LIVE TEACHING DEVELOPMENT TEAM PRIZE 2013

Development of a Veterinary Virtual Stethoscope

Virginia Luis Fuentes, Chris Trace, Sonya Powney, Adrian Boswood and Brian Cox[*]

Project Overview

Auscultation of heart sounds is a core skill in veterinary medicine, but the traditional approach to teaching this skill depends on the availability of suitable cases and one-to-one mentoring. A decline in cardiac auscultation skills has been widely recognised in medical students and newly qualified doctors,[1] although simulation-based training in auscultation has been shown to be effective in improving these skills.[2] A digital approach to teaching small animal auscultation could have similar benefits, increasing student exposure to a wide range of heart sound abnormalities in a self-study format, and extending access to preclinical and postgraduate students as well as clinical students.

The RVC already uses a heart sounds computer aided learning (CAL) programme[a] to help teach auscultation to 3rd year BVetMed students. The proposed project will expand the current limited library of heart sounds in conjunction with existing RVC electronic case-based teaching[3] for students on clinical rotations. The expanded heart sounds library will be used to adapt and extend a Virtual Stethoscope[b] already developed within the college to provide an innovative and interactive tool to help students gain familiarity with normal and abnormal heart sounds, challenging them to refine their diagnostic skills without compromising the safety of real patients.

The Virtual Stethoscope will be enormously valuable for increasing the confidence in auscultation of students on clinical rotations. As small animal cardiology is now a 'Tracking' rotation some students will not participate in the clinical rotation at all, so alternative methods for developing auscultation skills will be particularly important for these students. The Virtual Stethoscope will also enable preclinical students to develop their skills in auscultation of normal heart sounds at an early stage. With more challenging heart sounds, the tool is likely to find further applications for graduates. This may range from continuing professional development modules for general practitioners to advanced residency training for MVetMed postgraduates. It is intended to eventually extend the use of the Virtual Stethoscope under a restricted licence outside the RVC, through the development of a mobile app.

Background to Proposal

Electronic case-based learning resources are being increasingly used in healthcare education, partly in response to increasing demands on clinician time[4]. They allow students to practice making clinical decisions in a safe environment without risk to patients[5]. This model of learning is widely recognised as an effective means of providing exposure to clinical teaching material for both undergraduate and CPD learners[6]. Hege *et al.* (2007) described how important it is to integrate fully any case-based learning tools within a

---

[*] *Winner of Jim Bee Educator Award 2008*

curriculum to attain their maximum benefit. It is also recognized in medical education that the development of effective case-based online resources requires a significant financial and time commitment[7].

The RVC has been one of the leading centres of expertise in the use of electronic cases in veterinary education. This has included the development of a virtual emergency case simulator in 2003, introduction of a BVetMed heart sounds CAL,[a] development of interactive cases in 2008[8], and the introduction of e-cases to clinical rotations in 2010[3]. In 2012, Novartis Animal Health provided funding for the project team to develop a sophisticated set of problem-based clinical cardiology 'virtual patients', the first of which was launched at BSAVA in April 2013 as the eCardio Consult[b]. An integral part of these virtual patients is a facility to auscultate the canine chest.

Verbal feedback from final year students participating in the RVC Small Animal Cardiology tracking rotation confirms that students often feel anxious about their auscultation skills. While students generally perceive an improvement in their auscultation abilities over the course of the rotation, they recognize their shortcomings and are likely to welcome further learning opportunities. Students who do not select Small Animal Cardiology as a tracking rotation are likely to be at a further disadvantage in terms of auscultation skills.

This project sets out to develop a veterinary 'Virtual Stethoscope' that will be integrated into clinical teaching of undergraduate and graduate cardiology.

Project Aims

The project aims are:

(1) to record heart sounds from clinical patients seen by the Cardiology Service of the Queen Mother Hospital for Animals (QMHA)

(2) to integrate these sounds in an interactive tool (the 'Virtual Stethoscope') developed by the Project Team

(3) to employ the Virtual Stethoscope in a range of applications, including online auscultation tutorials, auscultation self-assessment exercises, and as part of the diagnostic data for 'virtual patients'

(4) to evaluate the impact of the Virtual Stethoscope by soliciting feedback and monitoring usage by clinical rotation students

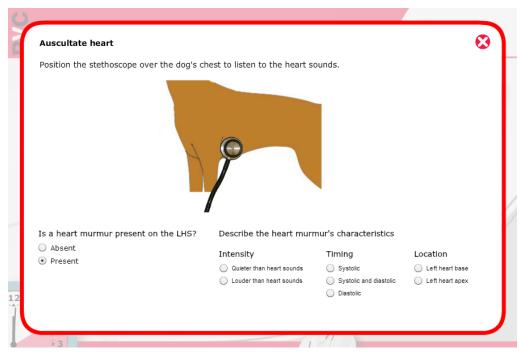## Methodology

(1) Recording heart sounds

Two Littmann electronic stethoscopes[c] will be used by clinicians and students of the Cardiology Service in the QMHA to record the heart sounds of canine and feline patients. Recorded sounds will be transferred by Bluetooth technology to a laptop with StethAssist™ software. For each heart sound recording, associated (anonymous) clinical details will be

recorded, including key history and physical examination findings. The audio files of recorded sounds will be uploaded onto the RVC's Asset Bank[d] and tagged to enable subsequent integration into the virtual stethoscope.

(2) Development of the Virtual Stethoscope

The Virtual Stethoscope will be a computer-based simulation of auscultation, based on further development of the existing basic stethoscope tool that was created for the Novartis eCardio Consult case. This tool will allow students to drag a virtual stethoscope chest-piece over an image of a canine or feline thorax to interrogate the different heart sounds. The existing stethoscope tool will be enhanced to provide a more sophisticated interface. Flash, iOS and Android versions will be produced so it will be usable on both computer and tablet devices. The recorded audio files and tutorials will be integrated, with the capability for addition of new heart sounds.

A range of abnormal heart sounds will be incorporated, including the main categories of heart murmurs, gallop sounds and arrhythmias. It will be possible to characterise murmurs according to the timing within the cardiac cycles (eg. holosystolic / midsystolic/ continuous/ diastolic) and by location over the thorax (see screenshot below of the existing stethoscope tool for the eCardio Consult). Further advances in the Virtual Stethoscope should also allow characterisation of intensity and murmur quality.

Screenshot of virtual stethoscope used in the eCardio Consult

(3) Applications of the Virtual Stethoscope

Tutorials will be created based on the Virtual Stethoscope, to guide the student through recognition of normal and abnormal heart sounds. Phonocardiogram graphic displays exported from the StethAssist software will help 'visual learners' recognise the difference in

sounds. Differential diagnoses will be provided for different heart sound abnormalities. These tutorials will be welcomed by clinical students rotating through Cardiology, but may be particularly valuable for those students who have not elected to participate in the Small Animal Cardiology tracking rotation.

Self-assessment exercises will be available where users can check their understanding and recognition of heart sound abnormalities. Random heart sounds will be played, giving the student the opportunity to test their auscultation ability. A similar example exists in an online ECG simulator[e]

eCases will benefit from addition of the Virtual Stethoscope, as auscultation is such a vital part of clinical investigation of cardiac patients. It is likely that eCases will be increasingly used for undergraduate, postgraduate and continuing professional development clinical teaching in the future.

A mobile app version will be created, to allow use of the tool offline on mobile and tablet devices.

(4) Evaluation of the Virtual Stethoscope's impact

A feedback form will be incorporated into the package for students to provide comments and suggestions, and usage of the tutorials and self-assessment exercises will be monitored. In addition, students will be asked to reflect on their use of the virtual stethoscope during clinical rotations. These data will be analysed and submitted as part of a peer reviewed publication at the end of the funded project. The project will be presented at the Association of Medical Education in Europe conference in 2014.

Benefits to learning and teaching in the college

Creation of an interactive Virtual Stethoscope would benefit veterinary undergraduates and graduates on a number of levels, including:

- providing early exposure to normal cardiac auscultation for preclinical students
- improving student confidence in cardiac auscultation
- providing a fun way for students to familiarise themselves with heart sounds, thereby improving student uptake
- enriching the content of eCases by providing key information on auscultation
- allowing an effective way for self-assessment of auscultation skills, which could benefit undergraduates and clinical training scholars
- providing a tool for formative and summative examining
- an opportunity for the RVC to further cement its position as a centre of excellence in online teaching

Team Members

Virginia Luis Fuentes	Project lead and clinical coordinator
Chris Trace	Project management and coordinator
Sonya Powney	Coding and instructional design of virtual stethoscope and mobile app.
Adrian Boswood	BVetMed Cardiovascular Strand Leader
Brian Cox	Technical specialist with expertise in editing audio and other media

Timescale

Project Phase	2013						2014								
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
Project planning	▓														
Heart sounds recording		▓	▓	▓	▓	▓	▓								
Tutorial Creation			▓	▓	▓	▓	▓	▓							
Tool Development								▓	▓	▓					
Evaluation											▓	▓	▓	▓	▓

Budget

	Days/Units	Unit Cost	Total
Staffing			
Project management (CT)	15	300	4500
Technical developer (SP)	10	300	3000
Digital editor (BC)	3	300	900
Equipment			
Littmann electronic 3200 stethoscopes (2)	2	288	576
Laptop for editing and uploading media	1	700	700
Dissemination			
AMEE Conference 2014			400
Total			**£ 10,076**
Total requested			**£10,000**

References

1. McKinney J, Cook DA, Wood D, Hatala R. Simulation-based training for cardiac auscultation skills: Systematic review and meta-analysis. *Journal of General Internal Medicine.* 2013;28:283-291

2. Alam U, Asghar O, Khan SQ, Hayat S, Malik RA. Cardiac auscultation: an essential clinical skill in decline. *British Journal of Cardiology.* 2010;17:8-10

3. Trace, C, Baillie, S. and Short, N. Development and Preliminary Evaluation of Student-Authored Electronic Cases *Journal of Veterinary Medical Education.* 2012; 39(4):368-374.

4. Patterson JS. Increased Student Self-Confidence in Clinical Reasoning Skills Associated with Case-Based Learning (CBL). *Journal of Veterinary Medical Education.* 2006; 33(3):426-431.

5. Bearman M. Is virtual the same as real? Medical students' experiences of a virtual patient. *Academic Medicine.* 2003;78(5):538-45.

6. Cook DA, Triola MM. Virtual patients: a critical literature review and proposed next steps. *Med Ed.* 2009;43(4):303-11.

7. Hege I, Ropp V, Adler M, Radon K, Mäsch G, Lyon H, Fischer MR. Experiences with different integration strategies of case-based e-learning, *Medical Teacher.* 2007; 29(8): 791-797

8. Allenspach K, Bell J, Whittlestone K. Interactive Clinical Cases in Veterinary Education Used to Promote Independent Study, *Journal of Veterinary Medical Education.* 2008; 35(4) 589-594

Links

a: https://intranet.rvc.ac.uk/TeachingOnlineLearning/Heart_Sounds/Index.htm

b: http://www.rvc.ac.uk/review/cardiocases

c: http://solutions.3m.co.uk/wps/portal/3M/en_GB/Littmann-Gallery/stethoscope/electronic/model-3200/

d: https://assetbank.rvc.ac.uk/

e: http://skillstat.com/tools/ecg-simulator