

SIMULATION IN MEDICAL EDUCATION

SCHOLARLY REPORT

On ML Web Assignment December 2009

By

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Foreword

Looking back, it feels as if it was just yesterday when we had come together at PSG FRI, Coimbatore for a two year fellowship in April 2008. What ensued has been a journey of discovery and enrichment through collective learning and mentoring. The Curriculum Innovation Project, the onsite training and interactions, facilitation, the ML Web experience, the ability to sustain change, the confidence from the strength that there is always someone to help – I can just go on. To just sum it up all, PSG FRI has been a wonderful and most memorable experience. It has definitely strengthened our skills not only in teaching but also in personal sphere. It has helped us develop into better individuals. I am sure we would all continue to do the good work that we have started and much more.

The two year long journey of Fellowship is about to end. We have treaded the path and learnt new things, made new friends and have been networked with many from around the world. The report that you are about to read is a cherished possession for me as this would be one of the first such things that I have attempted and reiterates the belief that we can learn new things anytime, provided we have the zeal and aptitude. Learning through the life's journey is the best way to enjoy it.

At this juncture when we are about to end our this lap of journey as Fellows of 2008 batch at PSG FRI, Coimbatore, I would like to thank a few people who have inspired and helped me and made this possible for me: **Dr C V Raghuv eer**, former Dean, KMC, Mangalore, for his whole hearted support, guidance and constant encouragement; **Late Dr B S Sajjan**, former Professor and Head of Community Medicine at KMC, Mangalore for his support; **Dr Thomas V Chacko** for his zeal, quest for perfection and exemplary behavior; **Dr Avinash Supe** for inspiring through his action and work; **Dr Tejinder Singh** for his oratory skills and knowledge; **Dr Rita Sood** for her enviable position and accomplishments; **Ralf** for her friendly and caring ways and down to earth nature; **Janet** for making me understand the importance and method of Distance Learning; **Bill** for the time and patience and occasional inputs in listserv; **Ray** for his inputs and especially the Alligator River game; **Dr Saira Banu** for her knowledge, wisdom, encouragement and enthusiasm; **Dr Supten Sarbadhikari** for his prompt guidance and support throughout; **Dr Nalin Mehta** for his witty and humorous remarks and pearls of wisdom (which we have been missing lately); **Dr Rashmi Vyas** for her help; **Reem** for her inspiration by means of silent work and publication; all my fellow 2008 PSG FRI batchmates and **Shital, Amol, Sundar, Das, Muhammad, Nirmala, Chitra**, and **Ashwini** in particular; the Dean **Dr Rajagopal**, Associate Deans **Dr M V Prabhu** and **Dr Mrs U Khadilkar**, the **medical education Unit team**, the **management and administrative staff** at my institution; the Head of Department **Dr Nagaraj** and **all my colleagues** in the department; all my **teachers** who have shaped my career; my **parents** for their support and words of advice; my family – wife **Rashmi** and daughter **Ira** for their constant unflinching support, patience and tolerating my absurd ways and eccentric moods at times; **my friends** who have been there during the good times and the bad. If I have missed out anyone, it is purely coincidental and unintentional – my apologies.

Thank you everyone. Enjoy reading!!

Animesh Jain

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Introduction

The Oxford Dictionary defines Simulation as *“The technique of imitating the behaviour of some situation or process (whether economic, military, mechanical, etc.) by means of a suitably analogous situation or apparatus, especially for the purpose of study or personnel training.”*

The use of simulation in Medicine perhaps dates back to 9th Century where a midwife used wax and wooden figures to illustrate reproductive processes. Madame du Coudray, a midwife in the court of King Louis XV, continued the use of childbirth simulators for training midwives of France. She was known in the 1700s for creating “the Machine,” an anatomically correct, life-size mannequin birthing pelvis, made of wicker, flesh-colored fabric, and leather and padded with sponges, and mannequin babies, made of cloth .Her mannequins were highly regarded for their lifelike appearance and she traveled with them throughout the French countryside, teaching village midwives how to deliver babies and perform maneuvers for managing childbirth-related complications.

There have been reports of Simulation in some form or the other being used in various places at different times. However, the use of mannequins (or mannekins) is relatively recent. The first mannekin for commercial use is reported to have been marketed in 1911.

Timeline for History of Simulation in Medical Education

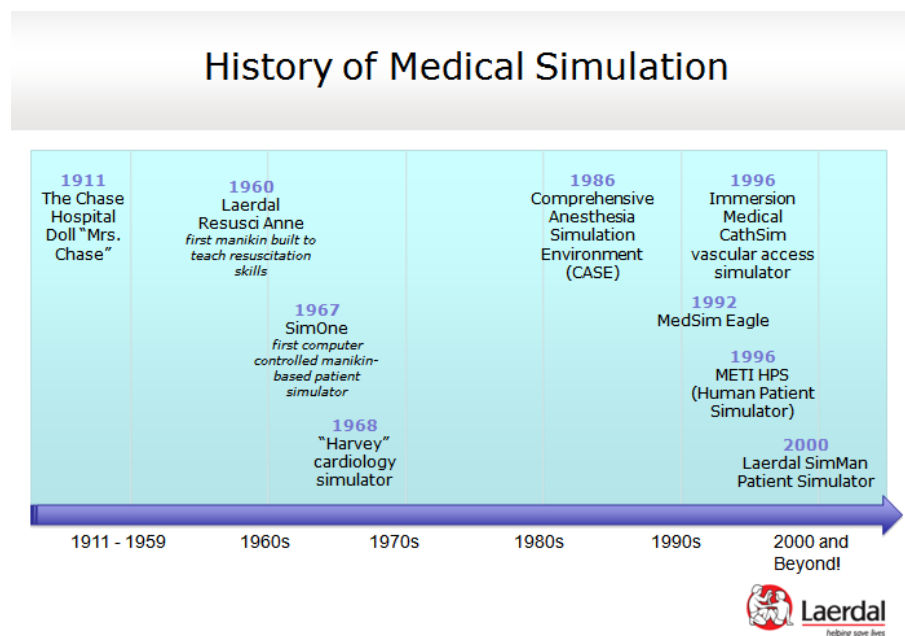


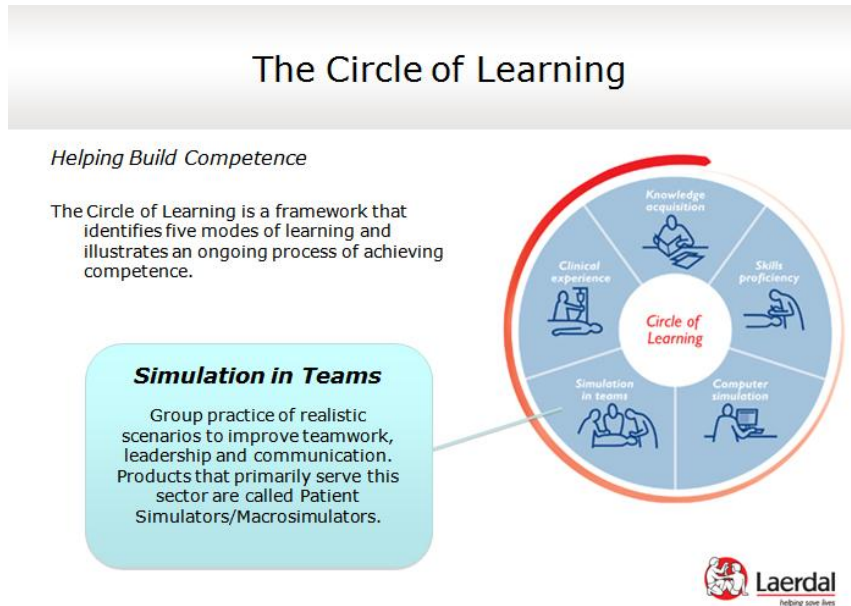
Fig 1. History of medical simulation

Anaesthesia was the first speciality during the recent times, in the mid 80s to have created a simulated training environment for anesthesia administration (ACRM – Anesthesia Crisis Resource Management). The Anaesthesia educators did this after studying the Aviation and Military training simulators. The introduction of affordable, portable, and versatile human patient simulators in the late 1990s & early 2000s transformed health care education and is the technology of the future for competency testing and continuing education. Today, Simulation is widely used in medical education. The simulation methodologies used at the present time range from low technology to high technology.

There are a variety of reasons to use simulation in medical training. The first and foremost being that the medical graduates are going to be dealing with lives of people. So they cannot experiment on the human subjects without some practice of certain procedures which require some skills. Besides certain cases are rare or sometimes some places there is a lack of number of patients for a particular condition, in such scenario, Simulation is very helpful.

Simulation is increasingly becoming popular as an adjunct or complement to learning and even medical colleges in developing countries including India are beginning to accept the need and implementing it in the curriculum.

Fig 2. The circle of learning



It has been said that learning is always better if it can be practical. Simulation gives the pupils a chance to practice the skills and also apply the knowledge that they have acquired. There is a Chinese proverb which aptly states “If I hear, I forget; if I see, I remember; if I do, I know.” The

simulatory sessions, if designed and carried out in a proper and planned way, help the students learn better. This is because they come under Active learning process as illustrated in figures below.

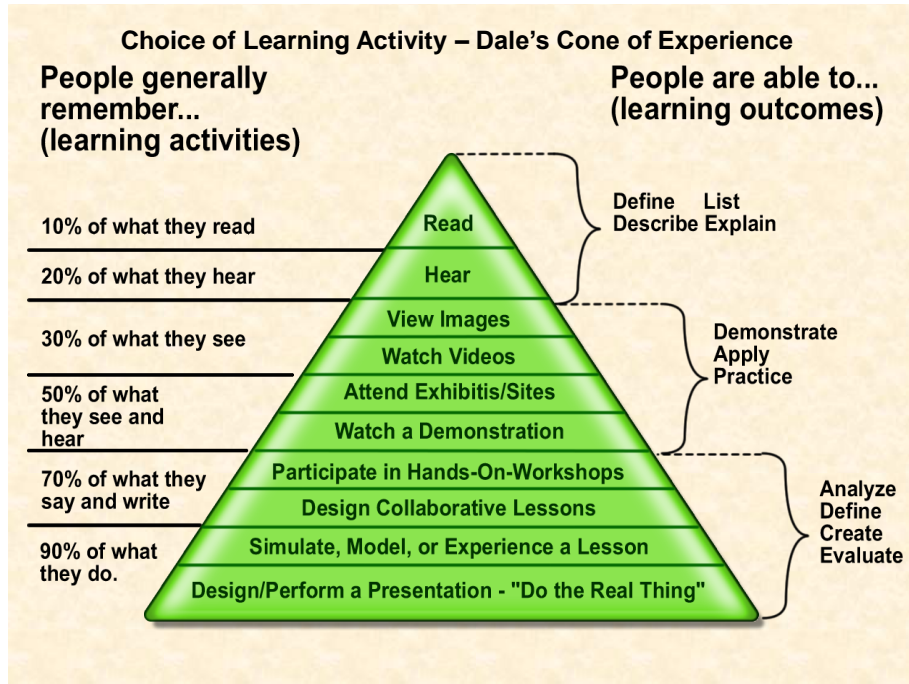


Fig 3a and 3 b. Why Simulation is better than just lectures or Passive learning?

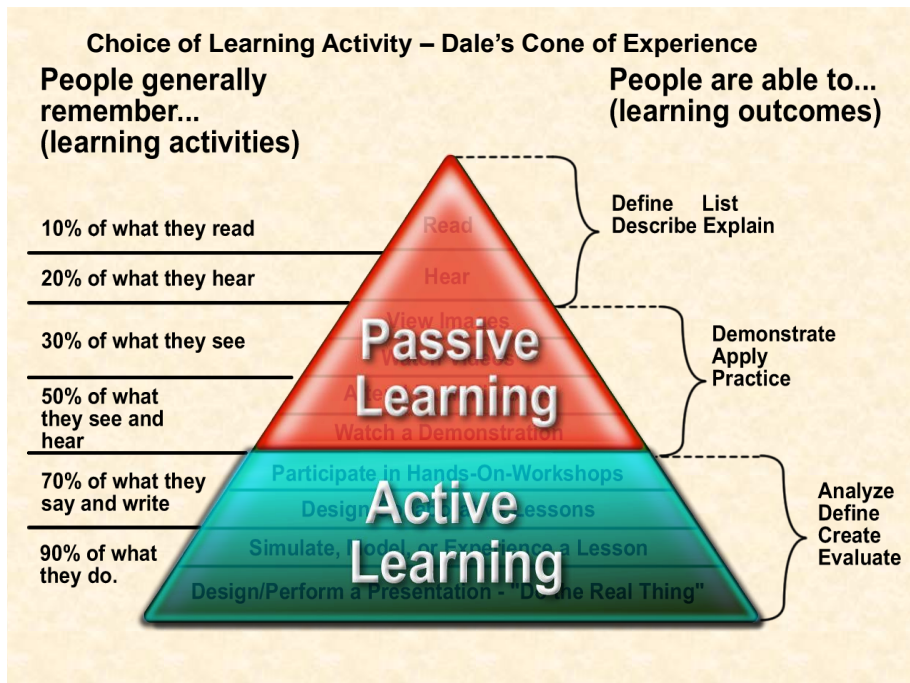


Table1. Need for Simulation in health care

Need for Simulation in healthcare
Simulation is needed for
1.Patient safety
2.Education
3.Training and retraining
4.Assessing performance
5.Facilitating recruitment
6.Improving quality
7.Research and evaluation
8.Organizational/ Team training

(Courtesy NCHPE 2009, Pune)

Types of Simulation

Simulation can be divided into Human and non human simulation

Non human Simulation includes:

1. Screen based computer simulation e.g., water edge
2. Case based/problem based simulation
3. Complex task trainers which can be low fidelity and high fidelity
4. Virtual reality laparoscopy

Human Simulation includes:

1. Role plays
2. Standardised patients

Uses of Simulation

Simulation can be used for both teaching as well as for assessment.

Advantages and Disadvantages of Simulation

Advantages

Immersive, experiential learning
Reflective learning
Multifaceted learning
 Knowledge, skills & attitude
On-demand learning
 Uncommon scenarios presented
 Same skill / scenario can be practiced repeatedly
 Same scenario to many trainees
Safe, risk-free learning environment: Helps to practice skills in a controlled environment.
Errors are allowed. Also helps in reducing human error
Allows multidisciplinary team training
 Non-technical skills
Ability to evaluate new equipment, procedures.
May allow for assessment with standardized clinical scenarios.
Standards against which to evaluate student performance and diagnose educational needs are enhanced.
Exposes learners to high risk/low volume events
Builds the learners competence and confidence

Disadvantages

- Human systems more complex than aeroplanes. Lots of information is gained from humans not instruments.
- Models aren't as diverse as humans
- Fidelity. It will never be really real!
- Expense. The greatest potential barrier to embracing new simulation technology is cost and infrastructure to conduct simulations.

Limitations:

- As the environment is artificial, a potential limitation is human behaviour during the simulation. Learners know that they are practising on a simulator and this can lead to behavioural changes that would otherwise not occur in the clinical setting.
- Some learners become hypervigilant; that is, they anticipate an adverse response and are overly cautious with their actions. Others demonstrate cavalier behaviour where they become overly casual with their interactions as there is no human life in the balance or 'real' consequences (Flanagan, Nestel and Joseph 2004).
- Implementing a simulation model into existing curricula is a labour-intensive process that requires considerable investment in academic time (Haskvitz and Koop 2004, Feingold et al 2004).

Examples of Simulation

There are a variety of ways by which Simulation can be used. Mock drills, Case based exercises, Constructed autopsies, Video and audio clips, Sim man and mannequins are just to name a few.

Table 2. Simulation Tools and Approaches Used in Simulation-based Medical Education

Type	Description
Low-tech simulators	Models or mannequins used to practice simple physical maneuvers or procedures
Simulated/standardized patients	Actors trained to role-play patients for training and assessment of history taking, physicals, and communication skills
Screen-based computer simulators	Programs to train and assess clinical knowledge and decision making, e.g., perioperative critical incident management, problem-based learning, physical diagnosis in cardiology, acute cardiac life support
Complex task trainers	High-fidelity visual, audio, touch cues, and actual tools that are integrated with computers. Virtual reality devices and simulators that replicate a clinical setting, e.g., ultrasound, bronchoscopy, cardiology, laparoscopic surgery, arthroscopy, sigmoidoscopy, dentistry
Realistic patient simulators	Computer-driven, full-length mannequins. Simulated anatomy and physiology that allow handling of complex and high-risk clinical situations in lifelike settings, including team training and integration of multiple simulation devices

Smallpox Inoculators

By the 1980s, the World Health Assembly declared that smallpox had been eradicated and recommended that vaccinations cease. Providers who had been trained in providing smallpox inoculations have since retired, left medicine, or died. Following the September 11, 2001, attacks, however, concerns about terrorists using the smallpox virus has created the need for a new generation of providers skilled in providing the inoculation. The **Smallpox Inoculation Training Unit (SITU)** was developed by The Simulation Group at Massachusetts General Hospital to provide training for future inoculators. The objective is to deliver a system that simulates smallpox inoculation, provides facts about smallpox, and demonstrates safe handling procedures. The expected outcome is a trained population of skilled, informed, and confident inoculators.

Designing and implementing a Simulation teaching module

(Courtesy Pre-conference workshop NCHPE 2009, Pune India)

The steps involved in designing and implementing a Simulation module are outlined here:

1. Define learning objectives

Domain to be tested
Curricular needs
Short term and long term outcomes

2. Discussion with the faculty

Inputs and suggestions
Identify simulator on which this objective is to implemented and achieved.

3. Procurement of the Simulator

Feasibility, infrastructure, manpower, maintenance, funding etc have to be borne in mind.
It could be an in-house indigenously prepared or Imported/ Indian

4. Formulation of structured teaching programme

By referring to standard textbooks, international guidelines and Consensus protocols on the subject.

5. Faculty Training Programme

The number of faculty needed and available, their working hours have to be kept in mind. Also, a provision for standby faculty should be made and all faculty should be trained in rotation.

6. Preparation of student teaching programme blueprint

The time of intervention, macro and micro planning for rotation of students, the number of attempts allowed, quality of performance all have to be borne in mind.

7. Rehearsal of teaching module by Faculty (Micro teaching)

To get familiar and also to improve the teaching and knowledge imparting skills.

8. Actual implementation of teaching module

After training sessions feedback to the students/ Debriefing is needed.

9. Assessment

Using a Checklist

10. Programme evaluation

Feedback questionnaires
Previous knowledge
Gain in knowledge
Teaching instructions

Challenges in using Simulation

The challenges are:

1. The training of the trainers in simulation. The trainers first need to be trained by people who are well versed with the use of simulators and also the art of teaching and assessment using these.
2. The acceptance of Simulation as a teaching tool by the senior faculties as well as the management to invest in clinical skill labs
3. Motivation is needed for the faculty to start using these as the use of simulation requires planning, practice and time.
4. Cost is another factor that is a challenge to widespread use of simulators. Though the simulators are good for learning and revisions, buying the good ones, maintaining them, the man power and infrastructure needed would cost a lot. Need to develop indigenous small, inexpensive models at departmental levels to incorporate in our teaching.

Excerpts from ML Web Discussion Dec 2009 (Courtesy Report by VV Sujatha)

The December group had a ML Web Discussion on the topic "*Simulation in Medical Education*". It was planned to discuss the topic under the following headings and plan as given below:

Dec 1-7	<ul style="list-style-type: none">• Introduction• Identify learning objectives	Dr Sujatha V V
Dec8-15	<ul style="list-style-type: none">• Literature review	Dr Marina Rajan
Dec 16-22	<ul style="list-style-type: none">• Resources• Advantages• Disadvantages• Success with simulation	Dr Sundar Kumar
Dec 23-30	<ul style="list-style-type: none">• Challenges with simulation	Dr Animesh Jain
Dec 31	<ul style="list-style-type: none">• Survey• Summary and wrap up	Dr Sujatha V V

A few excerpts from the discussion are reproduced below:

Simulation is a technique – not a technology – to replace or amplify real patient experiences with guided experiences, artificially contrived, that evoke or replicate substantial aspects of the real world in a fully interactive manner **(Sundar)**

An exercise, a person, device or set of conditions designed to mimic a real life situation in which the learner is given an opportunity to reason through a clinical problem and make diagnostic and treatment decisions **(Kalpana)**

Simulators are very useful in teaching or learning psychomotor skills especially when the patients are few, the procedure is risky to the patient, the student number is large. Simulators can be used again and again in drill and practice mode without any difficulty. Simulators can be used very well in situations of evaluating or assessing the skills of students in the psychomotor domain. **(Anthony)**

The first time I came across the terminology "simulation" was in 2003 when i was undergoing training at NTTTC, JIPMER. Not many among teaching faculty are actually aware of this in medical colleges. It's very important for us to disseminate this very important T/L method to provide students a near real experience especially in the present times of paucity of patients in a clinical setting. **(Vinutha)**

Medical training must at some point use live patients to hone the skills of health professionals. But there is also an obligation to provide optimal treatment and to ensure patients' safety and well-being. Balancing these 2 needs represents a fundamental ethical tension in medical education. Simulation-based learning can help mitigate this tension by developing health professionals' knowledge, skills, and attitudes while protecting patients from unnecessary risk. Simulation-based training has been institutionalized in other high-hazard professions, such as aviation, nuclear power, and the military, to maximize training safety and minimize risk. Health care has lagged behind in simulation applications for a number of reasons, including cost, lack of rigorous proof of effect, and resistance to change. Recently, the international patient safety movement and the U.S. federal policy agenda have created a receptive atmosphere for expanding the use of simulators in medical training, stressing the ethical imperative to first do no harm in the face of validated, large epidemiological studies describing unacceptable preventable injuries to patients as a result of medical management. Four themes provide a framework for an ethical analysis of simulation-based medical education: best standards of care and training, error management and patient safety, patient autonomy, and social justice and resource allocation. **(Muhammad** from the article Simulation-Based Medical Education: An Ethical Imperative by Ziv A et al. Acad. Med. 2003;78:783–788.)

There is evidence that the use of models can be more effective than the use of real objects in helping beginning tertiary students understand complex concepts. We can encourage students in making models or use computer assisted packages to create modules in physiology. **(Sujatha)**

....if we could implement simulations teaching would be more practical and inspiring. The Leicester assessment package is a noble idea. **(Lakshmi ANR)**

Of all methods mentioned, as a immediate start we can do role play in teaching (for clinical examination and history taking). In India I regularly use videos to reinforce what I teach, like heart sounds, murmurs, gastric emptying, neural regulation of respiration, hypoxia etc. These videos are short and crisp and got by thorough searching in net. **(Latha Rajendrakumar)**

Measurable benefits of Simulation... In teaching, it facilitates bridging the gaps In assessment, it allows structured, uniform assessment, minimizes the chance factor involved in one long, two short cases. **(Ranjana)**

Simulation has a wide range of application in medical education. We can easily incorporate some into our system. **(Komala)**

...simulation training improves provider and team self-efficacy and competence on manikins. Compared to procedural simulation improving operational performance, there is very less evidence that simulation training actually improves patient outcome. **(Barani)**

I think it is possible to use simulations in all subjects. All simulations are not expensive and they are affordable. **(Sathish)**

It is more effective when it is combined with human and non-human simulations. Time is not a constraint for the teacher and the learner. In the case of non-human simulators, there is no need to make a living person wait through the entire learning module. **(Sivan)**

.... agreed that mannequins do not give a 'real' experience. But to us Indians it should not be a problem. Our philosophy of life itself is that "whatever we see are 'maya' or virtual for that matter. Our highest ideal in education is this realization!!!" I think serious criticism about simulation being virtual is almost like a psychotic nostalgia where people are always on the 'look out for the real' ignoring what is right in front and in the here and now of life.

I think all learning initially has to happen on a more or less virtual situation or equipment. To me a simulation in medical education has that role. They could be mannequins, or any simulated situations. **(Marina)**

Note: *These are just the excerpts and selected randomly. This selected reproduction in no way tries to put down the inputs by others which have all become a part of the Summary of the ML Web discussion prepared by Sujatha for the December group.*

Once again, thank you everyone for having participated and made the December discussion so informative, interesting and lively.

Few Citations and Resources

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Few examples where experts also can benefit from simulators: (Courtesy Supten)

1. <http://www.medsim.com/profile/article1.html>
2. <http://www.medicalnewstoday.com/articles/128043.php>
3. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2323484/>

Public Health is one area where "simulation" can play a major role. For example:

1. <http://cpheo.sph.umn.edu/cpheo/umncphp/franklincounty.html>
2. <http://www.virtualpublichealth.com/>
3. <http://www.mclph.umn.edu/watersedge/>
4. <http://portal.acm.org/citation.cfm?id=1516746>

Conclusion

As we have concluded in our Web ML report Simulation is going to become a reality in near future for learning and assessment of both psychomotor skills and problem solving capabilities. The cost notwithstanding, the need of the hour is to recognize this change. Also, it would be prudent to think of developing indigenous ways of Simulatory teaching. Some examples have come up from amongst our own colleagues and fellows, who have developed Simulatory models or hands-on practice kits. They have all been very well received and the feedback from students as well as faculty is encouraging. With some more modifications and development these surely can be patented and even marketed on large scale so as to bring down the cost further. It would be a good idea if we start looking around with eyes open and inquisitive mind and find an opportunity or identify each scenario which could be a base for practical and simulatory training in some way. "A wise man sees opportunity in every difficulty," so goes an old saying, "and a fool difficulty in every opportunity." So let's be wise and intelligent. However we need to remember one thing - Simulation is just a compliment to education and not a substitute of the existing system.

To end,

"Medical simulation is state of the art education that allows us to create new and realistic methods of learning without putting patients at risk. It is particularly valuable during the crucial early phases of medical training."

....Steve Dawson, MD, program leader, Simulation Group at the Center for Integration of Medicine and Innovative Technology, Massachusetts General Hospital-CIMIT

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