Use of preclinical High Fidelity Medical Simulations (HFMS) to promote the integration of basic and clinical sciences

A discussion using our UCF College of Medicine preclinical HFMS curricular model

Background

What is high fidelity medical simulation? How does it differ from small group case-based learning or didactic learning?

- **HFMS:** use of computerized manikins to simulate real-life medical scenarios
- Fidelity defined by degree of clinical "realism"
  - High fidelity- can touch, feel, listen to SimMan
  - SimMan displays human features (talks, groans, sweats, urinates, wheezes, has seizures, etc)
  - Can administer drugs to SimMan and observe the effects on physiological parameters
- Employs team-based collaborative learning to diagnose & treat simulated illnesses
- Focus during experience on the simulated "patient"

Background

How does it differ from small group case-based learning or didactic learning?

In contrast to didactic

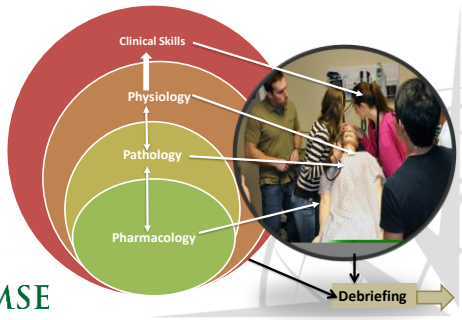
- HFMS active learning, much less passive then didactic
- Learners make decisions & complete actions to help SimMan in HFMS
- In HFMS, learners drive outcomes; faculty drive outcomes in didactic
- In didactics, leaners focus on the faculty (faculty directed) not the patient or problem

In contrast to small group

- HFMS = immersive – our small group sessions are computer or case-based (2 dimensional)
- HFMS more engaging, stressful, fast paced
- Feedback based on SimMan's progress, rapid, and outcomes are adjustable
- Small group focus may be on peer interactions, HFMS is "patient & problem focused"

Background

Visual representation of SimMan with second year medical learners



Background

Let's begin with an important question…Given the costs & challenges to using HFMS to teach 1st or 2nd year medical students, why teach subjects like physiology and pharmacology in HFMS?

- Curricula = tasked with reducing didactic learning
- Many basic scientists struggle with which methods of active learning are most effective
- Evidence is strong =simulations are a highly effective active learning tool for teaching physiology – growing data support teaching pharmacology

LCME ED-5A

A medical education program must include instructional opportunities for **active learning** and independent study **to foster the skills necessary for lifelong learning.**

Background

What does the literature tell us about us about why & how HFMS is effective in promoting learning ?

- Several excellent studies have reviewed the benefits of learning benefits of medical simulations – a few references will be provided at the end of this talk
  - Excellent reviews by Issenberg et al. & Rosen et al.
  - Gordon et al. showed teaching physiology in HFMS improved 1st year medical student learning & retention
  - Several studies supporting learning values of using HFMS to teach pharmacology to pharmacy students
  - Our research so far supports improved short and long-term learning of cardiopulmonary and autonomic pharmacology reinforced in HFMS

Background

What does the literature tell us about us about why & how HFMS is effective in promoting integrated learning?

- Previously Gorman et al. published manuscript on using medical simulations to integrate physiology & pharmacology with clinical medicine in preclinical learners
- Integration of basic and clinical sciences at the instructional level is critical to learner encapsulation of foundational concepts
  - HFMS demands learners integrate pathology, pharmacology, and clinical skills to diagnose and treat SimMan
  - HFMS promotes transfer of basic physiology, pathology, and clinical knowledge to treat real clinical problems
  - HFMS illustrates the clinical relevance of basic sciences

UCF COM Model

When and where should HFMS be implemented in the preclinical curriculum? The UCF COM model

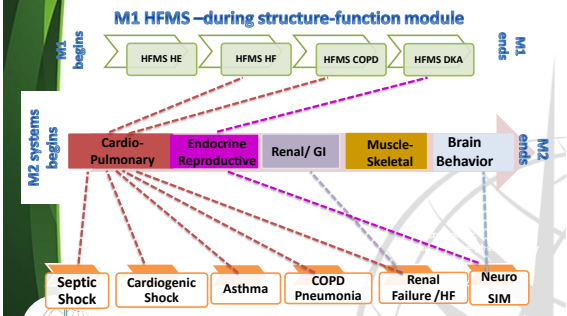
- Limited amount of research on where & how HFMS should be implemented in preclinical curricula – most studies are conducted in clerkship and residency-level learners
- At UCF COM, we have developed a curricular model to integrate HFMS into both 1st and 2nd year modules to support integration across the preclinical years
- M1 HFMS (4 cases) were developed to integrate our M1 Practice of Module with our Structure-Function (Anatomy-Physiology) Module
  - Experiences were scaffolded to reflect novice learner
  - M1 learners lack pathology & pharmacology knowledge

UCF COM Model

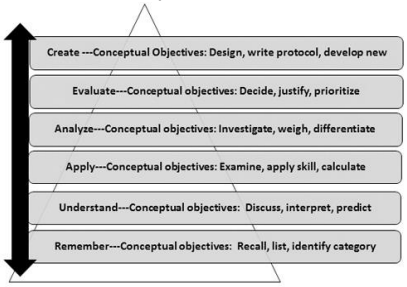
When and where should HFMS be implemented in the M2 curriculum? The UCF COM model

- UCF COM M2 curriculum is organ-system module based without a course structures for pathology, pharmacology, or clinical sciences.
- M2 HFMS (6 cases) were developed to integrate our M2 Practice of Module with different systems modules across the M2 year:
  - HFMS topics coordinate with learning of specific areas of pathology & pharmacology – schedules closely aligned
  - Topics coordinate across organ systems with selective reinforcement of M1 HFMS HFMS cases

UCF Preclinical Curricular Scheme



UCF COM Model: Objectives to scaffold experiences

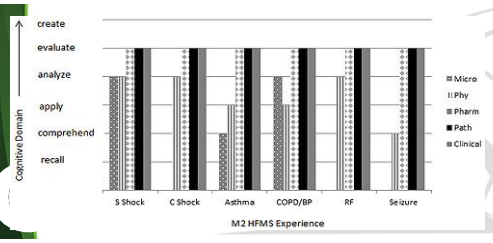


Discipline-related objectives per each HFMS

- M1 HFMS physiology objectives increased per HFMS
  - Ex: Heat exhaustion 1st HFMS – Recognize normal & abnormal variables, recall terminology
  - All HFMS required them to apply physiology knowledge, prioritize values & evaluate outcomes using physiology concepts
  - Last M1 HFMS – learners had to create a plan & evaluate outcomes for DKA case using physiology knowledge
  - For pathology & pharmacology, objectives were lower in M1 learners who had little discipline knowledge
    - Ex: HF HFMS, remember what receptor to target to increase contractility; Predict what variable an intervention might target

Discipline-related objectives per each HFMS

- For M2 learners, HFMS were scaffolded with higher order objectives in pathology, clinical sciences, and pharmacology due to higher level
  - Required to prioritize, evaluate, and justify diagnosis & treatments
  - M1 microbiology and physiology was also incorporated as they had to analyze and differentiate between likely causes and treatments



UCF COM Model: Faculty roles

Who is involved in the design, implementation, and facilitation of HFMS? What about the debriefing?

- Collaborative interdisciplinary design team for HFMS include physiologist, pharmacologist (major role in M2), and both generalist and specialist clinical faculty involved in both the Practice of Medicine and foundational modules
- M1 HFMS facilitated by physiologists and clinical faculty whereas the M2 HFMS facilitated by pharmacologist and clinical faculty
  - Tried different approaches as to who should be bedside with learners during the HFMS
  - Lessons-learned – have moved toward a "student-directed model" with faculty intervening only if HFMS goes off-track

UCF COM Model: Faculty roles

What about the debriefing?

- Collaborative interdisciplinary debriefing – stresses leaners reviewing their decisions, justifying rationale for choices, and reflecting on errors
  - Faculty facilitators should ask "why" questions
  - Reaction to error should be non-judgmental but encourage learner to reflect on what could have been done to resolve the situation
- M1 HFMS debriefings =physiologist and clinician
- M2 debriefings = pharmacologist and clinician
- Ideally the same faculty should debrief but not feasible at UCF COM with 120 students so debriefing faculty receive reports on team dynamics and outcomes during HFMS

UCF COM Model: Faculty roles

What about the debriefing?

- Debriefing must reflect the learner's level!
- Many mistakes in HFMS in preclinical learners involve lack of knowledge or poor transfer of classroom concepts
  - Debriefings must address preclinical learners needs & provide feedback on how to apply physiology, pathology, and pharmacology concepts
  - Lesson learned – debriefings covering too high level of clinical diagnosis & management create more confusion and cognitive overload that decreases learning
  - Our debriefings were most effective when not overloaded with new information-allow learners to "*rest, reflect, and digest*" prior HFMS experiences

UCF COM Model: Faculty roles

What about the debriefing?

- Lessons learned – debriefing must provide sufficient time for learners to reflect on questions and engage in peer discussion
- Role of the faculty is not to lecture or judge but to listen and guide discussions with questions that encourage reflection and clarify rationale for decisions in HFMS
- Some stress is appropriate to promote engagement but too much stress shuts down learning in the HFMS and the debriefing

UCF COM Model: Faculty roles

Don't forget about team dynamics…

- Lessons learned – both clinical and basic science faculty must encourage and support collaborative team-based learning
- Faculty members must provide good role models for interdisciplinary discussion that respect different perspectives within the HFMS and the debriefing
- Debriefings must consider addressing team functions and goals while concurrently addressing basic and clinical science concepts
- High intensity HFMS environments provide an optimal opportunity for collaborative learning (mimic real world situations) but may also bring out undesired behaviors (e.g. scapegoating) that can be addressed

Integration in debriefing

- Debriefings are interdisciplinary but not designated by subject to promote a higher level integration.
- EX: M2 debriefings, a clinician addresses clinical skills, exam findings, pathology & a pharmacologist addresses relevant basic sciences (physiology, pharmacology, some micro)
- Lessons learned–overlap is good- shared format; avoid all pathophysiology at beginning and pharmacology at the end (integrate throughout to illustrate the value of employing different concepts in reaching decisions)
  - Ask open ended questions that get learners to employ as much pathology, physiology, and pharmacology as possible in justifying their diagnosis & treatment
  - Lesson learned- avoid questions that allow learners to simply repeat observations & lists

Challenges

What are the challenges in using high fidelity medical simulation to integrate?

- Costs of equipment (Laerdal SimMan, computers, software, etc), staff, faculty, & maintenance
- Availability & logistics
- Potential "work-arounds"
  - Lower fidelity as an option
  - Use of video & rotation of "practicing group"

Challenges

What are the challenges in using high fidelity medical simulation to integrate?

- Faculty "costs" = time, workload, logistical issues – effective integration in preclinical HFMS requires getting both basic and clinical scientists collaborating together
  - Design and development, topic selection, curricular timing
  - Coordination /scaffolding experiences for novice learners
- Implementation – shared mental model of goals
  - Faculty directed vs faculty facilitated
  - Roles of faculty in debriefing process

Ultimate benefits

At UCF COM, we believe the benefits outweigh the challenges & we recommend using HFMS to integrate preclinical learning

- High faculty & student satisfaction with HFMS (both faculty & students look forward to them)
- Evidence of positive learning outcomes
  - Improved short-term physiology & pharmacology knowledge; improved long-term pharmacology retention
  - Appreciation of the clinical relevance of the basic sciences in diagnosing and treatment illness
  - Improved engagement & interest in learning foundational sciences -> greater "openness" to active learning approaches in general

Thanks for your time!

"Education is the kindling of a flame, not the filling of a vessel."
- Socrates

Some suggested HFMS references

1. Gorman L, Castiglioni A, Hernandez C, Asmar A, Cendan J, Harris D. Using Preclinical High-Fidelity Medical Simulations to Integrate Pharmacology and Physiology with Clinical Sciences. Medical Science Educator. 2015; 25(4):521-32.
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6. Rosen KR., McBride JM, Drake RL. The use of simulation in medical education to enhance students' understanding of basic sciences. Medical Teacher. 2009;31(9):842-846.