, and faculty development, as well as learning objectives and evaluation in topic-specific areas, such as ethics.

Women's Health. Association of Professors of Gynecology and Obstetrics (APGO) http://www.apgo.org.

This organization of women's health educators is focused on undergraduate medical education, specifically the ob-gyn clerkship. The web site has a number of useful resources, especially under the Women's Health Education Office, including a listing of medical school Women's Health Curriculum Models, an annotated bibliography in women's health, and a guide to fourth-year student electives in women's health. The APGO foundation provides awards for innovative education in women's health education; an annual call for member proposals occurs on October 1. In addition, there is a link to other Women's Health Grants and Awards Announcements. The site is useful for needs assessment, potential funding, and dissemination of curricula.

General Educational Resources Within Medicine

1. Association for Medical Education in Europe (AMEE) http://www.amee.org.

A European medical education organization that sponsors the journal *Medical Teacher* (http://www.medicalteacher.org), which is now available online. In addition, it sponsors Best Evidence in Medical Education (BEME) (http://www.bemecollaboration.org), devoted to an evidence-based approach to teaching. A bibliography of systematic reviews in medical education is available on the web site. Informs the GNA, educational methods, evaluation, and dissemination steps.

2. Association for the Study of Medical Education (ASME) http://www.asme.org.uk.

This is a British organization of physicians and medical educators concerned with education from undergraduate through CME. The web site lists a number of published texts in medical education, as well as links to British school curricula. The official peer-reviewed journal is *Medical Education* (http://www.mededuc.com), which has a number of helpful online features, including a "reading room" of important reviews and randomized trials in medical education. This is a good place for both needs assessment and dissemination.

3. Center for Instructional Support, University of Colorado Health Sciences Center (CIS) http://www.uchsc.edu/CIS/.

This is an educational support site maintained by the University of Colorado. It requires registration (but not payment). It has a wealth of resources for what is currently being done, with annotated bibliographies and links to funding sources.

4. Generalists in Medical Education http://www.thegeneralists.org.

This organization of educators includes basic scientists and clinicians interested in generalist education from the predoctoral to the postgraduate level. The organization hosts

2. American College of Physicians (ACP) http://www.acponline.org.

The largest professional organization for internists maintains active educational resources for all levels of learners. The teaching tab links to "Community-based Teaching" for faculty development resources, teaching materials, videos, etc., as well as to the FCIM curriculum, a resource guide for residency training. Informs GNA, learning objectives, educational strategies, and faculty development.

3. Association of Program Directors in Internal Medicine (APDIM) http://www.apdim.med.edu.

This organization consists of residency program directors in internal medicine. It maintains an Educational Clearinghouse (http://www.apdim.med.edu/ec/index.htm) online for anything related to residency education. It is a good resource for needs assessment and should be considered as well for dissemination. In addition, there is a new page "Resource Locker" (http://apdim.med.edu/locker/index.html) that includes recent workshops and resources related to the new ACGME competencies (see above) and outcomes.

4. Clerkship Directors in Internal Medicine (CDIM) http://www.im.org/cdim.

The "resources for the clerkship" links to the CDIM/SGIM Core Medicine Clerkship Curriculum Guide, as well as to about 30 internal medicine clerkship web sites ("what is currently being done"). The site also includes the reports of 6 task forces on "Evaluation" with reviews of the literature. Informs GNA, learning objectives, educational strategies, and evaluation steps.

5. Federated Council in Internal Medicine Resource Guide is located at the ACP web site http://www.acponline.org/fcim/index.html.

This is a very detailed curriculum resource guide for internal medicine residency programs, which lists learning objectives in multiple disciplines, competencies, learning sites, and evaluation strategies. The second edition, recently published, incorporates competency-based evaluations.

6. The Generalist Faculty Development Project http://www.im.org/facdev/gimfd/index.

This was a joint project of HRSA and several internal medicine organizations, to encourage faculty development of community-based teachers. Workshop materials from 3 regional meetings are accessible from the site, as well as a series of "TIPS for Teaching." If the curriculum project addresses teaching in outpatient settings, or faculty development (step 5), useful workshop materials can be found here.

7. Society of General Internal Medicine (SGIM) http://www.sgim.org.

The mission of SGIM is research, education, and clinical practice in primary care. SGIM publishes the *Journal of General Internal Medicine*, which has an open call for papers describing Innovations in Medical Education (a potential dissemination resource). The web site links to funding resources with shared missions, such as the National Library of Medicine. Most useful for dissemination step.

Informatics. American Medical Informatics Association (AMIA) http://www.amia.org.

While primarily concerned with use of medical informatics in the broad area of health care, this organization is concerned as well with education in this area. There is not much in specific curricula on its web site, but it has links for funding. The group also publishes a peer-reviewed online journal, *Journal of the American Medical Informatics Association* Informs the GNA, educational strategies, and dissemination steps.

Managed Care/Systems-based Knowledge. Partnerships for Quality Education (PQE) http://www.pqe.org.

This is a joint program funded by the Pew Charitable Trusts and the Robert Wood Johnson Foundation to promote medical education in systems-based care, through collaborations between academic medical centers and managed care organizations. It has a funding program for educational initiatives. The web site maintains a number of curricular resources, under the Managed Care Education Connection, http://www.mceconnection.org/mce/, which have been developed in managed care, including papers, case presentations, and curricula. This site informs GNA, learning objectives, educational strategies, and is a potential dissemination site.

Neurology. Consortium of Neurology Clerkship Directors/American Academy of Neurology (CNCD) http://www.aan.com/students/clerkship.

Contains a Core Clerkship Curriculum Guide, including a "checklist" for the neurologic physical examination. Informs the GNA, learning objectives, and evaluation steps.

Palliative Care/End-of Life Care. End-of-Life/Palliative Education Resource Center (EPERC) http://www.eperc.mcw.edu.

The purpose of EPERC is to assist educators in physician end-of-life education efforts. The web site, which requires registration, includes a list of core resources for training and funding sources. In addition, the center provides peer review of submitted educational materials (step 4), and is a potential resource for dissemination of curricula in this topic area.

Pediatrics. 1. Ambulatory Pediatrics Association http://www.ambpeds.org.

Published guidelines for training in ambulatory pediatrics, 1996 available online; in process of revision. Also links to "TIDE," an online program from the Medical University of South Carolina for teaching immunization delivery and evaluation (requires registration). Informs the GNA, learning objectives if pertinent to the topic, educational strategies, and implementation steps.

2. Council on Medical Education Student Education in Pediatrics (COMSEP) http://www.comsep.org.

In addition to curricula, this site has a page of multimedia resources including online cases, such as web-based clinical cases, the pediatric physical examination, and CD-ROM cases for use in problem-based learning. Informs the GNA, learning objectives, educational strategies, implementation, and evaluation steps.

Population-based Medicine. Agency for Healthcare Research and Quality (AHRQ) http://www.ahrq.gov.

While there is little that is strictly educational, there is a wealth of information regarding population-based health, which would be helpful for a general needs assessment in a population of interest, such as women's health, minority health, or child health. The AHRQ has a funding program that could also be explored for funding of educational projects in the priority areas. Roadmaps for Clinical Practice: Primer on Population-Based Medicine, is an expert consensus clinical

Behavioral Sciences and Medical Education (ABSAME), and Association of Directors of Medical Student Education in Psychiatry (ADMSEP) web sites might provide useful information for development of a curriculum in behavioral medicine or psychiatry.

a. Identify resources that target your level of learner (e.g., medical student, resident, practicing clinician, or faculty member).

b. Think about potential faculty development needs for your curricula. Several sites, such as the AAPP, AIM, American College of Physicians-American Society of Internal Medicine, and Society of Teachers of Family Medicine have faculty development resources.

3. Consider what educational methodology will be used. Look for methods that are congruent with your educational objectives.[1] General educational resources will have information related to educational theory, educational strategies, teaching and learning, and education technology.

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Medical Education Accreditation Bodies

1. The Association of American Medical Colleges (AAMC) http://www.aamc.org.

• The AAMC represents 125 accredited U.S. and 16 accredited Canadian medical schools, 400 teaching hospitals and health systems, and 90 professional societies. The AAMC publishes *Academic Medicine*, which accepts papers related to curriculum development. For curriculum developers, the most helpful subgroups are the Group on Educational Affairs (GEA), which has its mission to sponsor professionalism and scholarship in medical education: http://www.aamc.org/members/gea. The ideal approach of educators can be seen in the Medical School Objectives Project[3,4]; current approaches of educators can be found in the Graduation Questionnaires as well as the CurrMitt database, which contains current curricular content of member medical schools, all of which can be linked from this site.

2. Liaison Committee on Medical Education (LCME) http://www.lcme.org.

This is a joint committee of the American Medical Association (AMA) and the AAMC, which has been the official accreditation body for medical schools since 1968. The LCME criteria for a medical school curriculum, which would inform the general needs assessment and learning objectives, as well as the evaluation step, is the following document, available from the AAMC or LCME web site: Functions and Structure of a Medical School: Accreditation and the Liaison Committee on Medical Education, Standards for Accreditation of Medical Education Programs Leading to the M.D. Degree.

3. Accreditation Council for Graduate Medical Education (ACGME) http://www.acgme.org.

The ACGME is the organization responsible for accrediting residency programs, made up of 5 sponsoring organizations: American Hospital Association, AMA, AAMC, American Board of Medical Specialties, and the Council of Medical Specialty Societies. The web site has a list of program requirements for each specialty, which outlines expectations regarding learning objectives, educational strategies, and evaluations. Curriculum developers should look at the section under "Competencies," which includes the ACGME Outcomes Project toolbox, background on assessment methodology, and suggested methods for the 6 core competencies: http://www.acgme.org/Outcome/.

4. National Board of Medical Examiners (NBME) http://www.nbme.org.

The NBME prepares and administers qualifying examinations (the USMLE) for the practice of medicine in the United States. The NBME annually funds research proposals in the assessment of clinical skills through its Stemmler Research Foundation. Funded proposals as far back as 1995 are posted on the web site. This is a good source for GNA, potential funding (implementation), and evaluation steps.

5. Accreditation Council for Continuing Medical Education (ACCME) http://www.accme.org.

The ACCME is a voluntary accreditation body for continuing medical education (CME) activities. The most pertinent information for curriculum development here is the "Accreditation standards, Essential Area 2: Educational Planning and Process," available on the web site, which lists minimum standards for an educational program, which informs the program objectives. The site also posts "exemplary programs" with contacts (i.e., current/ideal approach).

Topic-oriented Resources

Basic Science. International Association of Medical Science Educators (IAMSE) http://www.iamse.org.

Association of basic science health educators, formed within the AAMC. The site has a listing of learning objectives for basic science disciplines, and also links to a number of other medical education resources, such as "Best Evidence in Medical Education." Informs the GNA, learning objectives, educational strategies, and evaluation steps.

Clinical Sciences. Alliance for Clinical Education (ACE) http://med.uvm.edu/MedEd/ace/.

An umbrella organization that links medical student clerkship sites. ACE produces the Guidebook for Clerkship Directors, available from the AAMC web site.

Family Medicine. Society of Teachers of Family Medicine (STFM) http://www.stfm.org.

This group publishes *Family Medicine*, which publishes medical education papers, and has several helpful Internet resources for outpatient-based medicine, including the *Preceptor Education Project*, a faculty development program for office-based teachers. Also under the Preceptor Education tab is a "Basic Book List" for residency and predoctoral medical education, which lists helpful resources. Resource for the GNA, especially current approach of educators, also educational strategies and implementation through faculty development.

General Medicine. 1. Alliance for Academic Internal Medicine http://www.im.org.

This recently formed organization is a merger of major academic-related professional societies related to internal medicine: Association for the Professors of Medicine (APM), Association of Program Directors in Internal Medicine (APDIM), Clerkship Directors in Internal Medicine (CDIM), Association of Subspecialty Professors (ASP), and the Administrators in Internal Medicine (AIM). Mostly a political grouping, the web site does link to all of the above organizations, as well as the Generalist Faculty Development Project.

Table 2. (Continued)

Acronym	Full Name	Helpful Content Available from the Web Site	Information on Available Funding for CD	Potential Dissemination for Developed Curricula
ADMSEP	Association of Directors of Medical Student Education in Psychiatry	Educational objectives for psychiatry clerkship; films; annotated bibliography	No	No
AERA	American Education Research Association	None on the site	Funding program	Several educational research journals
AMEE	Association for Medical Education in Europe	Best Evidence in Medical Education	No	Publishes *Medical Teacher*
AMIA	American Medical Informatics Association	No	Links for funding	Publishes *Journal of the American Medical Informatics Association*
APDIM	Association for Program Directors in Internal Medicine	Educational Clearinghouse	No	Annual meeting; publishes *Educational Clearinghouse*
APGO	Association of Professors of Gynecology and Obstetrics	Women's Health Education Organization list of model curricula	Links	Web site
ASE	Association for Surgical Education	Educational clearinghouse of curricula, videotapes, faculty development	Yes, through its Center for Excellence in Surgical Education, Research, and Training	No
ASME	Association for the Study of Medical Education	Lists of texts and links to British medical school curricula	No	Publishes *Medical Education*
ASP	Association of Subspecialty Professors	Resources for fellowship directors	No	No
ATPM	Association for Teachers of Preventive Medicine	Curricular materials and objectives in preventive medicine	Yes, with CDC	Publishes *American Journal of Preventive Medicine*
CDIM	Clerkship Directors in Internal Medicine	CDIM/SGIM Core Medicine Clerkship Guide	No	Publishes meeting proceedings in *Teaching and Learning in Medicine*
CNCD	Consortium of Neurology Clerkship Directors	Core Clerkship Curriculum Guide	No	No
COMSEP	Council on Medical Education Student Education in Pediatrics	Core clerkship curriculum, multimedia and case-based resources	No	Publishes *Pediatric Educator*
CIS	Center for Instructional Support	Annotated bibliographies of resources	Links to funding sources	No
EPERC	End-of-Life/Palliative Care Resource Center	Core resources	Funding sources listed	Peer review on web site
ERIC	Educator's Reference Desk	Searchable educational database	No	No
IAMSE	International Association of Medical Science Educators	Learning objectives for basic science disciplines	No	No
NBME	National Board of Medical Examiners	Funded proposals posted. Information on assessment.	Stemmler Research Fund	No
PQE	Partnerships for Quality Education	Curricular resources on site	Funding program	Web site
SDRME	Society of Directors of Research in Medical Education	Reviews of medical education topics	No	Web site
SGIM	Society of General Internal Medicine	See CDIM	Web site links to funding resources	Publishes *Journal of General Internal Medicine*; annual and regional meetings
Slice of Life		Educational multimedia	No	Annual meeting
STFM	Society of Teachers of Family Medicine	Preceptor Education Project	No	Publishes *Family Medicine*

CD, curriculum development.

Table 1. Six-step Approach to Curriculum Development for Medical Education[4]

Step	Title	Tasks Involved in the Step
1	Problem identification and general needs assessment	Identification and critical analysis of the health care problem that will be addressed by the curriculum. Requires substantial research to analyze what is currently being done by practitioners and educators, i.e., the *current approach*, and ideally what should be done by practitioners and educators to address the health care problem, i.e., the *ideal approach*. The general needs assessment is usually stated as the knowledge, attitude, and performance deficits that the curriculum will address.
2	Needs assessment of targeted learners	The general needs assessment is applied to targeted learners.
3	Goals and objectives	Overall goals and aims for the curriculum are written. Specific measurable knowledge, skill/ performance, attitude, and process objectives are written for the curriculum.
4	Educational strategies	A plan to maximize the impact of the curriculum, including content and educational methods congruent with the objectives, is prepared.
5	Implementation	A plan for implementation, including timelines and resources required, is created. A plan for faculty development is made to assure consistent implementation.
6	Evaluation and feedback	Learner and program evaluation plans are created. A plan for dissemination of the curriculum is made.

missions and activities, these organizations are primarily concerned with quality assurance, and usually have published goals and learning objectives, and often evaluation methods. Several have had recent revisions, such as the Association of American Medical Colleges (AAMC) Medical School Objectives Project[3] and the Accreditation Council on Graduate Medical Education (ACGME) General Competencies,[4] which have sparked the need for new curricula.

2. Explore resources related specifically to the topic of interest. For instance, the American Academy on Physician and the Patient (AAPP), Association for

Table 2. Alphabetical Listing of Internet Resources for Curriculum Development General Needs Assessment, Funding, and Dissemination

Acronym	Full Name	Helpful Content Available from the Web Site	Information on Available Funding for CD	Potential Dissemination for Developed Curricula
AAHE	American Association of Higher Education	Publications on educational issues in higher education	No	Publishes *Change*
AAIM	Alliance for Academic Internal Medicine	Links to Generalist Faculty Development Project/other academic-related societies in internal medicine	See links	See links
AAMC	Association of American Medical Colleges	1. Medical School Objectives Project 2. Functions and Structure of a Medical School	No	Annual meeting; regional GEA meetings; publishes *Academic Medicine*
AAPP	American Academy on the Physician and the Patient	Directory of resources on doctor-patient communication	No	Publishes *Medical Encounter*
ABSAME	Association for Behavioral Sciences and Medical Education	Curricular guide	No	*Annals of Behavioral Science* and *Medical Education*
ACCME	Accreditation Council for Continuing Medical Education	Accreditation standards for CME activities	No	No
ACGME	Accreditation Council for Graduate Medical Education	Program Requirements ACGME Outcomes Project	No	No
ACP-ASIM	American College of Physicians-American Society of Internal Medicine	FCIM Internal Medicine Resource Guide	ACP-ASIM Foundation	Publishes *Annals of Internal Medicine*, annual and regional meetings
ACE	Alliance for Clinical Education	Links to 7 student clinical clerkship sites: psychiatry, ob-gyn, neurology, surgery, internal medicine, pediatrics, and family medicine	No	No

(Continued)

Internet Resources for Curriculum Development in Medical Education

An Annotated Bibliography

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Curriculum development in medical education should be a methodical and scholarly, yet practical process that addresses the needs of trainees, patients, and society. To be maximally efficient and effective, it should build upon previous work and use existing resources. A conventional search of the literature is necessary, but insufficient for this purpose. The internet provides a rich source of information and materials. This bibliography is a guide to internet resources that are of use to curriculum developers, organized into 1) medical accreditation bodies, 2) topic-oriented resources, 3) general educational resources within medicine, and 4) general education resources beyond medicine.

KEY WORDS: **curriculum development; medical education.**
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Curriculum development in medical education is a scholarly process that integrates a content area with educational theory and methodology and evaluates its impact. When curriculum development follows a systematic approach, it easily fulfills criteria[1] for scholarship and provides high-quality evidence of the impact of a faculty member's educational efforts. Generalist faculty, because of their unique roles in both the delivery of health care and educational missions in academic medical centers, are often recruited to medical education reform efforts and curriculum development. Faculty are usually content experts, but may not be familiar with medical education organizations and educational resources for this work. Standard literature searches often fail to identify many of these resources. While many resources are available online and are applicable to various aspects of curriculum development, Internet resources have not previously been categorized for this purpose in the literature. We developed this bibliography to familiarize generalist faculty with easily accessible Internet resources for curriculum development in medical education.

A stepwise approach to curriculum development is outlined in Table 1.[2] These steps do not always follow one another in sequence, but do constitute a dynamic, interactive, and systematic process. No step is more important than the first, the general needs assessment (GNA). The goal of step 1 is to focus the curriculum, by defining the deficits in knowledge, attitude, or skills that currently exist in practitioners, and the ideal approach to teaching and learning these objectives. When completed, the GNA makes a strong argument for the need for the curriculum, sets the stage for the generalizability of the curriculum, and identifies potential educational research questions. Research for this step can extend over many fields of endeavor: public health and epidemiology, health care systems, utilization and resources, emerging knowledge of disease, patient support groups, and educational theory and practice. Previously developed and/or validated methods and curricula are identified as part of this step, in order to inform one's efforts and prevent the duplication of work. A well-researched step 1 impacts steps beyond the learner objectives by identifying educational methodologies, faculty development resources, potential funding resources, and opportunities for dissemination of the curriculum.

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Process of Identifying Resources

The sites listed below were selected based on the personal experience of the authors as members of educational organizations or as users of these resources, discussions with fellow educators, medical librarians, and curricular experts in medical education, and exploration of the sites. The bibliography is not intended to be exhaustive. It includes those sites that provided quick access to information and were felt to be most stable. Both authors are academic general internists, who have codirected a faculty development workshop in curriculum development for the past 9 years, and are involved in medical education of students, residents, and faculty levels. We acknowledge potential bias toward inclusion of internal medicine and generalist web sites in this list.

Organization and Use of the Bibliography

The bibliography is organized into the following 4 categories: 1) medical accreditation bodies; 2) topic-oriented resources; 3) general educational resources within medicine; and 4) general educational resources beyond medicine. When a web site could be placed in more than one category, we used the following hierarchy for placement: (1), (2), then (3) or (4). Where appropriate, the annotations refer to the steps in the curriculum development pathway most informed by the web site. Table 2 also provides an alphabetical list with highlights of the strengths of the different resources.

In using the bibliography, we suggest the following steps:

1. Review sites of the major accrediting bodies for your learners or institutions. Although multifaceted in their

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for students and residents, institutions must prioritize simulation in their hospitals and medical schools by properly rewarding educators through promotions and compensating them with protected time to teach and do further research in this area.

The field of medical simulation continues to grow. In a past publication,[113] Gaba predicted that simulation would be "embedded in the fabric of care" by the beginning of the 21st century. Advanced Initiatives in Medical Simulation (AIMS) was established to accomplish just that. AIMS is a coalition of individuals and organizations committed to promoting the use of medical simulation to improve patient safety, reduce medical error, and lower healthcare costs. With the efforts of AIMS, Rep. Randy Forbes (R-VA) and Rep. Patrick Kennedy (D-RI) introduced bill HR 4321, the Enhancing SIMULATION (Safety in Medicine Utilizing Leading Advanced Simulation Technologies to Improve Outcomes Now) Act of 2007.[31] This bill would advance the use of medical simulation in research and healthcare training and would create medical simulation centers of excellence. Indeed, it is very likely that the future will bring the widespread use of simulation in all aspects of our healthcare infrastructure.

DISCLOSURES

Potential conflict of interest: Nothing to report.

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of Physicians and Surgeons of Canada (RCPSC) has long incorporated standardized patients into its comprehensive objective examination in internal medicine. However, the RCPSC quickly recognized the limitations of standardized patients in producing accurate physical examination findings. In 2003, it augmented its examination with digitized cardiac auscultation videos.[107] By including simulation, the RCPSC was able to include an element of high-stakes assessment that is not otherwise possible with standardized patients alone. The Israeli Board of Anesthesiology Examination Committee fully integrated several simulation platforms into its board certification examination.[108] The Israeli Board of Anesthesiology Examination Committee integrated a simulation-based objective structured clinical examination component into the board examination process. It created 5 standardized scenarios to assess trauma management, ACLS, operating room crisis management, mechanical ventilation, and administration of regional anesthesia. A combination of high-fidelity mannequin simulators, standardized patients, and an artificial lung was used in the testing environment. To date, the Israeli Board of Anesthesiology examination is the first to incorporate such a robust use of simulation technologies. Its results yielded only adequate interrater correlation, and thus further investigation is needed to improve this model of examination. As new evaluation tools are tested and validated, the various medical specialties may be more likely to adopt the use of simulation for board certification and credentialing. Simulation offers reproducibility and realism.

Medical-Legal Applications

The use of simulation also has a growing impact in the medical-legal arena. The Consolidated Risk Insurance Company (CRICO) is the patient safety and medical malpractice company owned by and serving the Harvard medical community. In 2001, CRICO began offering insurance premium incentives for anesthesiologists who participated in simulation-based crisis resource management.[109,110] Upon analyzing its malpractice claims after several years of implementing this incentive, CRICO concluded that the program was effective in reducing the cost of malpractice claims. The benefit was so significant that CRICO implemented a similar program in obstetrics and gynecology.[70,110] It is conceivable that other insurance companies will make this type of training required for other specialties. In the book *Practical Health Care Simulations*,[11] Eason provides a theoretical rendering of using simulation in the courtroom. He discusses using medical simulation as evidence in a medical malpractice case. In his example, the medical case is recreated on a simulator for the jury. The intent is to prove or refute wrong doing by the physician. Although there are several legal considerations in using simulations as evidence, this is potentially a very interesting application of medical simulation.

CONCLUSION

Simulation in medical training is here to stay. From the learners' perspective, simulation affords the ideal opportunity to practice patient care away from the bedside and to apply the principles of adult learning and the principles of deliberate practice toward knowledge and skills mastery. From the patients' perspective, having students and residents pretrain with simulation increases the likelihood of a minimum competency level prior to clinical interaction and medical decision making. Patients are more willing to allow students to perform procedures on them after they have undergone simulation training.[47]

There are various practical limitations to implementing simulation-training programs. One recent study, which surveyed all emergency medicine residencies using simulation, found faculty time constraints to be the top barrier to simulation use followed by a lack of faculty training and cost of equipment.[3] Many of the technologies implemented by simulation educators are expensive. Depending on the fidelity of a simulator, the price for equipment alone can range from $6000 to $250,000. When this is coupled with the cost of equipment maintenance, space for educational labs, and personnel, the budget for a simulation center can be quite large. Many of these expenses can be minimized by the development of multidisciplinary centers in which funding is provided across various departments in an institution. Identifying qualified faculty skilled in simulation use and debriefing is another significant barrier. This includes availability in terms of protected time as well as those faculty trained to teach. This technology does not obviate the need for faculty trained in solid educational principles and teaching techniques. In other words, simulators do not replace good educators.

As the field of medical simulation continues to grow, an increasing number of educators are being formally trained to employ simulation. Currently, 4 emergency medicine programs offer fellowship training in simulation after residency.[3,112] Ultimately, to increase the availability of simulation

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were exposed to 12 unique, simulated intraoperative emergencies. Again, the simulation-based assessment distinguished the junior trainees from more experienced trainees and anesthesiologists.

Assessment using medical simulation can also be applied to evaluating impaired clinicians for continued practice or promotion. One article outlines the use of a human patient simulator in evaluating an anesthesiologist identified as having substandard medical skills.[95] In this report, the candidate underwent a psychological inventory, oral examinations, and a written test. These were performed to assess medical knowledge and suitability for remediation. The evaluation was enhanced by 4 simulated cases on a human patient simulator that was relevant to the candidate's practice. The simulation allowed an assessment of technical proficiency within the candidate's practice environment. In a separate report, some dentists with medical disabilities were evaluated in a simulated environment to determine their ability to perform clinically.[96]

CONTINUING MEDICAL EDUCATION

This past century has witnessed an explosion in medical knowledge. With the ever-changing landscape of medicine, there must be a mechanism by which clinicians can stay current in their medical knowledge and practice. Most state medical licensing boards and specialty boards require some form of CME. Over the years, CME programs have evolved into many forms. Despite its wide acceptance as a requirement for ongoing medical practice, there is little evidence that participation in CME improves patient care or outcomes.[97] However, several trends exist regarding CME activities. Marinopoulos and colleagues[98] performed an exhaustive review regarding the effectiveness of CME. They found 3 common themes: live media are more effective than print media, interventions with multiple media are more effective than interventions with single media, and multiple exposures are more effective than a single exposure. Simulation-based CME programs fulfill the first 2 themes on this list. Simulation-based CME is usually offered in combination with didactic lectures. Because of the cost and logistics of performing simulation, high-fidelity simulation-based CME is not as common as part-task training CME exercises. One study describes the use of high-fidelity simulation for crisis resource management in anesthesia.[99] Blum and colleagues[99] proposed that simulation-based courses should be more widely used. A separate study examining the use of a simulation-based course for difficult airway training suggests that this type of program is more conducive to affecting clinical practice.[100] Offering simulation-based CME requires a fair amount of resources. Simulators are costly, and a greater amount of time is necessary to perform simulations as opposed to lectures. Therefore, having sufficient faculty familiar with performing simulations can also be a problem. Several professional medical societies have recently begun accrediting simulation-based educational centers.[101–104] Although each group has its own criteria for accreditation, they set standards for necessary equipment, space, and faculty. Theoretically, these centers would be adequately equipped to offer CME programs in their respective specialties.

FUTURE OF SIMULATION IN MEDICAL EDUCATION

Board Certification and Credentialing

The use of simulation technologies for undergraduate and graduate medical assessment has become well established in multiple specialties. However, use of these technologies for credentialing and certification is in its infancy. The United States Medical Licensing Examination (USMLE) was the first testing organization to integrate computer-based case simulations.[105] Examinees are provided a chief complaint and a brief history and are required to care for the virtual patient. These simulations include changes in the patient's status requiring multiple interventions. In 2004, the USMLE also added a clinical skills assessment using standardized patients. Examinees are required to participate in 12 encounters while the standardized patient records progress on a case-specific dichotomous checklist. Several specialty boards incorporate oral case presentations as part of the board certification process. The American Board of Family Practice expanded its board certification examination in family practice to include simulation.[106] This examination includes computer-based case simulations that are uniquely generated from a knowledge-base database for each examinee. The system uses population distributions for disease states to create patients that evolve in response to candidate interventions, such as pharmacological and nonpharmacological therapies. A third-party application uses Bayesian theory to analyze the participant's progress and manipulate the clinical case. This is a significantly more advanced system than the prefabricated cases on the USMLE examination. The Royal College

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emergency medicine residencies by Okuda *et al.*[3] showed that 91% used simulation in training their residents. Of those using simulators, 85% used mannequin-based simulators. Of the emergency medicine residencies using simulation, many of the the programs are using simulation to train skills and algorithms such as intubation and resuscitation. To this end, one study demonstrated that simulation-based rapid-response team training correlated with improved team functioning and adherence to American Heart Association guidelines in real in-hospital emergencies.[81]

Crew resource management, in particular, is important in the emergency department, and much of the work done with emergency medicine simulation revolves around this concept. Crew resource management was a concept developed by the National Aeronautics and Space Administration to evaluate the role of human factors in high-stress and high-risk environments such as aviation. This model was adapted into medicine as crisis resource management. Currently, Stanford Medical School runs a compulsory crisis management course for its emergency medicine residents, with increasingly complex scenarios presented as residents progress through their training.[82] Numerous studies have concluded that participants in similar courses viewed their crew resource simulations favorably and believed that their knowledge and skills had been improved.[83] In a study by Bond *et al.*,[13] emergency medicine residents were exposed to scenarios in which they were expected to fail and later examine the decisions that led to their errors. The participants stated that they learned from their errors and ranked the experience second only to actual patient care in terms of educational benefit. Although the current evidence does not conclusively support whether simulation training can change behaviors, skills, or performance in emergency medicine, the increased interest in these possibilities means more research in coming years.

Pediatrics

Although much of the simulation work in general pediatrics has been focused on standardized patient encounters, high-fidelity simulation in pediatrics has focused on neonatal resuscitation. Numerous studies have highlighted deficiencies in providers' conformity to neonatal resuscitation guidelines.[84,85] Hence, there exists a need for better training in the skills and teamwork involved in handling pediatric resuscitation and emergencies. Halamek and his group at Stanford University[86] developed a neonatal resuscitation program in the mid-1990s. The program used high-fidelity pediatric simulation and emphasized teamwork and technical skills. Trainees reported that the simulations enhanced their critical thinking, behavioral, and technical skills. Although data are lacking on the transfer of these skills from the simulator to real patients, it is likely that the confidence gained through simulation augments the knowledge gained through actual patient encounters.

Critical Care

The critical care setting is highly dynamic and necessitates many skills that can be taught or honed through simulation. As in many other fields, teamwork and leadership skills are crucial to critical care and can be rehearsed in a simulation environment.[87] Procedures such as central line placement can also be practiced. Central line simulation before actual performance on patients was well received by participants in one study.[88] Still, no long-term outcome evidence exists about whether simulation training improves outcomes.

Competency Assessment and Physician Impairment

Public pressure on physician performance is increasingly compounding the dilemma of assessing competency. Traditionally, physicians were assessed while delivering care to live patients in real clinical situations. This method is growing increasingly unpopular because of public demand for an error-free learning environment. In fact, some malpractice suits have attempted to shift blame to the inadequacies of residency programs.[89] Bond and Spillane[90] outlined how simulation could be used to assess the ACGME core competencies in emergency medicine residents. Other work in the field of emergency medicine has elaborated on the evaluation of specific core competencies and ethical dilemmas.[91,92] This expands assessment beyond the evaluation of clinical care and into the realm of human rights and morality. Although few will argue that simulation is a convenient tool for competency assessment, many will question the transferability of this assessment in the simulation laboratory to the clinical environment. Two studies addressed this issue. In the first study, a group of emergency medicine residents at various levels of training were assessed on the basis of observable, objective events and time to completion of a surgical airway.[93] The simulation-based evaluation was able to discern novice residents from more advanced residents. A separate study compared anesthesiology residents at different levels of training with board-certified anesthesiologists.[94] These groups

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"tool box" with recommended teaching and evaluation modalities. The ACGME considered the use of simulation, including standardized patients and mechanical simulators, to be extremely effective for teaching and evaluating some of the so-called light competencies such as communication skills, professionalism, and systems-based practice. However, all 6 of the ACGME core competencies can be addressed through simulation.

Anesthesiology

Anesthesiologists such as Dr. David Gaba of Stanford Medical School have led the way in anesthesia simulation since the 1980s. Given the nature of anesthesiologists' practice environment, opportunities for learning are often sporadic. When adverse or crisis events do occur, little teaching takes place, and ubiquitous legal concerns often prevent debriefing and discussion among colleagues. Simulation enables learners to witness such events in a safe environment and creates learning opportunities.

A 1999 survey by Morgan and Cleave-Hogg[48] found that 71% of medical schools used some form of mannequin or simulator to teach anesthesia to medical students. Eighty percent of these institutions also used simulation for postgraduate training. This widespread use has been prompted by evidence that medical decision making and the occurrence of errors can be effectively examined in simulation labs and that improved performance can result from simulator training.[49–53] There is also evidence that simulation training improves provider and team competence on mannequins and that procedural simulation improves actual performance in clinical settings with respect to implementing ACLS protocols.[54]

It is not surprising that governing bodies have taken notice. Indeed, the American Board of Anesthesiology now requires simulator-based education to fulfill maintenance of certification in anesthesia requirements,[55] and Ziv *et al.*[56] reported the use of simulation by the Israeli Board of Anesthesiology Examination Committee as a crucial element in credentialing and certifying anesthesiologists. It is likely that the role of simulation will only grow in the field of anesthesiology, in which rare events and resource management training are so crucial.

Surgery

The role of simulation in surgical education is rapidly changing the traditional apprenticeship model, which often suffers from poor reliability when applied to performance assessment and teaching.[57] Surgeons need to learn new procedures and become proficient with new tools throughout their careers. The acquisition of new knowledge and skills can be especially challenging for surgeons, who often work under tremendous time constraints.[58–60] Although surgical simulation can be thought to start on the first day of gross anatomy class, high-fidelity, computerized models are replacing and augmenting traditional training.[61]

An impressive array of simulators is now available for use in the teaching, learning, and assessment of surgical competencies (from part-task trainers to virtual reality). The continuum of surgical care may be simulated through interconnected stations, each one focusing on a phase in the care of the surgical patient.[62] A review of surgical simulation showed that computer simulation generally showed better results than no training at all.[63] Most surgical trainees feel that simulation is essential to their current surgical training curricula.[64] Furthermore, data suggest the potential for clinical benefits from simulation-based skills development, especially in laparoscopic[65] and endoscopic procedures (upper endoscopy and colonoscopy).[66] Studies by Aggarwal *et al.*,[67] Stefanididis *et al.*,[68] and Korndorffer *et al.*[69] demonstrated that laparoscopic surgery simulation proved effective for surgical residents in training, maintaining skills, and improving performance in the operating room.

Obstetrics

A number of part-task trainers have since been created for training in common tasks (eg, determining the degree of cervical dilation), and high-fidelity birthing simulators now have motor-driven mechanics that can move a mannequin fetus out of the birth canal. The extant literature supports simulation for practicing routine and uncommon procedures and events, for improving technical proficiency, and for fostering self-confidence and teamwork among obstetricians as measured by self-report.[46,70] Many articles have been published describing simulators for teaching ultrasound-guided amniocentesis,[71] determining fetal station,[72] managing shoulder dystocia,[62,73–78] and managing obstetric emergencies and trauma.[79,80] A recent retrospective study by Draycott *et al.*,[75] which looked at neonatal outcome before and after shoulder dystocia training on a simulator, showed a reduction in neonatal injury from 9.3% to 2.3%.

Emergency Medicine

The use of simulation in emergency medicine has expanded since the late 1990s. A recent survey of

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A review of the videotaped large-group sessions showed extensive interactions within the groups, and student feedback revealed that 98% of students felt the correlation to basic science concepts was good or outstanding.

Physical Examination

Simulation has also been used to help teach physical examination skills such as the heart and lung examination. The cardiology patient simulator (CPS), developed by Dr. Michael Gordon in 1968, can be used to teach 30 different cardiac conditions, reproducing abnormal and normal findings such as respiratory sounds, heart sounds, pulses, jugular venous pulsations, and precordial pulsations. This part-task simulator was developed because of the limitations of relying on patient exposure to teach all abnormal cardiovascular examination findings to medical students. A multicenter study, involving 208 medical students, demonstrated significant improvement in clinical skills and knowledge when students were trained on a CPS during a fourth-year cardiology clerkship in comparison with standard bedside teaching.[6,35] Students on a cardiology clerkship were divided into a control group using standard bedside teaching and a CPS group using both standard and CPS training. Pretests between the 2 groups were not statistically significant. Upon completion of the training, the students in the CPS group showed statistically significant improvement on a written multiple-choice test and a clinical skills examination with both a CPS and a real patient. Issenberg *et al.*[36,37] showed similar findings in medical house staff.

Clinical Clerkships

The clinical clerkships are a period during which medical students begin to apply preclinical knowledge to the care of real patients. Simulation can help bridge this gap. Medical students have been placed in a variety of simulated scenarios, including airway management in anesthesia cases,[38] trauma management,[39] and critical care management.[40] Murray *et al.*[39] used trauma simulation to explore measurement properties of scores. Third-year and fourth-year medical students and first-year residents underwent a trauma simulation exercise and were subsequently scored on the basis of item-checklist completion, thought process, action performance, and care prioritization. Results from the study showed that timing and sequencing of actions distinguished high-ability examinees from low-ability examinees and correlated with the training level. This and other studies such as that of Boulet *et al.*[40] have shown that simulation is a valid measure of performance.[41] As a tool for performance improvement, Morgan *et al.*[42] had 299 fourth-year medical students undergo simulation sessions that involved working through 4 clinical scenarios that resulted in an unstable cardiac arrhythmia. Subsequent testing of knowledge and a review of actions showed statistically significant improvement in written test scores, global ratings, and completion of performance checklists.

Skills Training

Simulation-based training has also found utility in procedural and surgical skills training. Medical student training with virtual reality simulation has similarly led to greater knowledge acquisition and improved performances in simulated surgeries.[43] In one study by Van Sickle *et al.*,[44] medical students training with a laparoscopic suturing part-task simulator were able to learn advanced technical skills comparable to those of senior level residents in a short amount of time. For nonsurgical procedures such as cricothyrotomies, central lines, and chest tubes, medical students with simulation training felt more comfortable with and more willing to perform these procedures on their own than those trained without simulation.[45] In obstetrics, simulation has been used to teach management of shoulder dystocia and simple delivery.[46] Graber *et al.* demonstrated that patients are more willing to allow medical students to perform procedures such as venipuncture, lumbar puncture, or central lines on them after they have undergone simulation training.[47]

GRADUATE MEDICAL EDUCATION

In 1999, the Accreditation Council for Graduate Medical Education (ACGME) and the American Board of Medical Specialties defined competency in terms of 6 domains: patient care (including clinical reasoning), medical knowledge, practice-based learning (including information management), interpersonal and communication skills, professionalism, and systems-based practice (including health economics and teamwork). During the following decade, the ACGME identified common requirements for all residency programs. These common requirements mandate that programs must educate, evaluate, remediate, and determine that their graduates are competent in terms of these 6 domains. It is expected that the residency programs will document these processes. Because teaching and assessing some of these domains is complex and imperfect, the ACGME furnished a

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that emphasizes a process of learning building on concrete experience. His model describes 4 stages: (1) concrete experience, (2) observation and reflection, (3) abstract concept formation, and (4) active experimentation in which generalizations are tested and new hypotheses are developed to be tested in future concrete experiences. The simulation experience affords an excellent opportunity to expand on this model. Learners are thrown into a simulated concrete experience that allows them to progress through the cycle, ideally developing skills and knowledge to be applied in future simulated or actual concrete experiences. One of the most important parts of the experiential learning cycle is debriefing, a process that is often difficult to perform in the typical clinical learning experience. In a simulated environment, debriefing can be successfully accomplished.[28] A study by Savoidelli *et al.*[28] found simulation without debriefing showed no improvement in nontechnical skills in comparison with simulation with either oral or videotape-assisted oral feedback, which showed significant improvement ($P > 0.005$).[28]

UNDERGRADUATE MEDICAL EDUCATION

The recent growth of interest in simulation has led to a cascade of applications as a supplement to or replacement for current models of undergraduate medical education. The reason for this is the strong belief in its efficacy as an addition to and sometimes replacement of the current models of education. Traditional modes of education rely on noninteractive classroom lectures and more recently problem-based learning formats to relay basic science concepts and disease processes. Simulation-based training seeks to teach these concepts as well as cognitive and motor skills in an interactive way that more accurately reflects the clinical experience.

Many studies have shown that simulation is a valuable educational tool in undergraduate medical education. Simulation has been used as an evaluation tool to assess knowledge gaps in medical students and residents in the management of acutely ill patients.[29] A study by Young *et al.*[29] tested medical students and residents in the management of high-risk scenarios and sought to show differences in performance for each level of training with a steady increase in performance as training increased. Surprisingly, when the participants were assessed, all groups performed equally poorly in comparison with the expert-attending comparison group. This performance deficit signified that there might be a deficiency in the current model of the lecture-based and problem-based learning format of teaching. This also revealed potential dangers in the current medical system in which residents decide many critical actions.

As a teaching tool, simulation-based teaching has proved superior to the traditional problem-based learning format. A study by Steadman *et al.*[30] randomized fourth-year medical students to receive a problem-based learning or simulation-based teaching training intervention for the management of acute dyspnea. Each group received the other intervention for the management of abdominal pain as a control. After a weeklong study period that included an initial assessment, intervention, and final assessment on a simulator, scores were tallied on the basis of standardized performance checklists. The results showed that the group receiving the simulation intervention performed significantly better with a greater improvement in scores from baseline than the problem-based learning group. Next is a overview of simulation use within the various levels of medical school education.

Basic Science

Medical student educators have used simulation in basic science education. Online computer-based simulators and, more recently, high-fidelity mannequin simulators have been used to teach physiology and have been well received by both students and educators as an effective educational tool.[31,32] Via *et al.*[32] used a full-scale human simulator to demonstrate changes in cardiac output, heart rate, and systemic vascular resistance in response to volatile anesthetics for second-year medical students learning pharmacology. Student acceptance was high, with 95% of the students feeling that it was a valuable use of their time and 83% of the students preferring this method over didactic lectures. In another study by Seybert *et al.*,[33] students underwent cardiac scenarios including dysrhythmias, hypertensive urgency, and myocardial infarction. On the basis of preintervention and postintervention scores, students demonstrated improvement of knowledge, ability, and self-confidence in pharmacological management. Simulation in basic science education is often conducted in small-group sessions with the reasoning that it is more effective in such settings. However, Fitch[34] showed that it was possible to teach large groups basic neuroscience concepts with simulation in large settings. High-fidelity patient encounters were presented with physician actors in front of a large group of first-year and second-year medical students to demonstrate basic neuroscience concepts.

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grows, however, when the technical aspects of clinical instruction are introduced. Clinical skills, on the simplest level, are psychomotor skills learned via reinforcement and requiring straightforward instruction. In some ways, clinical skills would seem easier to master because students tend to remember 90% of what they do yet only 10% of what they read.[16] However, clinical skills consist of more than motor memory. They require the integration of problem-solving skills, communication skills, and technical skills in the setting of a complex medical context, and they require practice.

The ultimate goal in medical education is expertise or mastery of one's trade. Deliberate practice is an educational technique used to produce expert performance contingent upon 4 conditions: intense repetition of a skill, rigorous assessment of that performance, specific informative feedback, and improved performance in a controlled setting.[17] The true goal of deliberate practice, similar to the true goal of medical education, is to produce an expert or master of any trade. As Eppich *et al.*[18] explained, unless the goal is improved performance, merely participating in the activity will not lead to mastery. It would appear then that one way to improve medical education is to seek a mechanism for deliberate practice. A recent study by Wayne *et al.*[19,20] assessed the value of using simulation technology and deliberate practice to enhance acute resuscitation skills. This study of 41 second-year internal medicine residents using deliberate practice to teach advanced cardiac life support (ACLS) showed statistically significant improvements in education outcomes, including compliance with standard ACLS protocols as well as retention of skills and knowledge after 14 months.

In evaluating simulation as an educational tool, Issenberg *et al.*[21] and McGaghie *et al.*[22] described the features enhancing its utility (Table 2). Simulation provides the tools and the paradigm to enhance medical education, but it depends on intense preparation and support from faculty as well as buy-in from the participants. The ability to provide immediate directed feedback is the primary advantage of simulation. This opportunity is typically lacking in the clinical setting. It also effectively addresses the diversity of both learners and situations with its adaptable, programmable structure. The main limitation of simulation is learner-dependent, as it requires full participation and engagement by the individual.

FES addresses many of the challenges in today's medical education. First, it provides a medium and mechanism for clinical skill instruction. Everything from basic interview skills to lung auscultation to emergent cricothyrotomies can be practiced in a simulated environment. That environment allows for relevant, active learning with feedback, these being important components of clinical skill development.[23] Next, it creates a safe environment for practicing with new technologies and, importantly, ensures that practice occurs without endangering patient or practitioner safety. Traditional practice of "see one, do one, teach one" may no longer be ethical.[24] FES is also an ideal environment for the promotion of teamwork and communication. Many clinical problems cannot be solved simply by identification of the diagnosis; they often require resource management and teamwork, 2 practical skills well suited to simulation education.[25,26] A study by Ottestad *et al.*[26] demonstrated that simulation could be used to reliably assess nontechnical skills such as interpersonal communication and task management.[18] In Ottestad *et al.*'s study, house staff were videotaped managing a standardized simulated septic shock patient in teams, and a benchmark checklist of clinical and nonclinical skills was developed. The tapes were reviewed by 2 of the study authors pretrained in skill review, and interrater reliability was found in the assessment of both clinical and nonclinical skills ($r = 0.96$ and $r = 0.88$, respectively). Lastly, training with high-fidelity mannequin simulation improves knowledge consolidation. Wayne *et al.*[20,27] demonstrated by both retrospective case log review and simulator testing that comparing the acute cardiac arrest management of residents trained by simulation and those not trained on the simulator showed that students learning new material with the use of simulation retained knowledge further into the future than students studying with more traditional methods.

Medical learners may also benefit from experiential learning, a model explained by David Kolb

Table 2. *Features and Uses of High-Fidelity Medical Simulations That Lead to Effective Learning.*

1.	Mechanism for repetitive practice
2.	Ability to integrate into a curriculum
3.	Ability to alter the degree of difficulty
4.	Ability to capture clinical variation
5.	Ability to practice in a controlled environment
6.	Individualized, active learning
7.	Adaptability to multiple learning strategies
8.	Existence of tangible/measurable outcomes
9.	Use of intra-experience feedback
10.	Validity of simulation as an approximation of clinical practice

NOTE: The material for this table was taken from Issenberg *et al.*[21] and McGaghie *et al.*[22]

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simulations, such as fiber-optic bronchoscopy, to partial-task trainer devices designed to allow learners to practice procedures, including chest tube insertion and intubation, to full environment simulation (FES) using high-fidelity mannequin simulators.

Flight simulators are perhaps the most highly developed form of FES: full cockpit environments undergo all of the movements associated with real flight. High-fidelity mannequin simulators are typically used to recreate real patient encounters in a simulated clinical environment. Even the highly advanced mannequin simulators in use today can be used along a continuum of fidelity, reflecting the time and resources available to the instructor. Students participating in an anesthesiology-based curriculum may be run through a simple anesthetic induction and evaluated on their performance with a checklist of required tasks in a particular order. On the other end of the spectrum is the simulation theater, in which details, both subtle and overt, are embedded, creating emotion, confusion, and distraction and adding that element of reality which helps to enhance the experience. Instead of simply completing the tasks on an anesthesia checklist (eg, start an intravenous line, apply monitors, pre-oxygenate, induce anesthesia, and intubate), participants may face a difficult or inappropriate patient, may have to deal with an obnoxious or verbally abusive family member, or may have to address an inappropriate comment from a consultant. Standardized patients, played by actors, can be used in conjunction with FES to lend an even greater level of reality to simulation. This theater, which adds so much to the reality of the simulation experience, can be laced with emotional content to enhance the learning experience.

The ingredients of a full-environment simulation include the patient (high-fidelity mannequin simulator), other healthcare professionals, and ancillary equipment and supplies designed to replicate the clinical environment. Current mannequin-based simulator designs are computer- and model-driven, full-sized infant, child, or adult patient replicas that are capable of delivering "true-to-life" scenarios that simulate reality. The incorporation of the mannequins into a simulated clinical environment complete with monitors and medical equipment commonly found in real clinical scenarios allows participants the ability to suspend disbelief, thus creating a highly effective learning environment.[12] The lessons learned can be perceived as more realistic in comparison with simpler screen-based simulators.

FES provides the unique opportunity to not only practice procedures but also allow educators the ability to stage realistic settings in which the principal focus can be human behavior and interaction. In this environment, participants can be allowed to make mistakes and experience bad outcomes without patient harm.[13] These adverse outcomes can facilitate the generation of negative emotions among the participants, as no healthcare professional wants to be responsible for contributing to patient harm through a bad clinical outcome, especially when witnessed by colleagues. One of the major manufacturers alleges that its device "exhibits clinical signals so lifelike that students have been known to cry when it 'dies.'"[12] We theorize that the effectiveness of the simulator as an educational tool not only depends on the ability of the simulator to realistically emulate human physiology and physiological responses but also depends on the specially designed facilities and the expertise of the educators to accomplish FES that triggers these emotions.

SIMULATION AS AN EDUCATIONAL TOOL

The medical learner at any stage–undergraduate, graduate, or postgraduate–is truly an adult learner. Defined in various ways by education theorists, the adult learner, by all accounts, is seen to learn by different methods and for different reasons in comparison with earlier stages in his education. In 2008, building on the work of other education scholars (including Knowles, the father of andragogy, or adult learning theory), Bryan *et al.*[14] described 5 adult learning principles that apply to the medical learner (Table 1).

These are an adaptation of the assumptions of andragogy, which emphasizes the role of experience and self-direction as well as the need to know the benefits of knowledge and its potential applications before one embarks on the instructional journey.[15] The challenge then is to create effective educational pathways within this paradigm. The complexity

Table 1. *Five Adult Learning Principles That Apply to the Medical Learner.*

1. Adult learners need to know why they are learning.
2. Adult learners are motivated by the need to solve problems.
3. The previous experiences of adult learners must be respected and built upon.
4. The educational approach should match the diversity and background of adult learners.
5. Adults need to be involved actively in the process.

NOTE: The material for this table was taken from Bryan *et al.*[14]

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Dr. David Gaba,[1] is an instructional process that substitutes real patient encounters with artificial models, live actors, or virtual reality patients. The goal of simulation is to replicate patient care scenarios in a realistic environment for the purposes of feedback and assessment. Properly conducted, simulation creates an ideal educational environment because learning activities can be made to be predictable, consistent, standardized, safe, and reproducible. This environment encourages learning through experimentation and trial and error with the ability to rewind, rehearse, and practice without negative patient outcomes. It is not our intent to suggest that simulation, in its present form, serves as an acceptable substitute for the actual clinical experience, and we agree that the ideal setting for clinical education remains the actual clinical environment, but unfortunately, the ideal is not always practical.

One might question the necessity of simulation in medical education when the apprenticeship model of training under experienced clinicians has served us well for so many years. However, the world of medicine is changing because of a variety of issues affecting medical education. Patients are now increasingly treated on an outpatient basis, and less time is afforded to patient interaction. Continuity of care has also decreased as time limits are placed on resident work hours. Simulation technology has begun to gain widespread acceptance in medical education because of the safety of the environment, the ability to demonstrate multiple patient problems, the reproducibility of content, and the ease of simulating critical events.[2] Coupled with an aggressive medicolegal system in the United States, the idea of learning difficult and error-prone tasks by making errors on live patients is progressively less acceptable.[3] It has been said that we remember from our failures, not our successes. Those events that end with an untoward outcome create "seasoned" veteran clinicians.

To date, there is a small but growing body of evidence that simulator training improves healthcare education, practice, and patient safety, but Gaba[4] argues that "no industry in which human lives depend on skilled performance has waited for unequivocal proof of the benefits of simulation before embracing it." Patient safety and medical errors have come to the forefront of healthcare since the Institute of Medicine released *To Err Is Human: Building a Safer Health System* in 2000.[5] The effective integration of simulation into medical education and assessment can address this modern healthcare challenge.

Medical simulation is often divided into 4 areas by the educational tool: a standardized patient, a screen-based computer, a partial-task simulator, and a high-fidelity mannequin simulator.[6] This article reviews the utility of simulation in medical education and focuses mainly on the latter 3 areas related to simulation technologies, as a vast body of literature already exists for standardized patients.[7] We briefly discuss the history of mannequin simulation and types of simulators and then focus on the educational theory behind simulation as well as simulation as it applies to undergraduate medical education, graduate medical education, and continuing medical education (CME).

HISTORY OF THE MANNEQUIN SIMULATOR

The first mannequin used to teach airway and resuscitative skills was developed by 2 anesthesiologists, Dr. Peter Safar, an American, and Dr. Bjorn Lind, a Norwegian, during the 1950s.[8] Lind worked with a toy manufacturer to develop what has been known for over half a century as Resusci-Annie. Some 10 years later, Dr. Stephen Abrahamson, also from the United States, presented the advantages of training anesthesiologists with his full-scale, computer-controlled human patient simulator.[9] Toward the end of the 1980s, 2 teams of anesthesiologists, one from the University of Florida (Dr. Michael Good and Dr. John Gravenstein) and the other from Stanford (led by Gaba), developed a realistic mannequin simulation. They combined engineering skills and the idea of using simulation in education for team training and with the aim of improving patient safety. The result was an interactive, realistic patient simulator that could replicate the human response to various physiological and pharmacological interactions.[10] At the same time, Dr. Hans-Gerhard Schaefer and his colleagues in Basel, Switzerland developed full-scale simulators for crisis resource training of operating room teams.[11] Today, these high-fidelity mannequin simulators are capable of recreating physical examination findings, including normal and abnormal heart and lung sounds, pupil diameter, sweating, and cyanosis, as well as physiological changes, such as changes in blood pressure, heart rate, and breathing.

TYPES OF SIMULATIONS

Simulation, as defined earlier, is the replacement of real patient encounters with either standardized patients or technologies that replicate the clinical scenario. These technologies range from simple demonstrations through screen-based video game–type

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The Utility of Simulation in Medical Education: What Is the Evidence?

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ABSTRACT

Medical schools and residencies are currently facing a shift in their teaching paradigm. The increasing amount of medical information and research makes it difficult for medical education to stay current in its curriculum. As patients become increasingly concerned that students and residents are "practicing" on them, clinical medicine is becoming focused more on patient safety and quality than on bedside teaching and education. Educators have faced these challenges by restructuring curricula, developing small-group sessions, and increasing self-directed learning and independent research. Nevertheless, a disconnect still exists between the classroom and the clinical environment. Many students feel that they are inadequately trained in history taking, physical examination, diagnosis, and management. Medical simulation has been proposed as a technique to bridge this educational gap. This article reviews the evidence for the utility of simulation in medical education. We conducted a MEDLINE search of original articles and review articles related to simulation in education with key words such as *simulation, mannequin simulator, partial task simulator, graduate medical education, undergraduate medical education*, and *continuing medical education*. Articles, related to undergraduate medical education, graduate medical education, and continuing medical education were used in the review. One hundred thirteen articles were included in this review. Simulation-based training was demonstrated to lead to clinical improvement in 2 areas of simulation research. Residents trained on laparoscopic surgery simulators showed improvement in procedural performance in the operating room. The other study showed that residents trained on simulators were more likely to adhere to the advanced cardiac life support protocol than those who received standard training for cardiac arrest patients. In other areas of medical training, simulation has been demonstrated to lead to improvements in medical knowledge, comfort in procedures, and improvements in performance during retesting in simulated scenarios. Simulation has also been shown to be a reliable tool for assessing learners and for teaching topics such as teamwork and communication. Only a few studies have shown direct improvements in clinical outcomes from the use of simulation for training. Multiple studies have demonstrated the effectiveness of simulation in the teaching of basic science and clinical knowledge, procedural skills, teamwork, and communication as well as assessment at the undergraduate and graduate medical education levels. As simulation becomes increasingly prevalent in medical school and resident education, more studies are needed to see if simulation training improves patient outcomes. ***Mt Sinai J Med 76:330–343, 2009.*** *© 2009 Mount Sinai School of Medicine*

Key Words: graduate medical education, simulation, undergraduate medical education.

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As educators in the field of medicine, we have a tremendous responsibility to our students, patients, and society as a whole. Participating in medical students' professional development is truly a gratifying yet daunting task. We must help our students to develop the ability to recognize their own limitations and knowledge gaps and provide them with the tools to fill these voids. Simulation, in all its incarnations, is a tremendous tool for healthcare educators, in that it allows students to achieve these goals without our patients being put at risk. Simulation, as defined by

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FACULTY BIOS

Dr. Heather Mahoney is an Assistant Professor in the Department of Emergency Medicine at New York University (NYU) Langone Medical Center and Bellevue Hospital Center. A former assistant residency director, she now serves as the residency's Director of Simulation Education. Dr. Mahoney completed her medical training at Washington University in St. Louis, followed by a residency in emergency medicine at NYU / Bellevue Hospital. She is a graduate of the Harvard Center for Medical Simulation (CMS) Instructor Course. Dr. Mahoney is also an instructor of the TeamSTEPPS course.

Dr. Komal Bajaj is Faculty at the Institute for Medical Simulation and Advanced Learning (IMSAL) and Assistant Professor at the Albert Einstein College of Medicine. She is a board-certified OB-GYN physician and a board-certified clinical geneticist. Dr. Bajaj attended Northwestern University's Feinberg School of Medicine, and completed her OB-GYN residency training at Northwestern University, followed by a fellowship in Reproductive Genetics at Albert Einstein College of Medicine.

Dr. Nur-Ain Nadir is the current Medical Simulation fellow under the collaborative Medical Simulation Fellowship sponsored by the Institute for Medical Simulation and Advanced Learning and SUNY Downstate Medical Center / Kings County Hospital Center. She is an emergency physician who also holds an academic appointment as Clinical Assistant Professor. She graduated from the Chicago Medical School at Rosalind Franklin University of Medical Sciences in Chicago, followed by a residency in emergency medicine at SUNY Downstate / Kings County Hospital.

Mr. Howard Erskine has been in the audio and video business for over twenty years. He has worked as an Audio Engineer, Studio Musician, and today plays with various artists from Reggae to Rock. Mr. Erskine is a former EMT, and has worked voluntarily in the Kings County Emergency Department and the Bedford-Stuyvesant Volunteer Ambulatory Service in Brooklyn. Mr. Erskine's experience in simulation training starts with his love for aviation. He trained for his private pilot license at Mac Dean Aviation in Essex County, and continues to stay current with simulation when flying is not practical. He has worked at Downstate for 20 years, and has been the Head of the Audio and Visual Department in the Medical Research Library for over ten years.

Center for Healthcare Simulation
SUNY Downstate Medical Center

SIMULATION INSTRUCTOR COURSE
WEDNESDAY, FEBRUARY 27, 2013

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Bellevue Hospital Center

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SIMULATION INSTRUCTOR COURSE
WEDNESDAY, FEBRUARY 27, 2013

SCHEDULE

8:45 am: Check-in

9:00 am: Introductions

9:15 am: Group Learning Activity

10:00 am: Introduction to Medical Simulation
Heather Mahoney

10:45 am: Simulation Course Design and Curriculum Development
Komal Bajaj

12:15 -12:30 pm: Break / Lunch

12:30 pm: Medical Debriefing
Nur-Ain Nadir

1:45 pm: Technical Considerations in Medical Simulation
Howard Erskine