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Use of simulators in teaching and learning: Paramedics' evaluation of a Patient Simulator?

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Abstract

Objectives

This study was undertaken as a precursor to a larger study investigating the benefits of simulation in reducing management and technique errors in the prehospital management of trauma patients. However, prior to this it was considered necessary to conduct a preliminary study to address the following:

Undertake a structured evaluation of the Laerdal™ SimMan™ Patient Simulator.

Determine the "functional fidelity" of the Laerdal™ SimMan™ Patient Simulator that was used in this project from the Paramedic perspective.

Method

Participants taking part in the study were invited to complete an evaluation form that examined the various components of the simulator. A second evaluation form examined both the features of the simulator and their applicability to Paramedic practice. The simulator capabilities were assessed through an evaluation of the simulator features, and, with a qualitative element included, provided a descriptive analysis of simulator functional fidelity.

Results

Analysis identified 36 of 54 features (66%) of the simulator were rated by the respondents as at least 'average physiological accuracy'. An analysis of applicability to practice identified 41 of 54 features (75%) were rated at least beneficial to practice by greater than 80% of respondents. In combining these results, only 5 features considered applicable to Paramedic practice demonstrated a below average level of physiological accuracy. These findings indicate that, as a general concept, the use of this particular simulator as an educational experience was held in high regard within this cohort of participants.

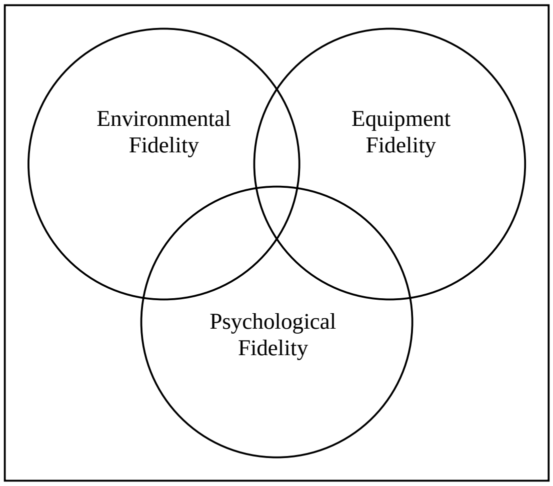
Conclusions

Previous studies in related health disciplines have identified an acceptance of a patient simulator as a learning tool by students. This study supports these findings, with Paramedic students evaluating the Laerdal™ SimMan™ Patient Simulator as having high functional fidelity, using the criteria outlined for this study. The findings from this study afford the opportunity for ongoing educational initiatives and research in the training of Paramedics utilising the Patient Simulator.

Introduction

The benefit gained from any teaching and learning intervention is influenced by the degree to which individual students embrace the learning environment, and the success of a teaching program can be judged, at least in the clinical setting, by the degree to which the learnt knowledge and skills are able to be transferred to actual clinical performance. Previous studies have suggested the transfer of training to the real world is determined by a number of factors, including the number of common sensory and motor characteristics, similarity of cognitive processing demands, and associations between physical aspects of the task and cognitive processes learned during the task.[1] This complex analysis has been packaged into a 'typology of simulation' (Figure 1) that provides a useful framework for further discussions concerning the applications and benefits of simulation as an educational tool.

Figure 1: A Typology of Simulation[2]



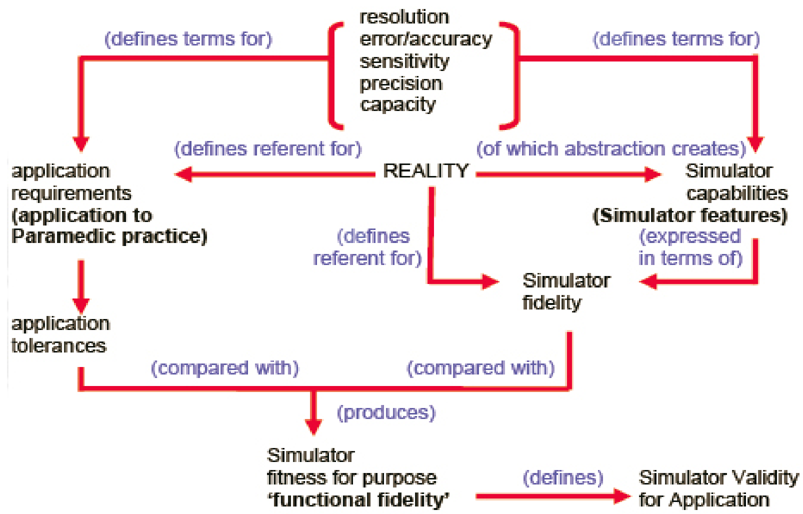
The first of the above dimensions, equipment fidelity, is concerned with how closely the simulator resembles the real life system, in this case, the patient. The second dimension, environmental fidelity, examines the context in which the simulator is positioned, how closely noise, light, visual cues are associated to those in the real world situation. Finally, the third dimension, psychological fidelity, concerns the degree to which the student perceives or accepts the simulation to be 'real'. All three dimensions are important and inter-related, however this study will address primarily 'equipment fidelity', whilst giving thought to 'psychological fidelity' in the consideration of the participants' perception of how applicable the simulator features are to their scope of clinical practice.

Champion and Higgins considered the issue of "…Fidelity – the extent to which the simulator reproduces the physical characteristics of the real world procedure, equipment or skill being simulated". They used as a definition of fidelity, "…the degree of similarity between the training situation and the operational situation which is simulated". The authors note that the bulk of data show that physical (objective) fidelity is not a requirement for successful simulation-based training. However, "…although the overwhelming preponderance of data from military, flight, and medical simulation shows that simulators do not have to exhibit high fidelity to be useful training instruments, they do have to have face validity (functional fidelity) for the end user. Face validity is the degree to which the simulator appears genuine and is adopted by the end users".[3]

The *functional fidelity* of a simulator can be considered its *fitness for purpose*, that is, a determination of the required level of simulator fidelity in order for a simulation exercise to achieve its goal. The following diagram (Figure 2) is adapted from systems modelling and provides a framework for considering *fitness for purpose* in the context of the education and training of ambulance and MICA Paramedics.[4] The inbuilt properties of the simulator (resolution, error/accuracy, sensitivity, precision and capacity) determine the **simulator capabilities** (features), and are based on the user's **application requirements** (ie. how 'real' does the simulator need to be?). The extent to which the simulator features replicate 'reality' is represented by the **simulator fidelity**, and the extent to which application requirements meet user's specific needs is represented by **application tolerances**. A comparison of the application tolerance against the simulator fidelity provides a basis for determining the simulator functional fidelity. This enables the basis for a qualitative analysis of user acceptance of the simulator.

This all sounds very complex, but essentially such a framework provides a basis to determine whether a particular simulator contains the appropriate features to match the clinical assessment and intervention capabilities of the user, to a level of 'realness' that aligns with the users interpretation of reality – that is, it is accepted as genuine by the user group, in this study being novice through to experienced Ambulance and MICA Paramedics.

Figure 2: A framework for functional fidelity



The use of a patient simulator for simulation training has been shown to be acceptable in a range of clinical specialty areas. A study involving the American Academy of Family Physicians reported by Issenberg et al, used "…Harvey, the cardiology patient simulator…" and reported that "participants were nearly unanimous (1280 of 1333) in thinking that the simulator was a valuable teaching tool with which they would like to have further experience.[5] A further study by Syrett et al, who used a whole body patient simulator in the training of emergency medicine residents, observed that the residents felt positively about simulator training and experienced increased physiologic and perceived levels of stress during critical events. The authors concluded "…simulator training is a realistic model on which to train residents to manage critically ill patients".[6] Using a patient simulator for simulations in a range of anaesthetists from residents to consultants in a study by Devittt at al concluded that "…subjects rated the realism of the test scenario highly, suggesting that familiarity or comfort with the simulation environment had little or no effect on performance".[7] In undergraduate medical education, both students and educators reported the simulation experience "…promoted critical thinking and active learning, and allowed them to build confidence and practical skills in a supportive environment".[8] In addition, hospital and ***prehospital care providers*** were accepting of a patient simulator as a training tool for multiple purposes including evaluation, treatment and reassessment.[9]

However, no studies were located relating specifically to the evaluation of the simulator that was used in this study (the simulator has only been available since late 2001) and only one study related to acceptance by prehospital care providers. Thus, an important preliminary step, prior to ongoing studies using the Laerdal™ SimMan™ Patient Simulator, is to determine the "functional fidelity" of the simulator in the population of Victorian Paramedics.

Evaluation of Patient Simulator

Methods

The patient simulator used throughout this study was the Laerdal™ SimMan™. The study received ethics approval through the Monash University Ethics Committee, and all participants signed consent forms prior to involvement in the study.

Participants in this study were Victorian Paramedics undertaking study programs at MUCAPS, ranging from first year Paramedic students to MICA Paramedic students with at least 5 years clinical experience. The final composition of respondents was: 57 first year Paramedic students; 34 second year Paramedic students; and 22 MICA Paramedic students.

All participants taking part in the study were invited to complete an evaluation form that examined the various components of the simulator as outlined in the manufacturer's specifications. Participants were initially briefed on the format of the evaluation form and given clarification of the various rating scale ranges.

Evaluation of Simulator Features

The focus in this section of the study was on quantifying whether the simulator does indeed exhibit the features specified as well as qualifying the physiological accuracy of the feature.

In this study, 'physiological accuracy' refers to how realistic the anatomical and physiological features of the simulator (such as pulses, breathing, breath sounds, heart sounds, etc.) appear to the individual participants. This analysis addresses the dimension of equipment fidelity discussed in the typology of simulation model. The rating scale ranged from 'not present'[1] to 'excellent physiological accuracy'.[4] When the feature was outside the scope of practice of the participant they were offered an 'unable to comment' option, this response receiving no rating. The evaluation form is attached as Appendix A.

Functional Fidelity

This section of the evaluation form was constructed giving consideration to the data generated by Champion and Higgins suggesting that physical fidelity is not a requirement for successful simulator-based training, however face validity (or functional fidelity) - the extent to which the user is able to align the simulator with their individual perception of reality - is important.[3]

Participants were asked to consider whether the various simulator features were relevant to their scope of practice, and these results were compared against their responses to the perceived physiological accuracy of the same features. A particular simulator feature receiving a strong applicability to practice and also rating as high physiological accuracy could be considered to be meeting a fitness for purpose, or of high functional fidelity. However a particular simulator feature receiving a strong applicability to practice but rating poor physiological accuracy could be considered not meeting a fitness for purpose, or of low functional fidelity. The evaluation forms developed are included in Appendix A.

The data was analysed both graphically and comparatively by recoding the responses into a binary variable where responses less than average physiological accuracy (simulator features) and less than beneficial (application to Paramedic practice) were assigned '0' and responses above this range were assigned '1'. A percentage relationship was then obtained between the features and their application to practice.

Results

Evaluation of PS Features

One hundred and thirteen (113) participants volunteered to complete the evaluation form, the results of which are summarised in Tables 1 through to Table 8. There are 54 features of the simulator in total and they have been grouped into related sets as represented in each of the tables. Where the feature is outside the scope of practice and participants have selected the 'unable to comment' option the response rates are very low and no significance can be interpreted from the data.

Table 1: Airway Features

	Mean	Median	Range	Inter-quartile Range	Valid N
Airway Anatomy	3.21	3.00	3.00	1.00	N=82
Chest rise and fall	3.27	3.00	3.00	1.00	N=97
Pharngeal obstruction	2.70	3.00	3.00	3.00	N=10
Tongue oedema	2.88	3.00	3.00	2.00	N=17
Trismus	3.34	4.00	3.00	1.00	N=29
Laryngospasm	2.50	2.50	3.00	3.00	N=12
Decreased cervical movement	2.31	3.00	3.00	2.50	N=13
Decreased lung compliance	3.09	3.00	3.00	1.00	N=32
Stomache decompression	2.50	3.00	3.00	2.00	N=10

Most of the airway features of the simulator rated between 'average physiological accuracy' (3) and 'excellent physiological accuracy'.[4] Pharyngeal obstruction, tongue oedema, laryngospasm, decreased cervical movement and stomach decompression were the only features to fall into the 'poor physiological rating' scale (table 1). It should be noted however that there was poor response to these features with only 10, 17, 12, 13 and 10 participants respectively rating these features.

Table 2: Blood Pressure Features

	Mean	Median	Range	Inter-quartile Range	Valid N
Automatic	3.20	3.00	3.00	1.00	N=35
Auscultated	3.20	3.00	3.00	1.00	N=84
Palpated	3.49	4.00	2.00	1.00	N=96
Systolic and diastolic settings	3.49	4.00	3.00	1.00	N=75
BP display	3.23	3.00	3.00	1.00	N=39

All blood pressure features registered in the average to excellent physiological accuracy range (Table 2). Participants rated the 'palpated' feature more strongly with 96 responses and only 5 (5%) below average physiological accuracy compared to the 'auscultated' feature with 84 responses and 16 (18%) below average physiological accuracy. All features received good response from participants, with 'automatic blood pressure' achieving the lowest response rate of 35.

Table 3: Monitoring Functions

	Mean	Median	Range	Inter-quartile Range	Valid N
Ecg library	3.72	4.00	1.00	1.00	N=36
Compression artifact	3.30	4.00	3.00	1.00	N=20
Cardiac monitoring 3ld	3.79	4.00	1.00	0.00	N=71
Defibrillation	3.50	4.00	3.00	0.25	N=22
External pacing	2.33	2.00	3.00	3.00	N=6

All the monitoring features of the simulator were rated in the average to excellent physiological accuracy range except for 'external pacing', which also received the lowest response rate of 6 (Table 3). ECG library and cardiac monitoring both received very high ratings from the participants.

Table 4: Pulse Features

	Mean	Median	Range	Inter-quartile Range	Valid N
Bilateral carotid pulse	3.03	3.00	3.00	1.00	N=77
Left brachial pulse	3.18	3.00	3.00	1.00	N=82
Left radial pulse	3.42	4.00	2.00	1.00	N=102
Bilateral femoral pulse	3.10	3.00	3.00	1.00	N=29
Synchronised with ECG or compression	3.63	4.00	3.00	1.00	N=46
BP dependent strength	3.33	3.00	3.00	1.00	N=82

The pulse features again all fell within the average to excellent physiological accuracy range. However it should be noted that the 'carotid pulse' feature was at the lowest level within this range

(Table 4). Of the 77 responses to the 'carotid pulse' feature, 17 (21%) rated it below average physiological accuracy. This is in comparison to 102 'L radial pulse' feature responses with only 8 (7%) rating below average physiological accuracy. All features received a good response rate, with the lowest 'bilateral femoral pulses' at 29.

Table 5: Airway Procedures

	Mean	Median	Range	Inter-quartile Range	Valid N
BVM ventilation	3.38	4.00	3.00	1.00	N=26
LMA placement	3.00	3.00	3.00	1.00	N=20
OPA placement	3.50	4.00	3.00	1.00	N=26
NPA placement	3.40	4.00	3.00	1.00	N=20
ETT intubation	3.38	4.00	3.00	1.00	N=16
Combitube placement	1.00	1.00	.00	0.00	N=3
Retrograde intubation	1.75	1.00	3.00	2.25	N=4
Lightwand intubation	1.75	1.00	3.00	2.25	N=4
Transtracheal jet ventilation	1.00	1.00	.00	0.00	N=3
Fibreoptic intubation	2.20	1.00	3.00	3.00	N=5
Needle cricothyrotomy	2.67	3.00	3.00	3.00	N=9
Surgical cricothyrotomy	2.20	1.00	3.00	3.00	N=5

A number of features in this set were rated well below average physiological accuracy. The low rated features are not skills routinely practiced by Victorian Paramedics and this may have been a factor contributing to the low scoring (Table 5). Only 3-5 participants were in a position to rate the 'combitube' to 'fibreoptic intubation' features.

Table 6: CPR Features

	Mean	Median	Range	Inter-quartile Range	Valid N
ABC check	3.41	4.00	3.00	1.00	N=69
Ventilation	3.58	4.00	3.00	1.00	N=40
Chest compression	3.60	4.00	3.00	1.00	N=30
ECG and HR display	3.71	4.00	3.00	0.00	N=59

The CPR features of the simulator all rated between average and excellent physiological accuracy (Table 6). While the trauma scenarios used in this project did not allow the utilisation of a number of these features, participants were permitted additional time outside the assessment period to investigate these features.

Table 7: Procedures

	Mean	Median	Range	Inter-quartile Range	Valid N
Surgical decompression mid-axilla	3.20	4.00	3.00	2.25	N=10
Chest decompression 2nd intercostal space	3.41	4.00	3.00	1.00	N=17
IV insertion	3.38	3.00	3.00	1.00	N=52
Subcutaneous injection	2.78	3.00	3.00	3.00	N=9
IM injection	3.10	4.00	3.00	3.00	N=10
Urinary catheterisation	1.00	1.00	.00	3.00	N=3
ETCO2	3.33	4.00	3.00	1.00	N=21
SpO2	3.44	4.00	3.00	1.00	N=27

Two features, subcutaneous injection and urinary catheterization, rated below average physiological accuracy. As previously, the fact these procedures are not routinely practiced by Victorian Paramedics may have contributed to the low scoring, with only 9 and 3 responses respectively (Table 7).

Table 8: Auditory Features

	Mean	Median	Range	Inter-quartile Range	Valid N
Simulator speaking through mike	2.93	3.00	3.00	1.00	N=101
Heart sounds	3.43	4.00	3.00	1.00	N=49
Lung sounds	3.44	3.00	2.00	1.00	N=88
Bowel sounds	2.88	3.00	3.00	2.00	N=16
User programmed sounds	3.20	3.00	3.00	1.00	N=20

There were frequent technical difficulties encountered when using the 'simulator speaking through microphone' feature and this is reflected in the participants' low rating of this feature despite a strong response rate of 101, with 37 (34%) rating below average physiological accuracy. As previously discussed, listening to bowel sounds is not a routine procedure adopted by Victorian Paramedics and the response rate to this feature was only 16 (Table 8).

Analysis of percentage of responses using a binary variable recoding supported the above findings, identifying that 36 of 54 (66%) features of the simulator were rated by the respondents as at least 'average physiological accuracy'. Of the remaining 18, 13 could be excluded from analysis due to a less than 10% response rate. The remaining 5 included: laryngospasm (12 responses), decreased cervical movement (13 responses), bilateral carotid pulses (77 responses), simulator 'speaking' through microphone (101 responses), and bowel sounds (16 responses). In support of these findings, several of these features have been the basis of individual qualitative comments:

- *'chest rubber rubs, all auscultation of lungs sounded bad';*
- *'poor voice, radial pulse very sensitive and inconsistent';*
- *'speech and noise functions are not transmitting at all well to SimMan';*
- *'unable to auscultate BP, poor voice, unrealistically light touch to palpate radial';*
- *'having to trigger off carotid pulse and only short duration does not allow for assessment'.*

In addition there were multiple comments regarding the lack of pupil response and lack of realistic skin colour changes. These responses and approval ratings are summarised in Table 9.

Functional Fidelity

Overall, participant response rates to the 'application to Paramedic practice' component of the evaluation were consistently higher. However, due to the poor responses to the 'evaluation of simulator features' for those features not within the scope of Victorian Paramedic practice it was not considered valid to include these items in the analysis of functional fidelity. Functional fidelity is designed to examine how well the simulator is accepted by the end user, therefore it is reasonable to only consider the 'evaluation of simulator features' responses for those features that are within the Victorian Paramedic scope of practice. As such, all features that received less than 10% response to the evaluation of features, or were not rated at least 80% applicable to Paramedic practice by respondents, were removed from the functional fidelity evaluation.

These combined criteria resulted in the removal of 15 simulator features, of which 12 satisfied both elimination criteria, less than 10% response to the evaluation of features and also a rating of less than 80% applicability to practice. The exceptions were 'subcutaneous injection', which only satisfied the less than 10% response criteria, and 'automatic BP' and 'BP display', which only satisfied the less than 80% applicability to practice criteria. While these features may be removed from the analysis of evaluation of functional fidelity for the purposes of user 'face validity', they should still be factored in from an economic perspective – that is, are we paying for simulator capabilities that are not currently required in the context of the education of Victorian Paramedics, where perhaps a lower fidelity, less expensive simulator may be as functional and as acceptable to the students.

Table 9: Approval versus Applicability Comparison

	Average or Excellent approval responses (%)	**Beneficial or Essential applicable responses (%)**	**Response Rate**		**Average or Excellent approval responses (%)**	**Beneficial or Essential applicable responses (%)**	**Response Rate**
Airway features				**CPR**			
Airway anatomy	95	98	62 (54%)	ABC check	93	99	69 (61%)
Chest rise and fall	86	99	97 (85%)	Ventilation	93	90	40 (32%)
Pharyngeal obstruction	85	95	10 (8%)	Chest compression	96	98	30 (26%)
Tongue oedema	82	88	17 (15%)	ECG and HR display	98	96	59 (52%)
Trismus	90	97	29 (25%)	**Sounds**			
Laryngospasm	62	89	12 (10%)	Simulator 'speaking' through microphone	66	97	101 (89%)
Decreased cervical movement	67	81	13 (11%)	Heart sounds	93	89	49 (43%)
Decreased lung compliance	87	96	32 (28%)	Lung sounds	95	99	88 (77%)
Stomach decompress	78	78	10 (8%)	Bowel sounds	57	74	16 (14%)
Pulses				User programmed sounds	79	85	20 (16%)
Bilateral carotid pulses	79	99	77 (68%)	**Multiple Skills**			
L brachial pulse	87	98	82 (72%)	BVM ventilation	85	97	26 (23%)
L radial pulse	93	98	102 (90%)	LMA placement	80	97	20 (17%)
Bilateral femoral pulses	89	93	29 (25%)	OPA placement	97	97	26 (23%)
Synchronized with ECG or compressions	100	96	46 (40%)	NPA placement	90	97	20 (17%)
BP dependent strength	88	96	82 (72%)	ETT intubation	89	93	16 (14%)
Cardiac Functions				Combitube placement	0	52	3 (2%)
ECG library	100	92	36 (31%)	Retrograde intubation	33	51	4 (3%)
Compression artifacts	83	91	20 (16%)	LightWand intubation	0	49	4 (3%)
Cardiac monitoring (3 ld)	100	100	71 (62%)	Transtracheal jet ventilation	33	49	3 (2%)
Defibrillation	86	98	22 (19%)	Fibreoptic intubation	33	46	5 (4%)
External pacing	75	73	6 (5%)	Needle cricothyrot.	78	73	9 (7%)
Blood Pressure				Surgical cricothyrot.	60	68	5 (4%)
Automatic	88	74	35 (30%)	Chest decompression – mid-axilla	78	79	10 (8%)
Auscultated	82	99	84 (74%)	Chest decompression – 2nd intercostal space	88	90	17 (15%)
Palpated	95	100	96 (84%)	IV insertion	93	95	52 (46%)
Systolic and diastolic settings	97	96	75 (66%)	Subcutaneous injection	67	84	9 (7%)
BP display	97	79	39 (34%)	IM injection	82	93	10 (8%)
				Urinary catheter	0	41	3 (2%)
				ETCO2	90	82	21 (18%)
				SpO2	96	85	27 (23%)

Key: Shaded boxes represent those features rated applicable to Paramedic practice by at least 80% of respondents but falling below an acceptable level of physiological accuracy.

An analysis of the functional fidelity, based on the previously outlined model, compared those remaining features of the simulator against the physiological accuracy ratings. Of these, 5 features stand out as being considered important and applicable to Paramedic practice but falling below an acceptable level of physiological accuracy based on at least 10% participant response rate. These comparisons are outlined in Table 9 and can be summarised as follows:

- Laryngospasm
- Decreased cervical movement
- Bilateral carotid pulse

- Simulator speaking through microphone
- User programmed sounds

In support of the quantitative analysis of functional fidelity, individual respondents offered the following personal comments on the quality of the simulation experience:
- *'an excellent scenario tool';*
- *'good concept, better than using a student, fantastic potential';*
- *'using SimMan is far better/more realistic than non-responding dolls and enhances realism';*
- *'essential part of practice, ideal for scenarios, nothing else gets this close, great for trouble shooting'.*

These comments indicate that, as a general concept, the use of simulation as an educational experience was held in high regard with this particular model of simulator.

Discussion

The simulator used in this study has only been available since late 2001 and there is little evidence currently available regarding its effectiveness as an educational tool. Similarly, there is limited research focussing on simulation in prehospital education, with only one study related to acceptance of simulation by prehospital care providers.[9] Thus an important preliminary step, prior to ongoing projects, is to determine whether the simulator does indeed exhibit the features specified by the manufacturer as well as qualifying the physiological accuracy of the simulator as assessed by a population of Victorian Paramedics.

The necessity to routinely use high fidelity manikins is questioned by Champion and Higgins who suggest that user acceptance of the simulator as genuine (that is, displaying functional fidelity) is more important than physical fidelity alone.[3] However, a standardized tool for measuring functional fidelity has not previously been available to evaluate the patient simulator, calling for the development of such a tool as a component of this project, as outlined earlier. A comparison of physiological accuracy and applicability to Paramedic practice has therefore been utilised in this study as a means of determining functional fidelity. Results from this comparison suggest that Paramedics find the Patient simulator used in this study to show a high level of physiological accuracy and also be applicable to Paramedic practice and therefore show functional fidelity.

Studies across a range of health disciplines indicate the use of the patient simulator for simulation training is generally well accepted, suggesting high fidelity manikins do indeed have functional fidelity.[5-7, 9, 10] Utilising the same simulator as our study, Weller engaged a cohort of 33 medical students in simulation training, with all returning positive feedback about the use of simulation as a training tool.[11] A study by Devitt, whilst using a different simulator and a cohort of 102 anaesthesiologists and 37 medical students, also received positive feedback from the participants who rated the environment and the simulator as realistic.[7] Bond et al evaluated the level of acceptance of a high fidelity simulator as a training tool among a group of 78 diverse health professionals, including 8 Paramedics. Participants commented on the 'realism' of the simulator and were accepting of the simulator as a multiple purpose training tool.[9] Similarly, Tsai et al involved 20 paediatric residents in simulation training, with 75% reporting the simulator manikin and the simulation environment as realistic. In addition, 95% reported enjoying the experience and 90% valued simulation as an assessment tool.[12]

This study supports these findings, with Paramedic students demonstrating a high rating of the functional fidelity of the simulator used in this study. However, there are limitations involved

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in direct comparisons between the various studies. Most of the studies use different cohorts of participants, ranging across paramedics, nurses, medical students, and various medical specialists. It is therefore unclear whether their respective comments can be considered comparable. Also, a variety of manikins were used across the studies, with varying degrees of fidelity and different features. As a result, it is unreasonable to compare feedback on specific features of the simulator, however it would seem reasonable to compare general comments on the nature of the simulation experience as, revisiting the comment by Champion and Higgins, user acceptance of the simulator is more important than the actual physical features.[3] Lastly, whilst the various studies adopt a similar theme in examining qualitative aspects of user acceptance of a simulator, the specific questions addressed in each study are variable. It can therefore be difficult and possibly unreasonable to accurately compare the findings.

Further limitations specific to this study relate to the particular method adopted to analyse functional fidelity, which may not be applicable to other cohorts or in other contexts. In addition, whilst participants may have recognised a particular feature as applicable to their practice, they may not have had sufficient clinical exposure to provide an accurate analysis of physiological accuracy, thereby potentially distorting the data. The findings should be considered in light of these issues.

Whilst the functional fidelity of the simulator can be considered only one factor contributing to the effectiveness of simulation based education,[13] it is an important factor in ensuring students embrace the learning experience. The findings from this study afford the opportunity for ongoing educational initiatives and research in the training of Paramedics utilising the simulator.

Conclusion

The objective of this study was to undertake a structured evaluation of the Laerdal™ SimMan™ Patient Simulator. This involved an analysis of the physiological accuracy of the simulator features and their applicability to the practice of Victorian Paramedics, with a view to determining the "functional fidelity" of the simulator from the Paramedic perspective.

Previous studies in related health disciplines have identified an acceptance of a patient simulator as a learning tool by students. This study supports these findings, with Paramedic students evaluating the simulator as having high functional fidelity, using the criteria outlined for this study. The findings from this study afford the opportunity for ongoing educational initiatives and research in the training of Paramedics utilising the patient simulator.

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Appendix A – Evaluation Proforma

MONASH UNIVERSITY

Centre for Ambulance and Paramedic Studies

Evaluation of a

Patient Simulator

Laerdal™ SimMan™

Introduction

The aim of this questionnaire is to determine the suitability of a patient simulator (PS) for the purposes of education and training of Ambulance and MICA Paramedics, with a particular focus on development and improvement of clinical performance.

The evaluation will be undertaken on the following levels:

- PS features based on suppliers/manufacturers specifications
- Application to Paramedic practice (applicable to paramedic students only)

These results will be correlated to determine the *functional fidelity* of the PS.

The responses from the various evaluation groups are based on a 4 point Likert scale from worse rating to best rating.

The results of the questionnaire may be used for publication purposes and for reports prepared for the Victorian Trauma Foundation. No findings that could identify any individual will be published. Only the combined results from all respondents will be published.

Level of Qualification (please tick appropriate box)

Stage 1 Ambulance Paramedic Student	
Stage 5 Ambulance Paramedic Student	
MICA Paramedic Student	
Physician (specify speciality)	
Nurse (specify speciality)	
Other (please specify)	

Evaluation of PS Features

The primary focus of this evaluation is the specific features of the PS as outlined by the manufacturer[1]. The focus is on quantifying whether the PS does indeed exhibit the features specified as well as qualifying how physiologically realistic the feature is, with the rating scale ranges from 'not present' to 'excellent physiologically accuracy'. Where a feature is outside the respondent's scope of clinical practice place a tick or cross in the 'unable to comment' box.

Please place a tick or cross in the appropriate box.

Specified Feature	**Not present (1)**	**Poor physiological accuracy (2)**	**Average physiological accuracy (3)**	**Excellent physiological accuracy (4)**	**Unable to comment**
Airway features					
1. Airway anatomy					
2. Chest rise and fall					
3. Pharyngeal obstruction					
4. Tongue oedema					
5. Trismus					
6. Laryngospasm					
7. Decreased cervical movement					
8. Decreased lung compliance					
9. Stomach decompression					
Pulses					
10. Bilateral carotid pulses					
11. L brachial pulse					
12. L radial pulse					
13. Bilateral femoral pulses					
14. Synchronized with ECG or compressions					
15. BP dependent strength					
Cardiac Functions					
16. ECG library					
17. Compression artifacts					
18. Cardiac monitoring (3 ld)					
19. Defibrillation					
20. External pacing					
CPR					
21. ABC check					
22. Ventilation					
23. Chest compression					
24. ECG and HR display					
Blood Pressure					
25. Automatic					
26. Auscultated					
27. Palpated					
28. Systolic and diastolic settings					
29. BP display					
Sounds					
30. Simulator 'speaking' through microphone					
31. Heart sounds					
32. Lung sounds					
33. Bowel sounds					
34. User programmed sounds					
Multiple Skills					
35. BVM ventilation					
36. LMA placement					
37. OPA placement					
38. NPA placement					
39. ETT intubation					

[1] The product specifications are as outlined in 'Bringing Simulation to Life', Laerdal Medical Corporation, 2001.

40. Combitube placement					
41. Retrograde intubation					
42. Light Wand intubation					
43. Transtracheal jet ventilation					
44. Fibreoptic intubation					
45. Needle cricothyrotomy					
46. Surgical cricothyrotomy					
47. Chest decompression – mid-axilla					
48. Chest decompression – 2nd intercostal space					
49. IV insertion					
50. Subcutaneous injection					
51. IM injection					
52. Urinary catheterization					
53. ETCO2					
54. SpO2					

Please comment on any identified features that were not listed above:

Application to Paramedic Practice

The primary focus of this evaluation is to determine the relevance of the various features of the PS for the purpose of education and training of Paramedics.

Please place a tick or cross in the appropriate box.

Feature	Not at all applicable	Probably not applicable	Beneficial	Essential
Airway features				
1. Airway anatomy				
2. Chest rise and fall				
3. Pharyngeal obstruction				
4. Tongue oedema				
5. Trismus				
6. Laryngospasm				
7. Decreased cervical movement				
8. Decreased lung compliance				
9. Stomach decompression				
Pulses				
10. Bilateral carotid pulses				
11. L brachial pulse				
12. L radial pulse				
13. Bilateral femoral pulses				
14. Synchronized with ECG or compressions				
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18. Cardiac monitoring (3 ld)				
19. Defibrillation				
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CPR				
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Sounds				
30. Simulator 'speaking' through microphone				
31. Heart sounds				
32. Lung sounds				
33. Bowel sounds				
34. User programmed sounds				
Multiple Skills				
35. BVM ventilation				
36. LMA placement				
37. OPA placement				
38. NPA placement				
39. ETT intubation				
40. Combitube placement				
41. Retrograde intubation				
42. Light Wand intubation				
43. Transtracheal jet ventilation				
44. Fibreoptic intubation				
45. Needle cricothyrotomy				
46. Surgical cricothyrotomy				

47. Chest decompression – mid-axilla				
48. Chest decompression – 2nd intercostal space				
49. IV insertion				
50. Subcutaneous injection				
51. IM injection				
52. Urinary catheterization				
53. ETCO2				
54. SpO2				

Please comment on any features you feel are essential for paramedic practice that were not included on the PS: