

The Role of Medical Simulation in the Teaching of Emergencies in Clinical Pathology Laboratory

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Abstract

Original Research Article

This study evaluates the effectiveness of a simulation workshop conducted at the Tangier Medical Simulation Center to train professionals in emergency medical biology techniques. The workshop, designed as a hybrid simulation, included participants from diverse professional backgrounds: 38% resident doctors in medical biology, 13% laboratory technicians, 44% technician students, and 6% equivalence biologists, predominantly female, with an average age of 23. The training involved a structured sequence of activities, including an initial briefing on medical biology emergency protocols, simulation of emergency sample collection, laboratory processing, and a final debriefing with skills assessment. The results demonstrated the workshop's ability to enhance participants' mastery of emergency protocols, improve technical competencies, and strengthen crisis management abilities, emphasizing the value of simulation-based training in medical biology education.

Keywords: Simulation, pedagogy, laboratory emergencies.

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INTRODUCTION

Medical biology emergencies are a key discipline for managing patients in critical situations, where speed and accuracy of analyses play a crucial role (M. Vaubourdolle *et al.*, 2016). Medical simulation is an innovative educational approach that trains health professionals in conditions close to clinical reality, preparing them for complex situations and specific protocols without risk to patients. With this in mind, we have developed a simulation workshop at the simulation center of the Faculty of Medicine and Pharmacy of Tangier, focused on emergency techniques in medical biology. The objective is to highlight the educational impact of this method on the training of medical staff, by emphasizing the mastery of technical gestures and the rapid and efficient management of urgent samples.

Educational objectives of the workshop

The simulation workshop aimed to train participants in emergency medical biology's theoretical and practical aspects. The specific objectives included:

1. Mastery of the recommendations of learned societies regarding the deadlines for returning urgent analysis results.
2. Knowledge of the regulatory aspects related to the communication of critical results to clinicians.
3. Training in technical procedures for emergency sampling, such as lumbar puncture and blood cultures.
4. The conduct and techniques for processing urgent samples in the laboratory (hematological, biochemical, and microbiological analyses).
5. Integration of skills in pre-analytical processing and management of technical emergencies.

MATERIAL AND METHODS

This analytical and prospective study was conducted during a workshop organized as a hybrid simulation at the Tangier Medical Simulation Center (Tangier'Sim Center). Participants included various professional categories: 6 residents in medical biology, 2

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laboratory technicians, 1 specialist in medical biology in equivalence internship, 7 laboratory technician students at the National Institute of Nursing Professions and Health Techniques of Tangier (NINHT). This diversity aimed to strengthen the skills of each group according to their role in processing urgent analyses.

The workshop methodology included the following steps:

1. Initial briefing: An introductory briefing allowed us to contextualize emergencies in medical biology. The facilitators recalled the recommendations of learned societies, the deadlines for rendering urgent analyses, and the regulatory obligations for transmitting results to clinicians.

2. Procedural simulation: A simulation session was set up for each urgent sampling and analysis type. The

participants demonstrated and reproduced the technical gestures, emphasizing critical samples (lumbar puncture, blood culture).

3. Management of laboratory analytics: Participants followed the protocols for processing various samples in emergencies: blood count, blood smear for detection of schistocytes and blasts, thick drop for malaria, hemostasis assessment, and pre-analytical treatment of biochemical biomarkers (such as troponin).

4. Debriefing and evaluation: A debriefing allows the review of the acquired knowledge of the session and discussion of areas for improvement. Participants were invited to evaluate the workshop and express their feedback.

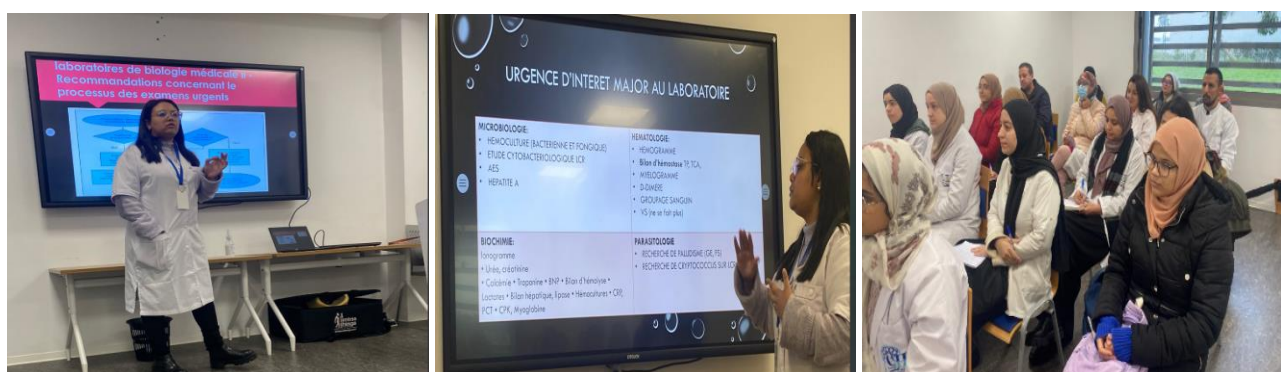


Figure 1: Initial Briefing Session of Workshop Participants



Figure 2: Procedural simulation session example of blood culture bottle sampling and processing in the laboratory

RESULTS AND DISCUSSION

Our population is made up of 38% of resident doctors in medical biology, 13% of laboratory

technicians, 44% students from the (NINHT) and 6% of equivalence biologists with a sex ratio of 0.2, predominantly female, with an average age of 23 years old (Figure 3).

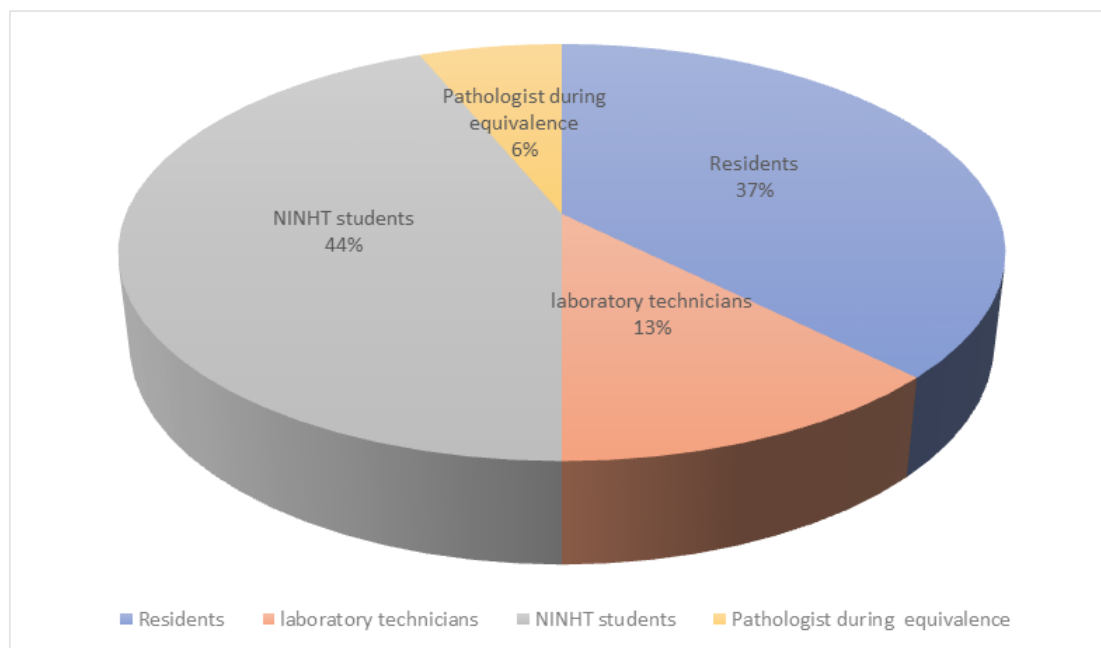


Figure 3: Distribution of workshop participants according to their status

Description of the simulation steps

1. Briefing on emergencies in medical biology

This introductory step presented the protocols and recommendations specific to emergencies in medical biology. It covered:

- Distinguishing the different types of emergencies in medical biology (*Feugeas JP et al., 2003, Challine D et al., 2010*):

Absolute emergency (or vital emergency):

- ✓ Unpredictable and sudden situation, endangering the patient's life in the absence of rapid care.
- ✓ Biological examinations are essential to establish a diagnosis and immediate treatment.
- ✓ "Critical" results require rapid therapeutic management.
- ✓ Very short deadlines may require the use of delocalized biology.

Relative emergency:

- ✓ Serious situation that may develop into a life-threatening situation in the short or medium term, or lead to complications.
- ✓ Certain biological parameters are essential for rapid diagnosis and treatment.
- ✓ A rendering time of less than a few hours may be required.

Organizational emergency:

- ✓ Cases where the rapid return of results optimizes care management (patient flow, discharges, exam scheduling).
- ✓ Allows for improving the organization of care units and overall patient care.

Biological emergency (Technical):

- ✓ Concerns about fragile samples or exams requiring rapid technical support.
- ✓ Aim to guarantee the quality of results.

Regulatory and normative aspects:

Highlights the importance of respecting the turnaround times for results for medical biology exams, paying particular attention to emergencies. Explain how to consider "current knowledge" as well as the information provided by the prescriber on the patient's state of health. With the development of a list of "examinations considered urgent (*M. Vaubourdolle et al., 2016*).

Recommended deadlines for the delivery of results:

According to international standards, the results of critical analyses (such as blood cultures and biochemical analyses for biomarkers such as troponin, as well as hematological analyses such as CBC and first-line hemostasis assessment) must be returned quickly to allow immediate management. For example, in 2006, the HAS published recommendations on the management of acute myocardial infarction, specifically outside cardiology departments (*Conférence de consensus. HAS, 2006*). These recommendations highlight the importance of troponin measurement, which plays a central role in the decision-making criteria for coronary unblocking in the event of acute infarction.

The obligations to notify urgent results, their transmission in real-time to the referring clinician, and the documentation of the transmission (*M. Vaubourdolle et al., 2016*).

The participants were thus able to understand the importance of time management and the rigor required to respect quality standards in emergency medical biology.

2. Simulation of emergency withdrawals:

In this section, participants were trained in carrying out technical procedures for urgent samples, in particular:

- **Blood cultures:** Performing blood cultures is crucial for the diagnosis of sepsis. Staff have been trained in aseptic sampling techniques to minimize the risk of contamination.

These exercises made it possible to simulate emergency conditions with suitable equipment and to reinforce the technical actions of professionals.

3. Sample processing in the laboratory:

The analytical component of the workshop covered the processing of emergency samples in the laboratory. Participants followed simulated procedures for various types of analyses:

- **Complete blood count (CBC) and blood smear:** The simulation allowed participants to detect abnormalities such as schistocytes, indicative of thrombotic microangiopathies, or the presence of blasts in cases of suspected leukemia.
- **Thick smear:** An essential technique for the diagnosis of malaria, the thick smear was simulated to raise participants' awareness of the rapid detection of parasites in situations where every minute counts.
- **Hemostasis assessment:** Participants worked on the specific samples and treatments for a hemostasis assessment, essential for patients in critical condition.
- **Preanalytical treatment of biochemical biomarkers:** This step highlighted the management of heart attack markers, such as troponin, which requires particular rigor for reliable results in a short time.

This part of the workshop allowed participants to simulate the sample processing and management flow in the laboratory, following quality standards and essential pre-analytical procedures for urgent samples.

4. Debriefing and skills assessment:

A debriefing followed the practical session, providing critical feedback on performance and allowing participants to ask questions. This discussion time helped identify areas for improvement and strengthened participants' confidence in their technical actions and decisions made in an emergency context.

Pedagogical benefits of simulation:

The integration of medical simulation into this workshop had several positive impacts on learning and skill development:

1. **Consolidation of theoretical knowledge:** The briefing allowed us to recall essential standards and contextualize the procedures. The participants thus acquired a more precise understanding of emergency deadlines and regulatory obligations.
2. **Strengthening of technical skills:** The procedural simulation offered an opportunity for intense and realistic practice, allowing to reinforce the gestures of taking and processing urgent samples. These technical skills, rehearsed in a safe environment, increase the confidence of the participants and allow them to reduce the risks of errors in real practice.
3. **Improvement of time management and priorities:** The simulation of an emergency environment made the participants aware of the speed of execution required in critical situations. They thus learned to prioritize gestures and analyses according to their degree of urgency.
4. **Interprofessional communication training:** The simulation context allowed participants to understand the importance of communicating critical results. They also learned how to collaborate effectively with clinicians, which is essential to optimize patient care in emergencies.
5. **Strengthening patient safety:** By training staff in rigorous practices, the workshop helped reduce the risks of sample contamination and analytical errors, which can affect patient safety.

Participant feedback indicates high satisfaction and a sense of improved skills, which confirms the educational value of simulation-based teaching (HAS, Guide 2012, *JC GRANRY et al., 2012*). This immersive and interdisciplinary approach is a valuable lever for training medical staff ready to meet the demands of emergency medical biology, thus contributing to better patient care and improved quality of care.

CONCLUSION

The simulation workshop at the Tangier Medical Simulation Center demonstrated the effectiveness of simulation in training medical biology professionals in emergency techniques. The combination of theoretical training, procedural simulations, and practices in the management of critical samples and results allowed participants to acquire essential skills for their professional practice. They became familiar with emergency protocols, consolidated their technical gestures, and strengthened their ability to manage crisis situations in the laboratory.

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