A Transdisciplinary Approach to Co-developing an Infection Prevention and Control Training App for Veterinarians

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School of Veterinary Medicine, University of Surrey
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Dr Wendy Thompson (chair)
University of Manchester

PEOPLE AMR NETWORK

Prescribers | Service Users | Communities

develoPing and Evaluating multi-faceted evidence-based interventions to prOmote Prudent antimicrobiaL use in community contExts.

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UNIVERSITY OF SURREY

Who are we?

Dr Sarah Tonkin-Crine
- Health Psychologist, University of Oxford

Prof Gail Hayward
- Clinical Academic GP, University of Oxford

Prof Alastair Macdonald
- Designer, Glasgow School of Art

Dr Abel Ekiri
- Veterinarian, University of Surrey

Dr Wendy Thompson
- Clinical Academic Dentist, University of Manchester

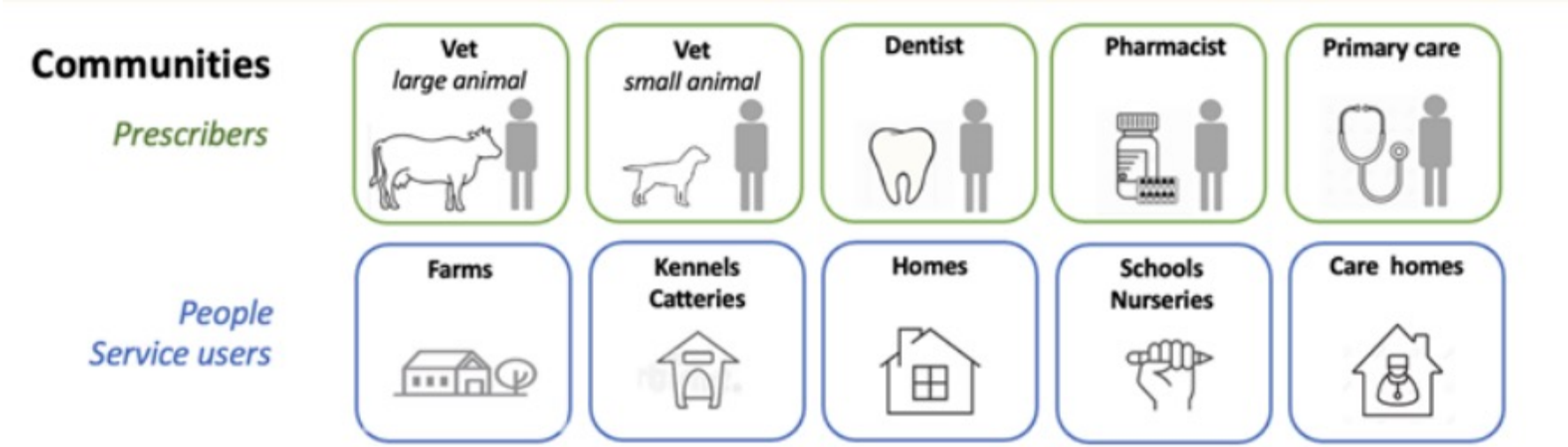
Ms Chika Anumnu
- Network Manager






Who is our target audience?

Everyone in communities who use antimicrobials.



What is our aim?

Co-developing stewardship interventions with people & prescribers

- Identify which interventions best support sustained behaviour change

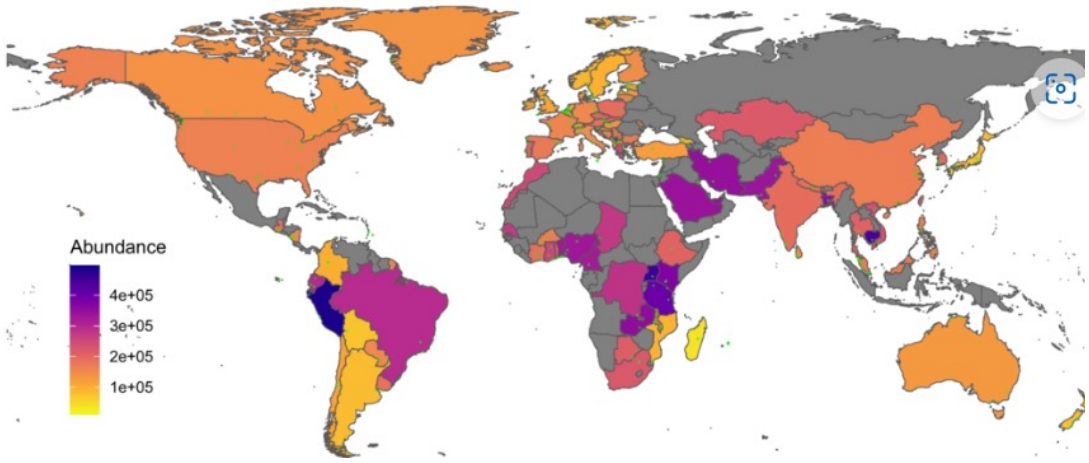
How?

By bringing together broad range of network disciplines and approaches

Disciplines	Arts and humanities	Social sciences	Human health science	Veterinary science
Approaches	Participatory design	Behavioural science	Clinical trials	Learning theory
	Health economics	Efficient study design	Information design	Economic modelling
	Implementation science	Statistics	Epidemiology	Behavioural economics
Interventions	Infection prevention control	Diagnostics	Biosecurity	Communication skills
	Vaccines	Audit and feedback	Antimicrobial stewardship	Public campaigns

Activities

- Building network and collaborations
- Knowledge exchange & dissemination
- EMCR workshops & placements
- Webinars and events
- Joint funding applications



Join us

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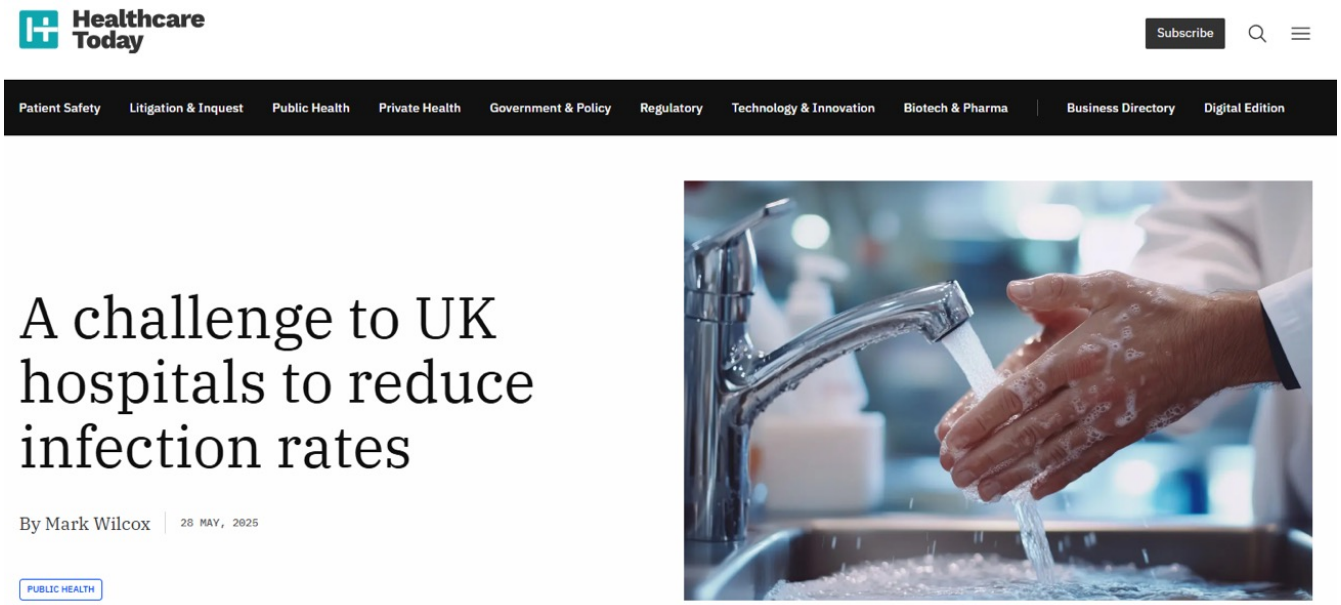
https://www.phc.ox.ac.uk/research/research-themes/infection-respiratory-and-acute-care-irac/people-amr-network-1/people-amr-network

Contact Chika Anumnu, PEOPLE AMR Network Manager
peopleamr@phc.ox.ac.uk

Hospital acquired infections (HAIs) in human healthcare settings



- Globally, between **7% and 8%** of hospitalised patients develop a HAIs.
- In the UK, NHS estimates the economic burden of HAIs at **£2.7 billion/year**.
- In the US, HAIs result in **$4.5 billion/year** in additional healthcare costs.
- Financial cost of HAIs is compounded by the threat of **antibiotic resistance**, which makes HAIs more difficult to treat and control.

There are parallels in human and animal healthcare settings wrt HAIs

https://healthcaretoday.com/article/a-challenge-to-uk-hospitals-to-reduce-infection-rates; *Reed et al 2009 The Ochsner Journal 9:27–31*

HAIs – Small animal practice settings

HAIs are a significant challenge in veterinary care settings - affect animal patients, hospital staff, and animal owners.

HAIs: urinary tract infections, bloodstream infections, surgical site infections.

Picture credits: Maria A. J. Lozano

Sykes & Weese 2013 Canine and Feline Infectious Diseases. 105–18; Willemsen et al 2019. Zoonoses Public Health. 66(5):439-457; Stull and Weese 2015 Vet Clin Small Anim 45:217–233; Jones 2013 Todays Veterinary Practice 72-76

Impact of HAIs: Small animal practice

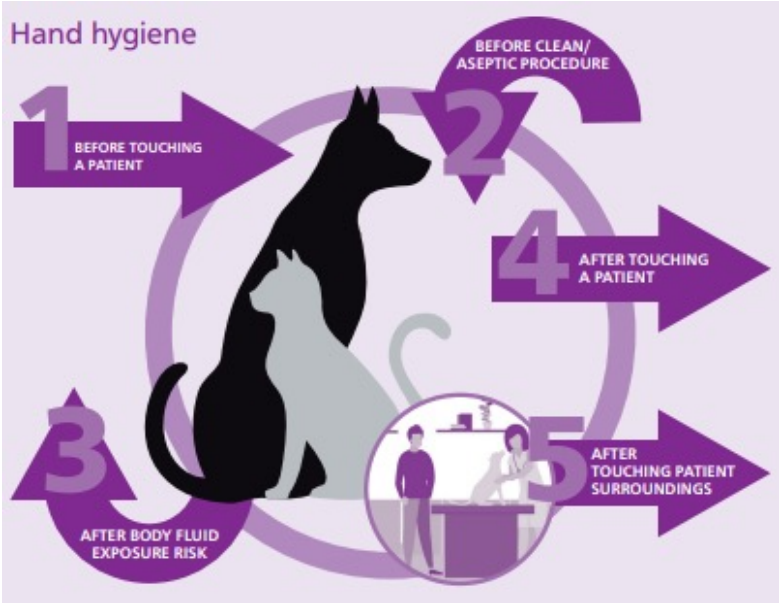
Picture credits: Maria A. J. Lozano

- Prolonged hospital stays and increased treatment costs.
- Increased risk of antibiotic resistance in HAIs in patients. Common resistant pathogens: *Acinetobacter* spp, *E. coli*, *Enterococcus* spp., *Salmonella* spp, *Staphylococcus* spp.
- Risk of transmission of hospital-associated and zoonotic pathogens.
- Risk of litigation due to increased scrutiny of hospital-associated and zoonotic infections.
- Loss of trust between the client and the veterinary practice.

Sykes & Weese 2013 Canine and Feline Infectious Diseases. 105–18; Stull and Weese 2015 Vet Clin Small Anim 45:217–233; Willemsen et al 2019. Zoonoses Public Health. 66(5):439-457; Gerard 2020 Veterinary Nursing Journal 35:38-41

Infection prevention and control (IPC) in the context of small animal practice

IPC encompasses ‘practices’ or ‘measures’ used to prevent and/or control infectious diseases in a hospital, **to minimize animal-to-animal, animal-to-human, and human-to-animal transmission of pathogens**.



Adaption to the WHO My five moments for hand hygiene, to encourage veterinary hand hygiene by the Royal Veterinary College, 2019. Credit: Parkes 2021 The Veterinary Nurse 12(10):448-452

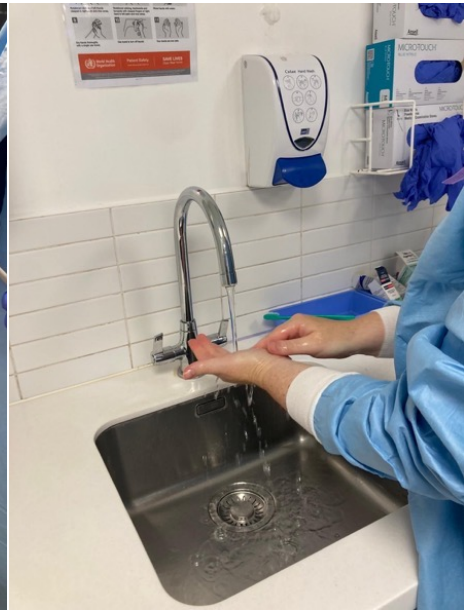
Picture credits: Maria A. J. Lozano

IPC practices may be written down in form of **guidelines, or standard protocols**, or standard protocols which form part of a formal hospital **infection control programme**.

Sykes & Weese 2013 Canine and Feline Infectious Diseases. 105–18; Parkes 2021 The Veterinary Nurse 12(10):448-452

Barriers to implementation of IPC procedures in small animal practice

- Staffing shortages
- High patient numbers
- **Inadequate or lack of IPC training**
- **Poor compliance with IPC practices** such as hand hygiene
- Inadequate hospital infrastructure



Picture credits: Maria A. J. Lozano

Lowe et al. 2021 Confict and Health 15:94; Gerard 2020 Veterinary Nursing Journal 35:38-41; Ekiri et al unpublished data

Credit: Dmitrii Anikin, Getty Images/iStockphoto

How do we improve uptake of IPC practices?

With the increasing HAI rates, and the challenges of spreading AMR, new solutions are needed to reduce infection risks in small animal hospital settings.

A transdisciplinary approach to co-developing an infection prevention and control training app for veterinarians

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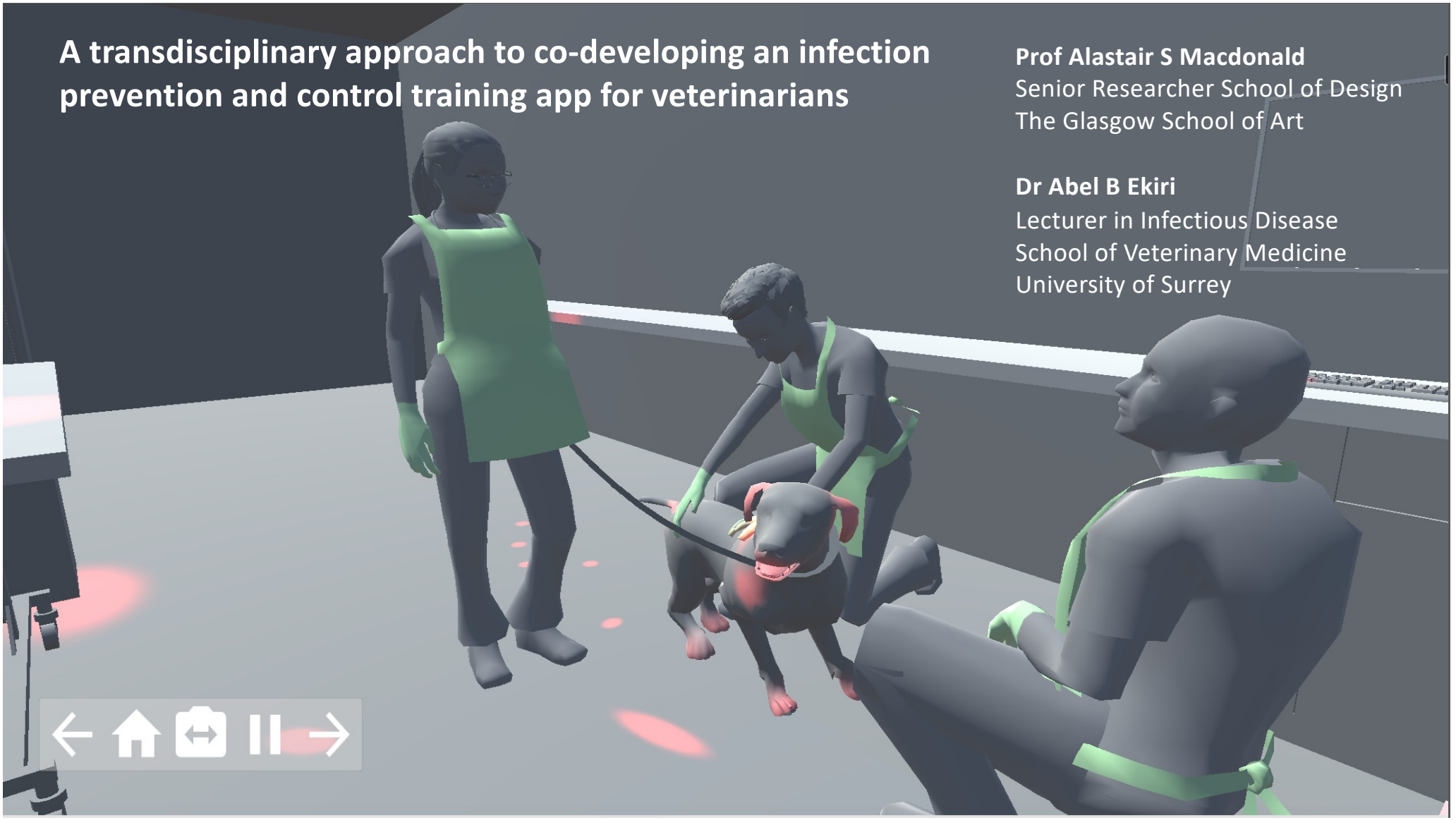


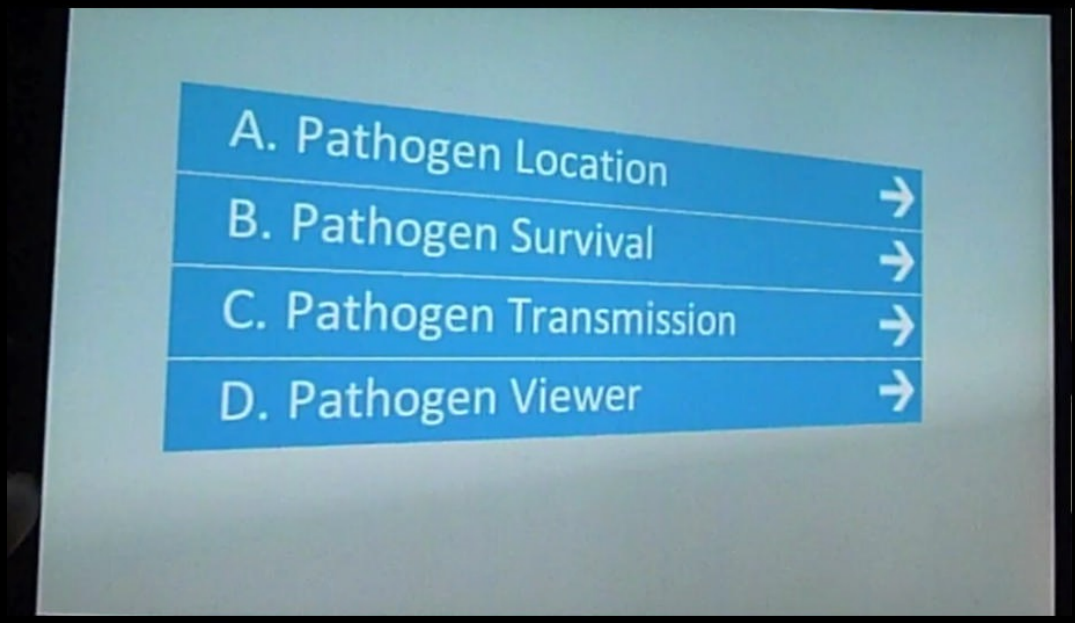
Early work: ***making the invisible, visible***

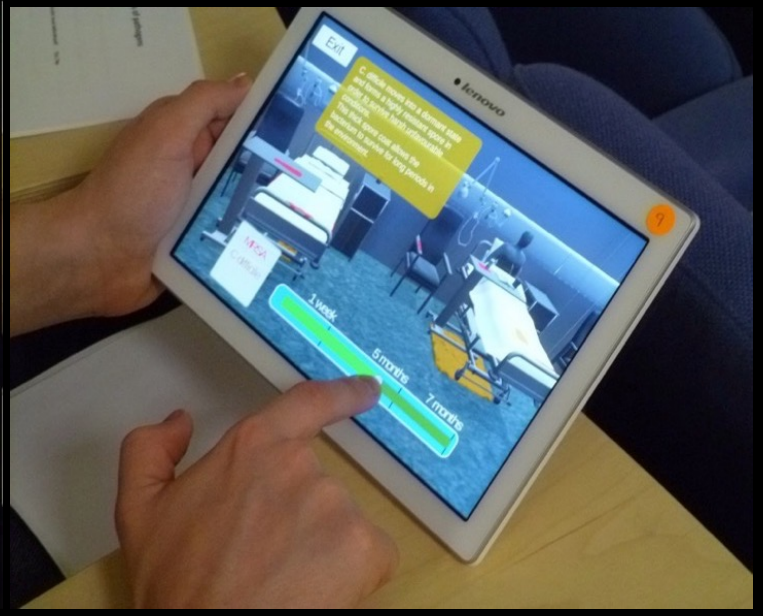
Study 1

vis-invis: *visualising the invisible: developing innovative approaches to visualisation to help NHS staff prevent and control healthcare associated infections*. AHRC/SFC Grant Ref: HR 09032

Early work: ***making the invisible, visible***

Study 2





visionOn: *The design and evaluation of a tablet-based tool for use in staff training for the prevention of healthcare associated infections*. AHRC Grant Ref: AH/M00628X

Studies 3 and 4: AMRSim / VIPVis with Surrey Vet School

Video ethnography

Level of risk analysis of behaviours and procedures

Risk Event	Time in the video*		Name of the interaction	Level of Risk	What is critical a	Contact Issues / Which surfacesare involved?
	Start	End				
1	00:22	00:35	Sitting on the floor with a	Low	Bugs from floor	Clothing, hands, dog, floor/seating
2	00:24	00:35	Dog-hand contact (body)	Low	Dogs have conta	Hands then surfaces/equipment touched imme
3	03:26	03:36	Taking rectal temperature	High	Taken periopera	Faeces, hands, dog
4	06:10	07:29	Anaesthetic nurse - dog -	Medium	Intensive conta	Hands, records, anaesthetic machine in prep an
5	05:57	05:59	Dog-xray equipment pre-	Low	Sandbags, ties a	Touchscreen computer, xray machine buttons, s
6	08:23	08:28	Surgical skin preparation	High	Potential for inc	Surgical site skin (incision site is the cranio-mec
7	10:46	11:02	Theatre floor	High	The theatre floc	Body fluid, floor, surgical site, patient equipme
8	11:41	11:53	Dog-xray equipment post	High	Sandbags, ties a	Touchscreen computer, xray machine buttons, s
9	12:33	12:37	Assessing wound	Medium	Wound palpate	Surgical site, hands, bedding
10	12:33	12:37	Kennel bedding	Low	Is the bedding t	Could bugs that the dog carried in with him hav
11				Please select...		

Importance (risk x frequency)	Event
8.00	Prep room extensive contact with dog (clothes, hands, face)
7.20	Touching various equipment (keyboard, pens etc)and dog in theatre without gloves (keyboard, pe
6.75	Kennel bedding - hands - dog
5.50	X-ray sand bags-buttons-hands-surgical site
4.80	Rectal temp
4.00	Picking up & carrying dog - contact with clothes
3.00	Insulating film & sheet dropped on floor then reused
3.00	Consultation room contact with dog - floor,clothes, computer
1.67	Endotracheal tubing touched by dog & ungloved hands

- **Companion animal referral practice**
- **15 hours of video following 3 of the same procedure (TPLO) from admission to post-surgery**
- **Behaviours risk-assessed and prioritised from video footage**
- **Pre-surgery preparation identified as highest risk stage**

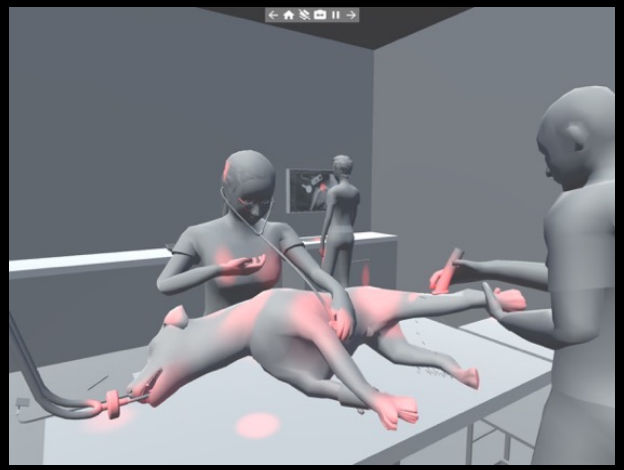
- **AMRSim**: ***A M**icrobial **R**eality **Sim**ulator for Veterinary Training and Practice*. AHRC Grant Ref: AH/R002088/1
- **VIPVis** *Veterinary Infection Prevention through Visualisation.* AHRC Grant Ref: AH/V001795/1.

3-layer 3D digital model

Layer 1: monochrome

1: sequences in monochrome incorporating the risky behaviours we had identified. Individuals invited to identify risks from the model.

Layer 2: + red

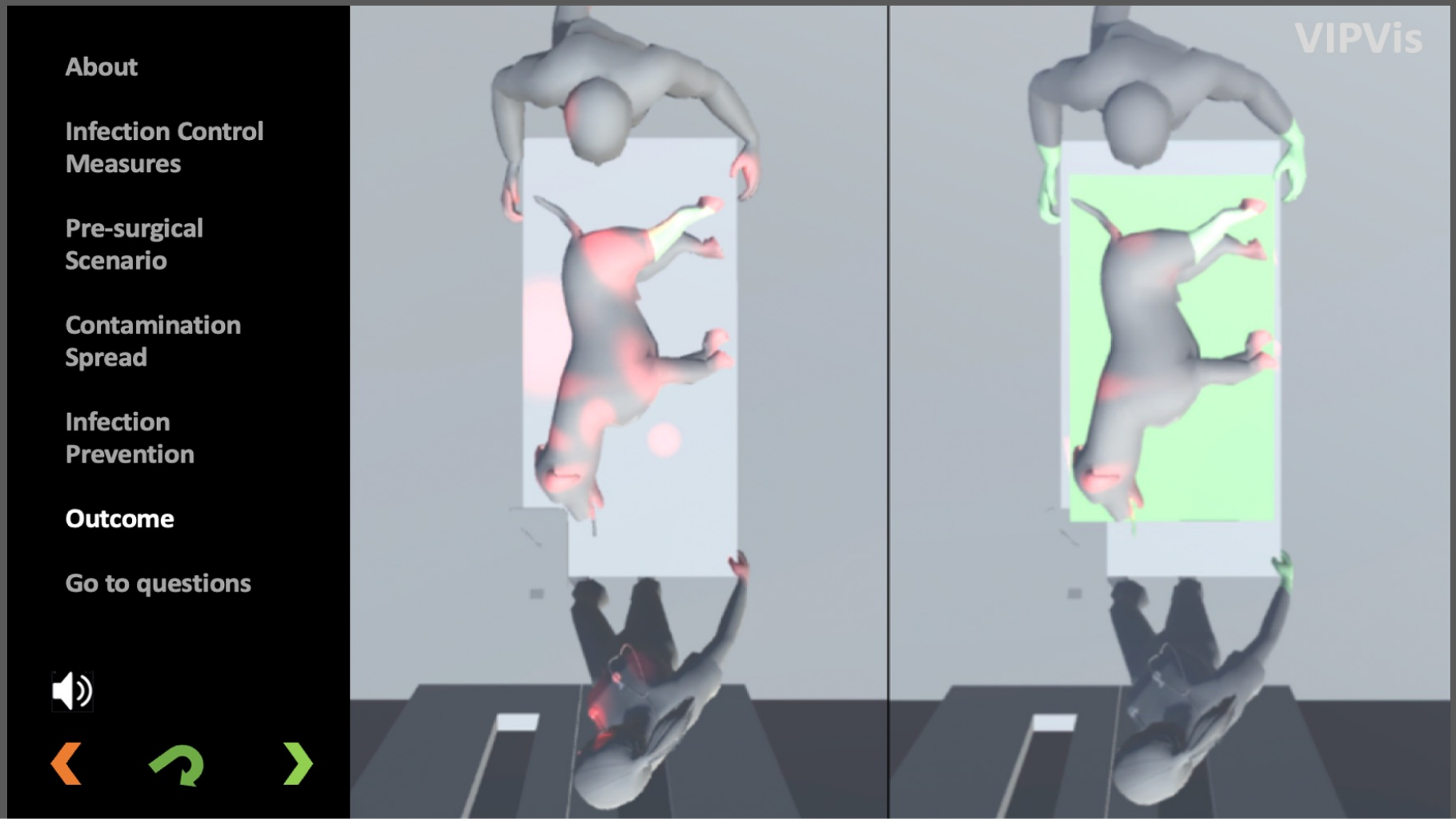


2: the reveal in red showing the consequences of risky behaviours and contamination by touch – then asked about IPC measures to mitigate these risks

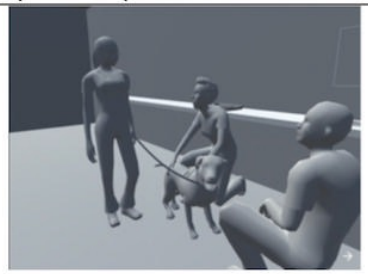
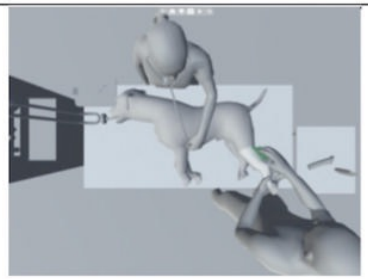
Layer 3: + green

3: the reveal in green showing which IPC measures would help minimise the risks

Comparison of outcomes



Co-development of the ‘serious story’ through a detailed script to support digital model

Spoken script	Time	Notes	Animations to support spoken script
I would now like to introduce you to Marley, who in this short, animated sequence is being anaesthetised and prepped for surgery. The animation is based on actual video footage taken here a few months ago. While you watch this (you’ll see this twice) please think about where the risks are for bacterial contamination of Marley, of his immediate environment, and of the people involved. Feel free to make notes under Activity 2 on page 3 of your workbook – or just watch. We use green shading in the animation to indicate where infection control measures are being applied. We have deliberately minimised these in this sequence.	4 min	*Show layer 1 (monochrome) sequence with minimised layer 3 (IPC) during dog’s leg shaving.*	 
OK, this time as you watch the simulation again, feel free either to call out any cross-contamination risks you spot, or continue to make notes on page 3 of your workbook. We’ll discuss these at the end of the animation.	4 min	*Show layer 1 sequence again pausing at the end of the ‘Entering Theatre’ scene.* *Helper – record comments as we go and any at the end.*	

Studies 3 and 4: AMRSim / VIPVis with Surrey Vet School

What can be done to get Marley into theatre with as little contamination as possible, both on him and left behind in the prep room?'

Structured learning approach: text with voice-over

Text screen with voice-over

Text screen with voice-over
or
animation

Text screen with voice-over
or
interactive animation

Structured approach to learning: text with voice over

Infection Control Measures

Start by thinking about what would happen when infection control measures fail.

TAKE TIME TO REFLECT

What would happen as a consequence of this during preparation for orthopaedic surgery?

Infection Control Measures

Here's what we came up with. How does our list compare with your concerns?

Consequences of failure of infection control measures include …

Infection Control Measures

Despite efforts at controlling infections, studies suggest that in referral level veterinary orthopaedics, where infection control measures should be well-implemented, post-operative bacterial infections occur in around 5% of cases …

Infection Control Measures

Some may advocate routine use of antibiotics pre-operatively to reduce the likelihood of such complications

TAKE TIME TO REFLECT

What would happen as a consequence of this approach?

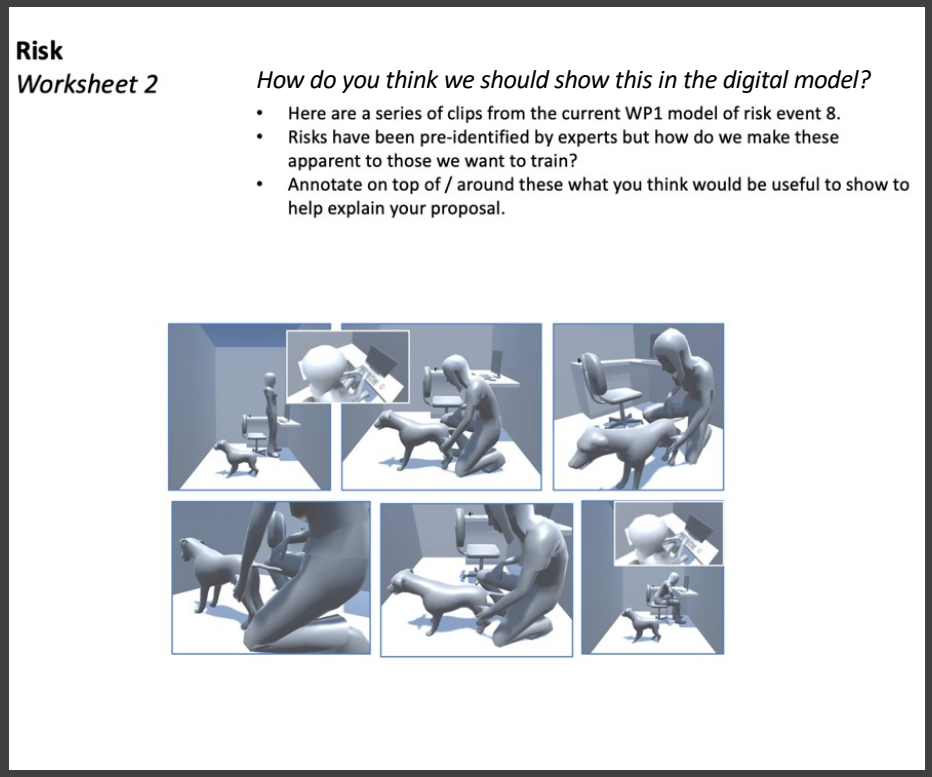
Infection Control Measures

Here's what we came up with.

Consequences of routine use of pre-operative antibiotics include …

Co-development process: workshop/workbook materials

involved veterinary scientists and practitioners, software engineers, psychologists and designers…



Question

- *How to get the diverse team involved in the co-development of the digital app?*

Approach

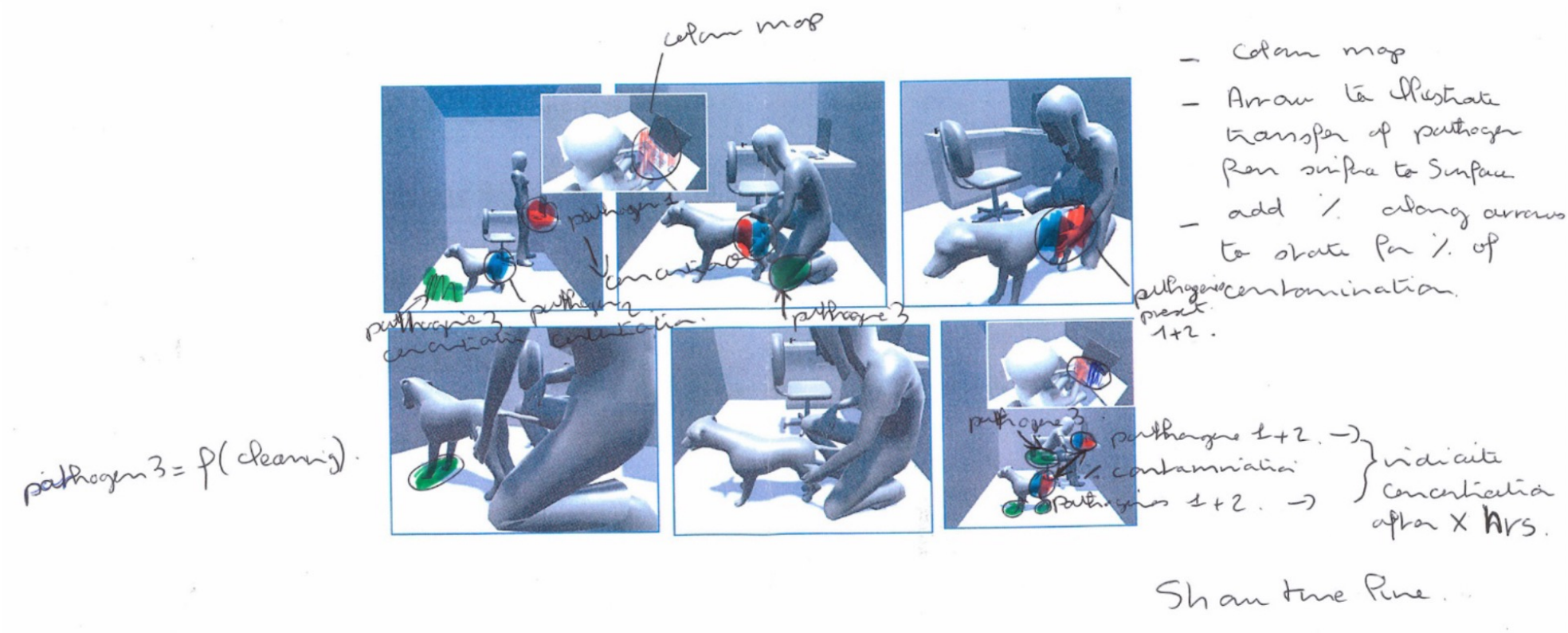
- *Co-development through materials, inspirational examples and workbook tasks*

Workbook example

- *How do you think we should show contamination and risk in our digital model?*

Co-development process: workshop / workbook materials

Show how you would represent contamination and risk of infection Veterinary professor's response

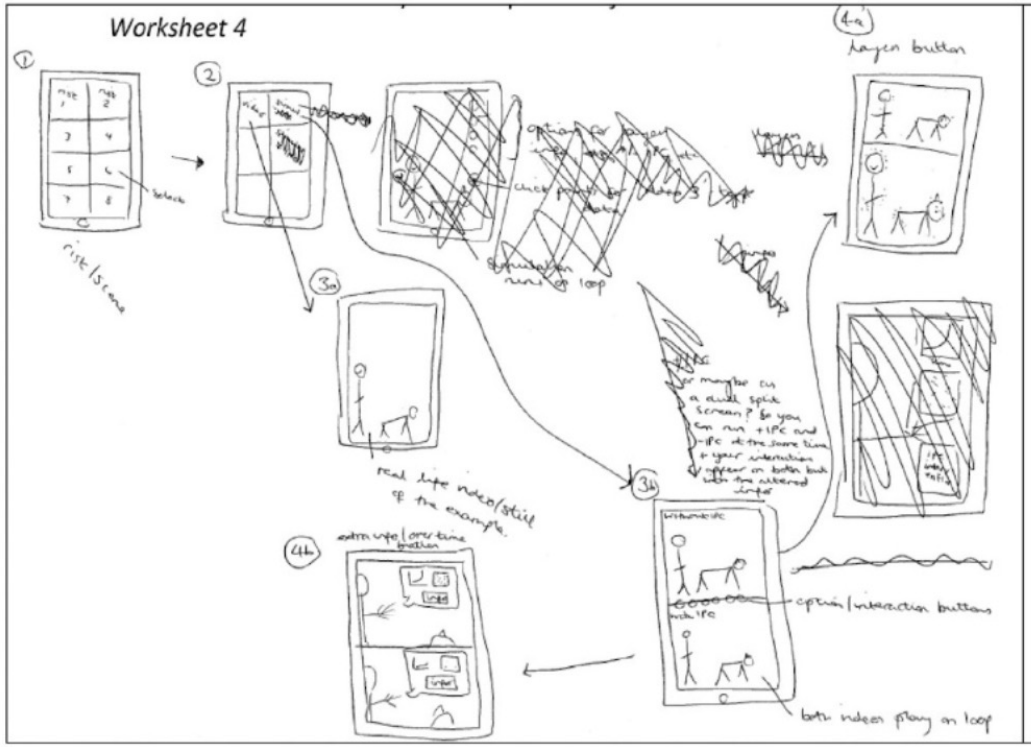


- Colour map
- Arrow to illustrate transfer of pathogen from surface to surface
- add % along arrows to state % of contamination.

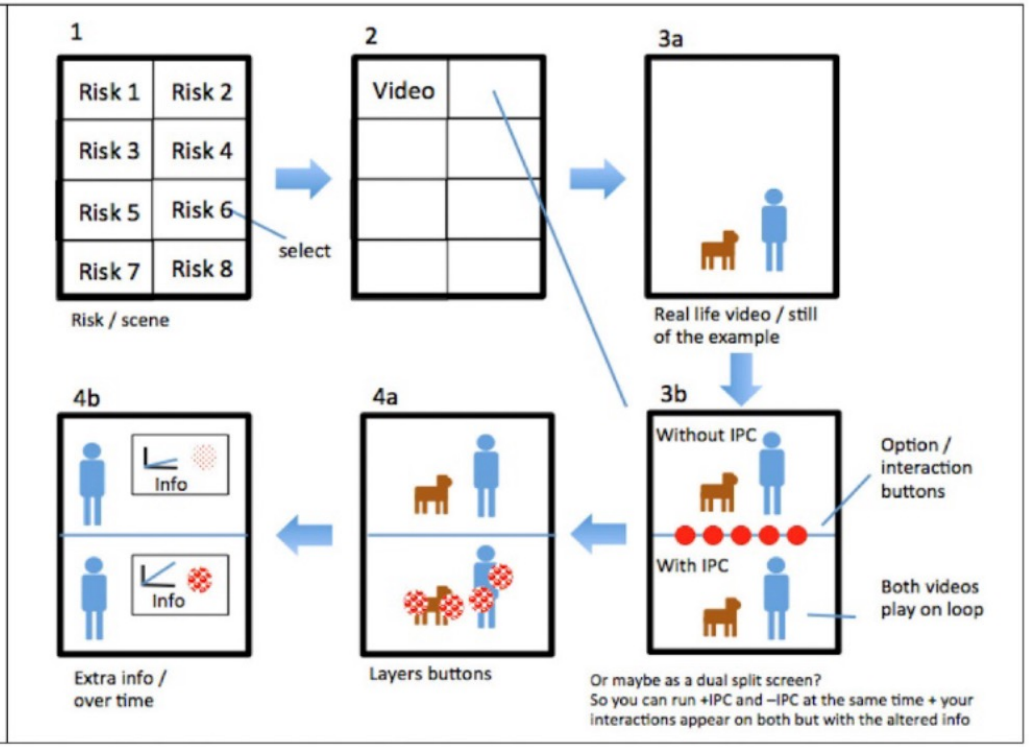
Co-development process: workshop / workbook materials

Show how you would represent the interaction interface and what this might show? Veterinary nurse example

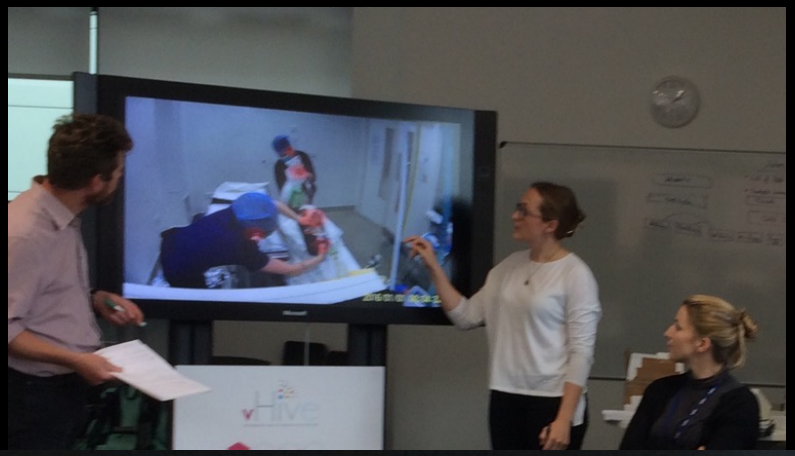
Original

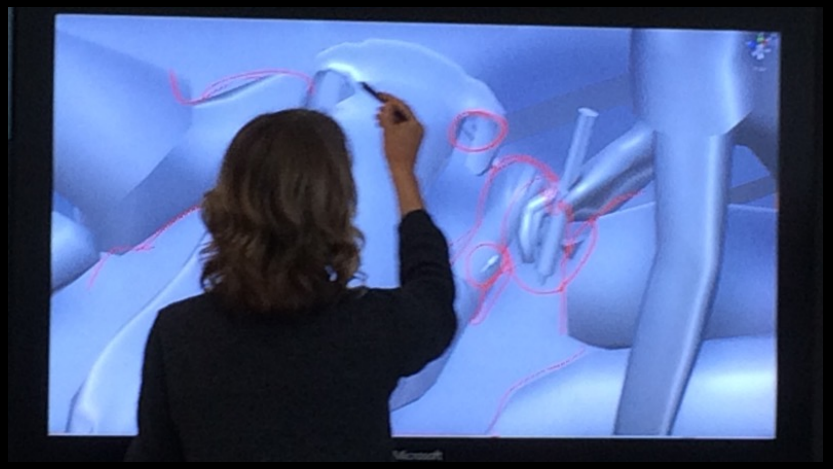


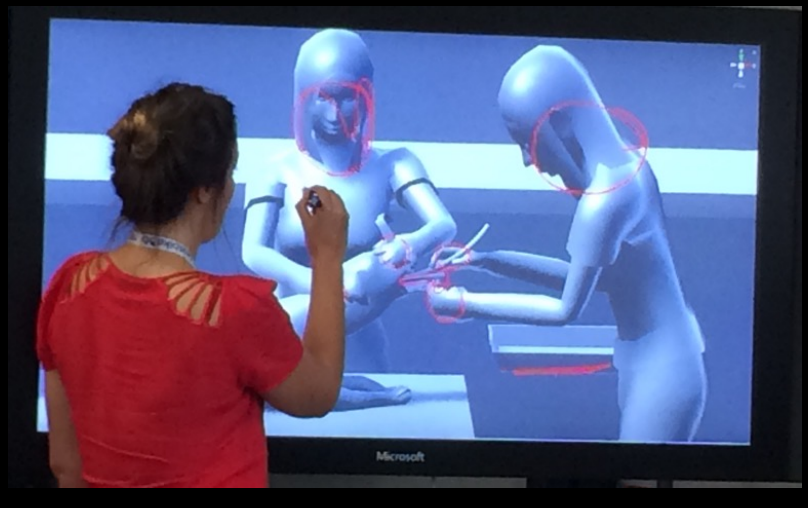
'Tidied' version



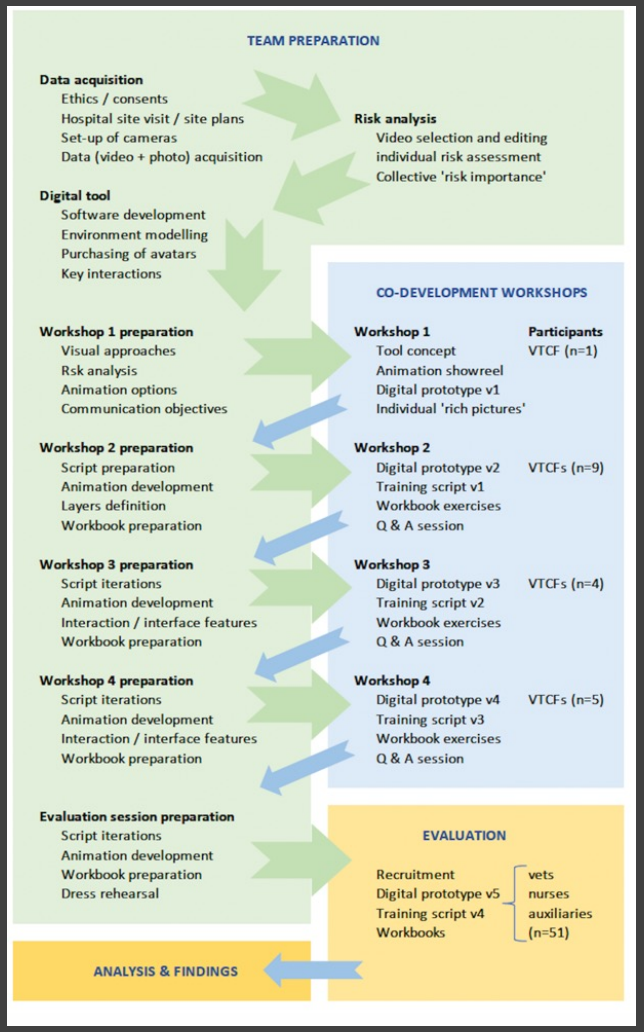
Co-development process: group work on large interactive screen







Iterative co-development process: team development / participatory workshops



Evaluating the AMRSim proof-of-concept

51 participants

- *46 were female (90.2%) and five males (9.8%)*
- *The average age was 29.4 years (range 19–54 years).*
- *21 (41.18%) were veterinary nurses, 7 (13.73%) veterinary surgeons, 19 (37.25%) auxiliaries, and 4 (7.84%) other roles including pharmacy and physiotherapy.*

Macdonald, A., Chambers, M., La Ragione, R. et al. (2020). Addressing Infection Risk in Veterinary Practice through the Innovative Application of Interactive 3D Animation Methods. *The Design Journal*, pp. 51-72. 10.1080/14606925.2020.1850225

Findings from AMRSim (proof of concept)

92% agreed to change their behaviour and stated an intention to implement an infection control behaviour that aligned with the learning objectives of the workshop by:

- increasing hand hygiene (31.37%)
- wearing gloves (15.69%)
- wearing protective clothing (15.69%)
- reducing unnecessary touching of animals (11.76%)
- being more aware of self-touching face, hair and glasses (19.60%)
- and intending to clean their equipment, work area or touchpoints more frequently (17.76%).

Subsequent discussions with vet student groups at Surrey found that they could readily transfer learning outcomes to other procedures, e.g., bitch spaying

Macdonald, A., Chambers, M., La Ragione, R. et al. (2020). Addressing Infection Risk in Veterinary Practice through the Innovative Application of Interactive 3D Animation Methods. *The Design Journal*, pp. 51-72. 10.1080/14606925.2020.1850225

PhD study

ISIAS ***I****nnovative* ***S****olutions to* ***I****mprove* ***A****ntibiotic* ***S****tewardship*
and reduced AMR in veterinary practices

UNIVERSITY OF SURREY

UNIVERSITY OF PLYMOUTH

THE GLASGOW SCHOOL OF ART

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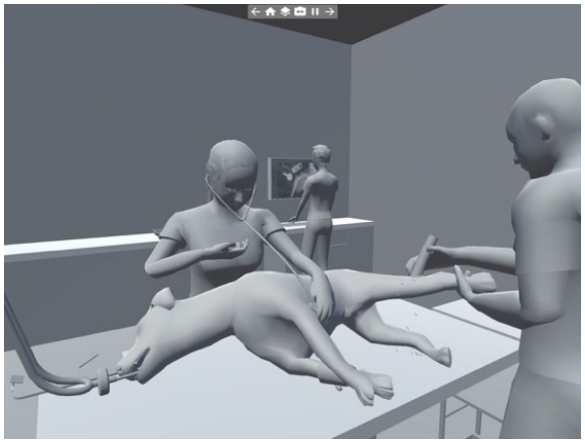
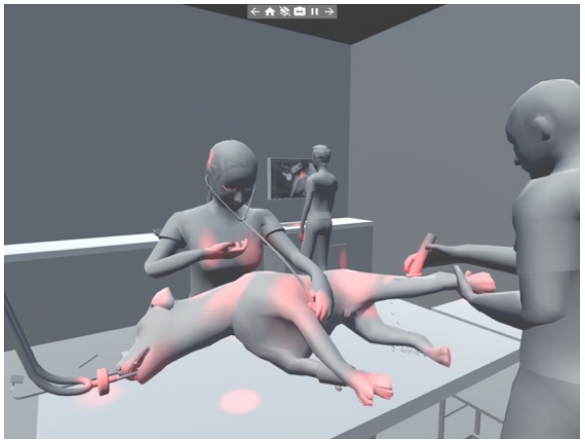
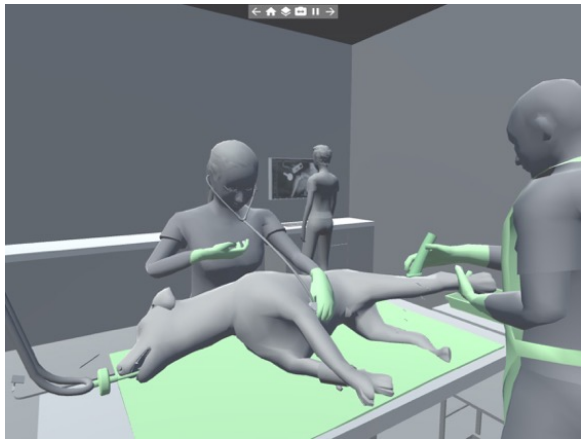
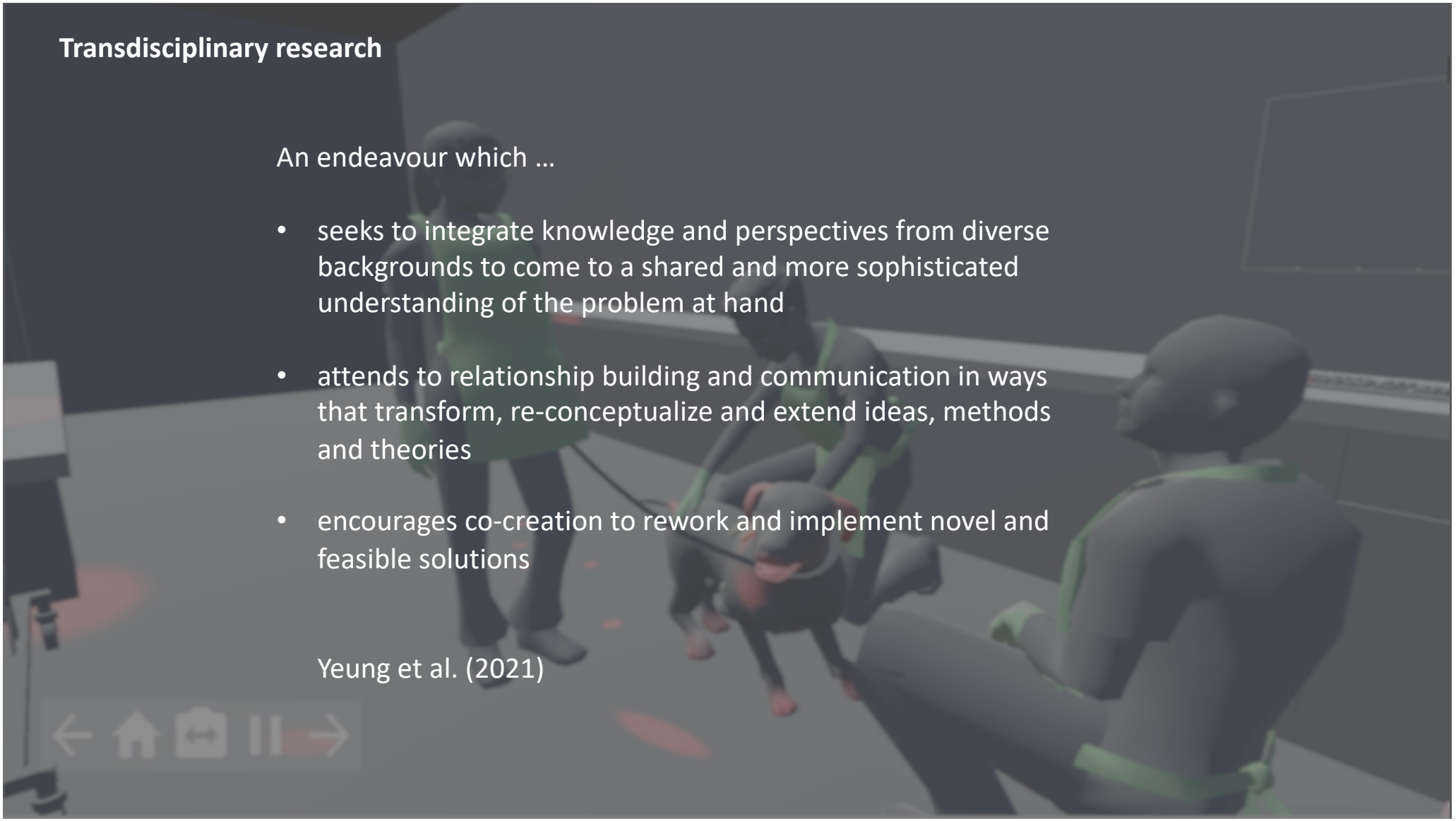






- Change perception of risk? √
- Change in behaviour ?
- Reduced incidence of infection ?
- Reduced use of antibiotics ?

What we don't yet know is, does this actually result in behaviour change and if so, for how long, and does this result in a reduction in infections – and the use of antibiotics?



Transdisciplinary research

An endeavour which …

- seeks to integrate knowledge and perspectives from diverse backgrounds to come to a shared and more sophisticated understanding of the problem at hand
- attends to relationship building and communication in ways that transform, re-conceptualize and extend ideas, methods and theories
- encourages co-creation to rework and implement novel and feasible solutions

Yeung et al. (2021)

Relevance to the PEOPLE network and the AMR call?

What has design brought to the table?

- integrating the expertise and methods of a field not traditionally associated with AMR, i.e. the arts and humanities, in this case design
- finding truly transdisciplinary ways of working through a non-hierarchical, participatory co-development process
- recruiting and facilitating end users as part of the intervention design team supported by appropriate materials and activities
- close understanding of user needs and 'what works' through iterative prototyping and testing
- skills in communicating complex issues through visual means
- an openness to using speculative 'what if…?' approaches, 'building to think'
- use of engaging scenario-building, narrative and interaction techniques
- use of prototypes to elicit forms of evidence through the testing of hypotheses, 'bringing … insights to the surface'

Outputs relating to AMRSim/VIPVis

Macdonald, A., Chambers, M., La Ragione, R. et al. (2020). Addressing Infection Risk in Veterinary Practice through the Innovative Application of Interactive 3D Animation Methods. *The Design Journal*, pp. 51-72. 10.1080/14606925.2020.1850225

Macdonald. A.S., McCorry, O., Poyade, M., Trace, C. & Chambers, M. (2023). The art of serious storytelling: using novel visual methods to engage veterinary practitioners in reducing infection risk during preparation for surgery. In O. Varsou (ed.) In: *Teaching, Research, Innovation and Public Engagement*: *New Paradigms in Healthcare*. Springer, Cham, pp. 91-107. 10.1007/978-3-031-22452-2_8

Acknowledgements 1

Funding: Arts and Humanities Research Council

Vis-invis
- AHRC/Scottish Funding Council *A Healthier Scotland Initiative*
- Grant Ref: HR 09032

VisionOn
- AHRC Follow-on Fund.
- Grant Ref: AH/M00628X

AMRSim: ***A M****icrobial* ***R****eality* ***Sim****ulator for Veterinary Training and Practice*.
- AHRC AMR Theme 3b grant.
- Ref: AH/R002088/1

VIPVis (Veterinary Infection Prevention through Visualisation),
- AHRC Follow-on grant.
- Ref: AH/V001795/1.

Acknowledgements 2

Team members / expertise

Visinvis

Colin Macduff [2]	Nursing
Fiona Wood [2]	Health and welfare
Alastair S. Macdonald [1]	Design
Charlie Hackett [3]	Social arts practice
John McGhee [4]	Computer-aided design
David Loudon [1]	Software engineering
Stephanie Dancer [5]	Microbiology
AnneMarie Karcher [6]	Infection prevention and control

[1] Glasgow School of Art, Glasgow
[2] Robert Gordon University, Aberdeen
[3] Gray's School of Art, Aberdeen
[4] Duncan of Jordanstone College of Art and Design, Dundee
[5] NHS Lanarkshire
[6] NHS Grampian

Team members / expertise

VisionOn

Alastair S. Macdonald [1]	Design
Colin Macduff [2]	Nursing
David Loudon [1]	Software engineering
Susan Wan [1]	Visual and 3D animation

[1] Glasgow School of Art, Glasgow, UK
[2] Robert Gordon University, Aberdeen, UK

Advisory Group
- Prof Stephanie Dancer, Consultant Microbiologist, Hairmyres Hospital, NHS Lanarkshire
- Karen Wares, Nurse Consultant, Healthcare Associated Infections, NHS Grampian
- Elaine Ross, Infection Control Manager, NHS Dumfries & Galloway
- Professor Minhua Eunice Ma, Associate Dean (International), Professor of Digital Media and Games, University of Huddersfield
- Dr Guy Braverman, Managing Director & Co-Founder, GAMA Healthcare Ltd.

Healthcare Partners
- NHS Lanarkshire
- NHS Grampian

Commercial partner
- GAMA Healthcare Ltd

Acknowledgements 3

Team members / expertise

AMRSim = proof of concept

Alastair S. Macdonald [1]	Design
Mark A. Chambers [2]	Veterinary bacteriology
Roberto La Ragione [2]	Veterinary microbiology/ pathology
Kayleigh Wyles [2]	Psychology
Matthieu Poyade [1]	Software engineering
Andrew Wales [2]	Veterinary surgery
Naomi Klepacz [2]	Lived experience/ social welfare
Tom R. Kupfer [2]	Psychology
Fraje Watson [3]	Veterinary nursing
Shona Noble [1]	Visual design / software RA

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[2] University of Surrey, Guildford, UK
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Team members / expertise

VIPVis = Beta version app

Alastair S. Macdonald [1]	Design
Mark A. Chambers [2]	Veterinary bacteriology
Matthieu Poyade [1]	Software engineering
Christopher Trace [2]	Learning theory / content
Orla McCorry [1]	Visual design / software RA

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