

The use of Human Patient Simulators to enhance the teaching of undergraduate Physiology and Pharmacology

Dr Peter Maskell

Department of Physiology & Pharmacology
and
Applied & Integrated Medical Sciences (AIMS)
Centre for Excellence in Teaching and Learning,
University of Bristol, UK



3 main topics in this presentation:

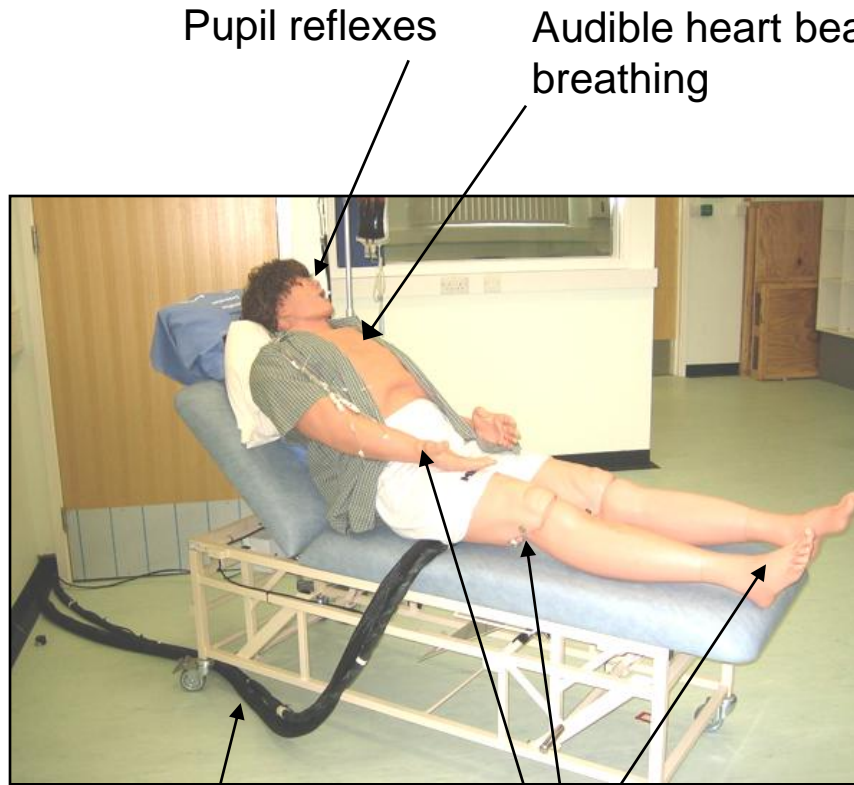
What is the Human Patient Simulator and what can it do?

Integrating, designing and validating scenarios for demonstrating Physiology and Pharmacology

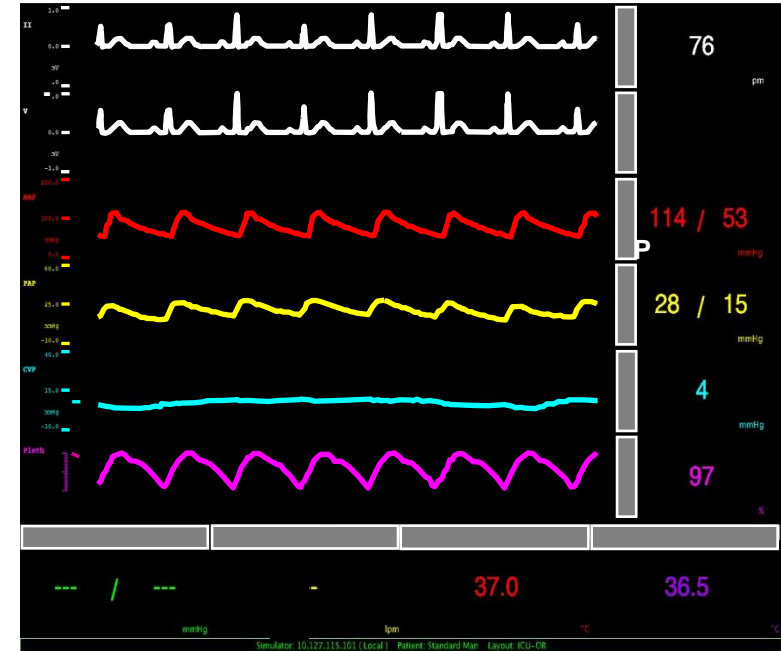
Is Human Patient Simulator teaching actually any good?



Overview of the Human Patient Simulator (HPS) - 'Stan'



Gas supply (compressed air, oxygen, nitrogen and CO₂)



Physiological data display

Physiological parameters:

- Heart rate and ECG
- Arterial and venous blood pressure
- Cardiac output
- Arterial oxygen saturation
- Composition of expired air

Drug recognition system



Drugs can be administered via:

- Bar-coded syringes that code for drug.
- Operator addition via computer

1. 'Standard' drug response is pre-scripted by the manufacturer.
2. Scripting of software by the user – 'pharmacology drug editor'

The Bristol Physiology & Pharmacology approach

- embed simulation **within** existing curriculum to enhance teaching & learning
- use simulation to **illustrate** physiology and pharmacology that students find conceptually difficult and / or cannot be demonstrated on the students themselves
- use simulation to extend the range of topics- eg. extreme physiology, drug interactions

Scenarios already embedded include illustration of

- normal function and breakdown of homeostatic mechanisms
- autonomic control mechanisms
- response to haemorrhage & physiology of the baroreceptor reflex
- response to breathing inspired air of different compositions -the physiological control of ventilation



Typical 'Stan' small group teaching session

- Groups of up to 20 students
- One teacher, one support technician
- Typical session lasts for around 30 - 45 min
- 'Stan'-based sessions are linked to 'hands-on' practical classes



First year undergraduate 'Stan' scenario

Sequence of events ...

- Protocol sheets for the session are circulated to students
- Sheets contain tables and diagrams to be annotated during the session
- Interaction with 'Stan' during the session is encouraged
- After the 'Stan' session, students analyse the data and draw relevant graphs



Second year medical students examine 'Stan'

Cardiovascular pharmacology scenario (30 minutes)

This integrated session looks at the *in vivo* effects of:-

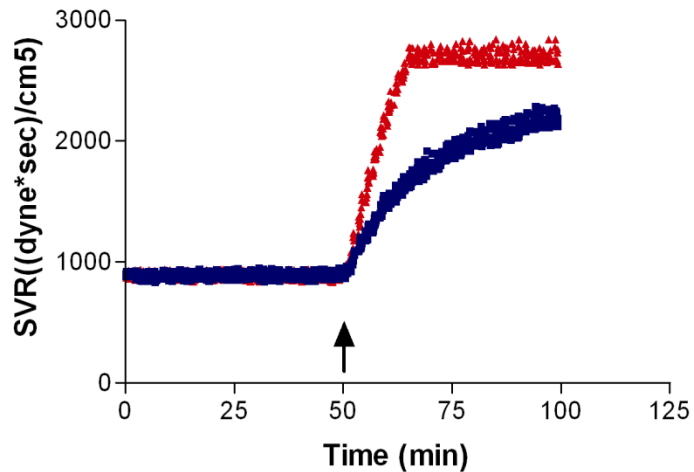
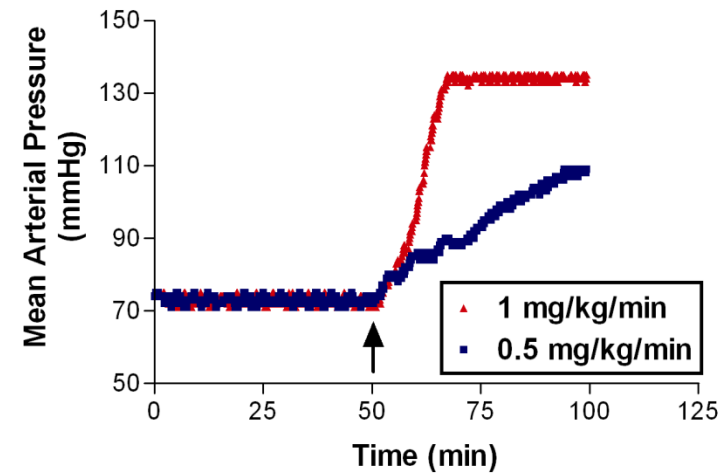
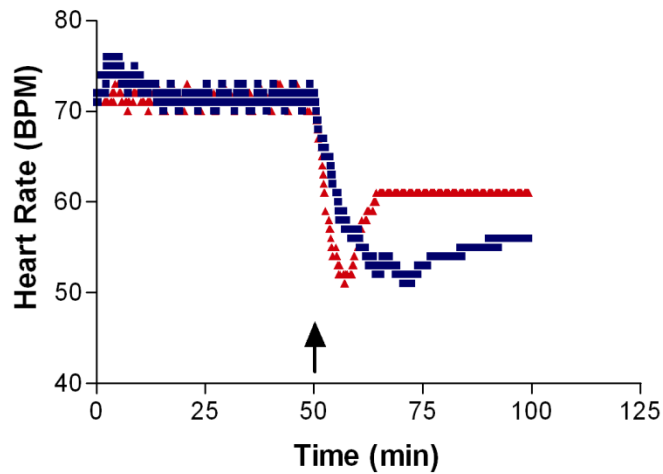
- Atropine
- Propranolol
- Dobutamine
- Phenylephrine

Direct measurements are made of:

- simulated heart rate
- cardiac output
- arterial blood pressure

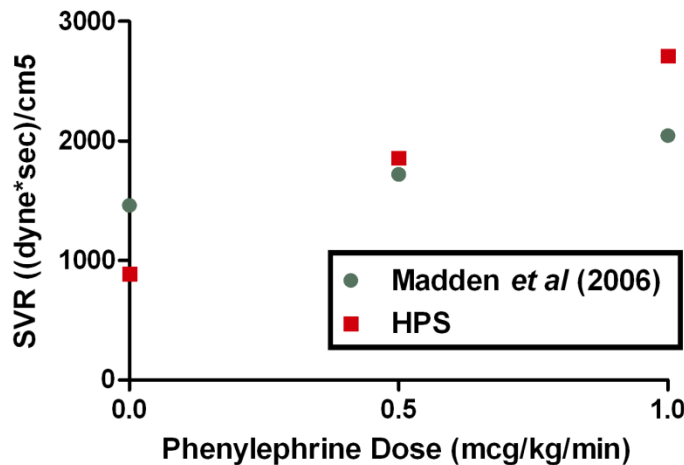
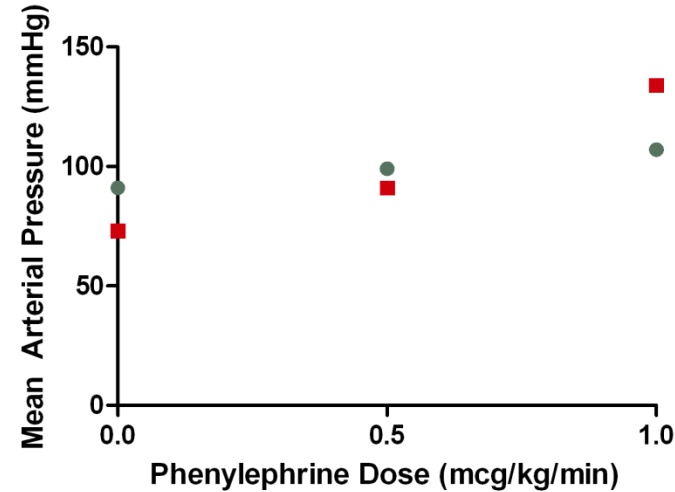
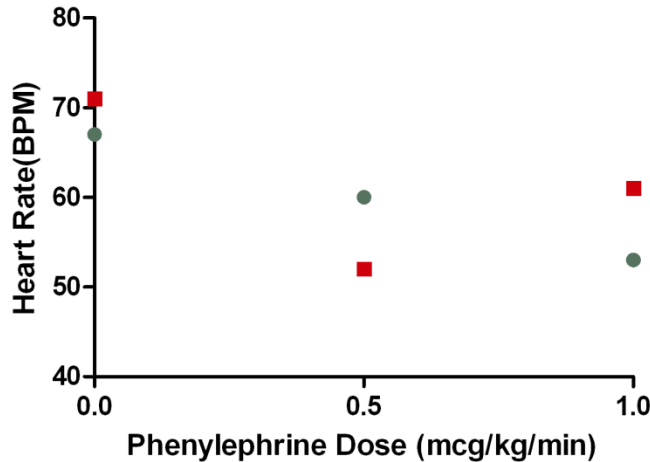
Values are derived for Mean arterial pressure and total peripheral resistance (systemic vascular resistance)

Effect of phenylephrine on heart rate, blood pressure and Systemic vascular resistance in the HPS



- Dose dependent effects obtainable
- But may be 'abnormal'

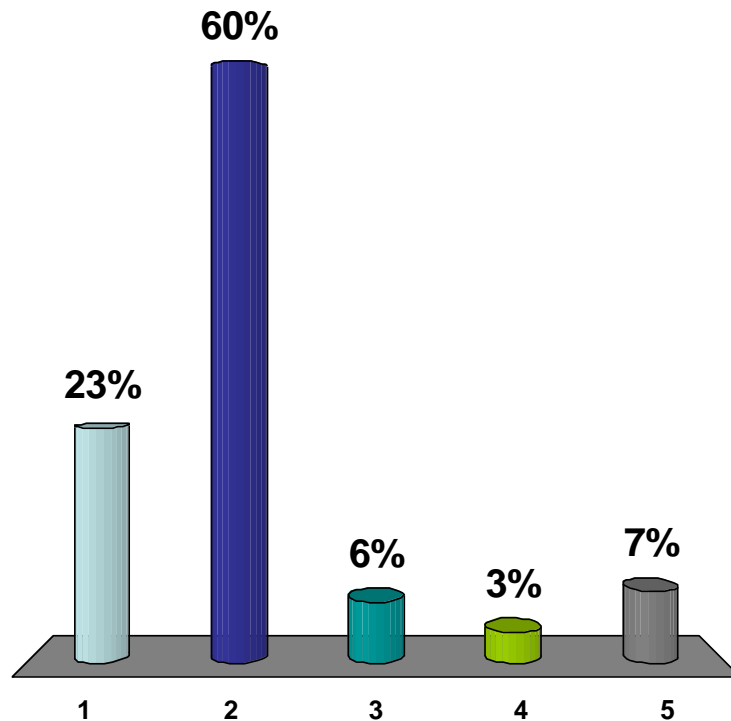
Comparison between HPS and Published Data



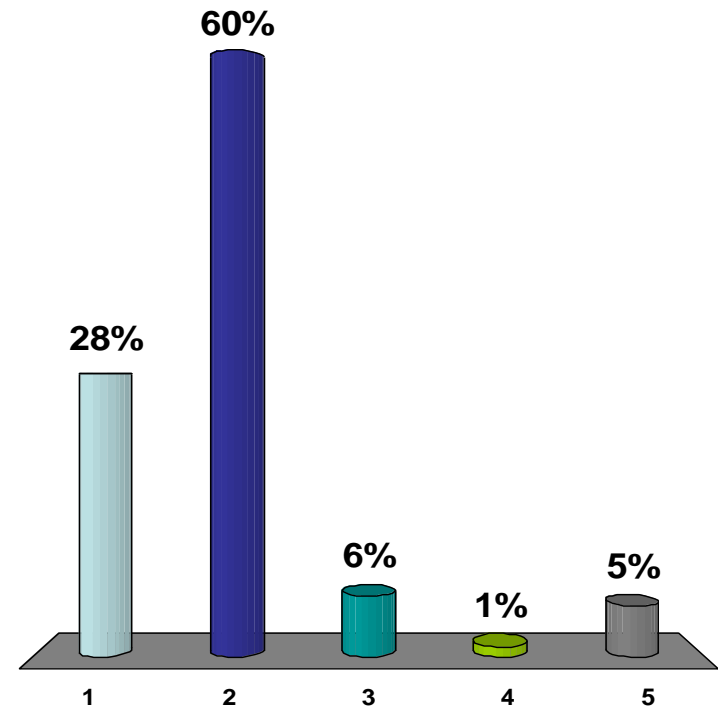
•The HPS pharmacology deviates from *in vivo* data in places

- Can be overcome as long as careful comparisons are carried out
- Correct doses need to be selected to fit the scenario
- May need scripting

Student feedback for the control of ventilation scenario (n=250)



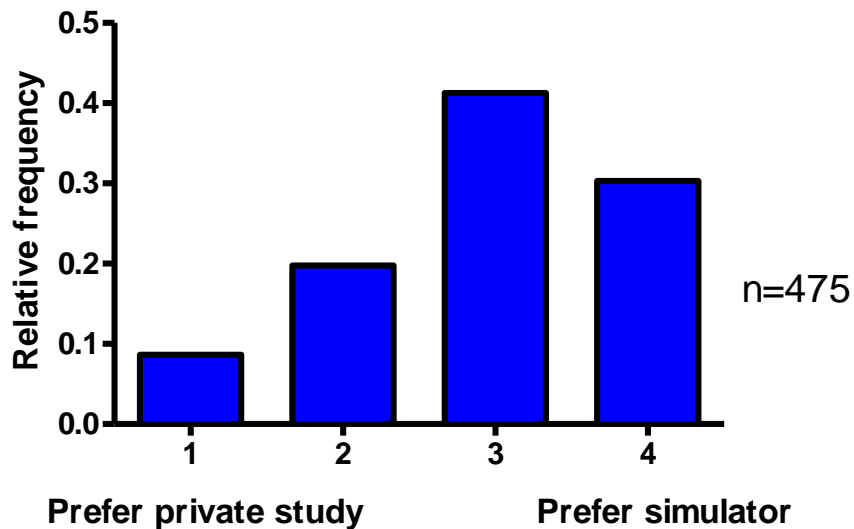
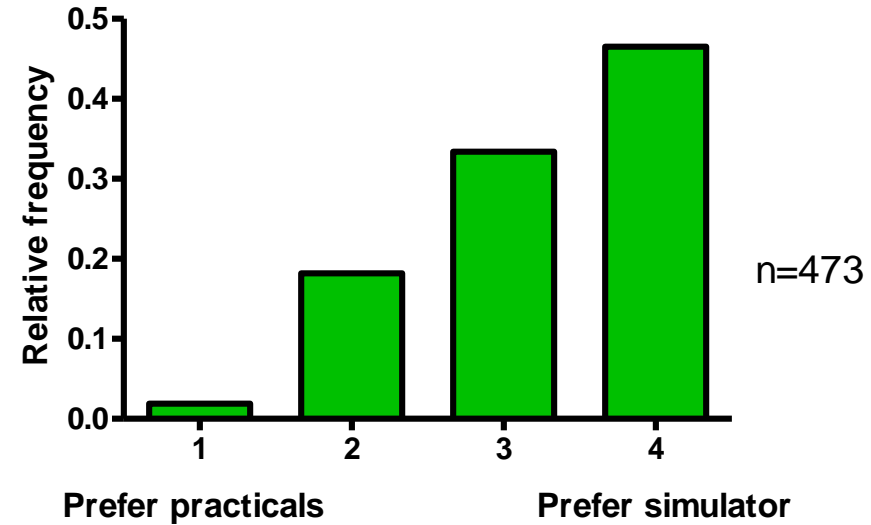
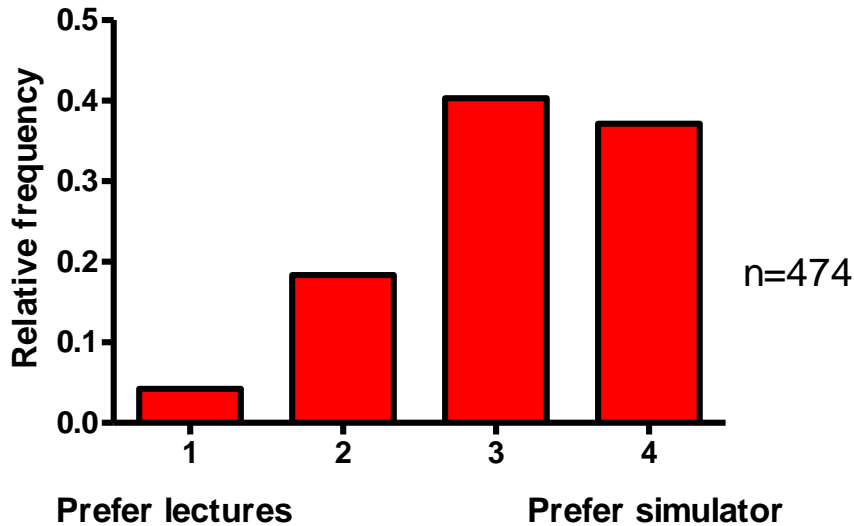
“The simulator session was helpful in increasing my understanding of the control of ventilation”



“The simulator session complemented the physiology teaching provided in the respiratory lectures and practicals”

1: Strongly agree; 2: Agree; 3: Neutral; 4: Disagree; 5: Strongly disagree

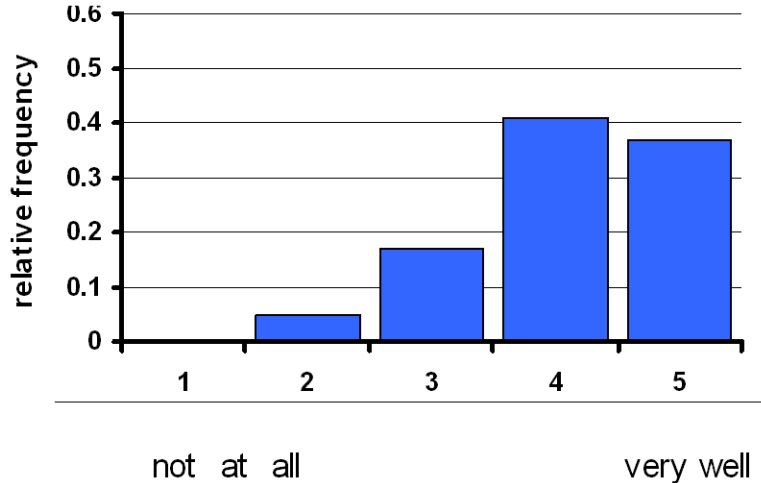
Learning preferences- physiology teaching with HPS



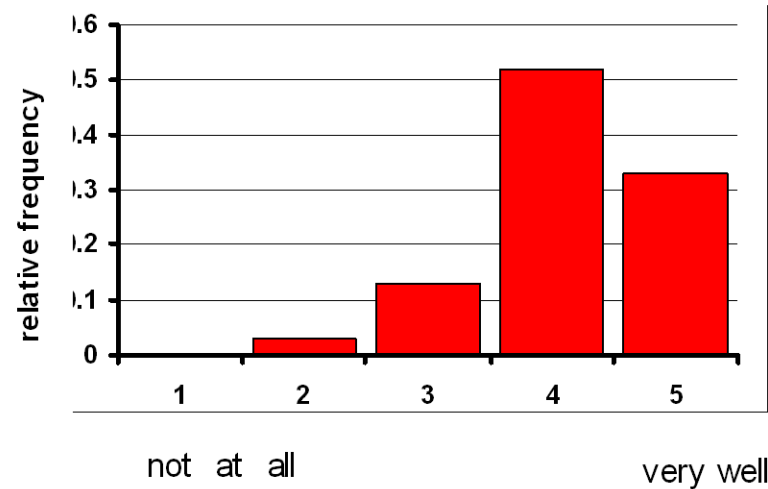
Learning and teaching preferences expressed by 475 first year students on a range of degree programmes

Student feedback from cardiovascular pharmacology 'Stan' session

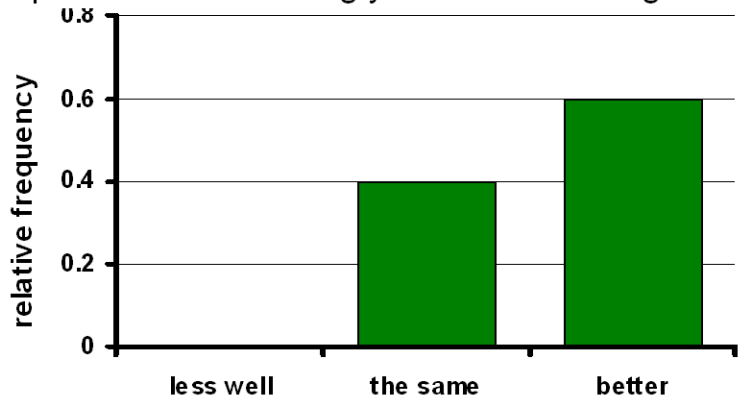
How well did the 'Stan' session help you understand the clinical relevance of drugs acting on the cardiovascular system?



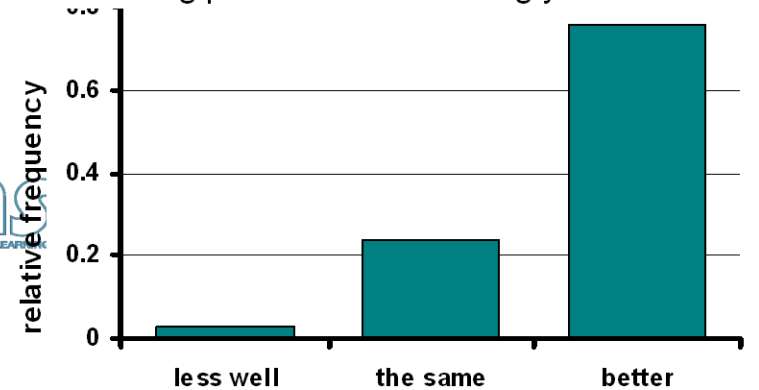
How well did the 'Stan' session help you understand the control of blood pressure?



How did the 'Stan' session compare with the Langendorf heart practical in increasing your understanding?



How did the 'Stan' session compare with the isolated vascular ring practical in increasing your understanding?



Effect of HPS teaching on achievement- control of ventilation scenario

	Pre-teaching test score (%)	Post-teaching test score (%)	Improvement (%)
Small group tutorial	44.6	51.5	7
Human Patient Simulator scenario	40.3	53.7	14

Preliminary study (2007-8) first year Dental Science students
(n=72)

'Stan' – more than just a teaching tool...

- Outreach
 - Summer schools
 - Widening participation
- Final year projects
 - Investigation and development of new scenarios

HPS in teaching physiology & pharmacology- benefits and limitations

Benefits

1. Effective for illustrating conceptually difficult scientific concepts and those that cannot be demonstrated on student volunteers
2. 'Standard' data
3. Engaging for students and staff
4. Hi-fidelity 'capable'
5. Teaching in pre-clinical years prepares students for later use in a clinical context
6. May be superior to traditional teaching methods in improving students' understanding of physiology

Limitations

1. Resource-intensive in small groups
2. Reduce appreciation of inter-individual variations in biometric data - important to combine with 'real' data measurement
3. Requirement to improve the fidelity of the simulated data compared with *in vivo* data
4. Modelling mainly limited to cardiovascular and respiratory systems

AIMS CETL HPS team

Dr Rich Helyer
Dr Tim Lovell
Dr Lauren Hughes
Prof Judy Harris

Dr Eugene Lloyd
Mr Peter Dickens
Mrs Clare Thompkins
Prof Stephen Lisney

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