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ORIGINAL RESEARCH

S-Vest: a novel hybrid method to allow standardised patients to put on the objective physical examination findings of a disease

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Received 2 July 2018
Revised 24 April 2019
Accepted 11 August 2019
Published Online First 28 August 2019

To cite: Berg D, Berg K. *BMJ Innov* 2019;**5**:78–81.

ABSTRACT

Background Simulation hybrids combine single modality simulation such as simulated patients (SP) with low-fidelity simulation to create a potentially more powerful set of educational tools. To make a hybrid that is credible, standardised and inexpensive remains a challenge. We describe the development of the simulation vest (S-Vest), an inexpensive, standardised teaching tool that is 'worn' by an SP to form a hybrid.

Methods We have created a vest which contains a set of speakers placed in an anatomical manner and produce sounds. The sounds played from a multitrack audio player are recorded in vivo from a patient with the real disease findings. The SP provides history while the vest provides the objective palpable and auscultatory findings. The speakers are placed in the routine standardised locations taught in physical examination.

Results We have developed several case scenarios designed for the vest. One of these cases is an elderly patient with aortic stenosis. The aortic stenosis case audio file has four unique tracks recorded over the precordium. Each track is played at the speaker appropriate to the physical exam findings. The SP plays an elderly man with chest pain. The vest provides the sounds of a loud systolic murmur with marked diminishment of S2 and a palpable thrill.

Conclusions The S-Vest is a low-fidelity, low-cost simulator to use in hybrid and simulation. The S-Vest can be used in a formative and summative Objective Structured Clinical Examination (OSCE) station and in skills attainment for learners in healthcare. We believe these tools will be of significant import to teaching clinical skills.

INTRODUCTION

The use of simulation in teaching and assessing skill sets has become an integral component of almost every healthcare provider training programme including medical school and residency. Many academic health centres and medical schools today have simulation centres, which use simulation teaching tools to teach and assess the attainment of these skills essential to clinical practice.

The teaching and assessment of clinical skills using simulation has been evolving for decades[1 2] and has been a major component in healthcare professional education.[3] With this evolution, several different modalities of simulation teaching tools have emerged, including human-based, low-fidelity and high-fidelity simulations.[4]

Human-based simulation includes simulated patients (SP) and standardised patients. In the past 40 years, human simulation has become a fundamental tool for reproducible, efficient teaching and assessment of skills in medical learners.[5 6] Barrows' classification[7] defines SPs as actors who can feign a specific history or a specific set of physical findings in a standardised, reproducible manner. Credible scripts and validated checklists are used to train these actors. Human simulation is excellent for teaching and assessing basic history taking, physical examination skills and interpersonal skills,[8 9] but lacks signs of physical disease unless the SP can feign the objective findings.

Hybrid simulations, which combine actors and task trainers, were described by Kneebone *et al*[10] in 2002 and have

Figure 1 Overall configuration of the vest. Wearable garment with speakers placed in material.

since evolved. Simulation hybrids combine single modality simulation such as SPs, and low-fidelity and high-fidelity simulations to create a potentially more powerful set of educational tools. To make a hybrid that is credible, standardised and inexpensive remains a challenge. We describe the development of an inexpensive, standardised, high-fidelity hybrid that combines an SP with the simulation vest (S-Vest).

In this paper, we present our experiences with the creation of this novel teaching and assessment tool and how we plan to use it for teaching and assessment purposes.

METHODS

Development of the S-Vest

We have created a garment which we call the S-Vest in which a set of speakers placed in anatomical manner produce sounds; one sound specific to each speaker. This S-Vest allows an SP to put on the objective physical examination findings of a disease. The components of the vest are illustrated in figure 1. The material is made of felt which has insulating properties to minimise the SP's native, heart, lung and abdominal sounds. The SP wears a shortened sleeveless T-shirt beneath the S-Vest. The speakers are placed in the vest on the inside to hide them. The placement is based on the routine standardised locations (figure 2) taught and used in physical examination.[11] Each hidden

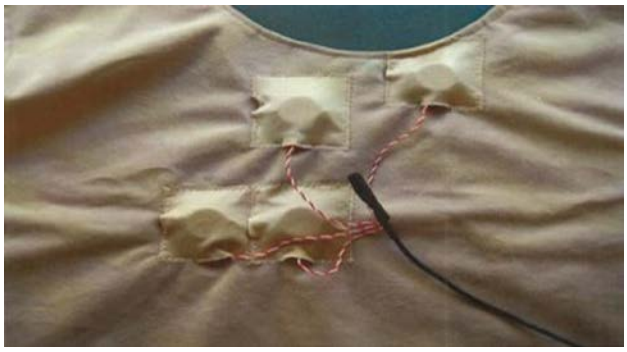

Figure 2 Placement of the speakers in standardised manner. Each speaker is attached to a different sound from the multitrack player.

speaker produces a specific sound that is generated by a multitrack recording of a real patient's findings. The recording was made using a recording stethoscope by one of the authors after receiving informed consent from a patient with the findings of a specific disease. The real patient's recorded physical exam findings are placed into an audio file that produces each sound, as recorded, at each site. Each sound recorded is played continuously from each speaker. To change real patient cases, a new file with different recorded findings from another patient is selected for use.

The audio player device is an MP3-type player that plays the recorded sounds of the real patient. The audio player device is affixed to the lower inside of the vest to hide it. The audio player device can be alternating current or direct current powered.

The S-Vest is fitted onto the SP so that the speakers are in appropriate physical examination places. The shirt is flesh coloured to represent simulated skin. Pockets for the speakers are sewn in or placed with Velcro strips on the inside of the vests, and Velcro is used to fasten the vest closed.

The examiner places hands on the surface of the S-Vest to palpate for pulsations and auscults using his or her own stethoscope. When placed in the appropriate sites, the examiner will hear the finding as heard from the original real patient. If the stethoscope is placed in an inappropriate site no finding is heard as the shirt insulates the examiner from the SP's native findings.

In addition to producing sound, the speakers, with the overlying material, are designed to produce a palpable vibratory sensation called a thrill. This palpable component of a murmur allows the learner to effectively grade the intensity of the murmur using the Levine system described in 1933,[11] in which a grade 4, 5 or 6 murmur has a thrill.

The total cost for the device is less than $400, which includes the speakers, the audio player device and the simulated skin material for the vest and time for vest construction.

Table 1 Examples of case scenarios for S-Vest

Diagnosis	Physical findings in S-Vest	History features
Aortic stenosis	Systolic murmur at base Diminished S2 Palpable thrill at base S4 gallop	Dizzy with exercise
Mitral regurgitation	Systolic murmur at apex Loud P2 Palpable thrill at apex S3 gallop	Dyspnoea with exercise
Pericarditis with pleuritis	Pericardial rub Pleural rub on left	Pleuritic chest pain Mild dyspnoea Mild orthopnoea

S-Vest, simulation vest.

A case scenario is written based, in part, on the original real patient's history so as to train the SP on history and case background.

RESULTS

We have two operational S-Vests and have several case scenarios specifically designed for the S-Vest (see table 1). One case is an elderly patient with aortic stenosis. The aortic stenosis case audio file has four tracks recorded over the precordium. Each track is played at the speaker appropriate to the physical exam findings as recorded on the real patient. The SP is cast to be an elderly man with chest pain that has some features atypical for angina and, when asked, reports slight dizziness with exercise, but no syncope. The patient is currently pain free. On examination, all is unremarkable except for the findings from the skin as simulated by the S-Vest. In this case, the right upper sternal border has a loud systolic murmur with marked diminishment of S2, and the left upper sternal border has a softer systolic murmur. The left lower sites have very soft, yet auscultative, systolic murmurs with a soft S4 present when the examiner listens with the bell. When palpating the precordium, the examiner can easily feel a thrill limited to the base of the heart.

In the postencounter, after the SP interaction, the learner is asked to state what findings she or he discovered. In addition, the learner is asked what the patient's diagnosis is and what the next step in evaluation should be.

This vest has been informally piloted with senior medical students during their fourth year Advanced Physical Diagnosis elective.[12] This class is offered three times per year with an average of 30 students per class. The vest has been used to teach students for the past 3 years. The majority of students reported the vest to be useful and easy to use, and stated it improved their cardiac auscultation skills. Future study is needed to measure the skills attainment and retention of learners' skills using the vest.

CONCLUSION

Teaching clinical skills with real patients can be challenging. In addition, the teaching and assessment of healthcare professionals in a reproducible standardised manner using real patients is often problematic. To meet these needs we developed the S-Vest. The S-Vest allows an SP to literally 'put on', that is, wear the objective findings of a disease.

Our teaching tool allows a high-fidelity transference of a specific patient's physical exam features to another individual to use them for standardised teaching and assessment purposes. The sounds are reproducible and of high fidelity because they are recorded in vivo from a patient with the real disease findings using a recording stethoscope. The sounds and pulsations are transferred in an exact anatomical pattern that is fitted to the individual SP.

The learner uses his or her own stethoscope to perform the exam on the standardised patient wearing the vest. This allows for skills attainment and structured practice in a credible patient-centric simulated environment. Another advantage is the user can effectively grade the intensity of a murmur using the S-Vest and thus learn the grading system as described by Levine.[11]

The limitations of the S-Vest include a need for the learner to still suspend disbelief. The garment must be perceived as the skin of the patient. In our initial use, one of the learners attempted to place the stethoscope under the S-Vest. The SP must be vigilant to make certain that the S-Vest fits correctly between learner encounters so that the speakers are in the appropriate physical examination locations. Future S-Vests will be made in small, medium and large sizes to accommodate for different sizes of SPs. Lastly, there must be access to patients with recordable physical exam findings to be placed in the S-Vest.

The S-Vest is a teaching and assessment tool which can be easily used in multiple venues in a standardised manner. The tool can be used in the classroom, in the simulation centre, in the clinic, or even at home for independent study and skills practice. The S-Vest is useful across all domains/disciplines and optimises hybrids—the coupling of an SP with a vest to provide subjective and objective features of a patient with a disease. This allows for the teaching and assessment of clinical skills such as history taking, physical examination and communication skills in a reproducible and standardised manner. The S-Vest is of simple design, portable and reproducible, and requires little maintenance. It can be used in any setting worldwide from the poorest to the most resource-rich areas.

We have described the development and potential uses of S-Vest, a new generation of high-fidelity but low-cost simulators for hybrid simulation. We are in the process of developing more real patient-based case scenarios for the S-Vest. Our goal is to use these in formative and summative Objective Structured

Clinical Examination (OSCE) stations and for both skills attainment and structured practice sessions for learners across disciplines and at multiple levels. We believe these tools will be of tremendous import to teaching clinical skills across disciplines and levels of training. Further research is needed to evaluate the efficacy of this model of hybrid simulation.

Acknowledgements We acknowledge Hy Kaplan (posthumously) for his advice during the development of the task trainer.

Contributors DB and KB designed and developed the task trainer, and wrote and edited the manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article.

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