RESISTANCE MOVEMENTS: COMBATTING INFECTION RISK IN VETERINARY PRACTICE THROUGH VISUALISATION METHODS

ALASTAIR MACDONALD
THE GLASGOW SCHOOL OF ART
A.MACDONALD@GSA.AC.UK

MATTHIEU POYADE
THE GLASGOW SCHOOL OF ART
M.POYADE@GSA.AC.UK

SHONA NOBLE
THE GLASGOW SCHOOL OF ART
S.NOBLE@GSA.AC.UK

ROBERTO LA RAGIONE
UNIVERSITY OF SURREY
R.LARAGIONE@SURREY.AC.UK

FRAJE WATSON
FITZPATRICK REFERRALS LTD
FRAJEW@FITZPATRICKREFERRALS.CO.UK

MARK CHAMBERS
UNIVERSITY OF SURREY
M.CHAMBERS@SURREY.AC.UK

ANDREW WALES
UNIVERSITY OF SURREY
A.WALES@SURREY.AC.UK

KAYLEIGH WYLES
UNIVERSITY OF SURREY
K.WYLES@SURREY.AC.UK

INTRODUCTION

Antimicrobial-resistant (AMR) bacteria are an established and growing issue in companion animal veterinary practice in the developed and developing world. Effective infection prevention control measures (ICMs) are essential for tackling the AMR problem to reduce antibiotic use. The uptake of appropriate ICM is heavily influenced by human risk perception and consequent behaviour and the way humans and animals interact with the physical environment of the veterinary practice. Effective communication and teaching tools are therefore necessary to ensure the understanding and behaviours of the broad range of individuals (clinical and non-clinical) comprising the team are in line with scientific recommendations. Whilst data exist to inform best practise in ICM, they are normally published in academic journals, thus having limited impact on how practitioners understand and practise ICM in their working environment. Innovative ways of communicating risks to practitioners in this context are therefore required.

AMRSim

The research team's ambition is to change the perception – in veterinary staff - of the risk of infection, leading to a reduced risk of bacterial contamination and infection, and ultimately reduced reliance on antibiotics.

The researchers' approach is to 'make visible the invisible' through the building of a three-dimensional graphical simulation tool (AMRSim: A Microbial Reality Simulator) showing the interior of a veterinary practice in which humans, animals, and microorganisms (bacteria in this study) interact, according to rules observed from real-life. This will be used to support an intervention, a training session with veterinary practice staff to encourage effective reflective behavioural changes that positively impact on microbial contamination, thereby reducing the risk of the development, acquisition and transmission of harmful bacteria.

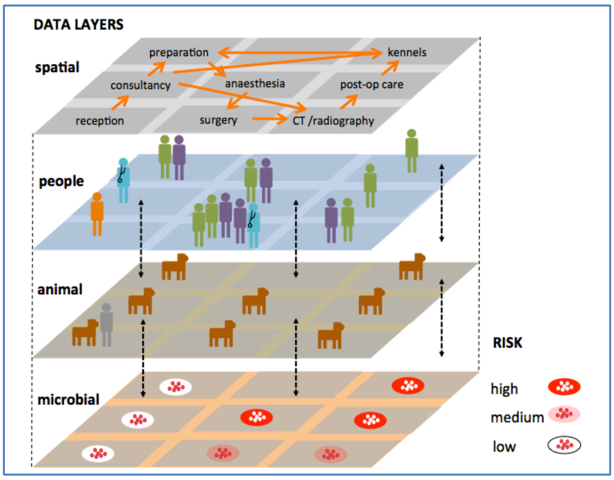

Figure 1: Original concept for the AMRSim tool: different layers of data which can be switched on and off singly or in combination.

The AMRSim tool is being co-developed by a multi-disciplinary research team (co-design, software engineering, environmental psychology, veterinary bacteriology, pathology and veterinary infectious disease expertise, microbiology, anti-microbial resistance and veterinary nursing) and through a series of co-development workshops involving practitioners.

METHOD: DEVELOPMENT PROCESS

The development process has had a number of stages:

1. VIDEO CAPTURE OF PROCEDURES

The team gathered video data for the purposes of 3D modelling through the capturing of similar surgical procedures performed on 3 separate animals during the patient journeys through the practice spaces. Two levels of data were captured on video: 1) the *flow* of humans and animals through the different rooms in the practice; and 2) *interactions* between humans, animals and their environment. This helped establish behaviours and movements, types of contact, and how much contact time there was between person-animal, person-surfaces, and animal-surfaces in each 'space'.

2. RISK ANALYSIS

One of the patient journey videos from stage 1 was selected and edited down for 'significant events' and then evaluated by five of the research team. Each person watched the video and independently recorded cross-contamination events, the event's risk level (low, medium or high) and their perception of risk for this event through a log file: the mean risk was calculated for risks identified by 3 or more experts. The frequency of these events was estimated and multiplied by the mean risk to give the overall 'risk importance'. A total of nine risk events were identified in the patient journey through this process, which were ranked in order of importance (risk x frequency) with a short phrase describing the event, and at what points in the edited video these occurred.

3a. PROCEDURE MODELLING AND ANIMATION

The above process was to identify, from the captured video footage, an understanding of potentially risky behaviour in a common surgical procedure which could be modelled and incorporated into the digital tool. Due to its risk importance established in the previous stage, the pre-surgical preparation stage of the patient journey was selected for modelling as this stage involved a number of different individuals (auxiliary, nurse, and veterinary surgeon) and a number of procedures such as anaesthetising, catheterising, and preparation of the site for surgery. The tool was conceived as having two layers: layer 1 for the modelling of 'visible' risks; and layer 2 for the 'invisible' risks (explained further below).

3b. VERBAL TRAINING SCRIPT DEVELOPMENT

As the digital tool was intended to support a staff training session, a detailed verbal script was also developed - in parallel with the above digital modelling of the simulated procedure - to engage trainees in a discussion to determine the extent to which the training objectives had been achieved.

4. INTERVENTION REFINEMENT

The above procedure modelling and script development was refined through an iterative process of four staged development workshops involving not only all the team members but participants external to the research team who were all veterinary teaching clinical fellows, i.e., practicing veterinary surgeons.

These external participants, who would not be involved in the final trial, were invited to a participate in a series of four co-development workshops, acting in the roles of trainees and/or critical friends (figure 2). They were invited to respond to a set of verbal and written questions and together with videos of these sessions, were used for post-workshop analysis.

5. INTERVENTION DEPLOYMENT

The intention is to run the training session within a 30-minute time slot, as this would realistically reflect time available during a busy practice day and feedback from early trials indicates the team is on target with this.

EVALUATION

Data will be collected at two time points: pre-intervention in year 1 of the project – the results of which have been used for input into the digital tool, and post-intervention in year 2 to be used to monitor changes in perceptions compared to the earlier data collected. For both time points, questionnaires with quantitative and qualitative components (e.g. using and adapting established measures) will be used on staff (vets, nurses, and auxiliaries); half of which will experience the intervention, Group A $n \approx 30$; whereas half will act as a control comparison Group B, $n \approx 30$).

Figure 2: Stage 3 workshop simulated training session with external participants (practicing veterinary surgeons).

DISCUSSION

Feedback during the above development process has indicated that:

- Although the software development for the 3D animation has been labour-intensive, it ultimately allows a much more flexible and adaptable approach to what can be presented to trainees. It is infinitely adaptable (compared with video which needs to be re-shot): each scene can be viewed from any angle, zoom-in/out, re-running of scenes, and the 'invisible' layer 2 can be placed into 3D space, rather than as a 2D overlay. These are adjusted by a series of controls.
- While there can be some pressure to develop a hyper-realistically detailed, fully coloured simulation of reality, previous studies [1, 2, 3] had proved it was very difficult to 'make visible' the other essential 'invisible' information against this.
- The 'two-layer' approach has appeared to work well: layer 1 provided a monochromatic 3D animation of the preparation procedure, behaviours, actions and interactions between staff, animal, equipment and environment (figure 3). Two versions of layer 1 allowed the showing of: 1) few ICM; and 2) a number of ICMs in place (green - figure 4). Layer 2 indicated, through the use of colour, the presence of bacterial contamination and its spread through physical contact (red - figures 5 and 6).

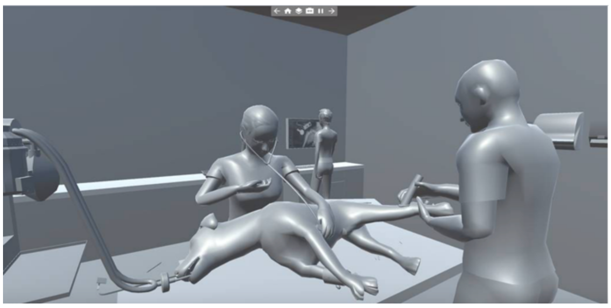

Figure 3: Layer 1 showing the surgical procedure with in-built risky behaviours.

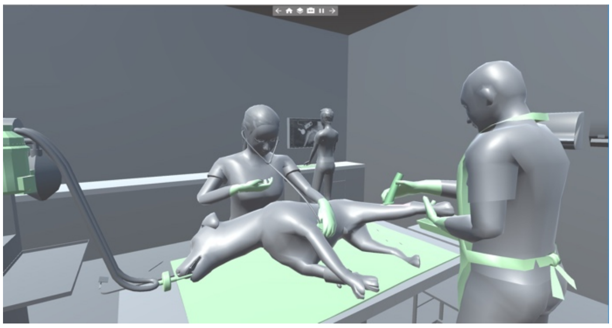

Figure 4: Layer 1 showing ICMs in place.

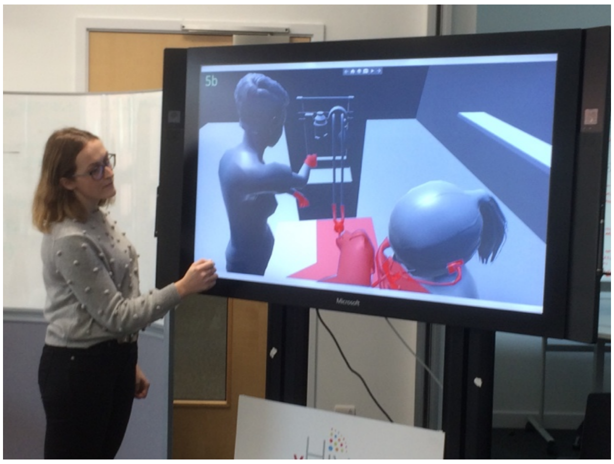

Figure 5: Stage 3 workshop interactive simulated training session with layer 2 'switched on' to illustrate transfer of contamination during a surgical procedure.

- A high degree of fidelity in the modelling of the details of the procedures, actions and interactions was required as feedback during the iterative development indicated that if details were inaccurate they proved to be a distraction to the particular training points to be made during the session. It was this investment in fidelity which proved to be reassuring to the external participants and allowed them to concentrate on the portrayal of risky behaviour and its consequences.

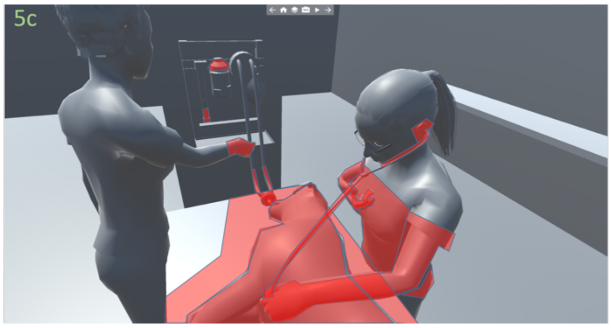

Figure 6: Layer 2 'switched on' to show transfer of 'invisible' contamination between animal, veterinary staff, surfaces and equipment during a surgical procedure if proper infection control methods are not being observed.

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