

# Clinical Simulation: A Protocol for Evaluation of Mobile Technology

Carey MATHER<sup>a,1</sup> Sanne JENSEN<sup>b</sup> Elizabeth CUMMINGS<sup>a</sup>

<sup>a</sup>University of Tasmania, Australia

<sup>b</sup>National Health Data Authority, Denmark

**Abstract.** For mobile technology to be accepted at point of care in healthcare environments there is a need to demonstrate benefits whilst ameliorating the risks and challenges. To provide a standardised approach to evaluation of mobile technology a simulation protocol was developed to provide guidance for its use in healthcare environments. Simulated conditions provide the opportunity to assess intended and unintended consequences and identify potential workarounds when using technology. The protocol can also be used to demonstrate the importance of the development of digital professionalism by end-users prior to students entering the clinical practice setting. The mobile technology protocol was adapted from a health information systems protocol developed and used at the ITX Lab, Denmark for use in other simulation laboratories. Use case scenarios were developed to enable evaluation of mobile technology for mobile learning of nurses, nurse supervisors, students and patients. The scenarios can be used in a range of simulated environments including hospital bedside, outpatient clinic or community settings. A case study exemplar of a nurse and patient is included to demonstrate how the mobile technology protocol can be applied.

**Keywords.** Clinical simulation, digital professionalism, learning and teaching, mobile learning, mobile technology, nursing, usability

## Introduction

For mobile technology to be accepted in healthcare environments at point of care, there is a need to demonstrate the benefits while ameliorating the challenges and minimising risks associated with its use. Development of a clinical simulation protocol for using mobile technology provides a standardised methodology to evaluate the usability of mobile learning by health professionals in a range of healthcare environments. This approach enables exploration of how mobile learning functions prior to implementation in the workplace. Intended and unintended consequences can be exposed and workarounds uncovered using clinical simulation. A secondary purpose of the methodology is its application in learning and teaching settings to facilitate end-user's understanding of the importance of developing digital professionalism prior to entering clinical practice settings.

Clinical simulation can be useful in a variety of processes in the human-centred design cycle [1]: it can be used to analyse and evaluate user requirements and work practices; and enables shared understandings between different stakeholders within the healthcare environment of interest [2]. Development and implementation of health and

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<sup>1</sup> Corresponding Author: Carey Mather, Email: [Carey.Mather@utas.edu.au](mailto:Carey.Mather@utas.edu.au)

information technology into healthcare environments is challenging due to the complexity of clinical work practices and range of healthcare settings. Standardising work processes and flows is a method traditionally used in healthcare to minimise risks, ensure portability and transferability of knowledge and skills across disciplines and organisations. In order to better understand the needs and requirements of these stakeholders clinical simulation can be used to gather data that can be used to evaluate new technology, study the interaction between users and technology and gauge the potential effects on clinical workflow and organisational issues [3]. Additionally, assessments using clinical simulation can provide insight into different work practices in a controlled environment with no risk of injuring patients. Results from clinical simulations can enable solutions to be formulated to minimise risks to patient safety and quality of care [2, 4, 5].

Methods such as observation, digital recording, and surveys of the interactions between actors, props and environment within the scenario being simulated can be employed to collect data [6]. A standardised simulation protocol can be used to guide the planning and implementation of clinical simulations to evaluate using mobile technology at point of care in a variety of healthcare settings. The development of a clinical simulation assessment protocol would provide a standardized tool to ameliorate an identified gap in the Australian literature regarding evaluation of the consequences of using mobile technology for learning and teaching in healthcare settings. An existing clinical simulation methodology was modified for testing mobile technology. This protocol was developed with transferability for use in other simulation laboratories. It was designed to enable the depiction of a range of healthcare environments [7] such as non-tertiary settings and community or mental health settings with nurse, nurse supervisor, student and patient interactions with mobile technology.

## **1. Overview of protocol**

The protocol provides a structured approach to designing a clinical simulation using mobile technology. The focus is on standardising the procedures when using mobile learning, as at a macroscopic level it is the environment that changes rather than user. The protocol provides guidance for clarifying the purpose of the clinical simulation. It can also be used to assist designing and identifying requirements necessary to ensure assessment of the intended practice. Furthermore, this protocol can be used to guide the development of scenarios to test the usability of specific mobile learning tools.

The aim of developing a clinical simulation protocol for mobile technology was the provision of a standardised process to enable prospective clinical simulation assessment methodologies to be implemented and compared across disciplines and organisations. This protocol focused on human-in-the-loop, by utilising end-users to gain an understanding and evaluate the implementation of mobile technology at point of care [7]. Table 1 summarises the purpose, challenges and achievements by using clinical simulation assessments to evaluate the implementation of new technology into healthcare environments.

Effective involvement of users can lead to improved levels of acceptance of the technology; greater understanding of the technology by the user resulting in more effective use; increased participation and ability to influence decision-making within organisations or at a national level.

**Table 1.** Overview of clinical simulation assessment (Modified from [1])

Topic	Requirement	Design	Implementation
Purpose	Analysis and evaluation of <ul style="list-style-type: none"> <li>• Work practice.</li> <li>• Requirements.</li> </ul>	Formative evaluation of new technology and work practice.	Assessment of application of technology in work practice. Formative and summative evaluation.
Challenges	No richness of interaction in low fidelity prototypes Not coverage of all possible applications of technology.	Does not cover <ul style="list-style-type: none"> <li>• long periods.</li> <li>• all parts of organisation.</li> <li>• all parts of workplace.</li> <li>• all possible events.</li> </ul>	Not a substitute for pilot implementation. Fewer errors than in real life.
Achievements	Involvement of <ul style="list-style-type: none"> <li>• users.</li> <li>• clinical context.</li> </ul> Appreciation of new concepts. Visualization of interaction between healthcare professions. Setting for exploration of cross-organizational work flow in new technology.	Alignment of expectations, mutual acceptance and understanding. Ownership and user involvement. Learning space. Shared understanding and common ground for discussion and negotiation.	Visualization of <ul style="list-style-type: none"> <li>• Possible workarounds</li> <li>• Potential patient safety hazards within settings.</li> <li>• Organizational and technical issues.</li> <li>• Safe space for analysis and experiments with future work practice and use of technology.</li> </ul>

To enable evaluation of the implementation of mobile technology for learning and teaching at point of care has required the modification of previously developed simulation scenarios [5]. Mobile technology implementation can be tested in healthcare settings, including but not limited to hospital ward, outpatient clinic, recovery room in an operating suite, treatment room, general practice surgery, community health visit, or outreach centre.

## 2. Methodology

The development of the protocol was undertaken after immersion in the ITX simulation laboratory. ‘Walk throughs’ using the existing protocol were used to demonstrate the proposed process. Understanding the complexity associated with acceptance of mobile learning was captured through the evolution of scenarios designed to evaluate the intended process being tested. The existing protocol was used to guide the development of a standardised methodology to enable accurate reflection of the use of mobile technology within healthcare settings. Scenarios were developed to also enable evaluation of mobile technology used for learning and teaching at point of care. A use case exemplar of using a mobile device within a healthcare setting is provided.

### 3. Use case: Patient education enabled with nurse using a mobile device

#### 3.1. Course and conditions for use case scenario

Tables 2-3 provide information about the course and conditions for appropriate set-up and delivery of this use case scenario (Table 4). Coupled with the three phased, 10-step process [1], implementation of the simulation assessment can be undertaken.

**Table 2.** Course of scenario

Scope	Duration	Participants	Props	Trigger
<b>Start:</b> The nurse visits the patient.	Approximately 30 minutes	Nurse Patient	Mobile tablet device	The patient indicates they want to understand more about what factors trigger an exacerbation of asthma.
<b>End:</b> The nurse gains the patient's trust and is prepared to be shown how to find credible information using a mobile tablet device.			Internet / access to web-based resources.	

**Table 3.** Pre and post conditions

Conditions
<b>Pre-conditions</b> The nurse has access to a mobile device and wireless Internet at point of care.
<b>Post-conditions</b> The patient will know where to find credible information on the internet about what factors trigger an exacerbation of asthma. The nurse will have enabled ehealth literacy development of the patient by sharing how to discern credible information and showing them how to browse for credible websites on this topic. The nurse will have gained an understanding about the lived experience of the patient and their need to know about management of their illness. The patient and nurse will have shared understanding about what factors trigger an exacerbation of asthma.

#### 3.2. Use case scenario

A patient with asthma seeks information about what factors trigger an exacerbation. The nurse uses a mobile tablet device to show the patient how to browse for a credible website about this topic. The patient knows how to use a mobile device for social media, email and browsing using a search engine, but is unsure about using a mobile tablet or checking credibility of information.

**Table 4.** Use case scenario

Patient education enabled with nurse using a mobile device	
1.	The patient indicates they want to know more about what factors trigger an exacerbation of asthma
2.	The nurse asks the patient if they would like to find out information using the Internet
3.	The patient indicates they would, but would like to be able to find the information again later
4.	The patient indicates they can use a mobile device for social media and email
5.	The nurse fetches the mobile tablet device to access the internet using wireless technology
6.	The nurse gives the patient the tablet device and suggests key terms to the patient that are input by the patient into the browser on the tablet
7.	The nurse browses the list with the patient and discusses which sites may contain credible information related to the information sought
8.	The nurse asks the patient which sites they think could contain useful information to the patient
9.	The patient chooses a website to browse
10.	The patient and nurse browse the webpage to find out whether it contains the information the

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- patient needs
11. The nurse asks the patient why they chose this site and they have a discussion about how to assess credibility and quality of website information
  12. The patient leads the browsing of information while the nurse remains with them
  13. The patient asks the nurse to explain some of the medical terms used on the website
  14. The nurse shows the patient how to search to find out what the words mean, and explains what the terms are while working with the patient to find the terms, using the Internet via the browser on the tablet device
  15. The nurse encourages the patient to return to the website with the information they originally sought
  16. The patient continues to browse the site and the nurse encourages and supports the patient in this activity
  17. The patient finds the information they need to increase their understanding about the topic
  18. The nurse asks the patient if they know how to capture the URL to keep it for later use
  19. The patient indicates they can use one of their social media accounts to track the URL
  20. Using the tablet device, the nurse shows the patient, how to forward the web links to their social media account
  21. The patient forwards the web links to their social media account
  22. The patient indicates they are satisfied they can access the information again when they need more information
  23. The nurse asks the patient if there is any other information they would like to search before the session concludes
  24. The patient indicates there is currently no further information required
  25. The patient returns the tablet device to the nurse.
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### 3.3. Research design

Clinical simulation involves real end-users as they simulate the use of mobile technology in a range of realistic environments whilst performing authentic tasks [5]. Users may be involved at different levels depending on the purpose of the assessment. In the case of mobile technology the most appropriate methodology for undertaking the clinical simulation assessment needs to be identified prior to planning the clinical simulation as the approach will change depending on the underpinning design chosen. In this use case exemplar user-centred strategies such as a focus on human factors or participatory design could be employed.

### 3.4. Fidelity

Level of fidelity is also an important consideration when developing a clinical simulation. Environment, equipment, functionality and task are dimensions that need to be considered when planning [8]. The combination of these factors reflect the degree of perceived realism or acceptance by the actors (clinicians) which may change the outcome of the simulation. The level of fidelity should reflect the purpose of the simulation [4]. It is important that the appropriate level of fidelity is chosen and understood prior to implementation of the clinical simulation. In this scenario for acceptance, it may be important for a high level of realism to be used, to evoke realistic interaction that could trigger intended or unintended consequences. These interactions may change depending on healthcare setting simulated.

### 3.5. Clinical simulation procedure

Clinical simulations are performed in three phases. These are introduction, simulation and evaluation. This is described as a 10 step-process devised by Jensen [1]. For this

use case scenario prior to the simulation, it will be important for the participants to be introduced to the technology to be assessed, the purpose of the simulation and to the simulation process. During the simulation the facilitator conducts the assessment and supports the participant actors (nurse and patient). An instructor is located in the observation room and guides the patient and simulation facilitator. Depending on the purpose, the simulation is observed by key stakeholders, such as colleagues, clinical, quality or policy managers, and their input is included as part of the assessment. In this use case the focus is the interaction between the nurse and patient using the mobile tablet device. After the simulation the process is evaluated using a range of techniques by participants and observers. Intended and unintended consequences and potential workarounds can be revealed in different settings by standardising the interactions of the actors as described in this example.

#### 4. Conclusion

The simulation protocol provides a standardised methodology for assessing the usability of mobile technology in a variety of healthcare settings. The use case exemplar provides an example of how a scenario can be used to identify intended and unintended consequences and potential workarounds by users. Scenarios can also be used for learning and teaching to demonstrate the need for, and enable development of digital professionalism prior to students entering the clinical practice setting. Assessing the usability of mobile technology at point of care will enable safe and appropriate implementation of this new andragogy within healthcare environments.

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