Biomedical simulation: applications to training, evaluation and research

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BIOMEDICAL SIMULATION

Definition

“Instructional process that substitutes real patient encounters with artificial models, live actors, or virtual reality patients with the goal of replicating patient care scenarios in a realistic environment for the purposes of feedback and assessment.”

Why simulate?
Why simulate?
Why simulate?
Why simulate?
Healthcare teaching dichotomy
Healthcare teaching dichotomy

Students

- Increasing number of students
- Constant need for update
- Increase concern with patient safety issues

Patients

- Less receptive to students
  - 50% allowed their presence
  - ~35% allowed examination or clinical interview

Healthcare teaching dichotomy

Dissociation between classroom learning and the clinical environment:

- Technical skills
- Soft skills

Inadequate training in:

- Anamneses
- Physical examination
- Diagnosis and decision making
- Critical/Emergency situations

Healthcare teaching dichotomy

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- Anamneses
- Physical examination
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- Critical/Emergency situations

Critical/Emergency situations

- High risk to patient
- Complex interventions
- Multidisciplinary teams
- Time as a key-factor
- Debilitated patients
- Rare situations
Why simulate?

We remember

DO 90%

READ 10%
Why simulate?

- Patient safety is a premise
- Patient higher expectations
- Technology push
- ‘See one, do one, teach one’ is no longer acceptable
What are the benefits?
What are the benefits?

- Realistic, interactive, safe and controlled environments
What are the benefits?

- Individual or team-training
What are the benefits?

- Focused on the trainee, adapted to the training needs
What are the benefits?

- Acquisition of competencies through practice
What are the benefits?

• Acquisition/training of soft skills
What are the benefits?

• WITHOUT risk to real patients
What are the **benefits**?

**Instructor**
- Focus on teaching
- Controlled environment
- Immediate feedback
- Objective and structured evaluations

**Trainee**
- Experiential learning
- Repetition
- Permission to make mistakes
- Soft skills training

**Patient**
- Confidence in the healthcare professional
- Better quality of the healthcare systems
- Patient safety culture
- Medical error prevention
Obstetric emergencies course – healthcare professionals

Pre-Post test study with a sample of 114 obstetricians and midwives.

Results:

• Both Obstetricians and Midwives reported an increase in knowledge and technical skills

• Midwives self-perceived knowledge and technical skills before the course were lower than those of Obstetricians, but no significant differences were observed after the course.

What are the benefits?

Outcomes – Clinical impact

Shoulder dystocia training – healthcare professionals
Retrospective, observational study comparing the management and neonatal outcome of births complicated by shoulder dystocia before and after the introduction of shoulder dystocia training.

Results:
- Significant clinical management improve: e.g. use of MacRoberts manoeuvre increased from 29.3% to 87.4%.
- There was a significant reduction in neonatal injury at birth after shoulder dystocia: from 9.3% to 2.3%.

How do we simulate?
How do we simulate?
How do we simulate?

**Patient-actors** (standardized patients)
Part-task trainers

How do we simulate?
How do we simulate?

Complex-task trainers
How do we simulate?

Simulation software
How do we simulate?

Patient simulators
How do we simulate?

Patient simulators
How do we **simulate**?

(patient simulators)

**Instructor**
- Initialization
- Control
- Simulator status
- Feedback
- ...

**Trainee**
- Clinical signals
- Physical signs
- Therapeutic interventions
- ...

**Software**

**Monitor**

**Simulator**

How do we simulate?

(patient simulators)
How do we simulate?
(patient simulators)
How do we **simulate**?

(patient simulators)
MEDICAL INFORMATICS AND SIMULATION?
What if I need a new simulator?
What if I need a **new simulator**?

1. Training needs analysis
2. Training media specification
3. Training media design
Example: DeFib – Manual defibrillator simulator
DeFib – Manual defibrillator simulator

Training needs ANALYSIS

• Cardiac resuscitation training includes delivery of electrical defibrillation and/or cardioversion therapy for malignant cardiac arrhythmias.

• Use of defibrillation equipment with the capacity to deliver electrical energy during simulation promotes trainee device familiarization, enhances fidelity, and encourages realistic interaction with the manikin.
DeFib – Manual defibrillator simulator

Training needs ANALYSIS

However, there are some disadvantages:

• Cannot be used in standardized patients or low-fidelity manikins
• Expensive
• It is not risk free

DeFib – Manual defibrillator simulator

Training needs ANALYSIS

• Device familiarization
• Correct use (rhythm identification)
• Safe use (one paddle at a time, stand clear, etc)

Additional needs:
• Realistic equipment
• Use in low fidelity simulators or standardized patients
• Use in-hospital or pre-hospital environment
DeFib – Manual defibrillator simulator

Training media SPECIFICATION

Specifications established by:

• Observation of a real defibrillator in use
• Opinions of trained users
DeFib – Manual defibrillator simulator

Training media SPECIFICATION

• Mimic a manual defibrillator and cardioverter
• Emulated monitoring of selected vital signs (ECG e SaO2)
• Simulation of 6 cardiac rhythms:
  ▪ sinus,
  ▪ atrial flutter,
  ▪ atrial fibrillation,
  ▪ ventricular tachycardia,
  ▪ ventricular fibrillation, and
  ▪ asystole
Training media SPECIFICATION

- Realistic physical interface with touchscreen selection of the synchronization (cardioversion), charge levels, monitored signals, etc
- Inclusion of audible signals associated with charging, charged and discharge
- Paddles with control buttons for charging and discharge
- Remote manipulation of the monitored signals
DeFib – Manual defibrillator simulator

Training media DESIGN

Hardware
DeFib – Manual defibrillator simulator

Training media DESIGN

Hardware: Tablet +
DeFib – Manual defibrillator simulator

Training media DESIGN

Hardware: Tablet + Electronic board
DeFib – Manual defibrillator simulator

Training media DESIGN

Hardware: Tablet + Electronic board + Paddles
DeFib – Manual defibrillator simulator

Training media DESIGN

Hardware: Tablet + Electronic board + Paddles + NumPad
DeFib – Manual defibrillator simulator

Training media DESIGN

Hardware: Tablet + Electronic board + Paddles + NumPad

Software: VisualBasic (Microsoft)

• Sets the scenario through instructor-interface
• Controls the user-interface
• Receives information from paddles
• Receives information from NumPad
KEY POINTS
KEY POINTS

• Current challenges in teaching, learning and assessment of health professionals require innovative and sustainable pedagogical approaches

• Several studies point to an improvement in the technical skills and non-technical skills after attending training activities based on simulation, with both educational and clinical impact

• Biomedical simulation is becoming a key component of education and training of health professionals and should be applied transversally and multidisciplinary

• Medical informatics may play an important role on developing and evaluation of simulation equipment
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DESTINATÁRIOS
Profissionais de saúde, docentes, investigadores e estudantes com interesse na simulação biomédica

DATAS
Cursos pré-congresso: 19 de fevereiro
Congresso: 20 e 21 de fevereiro

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PRAZOS
Submissão de resumos: 15 de dezembro de 2014
Notificação de aceitação: 31 de dezembro de 2014
Inscrição com desconto: 15 de janeiro de 2015

INSCRIÇÕES E INFORMAÇÕES
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