Towards a UCSF Children's Hospital Simulation Training and Assessment Program: Procedural Skills Training and Assessment for Pediatric Residents and Medical Students

Proposal for Innovation funding by the Haile T. Debas Academy of Medical Educators at UCSF

Funding start: July 2008

Authors:

Sandrijn van Schaik, MD, PhD vanschaiks@peds.ucsf.edu 415 476-3731	Health Sciences Assistant Clinical Professor in Pediatrics, Division of Pediatric Critical Care Medicine and Associate Program Director of the Pediatric Intensive Care Fellowship Program at UCSF
Thomas Shimotake, MD shimotake@peds.ucsf.edu 415 476-9277	Health Sciences Assistant Clinical Professor in Pediatrics, Division of Neonatology and Associate Program Director of the Neonatology Fellowship Program at UCSF

Other key faculty:

Colin Partridge, MD, MPH cpartridge@sfghpeds.ucsf.edu	Health Sciences Clinical Professor in Pediatrics, Division of Neonatology and Academy of Medical Educators Chair for Pediatric Education
Glenn Rosenbluth, MD rosenbluthg@peds.ucsf.edu 415 476-9185	Health Sciences Assistant Clinical Professor in Pediatrics and interim Program Director of the Pediatric Residency Program at UCSF
Stephen Wilson, MD, PhD wilsonst@peds.ucsf.edu 415 353-2082	Health Sciences Associate Clinical Professor in Pediatrics
Patricia O'Sullivan, EdD particia.osullivan@ucsf.edu 415 514-2281	Adjunct Professor in Medicine and Associate Director for Educational Research at UCSF

GOALS

Simulation is becoming increasingly important in medical education, as evidenced by expansion of simulation programs at UCSF and plans for a campus-wide simulation center. In pediatrics, little has been developed thus far and simulation-based training has a very limited role in pediatric residency training at UCSF. Our overall long-term goal is to develop a UCSF Children's Hospital Simulation Training and Assessment Program for diverse users across disciplines and levels of training. The first phase in the development of this program will focus on procedural skills training and assessment for pediatric residents and medical students on in-patient pediatric rotations at UCSF. In later stages, we will expand the program with the development and implementation of other simulation programs, such as resuscitation training (including neonatal resuscitation, pediatric advance life support and mock code training), physical exam training, and communication training (including inter-provider communication and provider-patient conferences). Of note, although we plan to learn from colleagues in adult medicine and hope to adapt educational modules and tools available for educational simulation in adults, it is important to realize that there is limited overlap between clinical skills used in pediatric and adult medicine. Adult simulation models are for the most part unsuitable for use in pediatric education. The number of learners that would benefit from pediatric simulation programs at UCSF is significant and includes 1) at the UME level, medical students on pediatric clerkships (approximately 150 per year), 2) at the GME level, pediatric residents (around 85 total in the program, pediatric subspecialty fellows (14 subspecialty programs with a total of 65-70 fellows), and residents/subspecialty fellows in other programs with a pediatric training

component (surgery, emergency medicine, anesthesia, neurology) as well as, 3) pediatric nurses (over 300), allied health professionals and faculty requiring CME.

OBJECTIVES

1. To develop a longitudinal procedural skills training program for pediatric residents and medical students using simulation technology, which will include three components: a self-preparation component available on-line, and instruction and practice in a skills laboratory. After the pilot phase, the training program will be opened to medical students on pediatric rotations and adapted for pediatric subspecialty fellows, nurses, and allied health professionals as applicable.
2. To develop assessment tools for learners and instructors of the program to evaluate progress of learners and determine competency in procedural skills.
3. To create an interactive web-based learning environment for participants in simulation training where educational modules, assessment tools and evaluations can be stored and retrieved.

BACKGROUND INFORMATION

Simulation-based Training

Simulation-based training is gaining importance in the education of health care professionals of all disciplines at all levels of education. Increased focus on patient safety has lowered the tolerance for learning from experience in real-life situations with actual patients and has increased the demand for risk-free, simulated learning opportunities. Advanced Initiatives in Medical Simulation, a coalition of individuals and organizations committed to promoting medical simulation, has drafted legislation to make simulation the standard in the training of health care professionals (SIMULATION Act of 2007) with goals to "improve health outcomes, patient safety, and quality; reduce medical errors and deaths; and increase health care cost savings"[1]. In addition, the Accreditation Council for Graduate Medical Education (ACGME) requirements regarding teaching and assessment of residents are forcing an increased use of simulation in medical education. Then executive director of the ACGME, David Leach, stated in 2005 that "simulation will be part of the new system of graduate medical education"[2]. More and more residency programs, including pediatric programs, are using simulation in resident education[3, 4]. An increasing number of reports describing pediatric simulation curricula and their effectiveness are appearing in the literature[3]. Examples of simulation-based programs with demonstrated efficacy are (neonatal) resuscitation training[5, 6], procedural skills training[7], patient management and assessment[8], and communication training[9].

Procedural Skills Training

The Residency Review Committee (RRC) for Pediatrics mandates procedural skills training during residency, and has put together a list of 29 skills in which the resident must have "sufficient training"[10]. According to a recent report in Pediatrics, up to 80% of pediatric residency programs in the United States use simulation to teach some procedural skills (such as bag-mask ventilation and intubation), whereas for other skills (including IV placement, venipuncture and arterial puncture), simulation-based training is rarely used[4]. In this same survey, program directors rated almost all of the skills listed by the RRC as important, whereas the majority of did not think residents in their programs were competent performers of these skills, with few exceptions. Thus, based on program directors' perception, current training in procedural skills is insufficient or ineffective, even when simulation-based teaching is employed. Of note, the use of simulation as an educational method was not further defined in the survey. There are many different educational strategies that can be categorized as simulation, but not all lead to

effective learning[11].

Current pediatric simulation-based training at UCSF Children's Hospital

At the current time, educational simulation at UCSF Children's Hospital is limited to teaching neonatal and pediatric resuscitation skills using simulated scenarios and low-fidelity equipment. One of the principal investigators, Sandrijn van Schaik, developed and implemented a structured pediatric "mock code" curriculum for pediatric residents and nurses based on a formal needs assessment[12], which consists of 3 one-hour sessions per month organized on-site using prewritten scenarios with pre-defined objectives. A similar program based on simulated neonatal scenarios was developed for house staff and nurses in the intensive care nursery (ICN) by the other principal investigator, Tom Shimotake. Simulation-based neonatal resuscitation training is also organized on an as-needed basis by one of our key faculty, Colin Partridge. No formal procedural skills training (simulation-based or other educational methods) is offered to our residents at this time. Residents mostly learn through practice on real patients, and have limited confidence in their skills[12].

Assessment, feedback, reflection and portfolios

In its new requirements for graduate medical education the ACGME emphasizes the importance of assessment of competencies, requiring documentation of progressive performance improvement and provision of adequate feedback. Procedural skills encompass several of the 6 ACGME-defined competencies; including medical knowledge, patient care and practice-based learning and improvement. Limited effective and efficient tools to guide and document competency in procedural skills are available, and none are currently in use in the pediatric residency program at UCSF. It has been demonstrated that repetitive practice followed by reflection and feedback is essential for effective acquisition of skills[13]. Frequent feedback during skills acquisition could come from faculty-instructors, but time and scheduling constraints limit the practicality of relying on faculty alone. The use of portfolios allows for learner-led assessment of competency and self-reflection[14]. Implementation of portfolios is highly encouraged by the ACGME but has not yet happened for pediatric residents at UCSF. There are limitations to self-assessment: it has been well-established that physicians' self-assessment correlates poorly with actual performance[15], although there is some evidence that self-assessment may improve over time[16]. Recent literature regarding peer-assisted learning of clinical skills during medical school suggests that assessment and feedback by peers may have a role[17], although we anticipate that explicit criteria are needed when peers are novices themselves. We propose the development of checklist for self-, peer and instructor assessment as well as portfolios to facilitate the learning process in our procedural skills curriculum. UCSF recently acquired a new expanded version of "E-value", a software program which allows for creation and storage of educational materials, portfolios and evaluation, making this the perfect time to start developing and implementing such tools. Of note, Sandrijn van Schaik has been appointed by Dean Robert Baron as one of the E-value "super users", with a goal of becoming an expert at UCSF in the use of all the features of the new system.

CURRICULUM DEVELOPMENT

A procedural skills training program involves both the acquisition of medical knowledge and of psychomotor skills. In developing the curriculum, we will follow the 6 steps outlined by Kern[18].

Problem identification and needs assessment

The first 2 steps, problem identification and needs assessment preceded this proposal, and are based on literature review (see above, background), and on comments from a survey assessing pediatric residents' confidence levels in resuscitation skills, which reflected on the inadequate training our residents reportedly receive in procedural skills[12].

Goals and objectives

The overall goal of the curriculum is for pediatric residents to achieve competency in procedural skills as mandated by the RRC, and for medical students to achieve cognitive understanding regarding these skills and learn the basic steps involved. We will define specific goals and objectives in measurable terms for each procedural skill included in the curriculum, using taxonomy for psychomotor skills as outlined by Kern[18]. We will set separate learning goals and objectives for medical students participating in the program, and will distribute these at the beginning of their pediatric rotation.

Educational strategies

An effective curriculum for the acquisition of psychomotor skills starts with demonstration, followed by deliberate practice, which is enhanced by reflection and feedback[11, 18]. We will develop **on-line educational modules** with content knowledge and video materials, in which each procedural skill is demonstrated. We plan to use available resources (such as existing video modules created at other institutions) and to create new modules in consultation with the Office of Educational Technology at UCSF. Both principal investigators as well as several of the key faculty (Colin Partridge, Steve Wilson and Glenn Rosenbluth) will serve as content experts for the educational modules and Patricia O'Sullivan will be consulted regarding educational validity. In addition, we have identified several members of the pediatric house staff with an interest in curriculum development, who are committed to help develop and test the educational program. **A skills laboratory** with simulation equipment will be set up for demonstration, instruction and practice of skills. A systematic review of simulation-based teaching revealed that repetitive practice and integration in the curriculum are among the factors that are important for effectiveness[11]. To ensure that learners can practice at anytime, the skills lab will be at a location convenient to residents and medical students and will be accessible at all times with an identification badge. We will coordinate scheduling of the instruction sessions with the residency program director and chief resident to ensure incorporation into the curriculum. Using the features of the new E-value system acquired by UCSF, **a web-based learning environment** will be created for storage of educational modules, portfolios, assessment tools and evaluations.

Implementation

In the pilot phase, we will implement the curriculum for a limited group of learners (see below, procedures) and provide training in the following 10 skills: bag-mask-valve ventilation, neonatal and pediatric endotracheal intubation, venipuncture, IV placement, IO placement, arterial puncture, umbilical vein catheterization, umbilical artery catheterization, defibrillation. These are skills in the categories "Life-saving" and "Vascular Access" skills that were rated as highly important by at least 50% of pediatric residency program directors surveyed[4]. We hope to have basic educational modules available for all 10 procedural skills before we start implementation, but will continue development of modules during the implementation phase as needed. We will prioritize development of modules for venipuncture, IV placement and bag-mask ventilation based on their high rating of importance by pediatric program directors and frequent occurrence.

Evaluation and Feedback

Learner evaluation and feedback: As mentioned above, ongoing reflection and feedback is essential for the development and maintenance of procedural skills. We will develop checklists for self-, peer and instructor assessment of each procedural skill. Learners will monitor their own progress by keeping a portfolio with reflection on real-life and skills lab experience. We will design a portfolio that collects both quantitative and qualitative data; quantitative data include, for example, number of successful and unsuccessful attempts at IV placement, whereas qualitative data include reflection on (perceived) obstacles and factors contributing to improvement and/or success. In the devlopment of assessment tools, we will consult with experts at other residency programs at UCSF with a procedural skills component, such as obstetrics/gynaecology, anesthesia and emergency medicine.

Program evaluation: We will distribute the programs' goals and objectives among participating residents at the beginning of the curriculum, and among medical students at the beginning of their pediatric rotation. We will design an on-line evaluation tool for annual evaluation of the program by the learners to assess whether goals and objectives are met. Comments regarding areas of improvement will be elicited and evaluation results will be used for curriculum improvement.

PROCEDURES

Learners:

We will pilot the curriculum with all 1st year residents entering the pediatric residency program in June, 2008 (29 residents) and all 4th year medical students on inpatient pediatric rotations at UCSF during the 2008-2009 academic year (approx 30 students).

Preparation:

We will introduced the new curriculum and orient residents to the use of the web-based learning environment during orientation to residency in June. In preparation of the first instruction session, residents will complete an on-line module, consisting of a pre-test, a pre-self assessment and an instructional module with video demonstration and knowledge content.

Instruction:

Each resident will attend two 3-hour instruction sessions during the first 6 months of residency training during which procedural skills are taught and practiced in the skills laboratory using simulation models. Medical students will attend at least one instruction session during their pediatric rotation, and will be instructed on a limited set of procedures depending on the nature of the inpatient rotation. Sessions will be offered to 6-8 learners at a time, twice per 4-week rotation, with 2-3 instructors available for each group. A schedule for session attendance will be created together with the program director and chief residents. We estimate that 3-hour sessions are practically feasible within the constraints of the residents' schedule, and that 2 sessions of this duration will be enough to go through instruction and practice of all 10 skills at least once. Learners can return to the skills lab at any time (outside scheduled sessions) for further practice, either alone or with peers, and can request instructor presence for further guidance and feedback. Residents are expected to practice skills in real-life under supervision of the fellow/attending on the service they're rotating with.

Assessment, reflection and feedback:

During the instruction sessions, the instructors will provide immediate, informal feedback on learners' performance with procedures. Learners will maintain a portfolio in which they document quantitative and qualitative data regarding skills experience both in real life and in the skills lab. At the end of each year, residents complete an on-line testing module with questions testing knowledge and trouble shooting strategies regarding each of the 10 procedural skills. In addition, a practical assessment in the skills lab will be performed in groups, and with the help of the checklists, competency in procedural skills will be assessed by the resident him/herself, by peers and by an instructor. Residents' performance will be videotaped to aid with assessment and feedback. After the session, instructors will discuss the residents' performance with each resident individually and provide formative feedback.

PLAN FOR MEASUREMENT AND DOCUMENTATION OF PROJECT EFFICACY AND OUTCOME

To document effectiveness of the curriculum:

We will monitor and quantify participation in the curriculum, in particular use of the skills lab for practice, use of portfolios and use of assessment tools by learners themselves and by peers. Results of pre- and post tests will be compared to assess the impact of the curriculum on

residents' learning. In addition, for a select set of procedural skills (IV placement, arterial puncture and defibrillation), competency of residents in the intervention group will be compared to that of a historic control group. This control group will consists of first year residents who started training in June, 2007, and whose competency will be assessed (using the instructor checklist mentioned above) at the end of their 1st year. The 3 skills selected for this comparison are skills not taught in any formal way during the first year of residency, as opposed to some of the other skills that are addressed throughout the year during mock code and resuscitation training.

To document effectiveness of assessment checklists

The end-of year assessment sessions will be videotaped, and independent observers will be asked to rate competency of residents based on the instructor checklist. The results will be compared with assessment checklists obtained from the instructors, peers and self-assessment.

CHR approval will be sought for the research component of the effectiveness testing, and results will be disseminated via peer-reviewed presentations and publications. We also plan to disseminate the curriculum to other residency programs via presentation at (inter)national conferences.

PLAN FOR CONTINUATION OF PROJECT AT THE END OF FUNDING CYCLE:

We plan to pilot the curriculum on the class of pediatric interns starting June 2008 and on 4th year medical students on pediatric inpatient rotations during the 2008-2009 academic year, but will continue this as a longitudinal curriculum throughout all 3 years of residency training after the pilot phase and expand it to include medical students of all levels on all pediatric rotations. In addition, we will adapt the program for subspecialty fellows, residents and subspecialty fellows from different departments with pediatric training needs (surgery, emergency medicine, neurology and anesthesia) and at a later stage for nurses, allied health professionals and faculty. We anticipate ongoing support from the department of pediatrics for the faculty effort after the pilot phase, and plan to apply for additional funding in the future to implement and test further innovations. We have identified other faculty in the department of pediatrics with an interest in becoming instructors in this program.

With this program, we will introduce the use of self-reflection and portfolios to the pediatric residency program at UCSF. Based on conversations with the pediatric residency program director and several subspecialty fellowship program directors, we expect that portfolio use will become more widespread in pediatric GME after the pilot phase of our curriculum.

As mentioned above, we see procedural skills training as a first step in the development of a Children's Hospital Simulation Training and Assessment Program, which will encompass much more than procedural skills training alone.

TIME LINE

Jan 2008 – June 2008:	Development of educational content, assessment tools (checklist, test), and web-based learning environment (unfunded as supported by the Chair of the Department of Pediatrics, for Sandrijn van Schaik this will be part of her Teaching Scholars Project)
July 2008 – June 2009:	Implementation of curriculum and continued development of educational modules.
June 2009:	First assessment of learners and of curriculum effectiveness as well as usefulness of assessment tools
July 2009 – onwards:	Expansion of program to include other learners

REFERENCES

1. Advanced Initiatives in Medical Simulation. Available at: http://www.medsim.org. Accessed October 17, 2007.

2. ACGME. ACGME Bulletin. Available at: http://www.acgme.org/acWebsite/bulletin/bulletin12_05.pdf. Accessed October 16, 2007.

3. Eppich WJ, Adler MD, McGaghie WC. Emergency and critical care pediatrics: use of medical simulation for training in acute pediatric emergencies. *Curr Opin Pediatr.* 2006;18(3):266-271.

4. Gaies MG, Landrigan CP, Hafler JP, Sandora TJ. Assessing procedural skills training in pediatric residency programs. *Pediatrics.* 2007;120(4):715-722.

5. Halamek LP, Kaegi DM, Gaba DM, et al. Time for a new paradigm in pediatric medical education: teaching neonatal resuscitation in a simulated delivery room environment. *Pediatrics.* 2000;106(4):E45.

6. Wayne DB, Siddall VJ, Butter J, et al. A longitudinal study of internal medicine residents' retention of advanced cardiac life support skills. *Acad Med.* 2006;81(10 Suppl):S9-S12.

7. Rosenthal ME, Adachi M, Ribaudo V, Mueck JT, Schneider RF, Mayo PH. Achieving housestaff competence in emergency airway management using scenario based simulation training: comparison of attending vs housestaff trainers. *Chest.* 2006;129(6):1453-1458.

8. Hickson GB, Cooper WO, Campbell PW, Altemeier WA, 3rd. Effects of pediatrician characteristics on management decisions in simulated cases involving apparent life-threatening events. *Arch Pediatr Adolesc Med.* 1998;152(4):383-387.

9. Roth CS, Watson KV, Harris IB. A communication assessment and skill-building exercise (CASE) for first-year residents. *Acad Med.* 2002;77(7):746-747.

10. ACGME. Common Program Requirements for Pediatrics. Available at: http://www.acgme.org/acWebsite/RRC_320/320_prIndex.asp. Accessed October 27, 2007.

11. Issenberg SB, McGaghie WC, Petrusa ER, Lee Gordon D, Scalese RJ. Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. *Med Teach.* 2005;27(1):10-28.

12. van Schaik S, Von Kohorn I, O'Sullivan P. Pediatric resident confidence in resuscitation skills relates to mock code experience. ; 2007.

13. Ericsson KA. Deliberate practice and the acquisition and maintenance of expert performance in medicine and related domains. *Acad Med.* 2004;79(10 Suppl):S70-81.

14. Clay AS, Petrusa E, Harker M, Andolsek K. Development of a web-based, specialty specific portfolio. *Med Teach.* 2007;29(4):311-316.

15. Davis DA, Mazmanian PE, Fordis M, Van Harrison R, Thorpe KE, Perrier L. Accuracy of physician self-assessment compared with observed measures of competence: a systematic review. *JAMA.* 2006;296(9):1094-1102.

16. MacDonald J, Williams RG, Rogers DA. Self-assessment in simulation-based surgical skills training. *Am J Surg.* 2003;185(4):319-322.

17. Field M, Burke JM, McAllister D, Lloyd DM. Peer-assisted learning: a novel approach to clinical skills learning for medical students. *Med Educ.* 2007;41(4):411-418.

18. Kern D. *Curriculum development for medical education. A six-step approach*. Baltimore and London: The Johns Hopkins University Press; 1998.

LETTERS OF SUPPORT

Sam Hawgood, MB BS, Chair, Department of Pediatrics

Scott Soifer, MD, Chief, Division of Pediatric Critical Care Medicine

David Rowitch, MD, PhD, Chief, Division of Neonatology

Kevin Souza, MS, Director, Office of Educational Technology