Physical Simulators for Training Clinical Palpation Skills

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Co-Investigators: Gregory J. Gerling, Ph.D., Assistant Professor, Department of Systems and Information Engineering & Reba Moyer Childress, MSN, FNP, APRN-BC, Assistant Professor, School of Nursing

Abstract
The goal of the proposed research is to design and build two physical simulators to teach palpation skills to medical and nursing students. These skills are important for clinical assessment and detection of prostate and thyroid cancers, among others. Our premise is that simulators, to be useful, must assess and train practitioners in particular disease cases by monitoring and providing feedback on trainee technique, facilitating the training experience via augmented feedback, and utilizing a range of graded practice scenarios that accurately reflect disease progression. Most importantly, the skills learned through simulation must transfer to actual clinical exams. The proposed work will expand upon past work with a breast cancer simulator. We will test each simulator design and training protocol with medical and nursing students at each stage of development. A set of one-day experiments and one longitudinal study will test each simulator's effectiveness by evaluating trainee competency, the consistency of training across trainee groups, and transfer of training. A tight collaboration between researchers in medicine, nursing, and engineering will ensure the successful integration of this work into the existing training programs at the University of Virginia.

Overview and Objectives

The long-term focus of this research is to ensure practitioners' clinical skills are systematic, time-effective, and highly accurate. The thorough training in military aviation might be comparable. The aim is to detect cancers and other diseases at the earliest possible stage. Toward that aim, we propose to design and build two physical simulators for training medical students to palpate for prostate and thyroid tumors. Our central premise is that simulators, to be useful, must monitor and provide feedback on trainees' technique, facilitate the training experience via augmented feedback, and utilize a range of graded practice scenarios that accurately reflect disease progression. Moreover, the skills learned via simulation must transfer to actual clinical exams. This training philosophy differs fundamentally from the ideas behind the design of practically all current low-tech simulators. Our proposed work expands upon our past work in training palpation skills for breast cancer screening. Our specific aims are to:

1. Determine the appropriate range of training scenarios of graded difficulty for each disease and develop the instrumentation needed to simulate this range of scenarios

2. Determine how to best monitor and evaluate exam technique and provide user feedback

3. Determine how to best facilitate the perception and discrimination of masses via augmented feedback

4. Evaluate overall performance competency, training consistency, and transfer of training

Simulator design will be based upon a comprehensive analysis of each exam, pertinent anatomy, and disease progression. Therefore, the focus of this work is first to determine the tasks and tactile discrimination skills needed for thorough training, and then to build the appropriate simulators. A set of one-day experiments and one longitudinal study will test each simulator's effectiveness. Outcome measures will be used to assess how well training improves trainee confidence, skill proficiency (high positive predictive value and low number of false positives), and transfer of skills. The simulators will be low-cost and designed to fit into the existing training programs at UVa. Our training philosophy will drive the design of each simulator. We feel that this training philosophy offers a new holistic approach to simulation training in general and could be applied to other clinical exams, possibly becoming a model for U.S. medical education. New intellectual contributions include: using augmented, device-delivered feedback that exaggerates *in vivo* findings for novice trainees, identifying patterns in exam technique via statistical analysis, and using computerized adaptive testing for skill assessment.

All three investigators have interest and experience in medical simulation. Dr. Martin is currently leading efforts to build a simulation center in UVa's new medical education research building. Ms. Childress is director of simulation for the School of Nursing and a member of a multi-site, National Simulation Research Team studying the integration of simulation into nursing education, sponsored by the National League for Nursing and Laerdal Medical Corp. Dr. Gerling developed and patented a physical simulator to train practitioners in breast cancer screening. His work was funded by the National Board of Medical Examiners.

Roadmap of proposal sections: background, research plan, project flow and major tasks, plans for publication and dissemination of results, roles of the investigators, and references.

Background

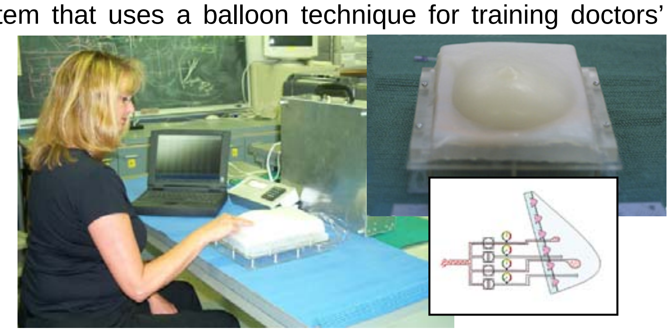
Breast, prostate, thyroid, and rectal cancers will kill an estimated 125,450 Americans in 2006, with approximately 585,960 new diagnoses [1]. Palpation exams are an important detection tool for each disease. They aid early diagnosis which is vital for long-term prognosis. In breast cancer, tumors as small as 0.5-1.0 cm can be detected through palpation exams. If tumors are discovered before reaching 2.0 cm in diameter, the five-year survival rate exceeds 98%. The clinical efficacy of breast palpation exams has been proven by the high frequency of diagnosis, stage at diagnosis, effective detection of interval cancers, and reduction in mortality rate [2, 3].

However practitioners often lack confidence in their palpation skills, and competency varies widely. For example, 43% percent of residents, faculty, and nurse practitioners are not confident of their skills in their performance of clinical breast exams [4-6] and most surveyed physicians acknowledge a need to increase their competence [6]. A 39-59% sensitivity range for clinical breast exams [7] appears to confirm the variance in skills between physicians. Lack of confidence and variance in competency are related, in part, to insufficient formal training in medical school and afterwards. This situation is unfortunate because this very effective tool may not be appropriately utilized when practitioners do not feel proficient [8]. The good news is that training can substantially improve performance and effective training tools can improve skill acquisition [9, 10].

Palpation skills are currently taught using patient volunteers (standardized patients), training videos, and artificial models. Standardized patients are central to medical training, but their availability is limited to available volunteers. These volunteers typically do not exhibit any disease conditions, and certainly not a range of potential conditions. Nevertheless, they serve a vital purpose because tactile skills proficiency does not necessarily correlate with cognitive knowledge [11] and can only be acquired through hands-on practice.

Beyond work with volunteer patients, training with artificial models made of rubber or silicone has been proven to improve exam sensitivity [9]. This “simulated” training can provide a 44-66% improvement in skills [10, 12] and allow trainees to detect tumors as small as 2-3 mm in diameter [13, 14]. Physical models expose practitioners to abnormal conditions, provide more consistent training, and increase accuracy and efficiency of performance. Students can be taught both technique (how to position and move their hands relative to the anatomy) and perceptual evaluation (to interpret what is felt). However, existing simulators present neither life-like tactile feel nor realistic anatomical structure, they give no performance feedback, and offer only one, generally simple, practice scenario. Additionally, tumors are often obviously present or absent, so trainees do not learn to discriminate subtle, graded differences in anatomy (tumor versus nodularity) or disease progression (e.g. prostatic hypertrophy). Simulation with virtual reality is also possible but still faces complex technological challenges. Almost all feasible virtual reality simulators provide force feedback through a handheld pen attached to a robotic arm. They are far from realistic and focus on multi-purpose technology, not on training specific tasks. Task analysis and the design of training protocols remain afterthoughts.

To address the aforementioned concerns with respect to teaching breast cancer screening, Dr. Gerling developed a physical breast model and electronics system that uses a balloon technique for training doctors' tactile skills [15, 16]. The location and stiffness of simulated tumors can be reconfigured, allowing repeated practice of new and progressively difficult scenarios. Also, enhanced feedback was introduced by oscillating the water pressure in the balloons that simulate tumors. The pulsating balloons do not realistically reflect *in vivo* conditions but they do effectively introduce small, deep tumors that are initially difficult to perceive. An experiment confirmed that training with the simulator increased the number of lumps detected by trainees, decreased the number of false positives, and improved trainees' transfer of skills to other simulators. The National Board of Medical Examiners and others have funded this work and aspects of the simulator have been patented (U.S. Patent 6,945,783).



Research plan with defined measurable outcomes

Our proposed plan is to build two new simulators to train palpation skills for prostate and thyroid tumors. The simulators will be designed according to the results of a task analysis that explores each exam as well as the pertinent anatomy and feasible progression of each disease. The usefulness of existing simulators will also be investigated. According to our design philosophy, each simulator must utilize a range of graded practice scenarios that reflect anatomy and disease progression accurately (Aim 1), monitor and provide feedback on trainee technique (Aim 2), and facilitate the perception of and discrimination between masses via augmented feedback (Aim 3). Through a series of one-day experiments and one longitudinal study with medical and nursing students, we will evaluate how well new training improves practitioner competency, consistency, and transfer of skills to other existing simulators (Aim 4).

<u>Specific Aim 1:</u> Determine the appropriate range of training scenarios of graded difficulty for each disease and develop the instrumentation needed to simulate this range of scenarios

Rationale. An ideal simulator would provide multiple, reconfigurable training scenarios that allow repeated practice, are graded from simple to very challenging, and accurately represent the anatomy and pathology of disease progression. In contrast, existing simulators generally present only *one* scenario, with tumors in random, non-reconfigurable locations, and in extreme states of disease progression. Because these simulated tumors are not reconfigurable, present simulators provide limited range of difficulty and little chance to deepen skills through repeated practice. Moreover because simulated tumors are often large, the cancer may have advanced and metastasized, all too obvious to any examiner. By practicing with multiple scenarios with our device on the other hand, trainees can compare healthy and diseased tissue at various stages and learn to "feel" the differences.

Methods. An engineering task analysis will evaluate the a) technique and tactile cues that inform practitioner perception for each exam, b) pertinent anatomy and various stages of disease, and c) any existing simulators. For each exam, we plan to define anatomically accurate scenarios and determine which tactile variables should be simulated, and how. Potential variables include: a tumor's 3D location, mobility, size, curvature, texture, stiffness; and the differential in stiffness between tumor and surrounding tissue. Feasible limits and number of discernable levels will be defined for each variable. For example, tumor size might best vary from 0.5 cm to 2.0 cm in four, 0.5-cm increments. Stiffness would be characterized by its material properties (measured in durometers), and matched to a discriminable range, each level being given a descriptive name. Dr. Martin will recruit faculty from the Department of Urology and elsewhere to help identify exam techniques, relevant anatomy and disease states, as well as perceptible dimensions. Physical assessment and pathology texts will be used [17]. We will make every effort to adapt the training to the existing curriculum to minimize disruption.

Expected Outcomes. Task analyses defining a problem are routinely published in engineering. Our task analysis will result in a conference paper and drive the design of the simulation device described in Aims 2-3.

<u>Specific Aim 2:</u> Determine how to best monitor and evaluate exam technique and provide user feedback

Rationale. Monitoring exam technique and providing both immediate and post-performance feedback can help improve trainee confidence and consistency. To be competent with his or her exam technique, a trainee must utilize specific hand pressure and motion, and search relevant anatomy. This is especially challenging for novice examiners. Engendering feelings of comfort with and confidence in their technique ensures an efficient and effective exam. Feedback can help verify that the trainee is not using too much pressure leading to discomfort for the patient, but nevertheless covers all anatomical "landmarks" and utilizes sufficient hand pressure for a specified duration.

Methods. Based on the task analysis from Aim 1, especially from the interviews with and observations of expert faculty examiners, we will instrument sensors and balloons to record trainee hand pressure, motion, location, search pattern, and time duration. A set number of sensors will be positioned at "landmark" locations necessary to be palpated. A strategic placement of sensors will ensure the precise collection and analysis of specific data and help us identify specific tendency patterns in examiner technique. Both immediate and post-performance feedback will be provided. Immediate feedback can be used to display human performance "in-the-loop" while post-performance feedback can provide a detailed summary after the exam.

Expected Outcomes. We expect to provide immediate feedback and summarize performance data for presentation after the exam. These measures should increase practitioner confidence and proficiency and will be pilot tested and tested more broadly in Aim 4. Statistical modeling and pattern-recognition techniques will be developed to quantify performance. The results will add to the few methods of analysis [18] in current literature.

<u>Specific Aim 3:</u> Determine how to best facilitate the perception and discrimination of masses via augmented feedback

Rationale. A practitioner may find relevant "landmarks" by employing palpation at sufficient duration and pressure, but may still misinterpret the dimensions of the tumor. Correct perception, not just technique is crucial. Augmented feedback – meaning feedback that generally exaggerates conditions found *in vivo* – is a useful tool for facilitating perception. In our breast cancer simulator we used pulsating tumors to make small tumors beneath a trainee's fingers more noticeable. Pulsation made tumors more easily localizable for the novice. In training with these enhanced cues, trainees' more readily identified tumor size, shape, and mobility. They could subsequently transfer their skills to similar, non-pulsating tumors in other breast models. Augmented feedback decreases the learning curve and enables trainees to move more rapidly through different, varied scenarios of increasing difficulty. In fact, feedback mechanisms that are customized to a trainee's needs – provided more frequently or overtly when a task is first introduced and then less so as the trainee becomes more competent – are more effective and support long-term retention [19].

Methods. We will determine a) which performance data from Aims 1 & 2 best augment learning and b) how to build a feedback delivery mechanism into the operation of the simulator (not via human instructor intervention). Feedback will be dynamically adjustable and designed to deliver training according to a trainee's skill level.

Expected Outcomes. We expect to increase accuracy in discriminating disease, improve spatial acuity, decrease the learning curve, as well as increase confidence and proficiency.

Specific Aim 4: Evaluate overall performance competency, training consistency, and transfer of training

Rationale. Performance competency in our opinion is a measure of practitioners' ability to adequately perceive, discriminate, and evaluate the simulated-disease conditions. Merely being able to follow the specified technique does not sufficiently reflect competency. Testing training consistency reveals whether *all* students have obtained the same skill capability in a systematic way. Additional testing is required to examine whether training with the simulator improves skill performance in actual clinical exams (or at least with other simulators for the same exam). These transfer of training tests ensure that simulators do not develop a specialized set of skills, not applicable to clinical exams.

Methods. We will run a set of one-day experiments and one longitudinal study to test each simulator's effectiveness by evaluating trainee competency, the consistency of training across trainee groups, and the extent of transfer of training to other simulators for the same exam. The format for the one-day experiments will be conducted as described in Task 3 below. All 3rd-year medical students will be initially trained with the physical model at some point (at month 3, 6, 9, or 12) in Dr. Martin's simulation course. Finally, we will consider the longitudinal effect of training on performance. The longitudinal study will determine effects of training after a 1 week, 3 month, 6 month, or 9 month interval between training and re-test. We expect to recruit 10-20 students from each of the four, previous one-day experiments. Each will perform a single, final palpation skills exam in month 12 in the Life Saving Techniques Workshop sponsored by Dr. Martin. Because training occurred at different points of the semester, students will have received their training either 1 week or 3, 6, or 9 months before the final test. Each of the four groups of 10-20 students will be divided according to the following: students will receive either a) regular retraining between the initial training and the final exam, b) retraining 1-3 days before the final exam, c) retraining just hours before the final exam, or d) no retraining.

Expected Outcomes. The outcome measures from the longitudinal study will focus on transfer of training to other simulators and competency (maximize positive predictive value and minimize false positives). Note: we would like to test transfer of training from the simulator to actual clinical practice but are limited by the availability of patient volunteers. For now we have to rely on the expertise of oncologists and on other simulators to examine transfer of training. In the future testing in a clinical environment may be possible.

Project Flow and Major Tasks

Five major tasks will be undertaken to achieve the specific aims.

Task Overview: 1) Task analysis for prostate and thyroid cancer exams involves acquiring information about relevant anatomy and pathology data and any existing simulators. Determine methods to deliver augmented feedback and record trainee technique*,* 2) Construction of prototype apparatus and definition of testing protocol*,* 3) Pilot tests with medical and nursing students to test the effectiveness of the prototype simulator, training protocol, feedback delivery, 4) Refinements to apparatus and testing protocol and addition of adaptive testing measures, and 5) Iterative prototype tests and a longitudinal study with 3rd-year medical students to evaluate effectiveness of the simulator and transfer of training. Approval will be obtained from the Institutional Review Board for Health Sciences Research before any tests with human subject are initiated or participants solicited.

Specific Details. In Task 1, a **task analysis** will be conducted on (1.a) prostate and thyroid cancer exams and the relevant anatomy and pathology and (1.b) existing static simulators that train for these exams. This analysis will **inform the initial design decisions** for feedback, evaluation of trainees' technique, and training protocols (1.c). Decisions will be made about the location of sensors, number of sensors, quantities (forces and displacements) the sensors will measure, methods for representing the anatomy and range of disease states, and mechanisms of feedback (1.c). For 1.a-1.c, we will define the initial parameters through physical assessment and pathology texts [17], and then deepen this knowledge about appropriate technique and disease states by observing practitioners and interviewing relevant faculty (1.d).

For Task 2, the **prototype physical models will be constructed and the training protocol defined.** Based on the analysis in Task 1 (determining feedback delivery, technique evaluation, and training scenarios), these design requirements will be incorporated in the physical simulators and electronics (2.a). The simulators will most likely be built using silicone, polyethylene bladders of pressurized water and electronic sensors. Each simulator will present the full range of tactile cues (variables) at the previously determined discernable levels within each cue's upper and lower perceptible limits (2.b). The level of performance required to pass each test will be assessed and feedback will be adjusted for each trainee (2.c).

In Task 3, **the physical models and training protocol will be evaluated in pilot tests.** The first pilot test with medical and nursing students will examine the effectiveness of concepts incorporated into the models and the associated training protocol, specifically number of disease states, graded scenarios and feedback (3.a). A more formal, second test will determine how well skills are transferred from one simulator to another (3.b). It will provide a measure for transfer of training and a guide to the necessary statistical power for the longitudinal study. Trainees will pre- and post-test on our simulators and another simulator with a short training period between tests. Trainees will be divided in three groups: receiving traditional training, verbal account of traditional (no hands-on) training, and palpation training. Participants will include first and second year medical students (~30-50), second year nursing students (~30-50) and nurse practitioner students (~30).

In Task 4, **the physical models and training protocol will be refined.** The pilot tests for Tasks 3.a and 3.b will likely lead to refinement of the models (4.a). Additionally, the training protocol, developed in Tasks 2 and 3, will also be optimized to utilize a staircase or computerized adaptive testing methodology (4.b). Note: Adaptive testing measures are based on computerized testing, such as the SAT or GRE academic entrance exams. These tests seek to rapidly assess skills to pinpoint a trainee's skill level with fewer tests. Because medical students' time is at a premium, the goal is to minimize time expenditure by rapid assessment of ability and targeted training to skills needing improvement.

In Task 5, a given the refinements, an **evaluation of training effectiveness** will be performed via a series of four one-day tests and a longitudinal study. The one-day tests (5.a) will follow the pre-test – training – post-test format from Task 3.b. The longitudinal study, as described in Aim 4, will be conducted during the last year (5.b). Training and testing will occur during Dr. Martin's simulation course or in the Objective Standardized Clinical Evaluations designed by Dr. Gene Corbett and Dr. Martin.

Plans for publication and dissemination of results

We plan contributions to two conference proceedings and publication of two journal articles. Potential simulation and medical education conferences include: Medicine Meets Virtual Reality, Annual Meeting of the Human Factors and Ergonomics Society (Healthcare Div.), and International Meeting on Simulation in Healthcare. Journal articles will be focused on simulation/training (Human Factors) and general medical education research (Medical Education, Academic Medicine) or clinical education (Cancer Detection and Prevention).

Timeline

Year	**2006**						**2007**												**2008**					
Task	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
1.a	■	■	■	■	■	■																		
1.b	■	■	■	■	■	■																		
1.c			■	■	■	■	■																	
1.d					■	■																		
2.a				■	■	■	■	■																
2.b							■	■	■	■														
2.c							■	■	■	■														
3 (.a and .b)								■			■													
4.a												■	■	■	■	■	■	■						
4.b												■	■	■	■	■	■	■						
5.a **														■			■			■			■	
5.b																			■	■	■	■	■	■

** adjustable based on School of Medicine timeline for 3rd year students

Roles of the Investigators

Dr. Gerling will oversee the day-to-day activities and supervision of the graduate student. This project will fulfill a masters' degree thesis requirement. Dr. Martin will provide access to his simulation lab, Life Saving Techniques Workshop, and the 3rd-year students in this workshop. He will also help coordinate physicians with expertise in particular exams. Ms. Childress will help solicit nursing and nursing practitioner students as well as provide access to existing simulators in the Laboratory for Clinical Learning in the School of Nursing.

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Budget: total request: $50,000 ($25,000 for each of two years)

Year 1 ($25,750)
1. Stipend for systems engineering graduate student to perform task analysis, build physical models, setup and proctor experiments, and perform data analysis: $23,000
2. Silicone, plastic, and aluminum raw materials and electronic parts for constructing physical models and associated control mechanisms: $2,250
3. Cost to purchase other, existing prostate and thyroid simulators: $500

Year 2 ($24,250)
4. Stipend for systems engineering graduate student: $23,000
5. Reimbursement for human subjects (medical and nursing students) participants: $750 **for (a) pilot testing in the first year, 20 participants by $10/hr and (b) 55 interim training periods in the second year by $10/hr**
6. Travel, hotel, and fees for systems engineering graduate student to conference presentation: $500

BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
Martin, Marcus MD	**Chairman, Department of Emergency Medicine** University of Virginia

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.*)

INSTITUTION AND LOCATION	DEGREE (*if applicable*)	YEAR(s)	FIELD OF STUDY
North Carolina State University, Raleigh, NC	BS	1970	Pulp & Paper Technology
North Carolina State University, Raleigh, NC	BS	1971	Chemical Engineering
Eastern Virginia Medical School, Norfolk, VA	MD	1976	Medicine

RESEARCH AND PROFESSIONAL EXPERIENCE:

PROFESSIONAL POSITIONS:

1976-1977	Commissioned Officer U.S.P.H.S., Staten Island, NY
1979- 1981	Emergency Medicine Resident, University of Cincinnati, Cincinnati General Hospital, Good Samaritan Hospital and Cincinnati, Children's Hospital, Cincinnati, Ohio
1977 -1978	General Medical Commissioned Officer, Indian Health Service, Gallup, New Mexico
1981-1982	Emergency Medicine Staff Physician, Allegheny General Hospital, Pittsburgh, PA
1982-1984	Associate Director Clinical Operations, Allegheny General Hospital, Pittsburgh, PA
1984-1995	Residency Director Emergency Medicine, Associate Director Division of Emergency Medicine, Allegheny General Hospital, Pittsburgh, PA
1989-1996	Associate Professor, Department of Emergency Medicine, MCP - Allegheny Campus, Pittsburgh, PA
1990-1995	Co-Director Combined EM/IM Residency Program, Allegheny General Hospital, MCP - Allegheny Campus, Pittsburgh, Pennsylvania
1992-1995	Vice Chairman, Department of Emergency Medicine, MCP - Allegheny Campus
1992-2002	Oral Board Examiner - ABEM
1995-1996	Acting Chairman, Department of Emergency Medicine, Medical College of Pennsylvania and Hahnemann, University, Allegheny Campus
1996-pres	Chairman, University of Virginia, Health Sciences Center, Department of Emergency Medicine, Charlottesville, VA

<u>RESEARCH</u>

An Evaluation of The Efficacy and Safety of Intravenous Nicardipine in Comparison to Placebo in The Treatment of severe Hypertension With or Without End Organ Damage - A Double-blind, Randomized Multicenter Study. Investigators at Allegheny General Hospital: Townsend R, Martin M. Dupont Chemicals: Sponsor.

An Open - Label Multiclinic Study to Evaluate the Tolerability and Antihypertensive Efficacy of MK-422 I.V. in Patients with Hypertensive Emergencies and to Evaluate the Conversion from Therapy with MK-422 I.V. to Oral MK-421. Investigators at Allegheny General Hospital: Dipette D, Ferraro J, Evans R, Martin M. Merck Sharp and Dohme Research Labs Sponsor.

A Parallel, Randomized, Double-Blind Study to Evaluate Time to Achieve Discharge Alertness and the Safety of a Combination of Fentanyl, Midazolam and Flumazenil VS. Fentanyl, Midazolam and Placebo in patients undergoing painful emergency department procedures. Investigators at Allegheny General Hospital. Harchelroad F., Martin M., Hanlon D., Hamilton R., Lucid E. J. Sponsor Hoffman-LaRoche, Inc.

The Proaction Study: Prospective Randomized outcomes study of acute CHF treated in observation units with Natrecor. Scios Inc. Principal investigator, UVa, August 2000.

A Comparison of the Efficacy and Safety of Tramadol HCl/Acetaminophen versus Hydrocodone Bitartrate/Acetaminophen versus Placebo in Subjects with Acute Musculoskeletal Pain. Ortho-McNeil Pharmaceutical Inc. CAPSS-216. Principle Investigator: M. Martin, University of Virginia

Use of Human Patient Simulation to Teach Medical Students Life Saving Techniques. Senior Investigator: M Martin.

Selected Publications

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Brady WJ, Perron AD, Martin M, Beagle C, Aufderheide T. (2000). Etiology of EKG St Segment Elevation in ED Chest Pain Patients. *American Journal of Emergency Medicine*.

Martin M. The Value of Diversity in Academic Emergency Medicine. *Academic Emergency Medicine*. September 2000.

Martin M (ED). The Family Emergency Handbook. Playmore Inc. (Playmore/Waldman) NY, NY 2003

Scott C, Martin M, Hamilton G. Training of Medical Professionals and the Delivery of Health Care as Related to Cultural Identity Groups. Academic Emergency Medicine. vol 10, No. 11 Nov 2003.

Martin M. Belvis T, O'Connor V, *SAEM Survey of AAMC CAS*. Aug, 2004, vol.11, no. 8.

Martin M, Leonard M, Allen S, Botchwey N, Carney M. *Annals of EM,* National Highway Traffic Safety Administration Notes, October, 2004, p. 413

Martin M, Blevins T, O'Connor V, Pines J, Srivasan R. *Society for Academic Emergency Medicine Survey of the AAMC Council of Academic Societies.* Academic Emergency Medicine August 2004, vol 11, no.8.

Martin M, Commentary on Dr. Death: Reflections on Death-Telling. "Life Goes On: Communications after death in the ED." Accepted for publication. Academic Emergency Medicine.

National Positions.

President: Society for Academic Emergency Medicine	2001-2002
President: Council of Emergency Medicine Residency Directors	1997-1999

Biographical Sketch for **Gregory J. Gerling, Ph.D.**

Assistant Professor in the Department of Systems and Information Engineering at the University of Virginia

EDUCATION

Institution and Location	Degree	Year	Field(s) of Study
University of Iowa	PhD	2005	Industrial Engineering
University of Iowa	M.S.	2001	Industrial Engineering
University of Iowa	B.S.	1998	Computer Science

A. Positions and Honors.

PROFESSIONAL EXPERIENCE

1997	Software Engineer Intern	Rockwell-Collins International
1998	Software/Robotics Engineer Intern	NASA Ames, Moffett Field, CA
1999-2000	Software Engineer (Full-time)	Motorola, Arlington Heights, IL
2000-2005	Research Assistant	University of Iowa (GROK Lab)
2001-2002	Teaching Assistant	University of Iowa
2002	Adjunct Faculty	Kirkwood Community College
2005-present	Assistant Professor	University of Virginia

HONORS AND AWARDS

1998	George S. Schaeffer Scholarship, University of Iowa
2000	Midtown Educational Foundation Volunteer of the Year, Chicago, IL
2000	Foreign Language Graduate Fellowship (FLAS), Universidad de Guanajuato, Mexico
2002	2nd place in Physical, Math, and Engineering Sci., Graduate Student Forum, U of Iowa
2002	President’s Award for Technology Innovation, University of Iowa
2003	5th Annual Student Interdisciplinary Health Research Poster Session Award (U of Iowa)
2003	Best Paper in Engineering Division at Iowa Academy of Science Annual Meeting
2004	Dean's Graduate Fellowship, University of Iowa College of Engineering
2005	Patent 6,945,783 with US Patent Office – Interactive breast examination training model

B. Selected peer-reviewed publications.

Refereed Journals and Transactions

1) Gerling GJ, Thomas GW, Augmented, Pulsating Tactile Feedback Facilitates Simulator Training of Clinical Breast Examinations, Human Factors: The Journal of the Human Factors and Ergonomics Society, 47 (3): 670-681 2005

2) Gerling GJ, Weissman AM, Thomas GW, Dove EL, Effectiveness of a dynamic breast examination training model to improve clinical breast examination (CBE) skills, Cancer Detection and Prevention, 27 (6): 451-456 2003

Conference Papers and Presentations

3) Gerling GJ, The Sampling Position Within, Not the Undulating Geometry of, Fingertip Skin Microstructure May Amplify the Sensation of Edges (Haptics Symposium - part of IEEE Virtual Reality and Computer Societies, 2006)

4) Gerling GJ, Thomas GW, Two Dimensional Finite Element Modeling to Identify Physiological Bases for Tactile Gap Discrimination (accepted for talk – Human Factors and Ergonomics Society Annual Meeting - September 26-30, 2005, Orlando, FL)

5) Gerling GJ, Thomas GW, The Effect of Fingertip Microstructures on Tactile Edge Perception (IEEE Virtual Reality Conference - World Haptics Symposium – March 18-20, 2005, Pisa, Italy)

6) Dunn Lopez, K., Kanak, M., Gerling, G. The Application of a Cognitive Engineering Work Analysis to the Issue of Patient Safety. Midwest Nursing Research Society, Competitive Research Symposium: Nursing Informatics Research. Annual Meeting 2005.

7) Gerling, G. J., & Thomas, G. W. (2003, October 5-8, 2003). Effect of augmented visual performance feedback on the effectiveness of clinical breast examination training with a dynamically configurable breast model. Paper presented at the IEEE Systems, Man and Cybernetics Conference, Washington, D.C.

8) Gerling, G. J., Thomas, G. W., Weissman, A. M., & Dove, E. L. (2002, September 30-October 4). Dynamic Simulator for Training Clinical Breast Examination. Paper presented at the Proceedings of the Human Factors and Ergonomics Society 46th Annual Meeting, Baltimore, MD.

Theses
9) Gerling G. Dynamic simulator for clinical breast examination training [M.S. thesis]. Iowa City, IA: University of Iowa; 2001
10) Gerling G. J. Fingertip microstructures aid tactile edge sensation [Ph.D. dissertation]. Iowa City, IA: University of Iowa; 2005

C. Research Support.

On-Going Research:
Title: Professors as Writers (PAW) Writing Grant
Dates: 10/05-5/06
Sponsor: University of Virginia, Teaching Resource Center
PI: Gregory J. Gerling
Goals: Develop grant and journal article writing skills with a writing coach/editor

Completed Research:
Title: Evaluating the Breast Exam Simulator as a Tool for Clinical Breast Exam Skill Assessment
Dates: 08/03-06/05
Sponsor: NBME Stemmler Medical Education Research Fund 2003
PI: Geb W. Thomas
Goals: Develop the breast model and assess its ability to train breast exam practitioners working with the Ontario Breast Screening Program
Role: Graduate Student

Title: Undergraduate Research Assistant for The Dynamic Breast Examination Simulator for Training CBE
Dates: 10/03-09/04
Sponsor: Iowa Research Experiences for Undergraduates (IREU)
PI: Geb W. Thomas
Goals: refine the existing prototype simulator (via silicone material measurements) and testing the effectiveness of the refinements with a group of clinical breast examination specialists in the Ontario Breast Examination Program (via experimental proctoring and data collection)
Role: Co-PI, undergraduate supervisor

Title: Interactive Breast Examination Training Model
Dates: 2002
Sponsor: Holden Comprehensive Cancer Center's American Cancer Society Institutional Research Grant
PI: Geb W. Thomas
Goals: computerize the prototype breast examination training model by developing a pressure regulation/sensing system that will allow the prototype to be controlled by computer.
Role: Graduate Student

Biographical Sketch for **Reba Moyer Childress, MSN, FNP, APRN-BC**

Assistant Professor of Nursing, University of Virginia

LICENSURES/CERTIFICATIONS
Virginia RN License – #0001 074720; Expiration – October 2007
Family Nurse Practitioner License – #0001 074720; Expiration – October 2007
Family Nurse Practitioner Certification – November 1994, Renewal due November 2010

EDUCATION

Institution and Location	Degree	Year
University of Virginia, Charlottesville VA	PhD Program, Special Student	Present
University of Virginia, Charlottesville VA	Certificate, Family Nurse Practitioner	1992
University of Virginia, Charlottesville VA	M.S. in Nursing, Critical Care	1991
University of Virginia, Charlottesville VA	B.S. in Nursing	1979

PROFESSIONAL EXPERIENCE (selected)

1980 – 1982	Staff Nurse	Medical Intensive Care Unit; University of Virginia (UVa)
1983 - 1985	Head Nurse A	Renal Unit, University of Virginia
1990 – 1995	Clinician III	Renal Unit, University of Virginia
1994 – 1995	Clinician III	Surgical Intensive Care Unit, University of Virginia
1996 – 1999	Clinician II	Surgical Intensive Care Unit, UVa Health System
1992 – 1999	Instructor	University of Virginia School of Nursing
1999 – Present	Assistant Professor	University of Virginia School of Nursing
1993 – Present	Director	Laboratories for Clinical Learning, UVa School of Nursing
1998 – Present	FNP/Study Coordinator	UVa Internal Medicine-Nephrology Division
2003 – Present	Project Coordinator	National League for Nursing/Laerdal Medical Corp.

MEMBERSHIPS IN PROFESSIONAL/SERVICE ORGANIZATIONS
American Nurses Association, Virginia Nurses Association, American Academy of Nurse Practitioners, Sigma Theta Tau International Nursing Honor Society, International Nursing Association for Clinical Simulation and Learning, Inc. (Charter Board Member)

HONORS/RECOGNITIONS

1994 – 2005	Elected Graduation Marshal (except for 2000, but nominated)
1997	Inducted into Omicron Delta Kappa National Leadership Honor Society, UVa
1998	Inducted into Sigma Theta Tau International Nursing Honor Society, Beta Kappa Chapter
1998	AIDS Education Award, First at the University of Virginia; Presented by Charlottesville's AIDS/HIV Services Group and student HIV/AIDS prevention service organization
2000	Omicron Delta Kappa National Leadership Honor Society's *Arthur F. Stocker Faculty Award* – in recognition of outstanding leadership by a faculty member to ODK
2000, 2005	University of Virginia Alumni Association's Innovative Teaching Award
2001	*Excellence in Teaching Award* sponsored by University of Virginia School of Nursing Alumni Assoc.
2002	Nominated by formal student to *Who's Who Among Teachers*
2002	Inducted into University of Virginia's Raven Honor Society
2004	University of Virginia Medical Student Recognition
2004	Invited Contributor, National Student Nurses Assoc. Mentorship Film, (Film Released Spring 2005).
2004	My Pilot IRB document was used as the template for the National Simulation Study.
2005	Beta Kappa Chapter Sigma Theta Tau Research Dissemination Award

RESEARCH PROJECTS/SCHOLARLY WORKS
Research Projects (selected):
Title: Integration of Simulation into Nursing Education
Dates: June 2003 – June 2006
Sponsor: National League for Nursing and Laerdal Medical Corporation
Project Director: Pamela Jefferies, Indiana University
Goals: Investigate the integration of simulation into nursing education; design simulation education model, develop pilot project and national simulation project to implement and evaluate the simulation model
Role: Project Coordinator for University of Virginia School of Nursing (1 of 8 sites selected; 156 applicants)

Title: The Effect of Positioning, Timing, and Healthcare Examiner on Manual Blood Pressure Measurements in an Ambulatory Cardiology Clinic Setting
Dates: 2005 – 2006
Sponsor: University of Virginia Health System
Goal: To identify the effect of variables on blood pressure in an ambulatory cardiology setting
Role: Standardized healthcare providers obtaining blood pressure readings

Other Scholarly Works (selected):

1. Contributor: “Ask the experts” featured piece for International Nursing Association for Clinical Simulation & Learning’s On-Line Journal. (Published January 2006.)
2. Interviewed for & contributed to “Practice makes perfect: Simulation training is a win-win for nurses and their patients” by Goulette, Candy. Article published by Advance for Nurses 2/06
3. Abstract Submitted: "Promoting Knowledge and Collaboration through the Use of Simulation in Nursing Education Research". Fourth Sigma Theta Tau International Evidence-Based Nursing Pre-Conference and 17th International Nursing Research Congress (July 19-22, 2006). (Accepted March 2006.)
4. Abstract Published: "An Exploration of Simulation in Nursing Education: A Collaborative Approach Utilizing a Mock Code". A National League for Nursing & Laerdal Corporation Grant, Virginia Nurses Association Publication (December 2005).
5. Interviewed and featured in a local NBC (Channel 29) media piece related to the use of simulation technology in education. Charlottesville, VA. (November 11, 2005)

CONSULTATIONS:

1. Co-Organizer and Host for first State-Wide Nursing SMUG Meeting. Sponsored by Laerdal, Corp. March 9 & 10, 2006. U. of Virginia School of Nursing. Other Co-Organizers: Russell Smith, Laerdal Regional Manager for Virginia and Kristy Chambers, MSN, RN, Laerdal Simulation Educator. (> 80 in attendance)
2. Simulation Lab. Consultant for Virginia Commonwealth U., Richmond, VA. May 2005 – Present. (For Fee)
3. Simulation Grant Consultant (For Fee) to get simulation integrated into organization and curricula: Southside Virginia Community College, Keysville, VA. September 2005 – Present. (Grant Awarded)
4. Other Simulation Labs & Simulation Education Consultations: Germana Community College, Eastern Mennonite University, Lynchburg Community College, Norfolk State University, Piedmont Virginia Community College, University of Virginia Health System and Other Internal Schools/Departments

PRESENTATIONS/POSTERS (selected):

1. Panelists: “Reality Show: Successful Simulation Labs”; NAP/AACN 2006 Conference – Nursing Advancement Professionals: Building Blocks for Success; Washington, DC (March 11, 2006)
2. “What’s Going on Nationally?: The NLN/Laerdal Research Project”; 1st, State-Wide Virginia Nursing Simulation Users’ Group Conference; Charlottesville, VA (March 9, 2006)
3. Poster Presentation: "An Exploration of Simulation in Nursing Education: A Collaborative Approach Utilizing a Mock Code". A National League for Nursing & Laerdal Corporation Grant. Virginia Nursing Association Convention (over 100 participants); Falls Church, Virginia. (October 14, & 15, 2005)
4. “NLN/Laerdal National Simulation Study Presentations”; 2005 NLN Education Summit: Navigating toward New Horizons (2 presentations provided during conference; Baltimore, MD (September 2 – October 1, 2005)
5. NLN/Laerdal National Simulation Study Presentations”; The 6th National Conference on Nursing Skills Laboratories; (2 presentations provided during this conference); San Antonio, TX (June 23 – 25, 2005)
6. Intravenous Cannulation Workshop; University of Virginia School of Nursing; Charlottesville, VA; Medical Students of the National Medical Student Association (November 2004)
7. Panel & Poster Presentation; Integration of Simulation into Nursing Education (An NLN/Laerdal National, Multi-Site Study); 2004 NLN Summit; Orlando, FL (October 1, 2004)
8. An Exploration of Simulation in Nursing Education: A Collaborative Approach Utilizing a Mock Code (A National League for Nursing/Laerdal Grant); Panel & Poster Presentation; 10th Biennial Learning Resource Center Conference; Spokane, WA (June 24 & 25, 2004)
9. Arterial Blood Gases & Central Lines Seminar Workshop Labs; Co-Lab Teacher with Audrey Snyder at the 19th; American Acad. of Nurse Practitioners’ Conf. (1 ½ Day Seminar); New Orleans (June 11 & 12, 2004)
10. Intravenous Cannulation Workshop; University of Virginia School of Nursing; Charlottesville, VA; Medical Students of the National Medical Student Association (May 17, 2004)
11. “Clinical Skill Acquisition in the Midst of Culturally Competent Healthcare Promotion: A Rural African-American, Faith-Based Perspective”, 5th National Conference on Nursing Skills Laboratories, San Antonio, TX (June 27, 2003)

SCHOOL OF MEDICINE
Office for Student Affairs

April 11, 2006

The Academy of Distinguished Educators
University of Virginia
School of Medicine
Undergraduate Medical Education Research
Grant Application Review Board
PO Box 800793
Charlottesville, VA 22908

Dear Grant Application Review Board,

I am writing this letter in support of the grant application entitled "Physical Simulators for Training Clinical Palpation Skills." The investigators for this grant application are as follow:

> **Marcus L. Martin, MD:** Professor and Chair, Department of Emergency Medicine, University of Virginia
> **Gregory J. Gerling, PhD:** Assistant Professor of Engineering, Department of Systems and Information Engineering, University of Virginia
> **Reba Childress, RN:** Assistant Professor, School of Nursing, University of Virginia

Of note, Dr. Gerling is a recent addition to the University of Virginia Department of Systems and Information Engineering faculty and has previously developed a breast cancer simulation part-task trainer.

The three investigators are now collaborating on the development of innovative physical simulators for training clinicians in palpation skills. Specifically, the goal of this proposal is to acquire financial support for the design, construction, and development of part-task simulators to train medical students in the early diagnosis of thyroid and prostate cancers. The investigators' premise is that, to be useful, simulators must assess and train practitioners in particular disease cases by monitoring examination techniques, providing performance feedback, and utilizing a range of graded, practice scenarios that are analogous to actual disease progression.

The investigators plan to test the simulators' designs and training protocols with medical and nursing students during each step of the development. Specifically, the simulators' effectiveness with respect to trainee competency, trainee consistency and transfer of training will be assessed through longitudinal studies.

The existing breast model simulator utilizes both electronics that inflate balloons of various sizes beneath synthetic breast tissue simulating differing degrees of tumor size and reconfigurable tumor location and stiffness which allow repeated practice of new and progressively difficulty scenarios. Similar technology will be utilized to develop prostate and thyroid models. Eventually, the investigators will consider extremity models to teach students how to palpate clots and masses such as lipomas. Additionally, the investigators are considering developing part-task simulators for training clinicians in the detection of uterine and ovarian masses.

This collaboration of medicine, nursing, and engineering to develop these part-task simulators is exciting. I believe this research will produce substantive benefits for medical education and deserves the support of the undergraduate medical education research grant. I'm excited about this research and support the application whole-heartedly.

Sincerely,

Richard Pearson, MD
Senior Associate Dean
School of Medicine
University of Virginia