

Healthcare Associated Infection Visualisation and Ideation Research Network

HAIVAIRN

Report on the HAIVAIRN
network grant funded by
the Arts and Humanities
Research Council

Alastair S Macdonald
Colin Macduff

THE GLASGOW
SCHOOL OF ART

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Contents

p. 2

Executive summary

p. 4

Introduction

p. 6

Objectives

p. 8

Coalescing expertise

p. 10–19

Methodology

p. 20–39

Findings

p. 40–42

Reflections

p. 44

Recommendations

p. 46

Contact

p. 47–50

Appendices

Executive summary

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Healthcare associated infections (HAIs) are a major global problem and the pathogens that cause them are invisible within everyday life. Science has helped to make these causative pathogens visible through the microscope, and there are a variety of populist images of ‘bugs’, but what other ways of seeing (and thinking) could be helpful for better understanding pathogens’ interactions with contexts, processes and people? And how then could visualisation-based approaches used in the arts and humanities, along with those in other disciplines, contribute to better prevention and control of these HAIs?

These questions gave impetus to the development of the AHRC funded HAIVAIRN project (July 2016-January 2018) and this report summarises its collaborative work. Following description of objectives and networking processes, the report explores and maps areas of perceived need and opportunity for research in this field. To exemplify some of these areas and intersections, brief insights into relevant ongoing and new research studies are then shared. Final reflections focus on the nature and wide scope of enquiry, and the need for more in-depth work within and across key areas. The potential value of cross-disciplinary research focusing on use of visualisation to help prevent HAIs and antimicrobial resistance (AMR) is highlighted for practice developers, researchers, educators and policy makers. Within this context the report seeks to stimulate further creative thinking and associated developments.

Introduction

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Healthcare associated infections (HAIs) caused by pathogens such as MRSA, norovirus, and *Clostridium difficile* are a substantial problem in developed and developing countries around the world and within the NHS. In addition to the distress caused to patients who are infected, the cost of HAIs to acute services in the NHS is high. This issue sits within the major global challenge of the rise of antimicrobial resistance (AMR) well articulated elsewhere [1].

Educational interventions are a major component in the battle against HAIs but a key challenge underlying attempts to explain and instruct in these areas is that the pathogens responsible for HAIs are invisible to the naked eye. As such, expertise from the arts and humanities in visualisation and associated ideation would seem to have much relevance in addressing such a challenge. Moreover, as clinical scientific data on spread of infections has become more complex and sophisticated, the role of visualisation to better communicate this information in a way that engenders meaningful engagement is also highlighted. However, until very recently, the contribution of the arts and humanities to the prevention and control of HAIs has been very limited indeed.

While two prior studies [2, 3] led by the authors explored aspects of this territory, a wider exploration seemed necessary given the scale of the challenge and the scope for collaborative working. This has been taken forward through a new arts and humanities-led cross-disciplinary network, HAIVAIRN (Healthcare Associated Infection Visualisation and Ideation Research Network), which ran from June 2016 to January 2018. This exploration was focused around one central question:

How can we better address the problem of HAIs through visualisation-related ideation and applications?

The activities and achievements of the network are described here under the following main headings: objectives, coalescing expertise, methodology, findings, reflections and recommendations. The methodology and findings are reported in summative form.

This report is intended for researchers, educators and practice developers with interest in applying visualisation approaches to HAIs (and AMR), organisations and individuals with interest in better articulating the potential contribution of arts and humanities led approaches within healthcare generally, and the field of AMR particularly, research funding councils and policy-makers.

The report has been written by the investigators Alastair Macdonald and Colin Macduff who conceived, designed and delivered the project with the support of the Research Office at The Glasgow School of Art. Section 5 of the Findings has been contributed by PhD student Kostas Tsattalios (Robert Gordon University) based on his ongoing research on visualisation-centred interventions in this field. There is grateful acknowledgement of the valued input and support from the following: all network participants, including contributions from those unable to attend the workshops; the project administrator, Frances Kennedy; Professor Paul Crawford and Dr David Pearson for reviewing the final report and for their suggestions for enhancement.

The authors gratefully acknowledge the support from the Arts and Humanities Research Council (network grant AH/N006429/1).

- 1 O'Neill, J. (2016). Tackling drug-resistant infections globally: final report and recommendations. The review on antimicrobial resistance. Wellcome Trust / HM Government.
- 2 Macduff, C., Wood, F.K., Hackett, C., McGhee, J., Loudon, D., Macdonald, A.S., Dancer, S. & Karcher, A. (2013). Visualizing the invisible: applying an arts-based methodology to explore how healthcare workers and patient representatives envisage pathogens in the context of healthcare associated infections, *Arts & Health: An International Journal for Research, Policy and Practice*, 6(2): 117-131.
- 3 Macdonald, A.S., Macduff, C., Loudon, D. & Wan, S. (2017). Evaluation of a visual tool co-developed for training hospital staff on the prevention and control of the spread of healthcare associated infections. *Infection, Disease & Health*. DOI: 10.1016/j.idh.2017.06.002

Objectives

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The HAIVAIRN objectives were:

- To coalesce a diverse range of national and international expertise around visualisation-related ideas to address the prevention and control of HAIs, working from a foundation in arts and humanities.
- Through a series of workshop events, to explore and identify areas of research need and opportunity, articulating possible cross-disciplinary contributions.
- To create a set of visual mappings locating main priority themes for enquiry, promising sub-themes and related loci and foci for cross-disciplinary interactions.
- To generate a range of relevant researchable questions from this basis.
- To develop these as feasible cross-disciplinary proposals.
- To disseminate network activities to increase visibility and connectivity in this field.

Coalescing expertise

The ambit of the work was envisaged as ranging from visualisation of *micro, unseen phenomena* such as pathogens and the workings of the mind's eye, to visualisation of *macro phenomena* relating to human interactions in healthcare environments and beyond. This covered a spectrum, from aspects of the imagination and new, scientific information (e.g. microbiological data) through to related professional behaviours and wider influences. Exploring these conjunctions of pathogens, places and people thus necessitated the involvement of a broad range of disciplines to inform this arts and humanities driven network.

During preparation of the network proposal, knowledge of relevant published work and existing professional contacts were used as an initial basis for inviting a diverse group of 12 academics and clinical practitioners/managers to participate in three workshop events. In order to provide structure for this collective exploration, it was decided to theme the first and second workshops around micro and macro phenomena respectively, with related guest speakers. The third and final workshop would draw together findings and project ahead. As the network evolved, a small number of new participants were recruited based on identified areas of knowledge deficit and contacts within the group. Participants in the three workshops are listed in Appendices 1-3 along with those invitees who could not attend but contributed preliminary responses to questions.

Methodology

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Summary

HAIVAIRN used a 3-stage methodology to achieve its objectives.

Stage 1

- Three key questions were posed by the researchers requiring participants to respond to these for circulation to all participants prior to the workshop.
- At the workshop, three guest presentations were invited, these presenters having been briefed on the focus of the workshop.
- A discussion ensued, guided by the responses to the questions and provoked by the presentations.
- An analysis of the data and discussion was made which was used to inform the subsequent stage.

Stage 2

- This followed a broadly similar approach with the addition of a small exploratory consultation study with hospital cleaning staff and two mapping activities.

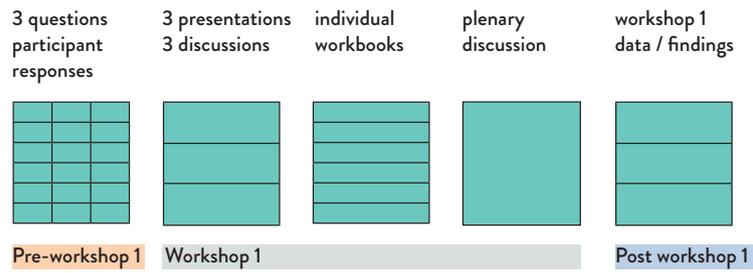
Stage 3

- The researchers summarised and presented for discussion the findings of stages 1 and 2 to existing HAIVAIRN network members and additional invited members from the AHRC-led AMR Theme 3 call.
- These Theme 3 call members presented short summaries of their new projects.
- The discussion was opened up to explore the potential contribution of the wider arts and humanities community to the AMR challenge.

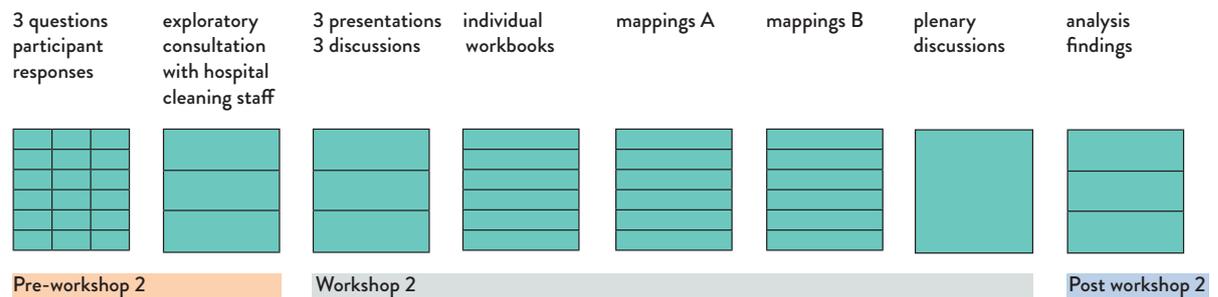
Visual summary

Findings were developed from a synthesis of analysis of the data acquired from each of the activities at each stage.

STAGE 1



STAGE 2



STAGE 3

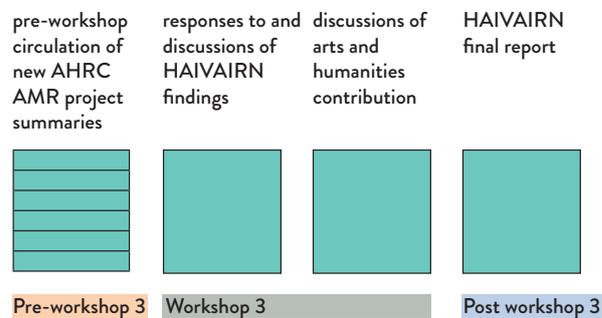


Figure 1. Visual summary of methodology.

Detail

STAGE 1:

Micro-phenomena – the invisible and the unseen in healthcare environments

The issue + 3 key questions

Prior to workshop 1, all invitees were requested to respond to the ‘micro-phenomena’ issue posited by the investigators, by addressing three key questions:

- Issue:* When dealing with issues which are problematic to conceptualise and convey, we often entertain notions or ideas in the ‘mind’s eye’. These may or may not align with how others ‘see’ these. This poses the challenge of conceptualising, ‘ideating’, ‘visualising’ and communicating these in forms which are meaningful to others and might influence their thinking and behaviour.
- Question 1:* We’re interested in the topics of ‘visualisation’, ‘ideation’ and ‘the mind’s eye’ – in their broadest senses, and what these mean to individuals from different disciplines trying to bring into being ideas and concepts which require to be ‘seen’ in some form or another. What meaning do these three terms have for you and your discipline area? When you want to conceptualise something which is not yet ‘visible’, how do you do this? What mental and conceptual models are used in your discipline for making ideas and concepts visible?
- Question 2:* Given the nature of our study and that pathogens are ‘invisible’, and (with reference to your answer to Q1 above) what, if any, value do you think your field’s approach to these might have in relation the challenges facing the infection prevention and control (IPC) of healthcare associated infections (HAIs)?
- Question 3:* Given our interest in the application of ‘visualisation’, ‘ideation’ and ‘the mind’s eye’ models, are you aware of approaches from outside your own particular field, across the Arts and Humanities, or indeed in any other fields, which might have relevance for our work?

Participants (and those invited but unable to attend) provided their individual responses which were assembled into a matrix, circulated and shared with invitees prior to the workshop. This enabled all participants to view the different responses. This matrix helped identify initial themes and was also helpful during facilitation of the discussions following each of the presentations and in the plenary discussion, providing the investigators with a ‘prompt sheet’ for calling in various participants’ views.

Guest presentations

Three participants were invited to provide a 25 minute slide presentation responding to the above questions from their own / their discipline's perspective:

- Prof Stephanie Dancer, Consultant Microbiologist, Dept. of Medical Microbiology, Lanarkshire Acute Hospitals NHS Trust.
- Prof Brett Mitchell, Professor of Nursing, Avondale College Faculty of Nursing & Health, Sydney Campus.
- Dr David Pearson, Reader in Psychology, Anglia Ruskin University, Cambridge Campus.

Following each presentation, an open 30-minute discussion of points and issues raised was facilitated.

Workbooks

Following the three presentation-discussion sessions, each attendee was asked to complete a workbook recording their own thoughts and reflections on research opportunities and needs identified as a result of the day's presentations and discussions.

Plenary discussion

The workshop finished with a facilitated discussion bringing together and summarising the main issues and conclusions arising from the day with a focus on how to proceed to the next workshop.

STAGE 2:

Macro-phenomena – human interactions and behaviour in healthcare environments

The issue + 3 key questions

All invitees to Workshop 2 were requested to respond to the ‘macro’ issue posited by the investigators, by addressing three key questions:

- Issue:* For this workshop, we are interested in ‘macro-phenomena’, specifically human interactions and behaviour in healthcare environments. This poses the challenge of conceptualising, ‘ideating’, ‘visualising’ and communicating these in forms which are meaningful to others and might influence their thinking and behaviour.
- Question 1:* We’re interested in ‘movements’, ‘patterns’ and ‘densities’ in their broadest senses, and what these mean to individuals from different disciplines trying to bring into being ideas and concepts which require to be ‘seen’ in some form or another. What meaning do these three terms have for you and your discipline area? What models or techniques are used in your discipline for making these concepts visible?
- Question 2:* How does your discipline understand, model, and represent ‘human behaviour’ and ‘interactions’ between individuals themselves, and between individuals and their environment? Here, it might be useful to think of, e.g., forms of mappings of types of events which might be recorded digitally or automatically.
- Question 3:* Within the sphere of human behaviour, and in the context of the consequences of actions and behaviours, how does your discipline take account of the different dynamics of the single individual and the teams/groups? Here, it might be useful to think of desired outcomes to certain issues or problems and what might need to be achieved both at an individual and at a team level.

Participants provided their individual responses which were assembled into a matrix, circulated and shared with invitees prior to the workshop. This enabled all participants to view the different responses. This matrix helped identify initial themes and was also helpful during facilitation of the discussions following each of the presentations and in the plenary discussion, providing the investigators with a ‘prompt sheet’ for calling in various participants’ views.

Guest presentations

Three participants were invited to provide a 25 minute slide presentation responding to the above questions from their own / their discipline's perspective:

- Prof Daniyal Zuberi: RBC Chair and Associate Professor of Social Policy at the School of Public Policy and Governance, with a Joint Appointment to the Factor-Inwentash Faculty of Social Work at the University of Toronto.
- Dr Dilum Dissanayake: Lecturer in Transport Modelling, Planning & Management, School of Civil Engineering and Geosciences, Newcastle University.
- Dr Sarah-Anne Munoz: Senior Research Fellow in Rural Health, Centre for Health Science, Inverness University of the Highlands and Islands.

Following each presentation, an open discussion of points and issues raised was facilitated.

Workbooks

Following the three presentation-discussion sessions, each attendee was asked to complete a workbook recording their own thoughts and reflections on research opportunities and needs identified as a result of the day's presentations and discussions.

Mapping exercises

Participants were invited to map their research interests as follows:

Mapping Exercise A: Using a scalar diagram participants were asked to map their current research interests indicating: 4 = Area of very substantial and high priority for me; 3 = Area of substantial priority for me; 2 = Area of moderate priority for me; 1 = Area of a little priority for me; 0 = Area of no priority for me.

Mapping Exercise B: Participants were asked to provide three ideas or thoughts from the day which could form the basis for A&H-driven studies and which could be developed to address HALs and AMR. They were then asked to indicate which areas they could envisage joining.

Plenary discussion

The day finished with a facilitated discussion bringing together the main issues and conclusions arising from the day with a focus on how to proceed to the next workshop.

STAGE 3:

Forward scoping

Pre-workshop

New network members, awarded grants from the AHRC-led AMR Theme 3 call, were invited to attend and to provide a lay summary of their research projects. These were circulated to all attendees in advance of the meeting. They were also invited to prepare a brief 5-minute slide summary of this work to present at the meeting.

HAIVAIRN findings

The HAIVAIRN team summarised and presented the findings from HAIVAIRN stages 1 and 2, which are detailed in the following section. Additionally, an affiliated PhD student, supervised by one of the team, provided brief summary of processes and initial findings from his integrative review on visual interventions in HAs which was linked thematically to an aspect of the HAIVAIRN study. This led to an open discussion.

AHRC-led AMR Theme 3 project presentations

Each of the AHRC-led AMR Theme 3 call members presented short summaries of their new projects as follows:

- Prof Tim Sharpe, Mackintosh School of Architecture, Glasgow School of Art: *Influence of ventilation design on the prevalence of anti-microbial bacteria in homes.*
- Associate Prof Catherine Stones, School of Design, University of Leeds: *Lifting the lid on bacteria: designing ambient communications to improve hygiene in primary school toilets.*
- Dr Kerstin Sailer, The Bartlett School of Architecture, University College London: *Paths of resistant pathogens in hospitals: architecture, design interventions, transmission risks.*
- Dr Emmanuel Tseklevs, ImaginationLancaster, Lancaster University: *Exploring hygiene practices in different home environments in Ghana to understand how homes are a source of infection of AMR bacteria carried by dust.*
- Mr Richard Beckett, The Bartlett School of Architecture, University College London: *Niches for organic territories in bio-augmented design (NOTBAD).*
- Dr Colin Macduff, School of Design, Glasgow School of Art: *Re-envisaging infection practice ecologies in nursing through arts and humanities approaches (RIPEN).*
- Dr Elta Smith (for Dr Emma Pitchforth, University of Exeter), RAND Europe: *AMR policy development: looking forward through history.*
- Prof Nik Brown, Department of Sociology, University of York: *Pathways, practices and architectures: containing antimicrobial resistance in a cystic fibrosis clinic.*
- Prof Sue Walker, Department of Typography and Graphic Communication, University of Reading: *Information design and architecture in persuasive pharmacy space: combating anti-microbial resistance.*
- Prof Alastair Macdonald, School of Design, Glasgow School of Art: *AMRSim: a microbial reality simulator.*
- Prof Alan Short, Department of Architecture, University of Cambridge: *Excising infection in the surgical environment.* [4]

4 NB provided summary only, unable to attend

Discussion

Using as a platform the HAIVAIRN findings and the new AHRC-led AMR Theme 3 projects, the discussion was opened up to explore the potential wider contribution of the arts and humanities community to the AMR challenge, responding to the following questions:

- What is the potential value and the contribution of the Arts and Humanities community to the Global AMR challenge?
- Does this need to be better articulated?
- What is the Arts and Humanities agenda for this AMR challenge?

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Findings

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1.

Laying the ground: sharing foundational ideas

The scope of responses to the pre-workshop questions was wide, reflecting different disciplinary understandings and possible contributions. Selected responses to some of the main questions are presented here to give a sense of the diversity and necessity of this foundational sharing.

Perspectives on visualisation spanned the micro and macro:

A visualisation in my field is more commonly a designed artefact (Graphic Design)

... most often relates to the visualisation of spatially referenced data within maps (Health Geography)

... the system we choose to visualise will be dependent on the nature of the problem and the prejudices and expertise that the team involved brings to the table... (Science, Technology and Innovation Studies)

... refers to a process in which an individual represents information using visual representation. This can take the form of either internal mental representations (i.e. mental images) or external representations (sketches, models...) (Psychology)

Responses often included ideas related to: generation; formation; orientation; representation; illustration; and/or illumination. The concept of the mind's eye had meaning for many but not utility for all:

... the mind's eye – the ability to imagine and visualise scenes, processes and concepts (NHS Domestic and NHS Support Services Management)

The role of light is integral to notions of vision yet development of notions of vision without light (mind's eye) might prove interesting (Health Humanities)

Ideation and the mind's eye are not in common use (Human Geography)

One of the most important things we do in English Literature is train our students not to visualise – or, rather, to read the words on the page, rather than any mental imagery they might be having (English Literature)

All the participating disciplines felt they had some potential contribution to make to preventing and controlling HAIs, and most could readily identify the potential of other approaches outwith their discipline:

Art can defamiliarise what is known as “real” and “familiar” and unusual or unexpected aesthetic visualisation of HAIs may reposition or mobilise key information and provoke fresh conceptualisation or awareness (Health Humanities)

...we can harness clinical medicine, microbiology and art in order to illustrate the microscopic world for the benefit of staff and patients (Clinical Microbiology)

Other approaches that might be of interest include video reflexive ethnography, the use of social media and videos that target the general public. In so doing, we can try to link a problematic practice or risk to an outcome visually (Nursing)

I also wonder about “casting the net” really wide to look at ways artists now, and in the past, have represented disease, dirt and cleanliness (Graphic Design)

Similar richness was evident in responses to key questions before the second workshop. **Movements, patterns and densities** had meaning at macro and micro levels, and were often seen as interconnected within particular disciplinary or environmental contexts:

Transport planners estimate the movements’ flows between locations (between origins and destinations). This will be useful for understanding the flow patterns and the densities (Transport Planning)

Anthropologists undertake research that traditionally uses participant-observation type methodologies. This kind of research starts at a very basic level with the recording of people movements and noting whether these occur at the density of a group or an individual. A very important aspect of this research is to note whether certain patterns of behaviour can be identified over the course of the research, and whether these patterns suggest certain patterns of culture (Anthropology)

Patterns and density are calculated using a mixture of historical practice, square meterage, activity, clinical demand and work content (NHS Support Services Management)

One major subfield of sociology studies social movements, including the conditions and factors that shape mobilization and outcomes. Another subfield – network analysis – focuses on individuals and connections to understand the role of social relationships for various outcomes, from employment to autism and obesity. Many scholars are focused on identifying patterns in data (Social Policy)

The above responses also yield some insights into how different disciplines **understand and model human behaviour, and interactions** within and between **individuals, groups and environments**.

As such, the use of some preliminary questions and the prior sharing of responses usefully laid the ground for subsequent discussions by highlighting a range of relevant understandings of key terms and concepts. In turn this helped to set a context within which no one discipline was seen as having a monopoly on relevant insights.

2.

Scoping the field: initial exploration of areas of need and opportunity

Workshop 1 focused largely on scoping areas of research need and opportunity in the field. Using a 5W1H ^[5] perspective to consider the data from the workbooks and discussions it was possible to characterise the emergent themes broadly within the ambit of four questions:

- 1. What is, and has been, going on regarding the less visible/invisible experiences of key groups involved in the prevention and control of HAIs (and how do we best apprehend and understand these)?**

This pertains to issues of untapped/tacit perceptions, conceptions, knowledge and values, and may involve all senses, not only visual. This would include contextualised relationships to pathogens and places, as well as other people. The role of intra-staff narratives, rituals and risk, mental health and “6th sense” were seen as worthy of further exploration. Cleaning staff were thought to be a relatively invisible and undervalued group within this context, as were visitors. This might involve a range of research methods, especially qualitative/ethnographic/spatial.
- 2. What is, and has been, going on regarding the location and movement of pathogenic microorganisms within and outwith clinical environments (and how do we best visualise and understand these phenomena)?**

This pertains to understanding of the ecology and dynamics of pathogen behaviours within particular contexts, involving questions about space, time and scale, and interaction with humans. It also involves exploring what data to collect and how best to model and analyse these. Microbiology, mathematical modelling and social/environmental research approaches are seen as particularly relevant.
- 3. What is, and has been, going on in terms of policy and practice in communicating risk in this field through visual and other means (and how do we best investigate and understand this)?**

This pertains to understanding dominant visual tropes and cultural histories of representation, along with current framing of related narratives and discourse. It also involves investigation of what works best with generic and specific populations, and the tension between positive and negative representations of risk. Historical, cultural, literary and design approaches are seen as particularly relevant.
- 4. How can health and social care practices within this field be best improved through understanding and application of visual-related approaches (and what data and analysis methods are necessary)?**

This pertains to understanding behaviours and the role of visualisation within these, and then using visual approaches as part of interventions to facilitate behaviour change. It can involve theory from a range of disciplines such as psychology, sociology, design and health services research, and a related gamut of data-gathering and analytic techniques.

3.

Staking the field: mapping of interests and priorities

Following Workshop 1 we gave further consideration to these four questions and how they might best be mapped visually. From an early stage in network discussions it had become clear that the micro-macro, visible-less visible, distinction could be useful, albeit that movement between these poles was often dynamic when participants considered visualisation and HAls. Moreover, some areas of need and opportunity tended to focus more on people, often within their practice role, while others focused more on particular aspects of context. Again this was seen as a dynamic relationship spanning a continuum from the individual person, through groups working in practice, to contingent aspects of context such as place, policy and power. This led to an initial quadrant diagram mapping (Figure 2):

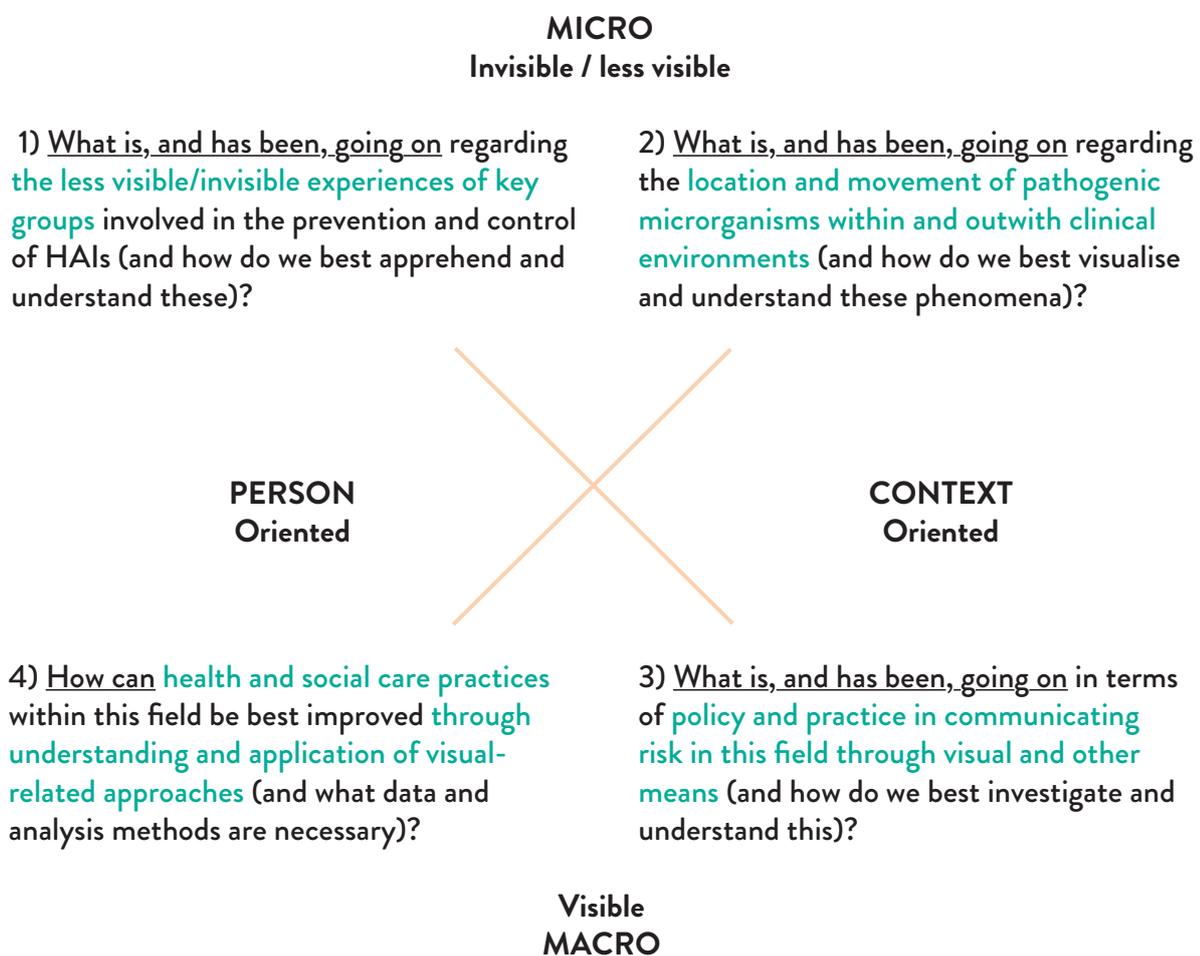


Figure 2. Quadrant diagram derived from analysis of workshop 1 responses.

This was then further developed into the format below for the purposes of eliciting Workshop 2 participants' individual areas of interest and priority (Figure 3).

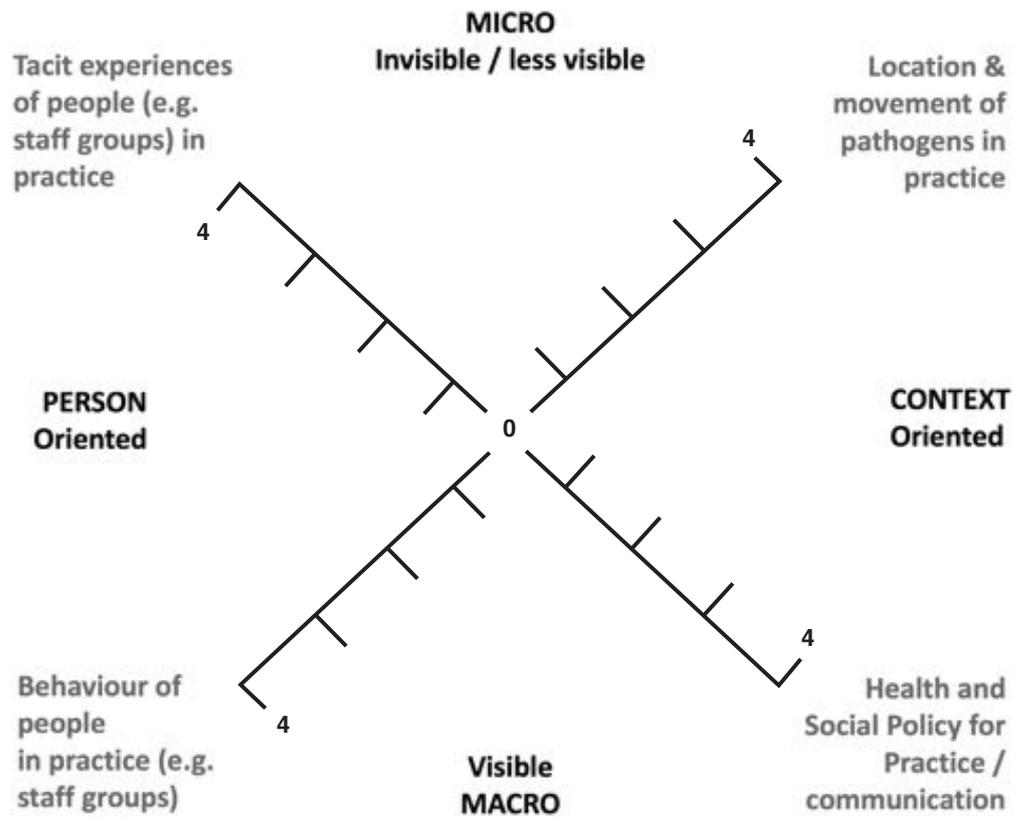


Figure 3. Scalar diagrammatic format, derived from figure 2 mapping, used in Workshop 2.

Participants were asked to mark a point on each scale with a score of 4 indicating very substantial and high priority, 3 being substantial priority, 2 being moderate priority, 1 being little priority, and 0 indicating no personal interest or priority. Interestingly, most of the 12 participants indicated interests of moderate to high priority in at least three of the four main areas, resulting in profiles such as in Figures 4 and 5:

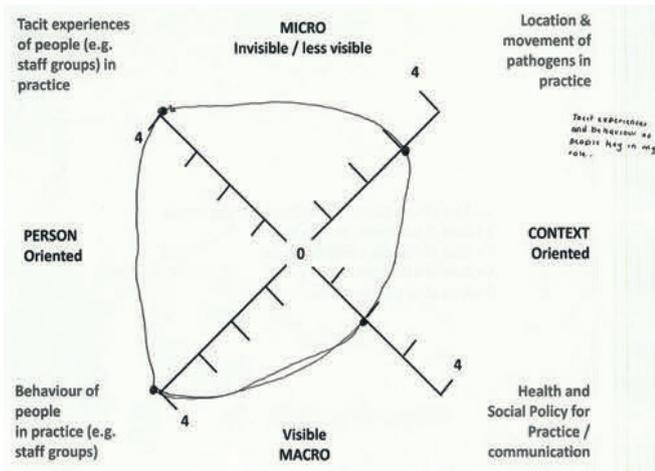


Figure 4. Mapping from NHS Facilities Management.

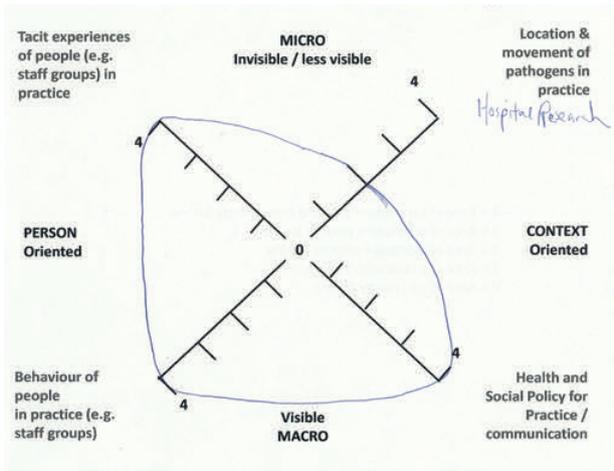


Figure 5. Mapping from Social Policy.

However some participants had rather more defined areas of interest and priority (Figures 6 and 7):

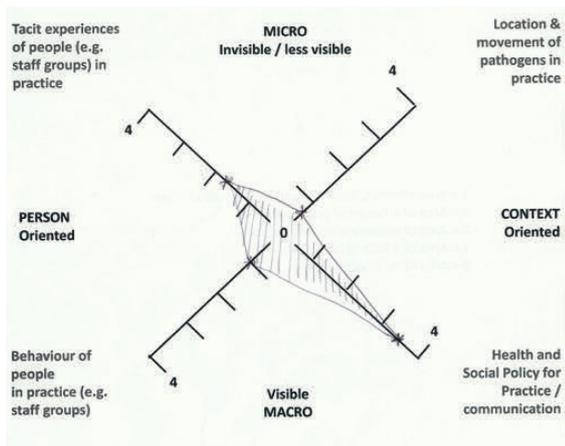


Figure 6. Mapping from English Literature / Medical Humanities.

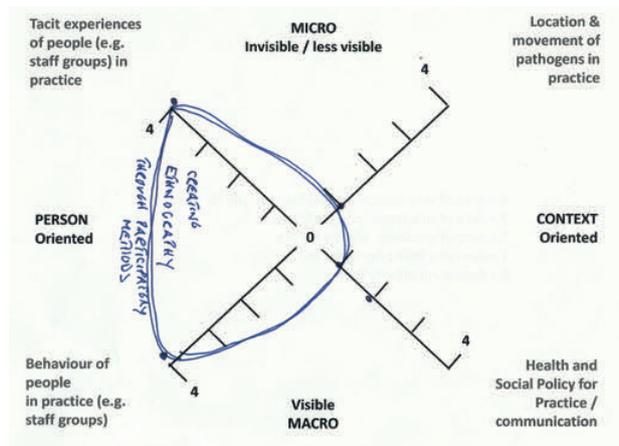


Figure 7. Mapping from Anthropology.

Sharing of these individual mappings in the workshop helped participants to identify areas of particular mutual interest and to subsequently propose ideas for possible collaborative studies, for example:

Put together modelling of healthcare professionals' movements 'through' hospitals with narratives about their behaviour / experience. Why? Start to generate predictive models of HAI risk.

Can we empower cleaners with training technology and participatory power in hospitals to be the effective frontline in infection control through enhanced environmental services?

How HAI & AMR are a way of representing global class politics. Daniyal's presentation showed how neoliberalisation and globalisation are important explanatory factors in the story of HAIs & AMR.

These topics indicate the range of issues seen as relevant for the application of visualisation approaches and reflect some of the momentum and enthusiasm in the workshop discussions.

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4.

Mapping the field: schemas giving indicative overview

Building from the individual mappings and sharing of specific ideas, the visual mapping below (Figure 8) summarises the nature, location and interrelationship of the main topics and methods that participants saw as research needs and opportunities:

Areas of research need and opportunity for visualisation approaches to HAIs (topics and methods)

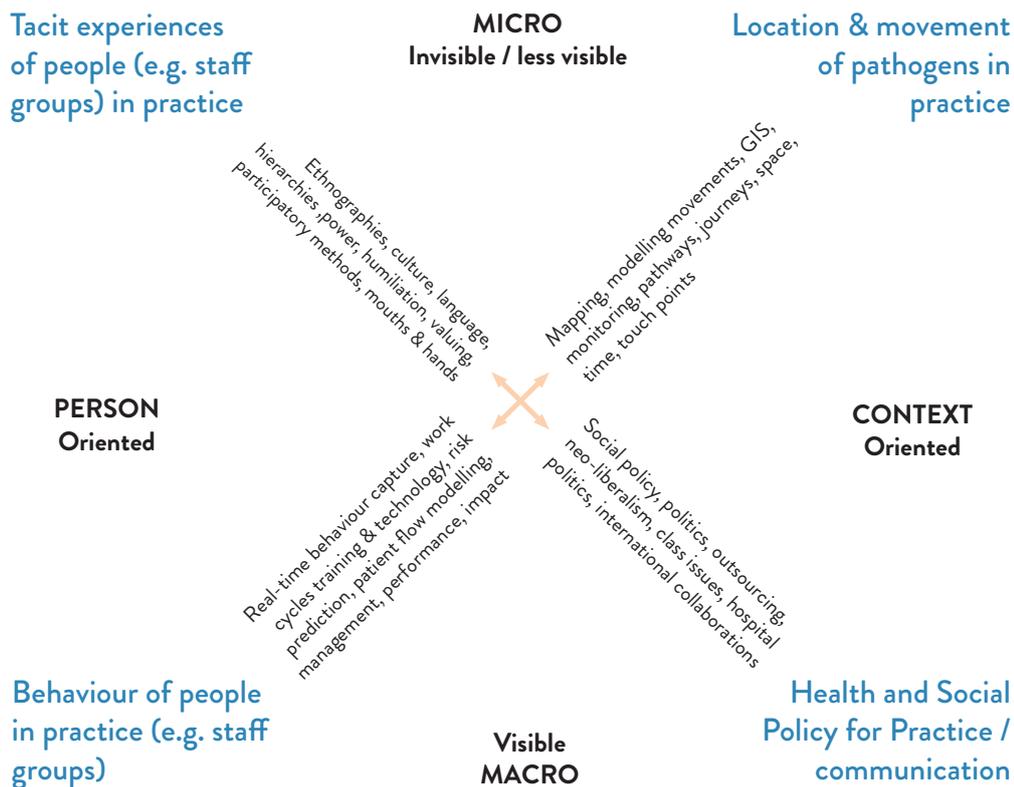


Figure 8. The nature, location and interrelationship of the main topics and methods that participants saw as research needs and opportunities.

Within the mapping above, the two main diagonal axes each comprise a dynamic continuum. The potential for mapping, modelling and monitoring movement of pathogens and people through contexts of space and time (top right through to bottom left) was seen as very promising by many of the participants. By achieving enhanced understandings of these phenomena better prediction of risk and associated management could be developed in cleaning and health professions' practices.

While the axis that runs between top left to bottom right is arguably less integrated as a continuum, there was seen to be much need to use visual approaches to illuminate and better understand tacit aspects of culture/prevaling hierarchies and their interrelationship with wider social policy and international developments. Perhaps the onward link from these better understandings to enactment of healthcare practices is as yet less obvious on this axis, but there was accord about the potential for further developing this.

Stepping back from the diagonal dynamics within this mapping, it is also useful to consider the nature of lateral relationships between the four individual “arms”. Our subsequent mapping (Figure 9 below) provides some examples of relevant connections by adding in some aspects that surfaced in participants’ reflections.

Areas of research need and opportunity for visualisation approaches to HAIs (topics and methods)

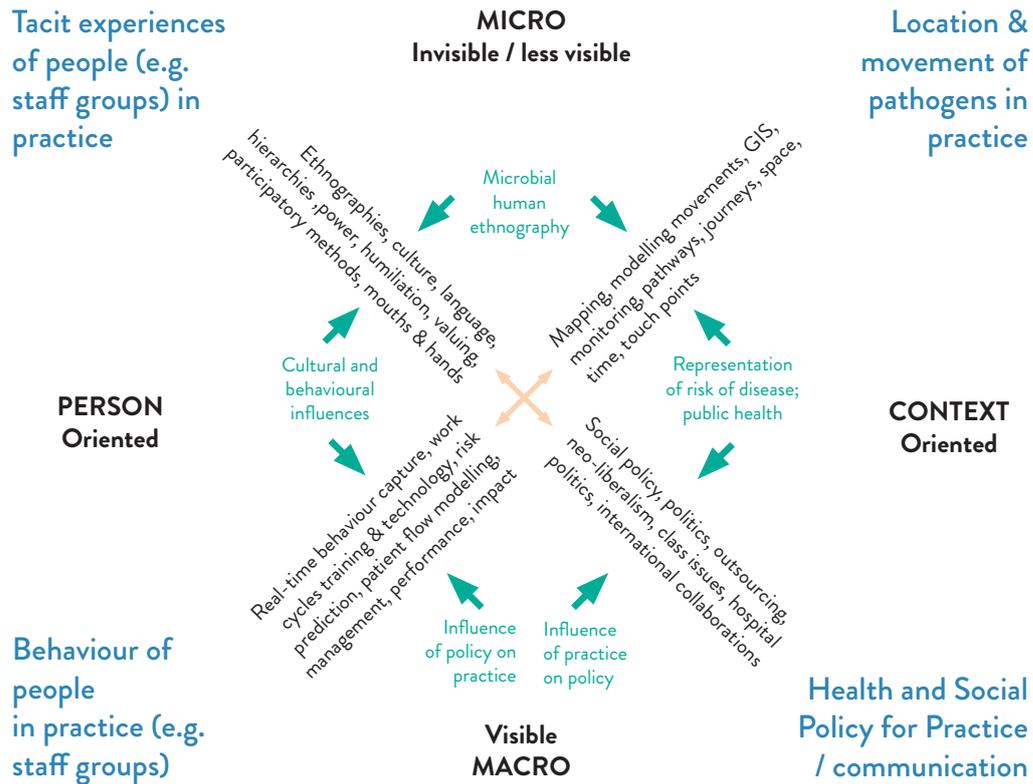


Figure 9. Examples of relevant connections by adding in aspects that surfaced in participants’ reflections.

Thus Figures 8 and 9 build from Workshop 1 and 2 to provide an initial indicative map that gives overview of this emergent field and enables consideration of potential related work streams. Significantly these mappings reflect the multiple contingent factors involved with HAIs, and the many related opportunities for developing and deploying visualisation approaches. However they also pose a challenge, noted by several participants, for honing research focus around particular conjunctions of topics and methods. The next section provides a glimpse of ongoing work which is “drilling down deeper” to investigate aspects of behaviour pertinent to the bottom left quadrant depicted in Figure 9.

5. Zooming in: reviewing and mapping studies of visual interventions for behaviour change ⁶

This section reports on one aspect of an ongoing PhD study that has three stages (Figure 10). The final goal of this project is to compile a set of recommendations for researchers interested in the use of theory and visualisations for the development of behaviour change interventions in the field of infections prevention and control (IPC) and healthcare-associated infections (HAIs). The final set of recommendations will comprise the findings from each of the three stages.

This “snapshot” report focuses on Stage 1, as shown in Figure 10, and more specifically on the findings of *Integrative review 2 (visualisations)*. The scope of the review was to identify visualisation-centred interventions used in the IPC and HAIs fields within a behaviour change approach. Consequently, the aims of this review were threefold, (i) to explore the range and types of visualisation-centred interventions, (ii) to describe their structure and application and (iii) to determine their effectiveness.

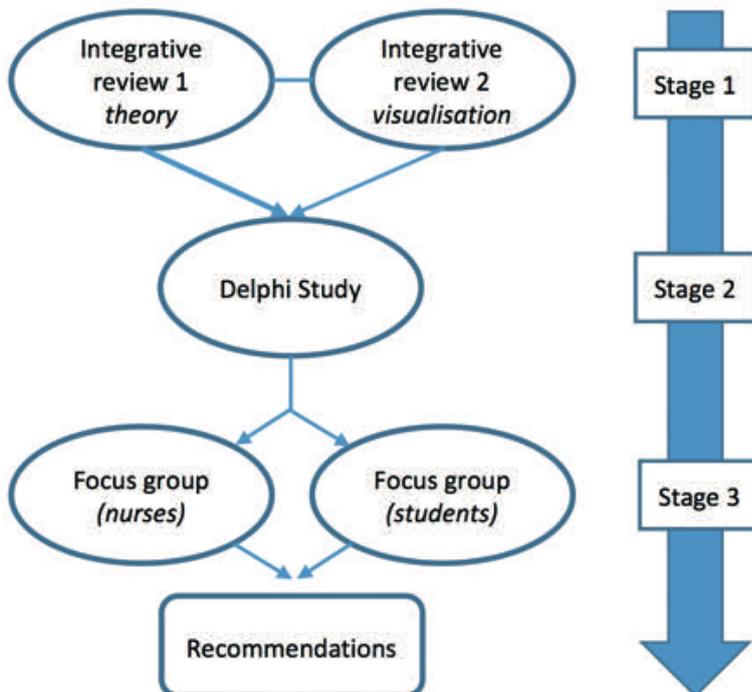


Figure 10. Stages of current PhD project.

⁶ By Kostas Tsattalios, PhD student, Robert Gordon University (RGU), Aberdeen

Visualisation: operational definition

For the context of this PhD project, visualisation is operationally defined as:

the creation and/or deployment of **visual artefacts** (such as static or dynamic imagery), and/or the stimulation of guided mental imagery, used as the **central, substantive focus** of an evaluated intervention within education, practice development/quality improvement or research in order to prospectively and **positively influence healthcare staff** to prevent and control healthcare associated infections (excluding visual artefacts used primarily for purposes of microbiological detection or surveillance, and written text based artefacts without a central focus on substantive integral visual imagery).

More information about the context shaping this review as well as its procedural and structural details can be found online in its published PROSPERO protocol (Tsattalios et al., 2017) [7]

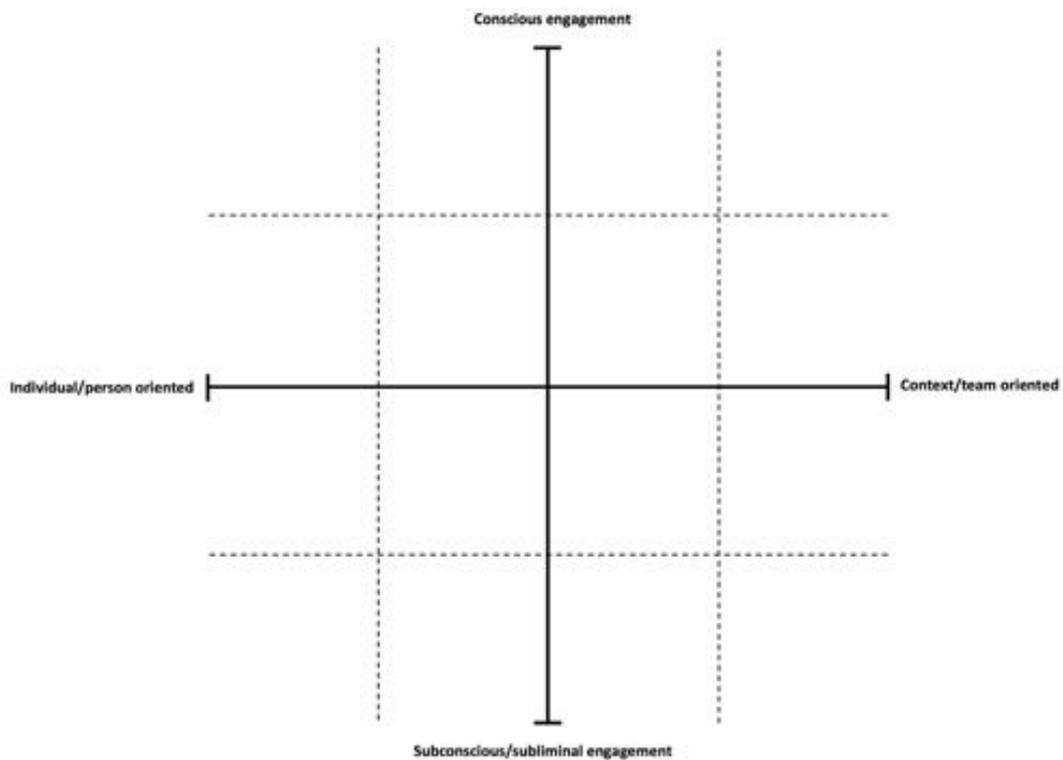


Figure 11. Template of mapping.

7 Tsattalios, K., Macduff, C., Stephen, A., & Henderson S. (2017). Visualisation-centred interventions to aid healthcare staff to prevent and control healthcare-associated infections: an integrative review protocol. PROSPERO 2017 CRD42017048142 Available from: http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42017048142

Out of the 397 initially retrieved studies, 23 were finally included in the review. During the initial screening process of the studies, it became apparent that common themes were shared by groups of studies. These themes were based on whether the identified studies aimed for the participants' conscious or subconscious engagement with the intervention, and whether performance feedback was given to participants or not. The above themes were used as a 'pre-qualification' system that formed the basis for clustering the potentially relevant studies.

After further screening and pilot-testing studies against the inclusion/exclusion criteria, the above cluster approach was better honed into a final mapping template as shown in Figure 11. This template is plotted on two axes, one depicting the interventions' intended level of engagement in terms of consciousness (vertical) and the other depicting the interventions' orientations around the individual/person-context/team level (horizontal).

Initial mappings

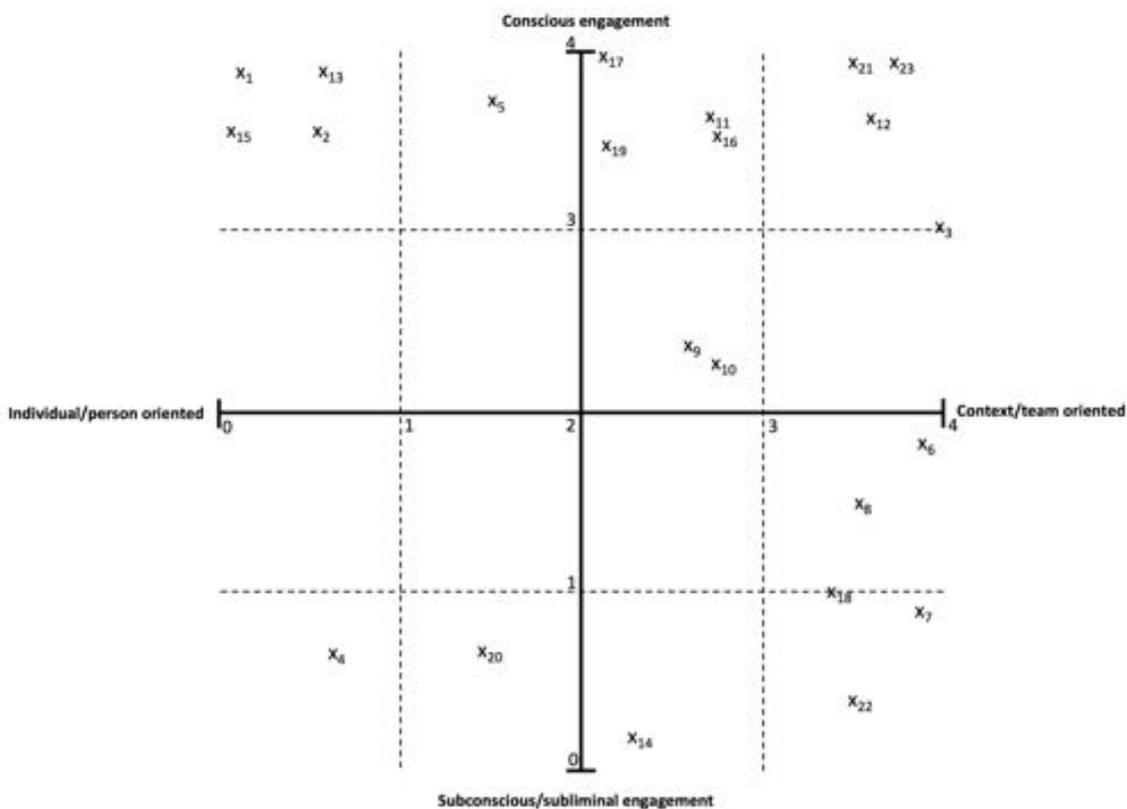


Figure 12. Mapping of modes of orientation and engagement for 23 visualisation-centred interventions.

Figure 12 represents mappings for the 23 included studies across the aforementioned template. These indicative mappings were determined by the current author and as such form a relative positioning of the studies within the quadrants rather than a definitive one. Nevertheless, the figure is believed to be an informative depiction of the studies' scope and may be regarded as a useful depiction of the concept of behaviour change in the IPC and HALs context.

Specific examples of visualisations-centred interventions are given for the three most populated quadrants as shown in Figure 13. Each of the 23 included studies has been considered by the author in the light of the three approaches to change proposed by Chin and Benne (1969) [8]: Empirical-Rational, Power-Coercion, Normative-Re-educative. In some cases, across the 23 included studies, a combination

8 Chin, R., & Benne, K.D. (1969) *General strategies for effecting changes in human systems*. In W.G. Bennis, K.D. Benne, & R. Chin (Eds), *The planning of change* (pp. 32-59). New York: Holt, Rinehart & Winston.

of approaches to change was detected whereas in others only one approach to change seemed evident, as was the case with the three examples shown.

Within this context, at the bottom right quadrant Nevo et al. (2010) [9] employed visual cues and flashing lights across the clinical environment as a means of improving healthcare staffs' hand hygiene. The dominant approach to change in this study appears to be Power-Coercion.

In the top right quadrant Wyer et al. (2017) [10] engaged patients and nurses by using the video reflexive ethnography approach in the exploration of IPC-related complexities. The Normative-Re-educative approach to change appears to be most dominant one.

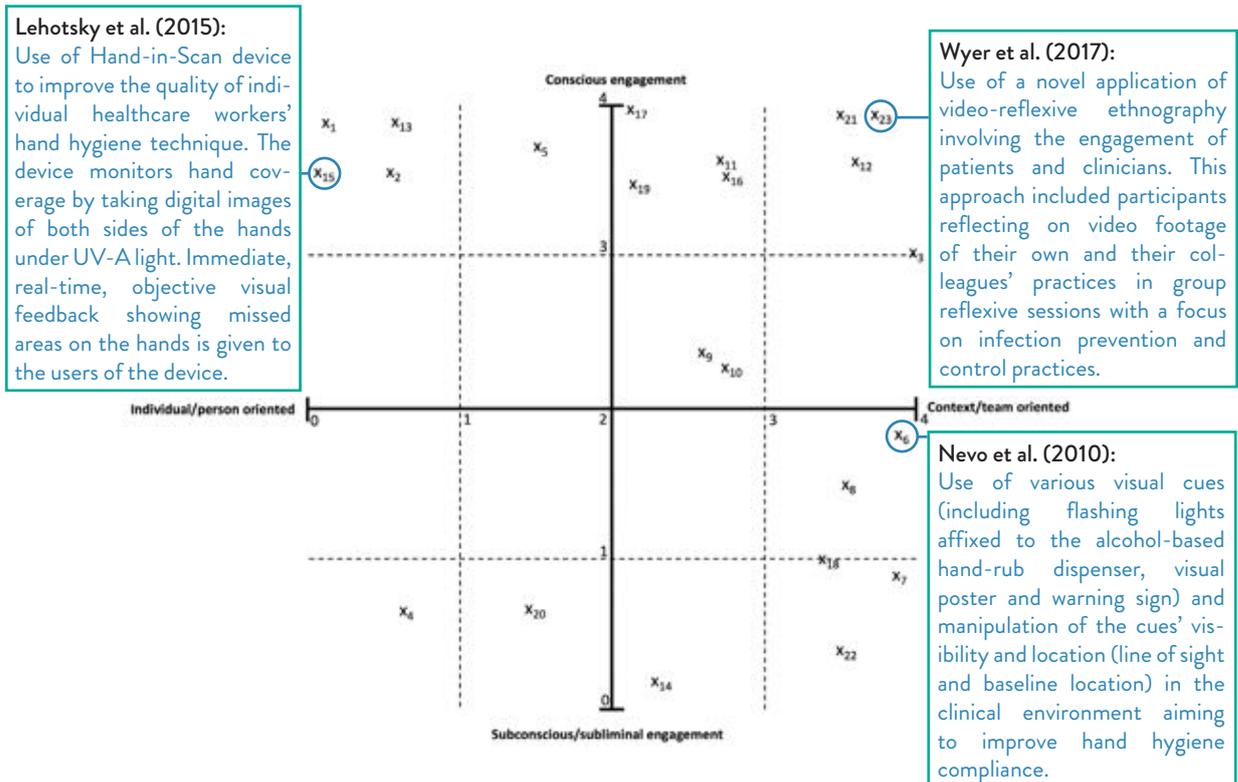


Figure 13. Example of visualisation-centred interventions.

Finally Lehotsky et al. (2015) [11] in the top left quadrant used a training device targeting hand hygiene technique providing real-time and personalised feedback. This appears to adopt an Empirical Rational approach to initiating change.

The work reported above is ongoing within the context of thesis development and is linked to an oral presentation entitled, “Visualisation-centred interventions in the healthcare-associated infections field: An integrative review” delivered at the Australasian College for Infection Prevention and Control (ACIPC), 6th International Conference, Canberra, 20th-22nd November, 2017. This won the Elaine Graham Robertson award for best oral presentation. The award was accompanied by a prize to the value of \$500. More details about the conference and for accessing the presentation’s abstract can be found here: <http://2017.acipconference.com.au/>.

- 9 Nevo, I., Fitzpatrick, M., Thomas, R. E., Gluck, P. A., Lenchus, J. D., Arheart, K. L., & Birnbach, D. J. (2010). The efficacy of visual cues to improve hand hygiene compliance. *Simulation in Healthcare*, 5(6), 325-331.
- 10 Wyer, M., Iedema, R., Hor, S. Y., Jorm, C., Hooker, C., & Gilbert, G. L. (2017). Patient Involvement Can Affect Clinicians' Perspectives and Practices of Infection Prevention and Control: A “Post-Qualitative” Study Using Video-Reflexive Ethnography. *International Journal of Qualitative Methods*, 16(1), 1609406917690171.
- 11 Lehotsky, Á., Szilágyi, L., Ferenci, T., Kovács, L., Pethes, R., Wéber, G., & Haidegger, T. (2015). Quantitative impact of direct, personal feedback on hand hygiene technique. *Journal of Hospital Infection*, 91(1), 81-84.

6.

Shoots and fruits: three new funded studies

During the lifetime of the project the cross-council AMR initiative issued its AHRC-led Theme 3 call for research proposals in the area of Antimicrobial Resistance (AMR) in the Indoor and Built Environment. Several members of the HAIVAIRN network developed ideas into bids. Three were successful in gaining funding and all of these have visualisation as a central element. Interestingly, while all three projects are ultimately concerned with moving towards behaviour change, each is concerned substantively with at least two of the other main areas on the Figure 8 mapping. Summaries of these three projects are now presented:

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Lifting the lid on Bacteria:

PI Associate Professor Catherine Stones, University of Leeds

Context: AMR can be directly tackled by reducing the spread of infection in the first instance. The primary school toilet is a risk-laden space for the spread of bacterial infection given the behaviour of its users. Research reports that fewer than half of the children who use school toilets wash their hands afterwards. Neutral poster-based messages such as 'Now Wash Your Hands' or classroom material may aid understanding and reinforce hand hygiene messages but what is the potential of using more novel, engaging, friendly and site-specific communication in the toilet environment itself?

Aims and objectives: The primary aim of this communication design-led research is to investigate the potential of using ambient, surface-based communications in the primary school toilet environment to improve hand hygiene practices (lowering the toilet lid, hand washing and hand drying). Ambient communication involves the clever and unexpected integration of graphics and media messages in specific environments. It is usually employed by commercial companies to improve engagement with a product or brand but it holds much potential for application in other areas. If bacteria and other appropriate message/ images were cleverly represented in the environment, for instance, what impact would it have on behaviour in that space? This research involves three phases. Firstly a historical review of everyday representations of bacteria and hand hygiene aimed at children will be carried out. This will provide new knowledge of dominant ideas from the 20th Century about children, hygiene and bacteria and provide selected imaginative material to show to children in subsequent workshops. Secondly school children will be directly engaged with to gauge their understanding of the toilet space, what bacteria might look like there and where it is. Participatory design methods will be used to understand what children would design and why. Thirdly a set of ambient designs will be developed, informed by historical and contemporary design practice and children's imaginative ideas, for testing in school toilets and the toilets at Eureka! The National Children's Museum. The installation of the designs will facilitate the testing of the concept and provide opportunity for a pilot study of evaluation methods – what are the most effective and feasible ways to measure success of such an intervention?

Lifting the lid on Bacteria is a collaboration between the University of Leeds, The Glasgow School of Art and Eureka! The National Children's Museum.



Figure 14. Trap your germs in your handkerchief. <https://wellcomecollection.org/works/cg846t6k?query=trap+your+germs+in+your+handkerchief> Image © Wellcome Collection, licensed under Creative Commons / <https://creativecommons.org/licenses/by/4.0/> Cropped from original.



Figure 15. Dirty Germ. <http://vector4free.com/vector/free-vector-virus-cartoon/> Image © Vector 23 / licensed under Creative Commons / <https://creativecommons.org/licenses/by-nc/3.0/>

AMRSim: A Microbial Reality Simulator:

PI Professor Alastair Macdonald, Glasgow School of Art

The Problem: Antimicrobial-resistant bacteria are an established and growing issue in small animal veterinary practices in the developed world. AMR bacteria are more likely to emerge and transmit where there are higher microbial densities. Effective infection prevention and control (IPC) is essential for tackling the AMR problem. The uptake of appropriate IPC is heavily influenced by human risk perception and consequent behaviour and the way humans and animals interact with the physical environment of the vet practice. Effective communication and teaching tools are therefore necessary to ensure individuals' understanding and behaviours are in line with scientific recommendations. Whilst data exist to inform best practise in IPC, they seldom incorporate multiple factors and are published in academic journals, thus having limited impact on how practitioners understand and practise IPC in their working environment.

Our solution: Using a co-design process, we shall build a dynamic interactive virtual model (AMRSim) of the vet practice that takes human, animal and microbial data from the real world, and makes them 'come alive' in a visual way. Importantly, the model will allow the normally invisible bacteria to be 'seen' as they multiply and spread through the indoor environment on people, animals and surfaces.

Underlying hypothesis: As practitioners interact with the model, both in its development, and then in its application, they will gain a greater appreciation for: 1) the impact IPC can have on infection control; 2) where weaknesses lie in current practise; and 3) where changes made to the way people and animals interact with each other and their environment can disrupt the *status quo*. These will lead to a reduced risk of bacterial contamination and infection, and ultimately reduced reliance on antibiotics.

Outcome: We shall use AMRSim with veterinary practice staff to encourage effective reflective behavioural changes that positively impact on microbial contamination, thereby reducing the risk of acquisition and transmission of AMR. Through proof of principle we shall have a theoretical and practical framework and a tool with which to apply this approach more widely, e.g. for teaching students or application to other areas where biosecurity in the indoor environment is paramount.

AMRSim is a collaboration between The Glasgow School of Art, University of Surrey School of Veterinary Medicine, and Fitzpatrick Referrals.

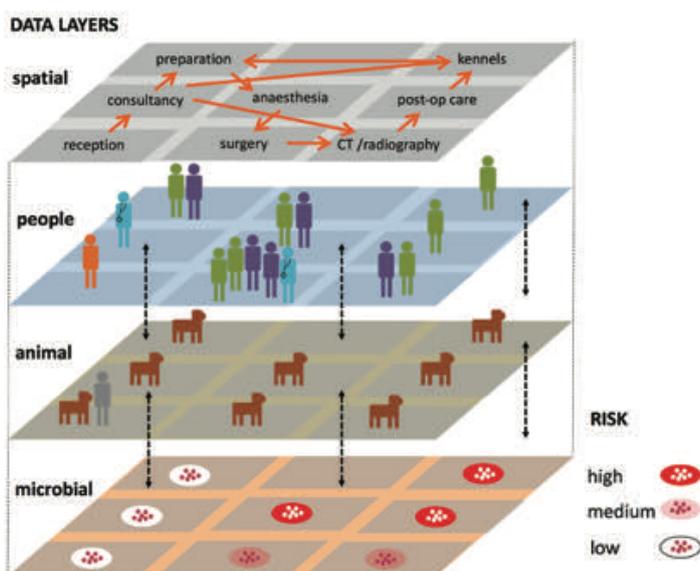


Figure 16. Conceptualisation of the main data layers to be created in the AMRSim microbial reality simulator.

Re-envisioning Infection Practice Ecologies in Nursing through Arts and Humanities Approaches (RIPEN):

PI Dr Colin Macduff, Glasgow School of Art

Across the world nurses constitute the largest professional healthcare workforce and typically nurses have numerous daily interactions with healthy and ill individuals, family members, community groups and other care professionals. As yet, however, the profession has not leveraged its full potential to prevent AMR advancing or to countenance the consequences of failure.

The RIPEN research project seeks to approach this issue by starting from where practising nurses are just now in their daily working lives and using mostly visual methods from design, history, art, nursing and health services research to explore how we can develop practice in this area. We aim to draw on and foster nurses and allied colleagues' creativity to address four main questions:

1. How do groups of hospital and community based nurses understand and respond to the priorities and consequences of AMR within the context of their everyday working lives?
2. How can co-design and visualisation based approaches help these nurses to identify and construct sets of meaningful practices that optimise present prevention of AMR?
3. How can co-design, visualisation, history and other relevant arts and humanities approaches help nurses to re-imagine and re-envision their infection control practice ecologies in a future with minimal or no effective antibiotics?
4. What priority issues and other questions does this initial enquiry raise, and how can these best inform policy and planning, education and further research?

The main phase of the project will involve small groups of nurses and allied healthcare workers taking part in four one-day workshop events held in London and Glasgow over the course of one year. These workshops will explore each of the main questions, with interim sharing and development of experiences being supported by a virtual learning environment (VLE). Outputs from this phase will inform a final Policy Lab event at King's College, London where a range of key stakeholders will gather to consider practical implications and priorities for action.

RIPEN is a collaboration between The Glasgow School of Art, King's College London, University of the Arts London, Glasgow Caledonian University and Imperial College London.



Re-envisioning
Infection Practice
Ecologies in Nursing

Figure 17. RIPEN logo.

7. Dissemination

In addition to the more informal dissemination of information about the network undertaken by members, two international conference presentations have taken place so far:

Macduff, Colin and Macdonald, Alastair (2017) *Developing a new cross-disciplinary network to realise the potential of visualisation approaches to address healthcare associated infections*. In: Infection Prevention and Control (IPAC) Canada 2017 National Education Conference, 18-21 June 2017, PEI Convention Centre, Charlottetown, Prince Edward Island, Canada.

Macduff, Colin; Macdonald, Alastair and Tsattalios, Kostas (2017) *Unlocking the potential of visualisation approaches to address healthcare associated infections: a new international, cross-disciplinary, network*. Australasian College for Infection Prevention and Control (ACIPC) Conference, 20th -22nd November 2017. National Convention Centre, Canberra, Australia.

The latter presentation was delivered by Kostas Tsattalios who was kindly hosted by Professor Brett Mitchell, Avondale College Faculty of Nursing and Health, Sydney Campus, Australia.

The project website has also provided a key external interface during the course of the network's development: http://radar.gsa.ac.uk/5642/1/HAIVAIRN_Final_online.pdf

8.

Taking stock: final workshop review

The final Workshop 3 started with brief review of HAIVAIRN’s progress and used the following Table 1 (informed again by the 5W1H framework) to summarise some of the main aspects engaged with during the project.

Table 1: Summative mapping of HAIVAIRN using 5W1H

Why?	What (Needs Visualised)?	How?	Who? When? Where? What Next? (opportunities)
Conceptualisation/ Definition (language and meaning: what are ideation and visualisation?)	Systems Relationships Space Place Data Pathogens Movement Patterns People Behaviour Feelings Culture Policy Power	Ideas, Artefacts, Media and Methods	Particular proposals and projects on HAIs
Theorisation (understanding and explanation)		Generation Formation Information Representation Illustration	Future of HAIVAIRN network itself
Application (interventions for addressing HAIs)		Text Images Digitisation	Transference of specific ideas to related issues such as AMR
		Design/co-design Investigation Co-production Education Collaboration Empowerment Manipulation Co-ercion?	The HAIVAIRN network as a potentially useful model for advancing in a new area
			HAIVAIRN as a catalyst for more substantive and integrated articulation of the wider A&H contribution to the AMR challenge

The need for application of visualisation approaches has been the primary rationale for HAIVAIRN’s work so far with recognition, however, that matters of conceptualisation and definition are important for this cross-disciplinary work. While underpinning theories of various types have been referred to during the workshops, to date this aspect has not received in-depth development. The nature and scope of what may need visualised is very wide, with the examples in the table being indicative only. Likewise, the ideas, artefacts, media and methods that can be involved in applying visualisation approaches are varied and draw from many different disciplines.

The main part of Workshop 3 involved looking ahead, and it was recognised that the HAIVAIRN initiative has proved very useful in establishing ideation and initial momentum within this emergent field of enquiry. Although the funded initiative was drawing to an end, it was clear that network members would continue to develop ideas and collaborative proposals. Moreover, the three examples of recently funded studies in the related area of AMR show how some of the ideas explored within the network could be transferable into particular contexts.

The final section of the report reflects further on HAIVAIRN with particular focus on transferable lessons and harnessing the initiative’s momentum as part of wider efforts to articulate the Arts and Humanities contribution to combating the urgent international AMR challenge.

Reflections

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Achievement of objectives

From the summary of findings presented above it can be seen that the project has substantively achieved its pre-set objectives in terms of coalescing relevant expertise, delivering the workshops, mapping areas of need and opportunity, and generating questions for cross-disciplinary research proposals. Indeed it has gone some way beyond these by also gathering foundational disciplinary understandings, supporting more detailed integrative review work in a key area, and securing funding for three relevant research proposals.

Lessons learned

The investigators and the network participants have accrued valuable learning from the process elements of this project. This report seeks to share some of this learning with a wider audience.

Designing the first two workshop events to respectively address “Micro” and “Macro” aspects helped give each an initial frame, but in reality it was seldom useful to consider either aspect in isolation. The approach that emerged for mapping helped overcome this by considering macro and micro as related aspects within a bigger picture. Within this context it is worth highlighting that although macro aspects are visible in the sense that they *can* be seen, they may often be *unseen* in the sense that they are not consciously perceived. Macfarlane [12] makes this point well in relation to landscapes, citing the work of the artist Paul Nash. This means that such macro phenomena can benefit as readily from the application of visualisation approaches as micro phenomena that are unseen due to invisibility. The mapping schemas presented in this report attempt to reflect these points while indicating the scope of the main field, but clearly they are provisional and developmental in nature.

Within this field the network has not tried to identify one overriding priority area or theme for enquiry. While proposals often gravitate towards the design of interventions (see funded proposals) that aim to improve practice by aiding behaviour change (see Question 4, Section 2 of Findings), there is also concurrent need to better understand related areas by first ascertaining what is going on (see Questions 1-3, Section 2 of Findings). A good example of this emerged early in the project when discussions in Workshop 1 highlighted the work of hospital cleaners as being particularly amenable to benefits from visualisation approaches. While it was felt that visualisation could help within their training to improve cleaning practices, it was also contended that this group of workers themselves tended to be unseen in terms of recognition of their contribution and its impact. Thus their behaviours might be better understood by finding out more about their narratives, culture and political position, and thereby making these more visible. Accordingly a small consultation activity was undertaken with frontline hospital cleaners following Workshop 1 and a summary of this (see Appendix 4) was fed into Workshop 2 which also featured a presentation by Professor Zuberi on lessons learned from the outsourcing of cleaning in Canadian hospitals.

To illustrate the diversity of the terrain discussed and explored, a few from the many topics discussed, included: 1) how neo-liberalisation and globalisation are important explanatory factors in the story of HAIs & AMR and reflect global class politics; 2) the need for agent-based modelling approaches and large-scale data collection; 3) the contrast and comparison of the narratives of hygiene and observed behaviour (the say and do dilemma); 4) the use of qualitative GIS and the link between environment and memory; and 5) space-time mapping to capture dynamic interaction between people, behaviour and environment.

Hence what has emerged clearly is not only the need for work within each of the quadrants in Figure 8 to look more systematically at what research has been undertaken to date (in a similar way to the ongoing doctoral work outlined in Section 5 of the Findings), but also the need for further integrative work spanning the areas depicted in interconnected quadrants.

In this way HAIVAIRN has highlighted the expansive nature of the concept of visualisation from micro pathogens through to macro social policy. In doing so HAIVAIRN has moved from a starting base in arts and humanities to engage with a wider range of disciplinary and cross-disciplinary perspectives. Developing and applying these various perspectives through further collaborative working could help towards better addressing the problem of HAIs.

Other knowledge and experience accrued in the process of this network development may have value. While the project methodology was used for the very specific HAIVAIRN visualisation and ideation objectives within the HAI and wider AMR contexts, it may be that this approach could provide a model for bringing together different disciplines to explore other new areas in an inter-disciplinary manner. The variety of modes of engagement, e.g., of responding to questions, presenting ideas and concepts visually, mappings, plenary discussion, analysis and feedback of findings, created a number of rich data sets as a background for informed and stimulating discussions. The specific focus of the presentation of the HAIVAIRN stage 1 and 2 findings coupled with the stimulus provided by workshop 3 presentations on the recently awarded AMR AHRC-led Theme 3 projects provided the basis for a conversation which began to articulate the arts and humanities community's contribution to – and agenda for – the wider AMR challenge. The citing of exemplars from other communities articulating their contribution to the AMR challenge, such as the social sciences [13] and social theory [14] were useful here. An exemplar of how arts and humanities research contributed to another area – mental health and wellbeing [15] – was also cited. Thus it is suggested that this network project may have value as an exemplar in its own right and as a catalyst for further arts and humanities developments in related fields.

13 ESRC. (2014). Antimicrobial resistance: setting the social science agenda. Report of an ESRC working group. Retrieved 1 November 2017. Available at: <http://www.esrc.ac.uk/files/funding/funding-opportunities/amr/anti-microbial-resistance-setting-the-social-science-agenda/>

14 Chandler, C., Hutchinson E. & Hutchison C. (2016). Addressing Antimicrobial Resistance through Social Theory: An Anthropologically Oriented Report. London School of Hygiene and Tropical Medicine. Retrieved 1 November 2017. Available at: <http://researchonline.lshtm.ac.uk/3400500/1/Addressing%20Antimicrobial%20Resistance%20Through%20Social%20Theory%20GOLD%20VoR.pdf>

15 AHRC. (2017). Exploring Mental Health and Wellbeing: the role of arts and humanities research. Retrieved 1 November 2017. Available at: <http://www.ahrc.ac.uk/documents/project-reports-and-reviews/mental-health-and-wellbeing/>

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Recommendations

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Based on the processes of enquiry, findings and reflection on lessons learned, three recommendations are made:

1. That researchers, educators and practice developers with interest in applying visualisation approaches to HAls (and AMR) consider how our findings may relate to, or inform, their own endeavours.
2. That researchers, educators and practice developers who may be setting up similar time-limited formal networks consider how our methodology may relate to, or inform, their own endeavours.
3. That organisations and individuals with interest in better articulating the potential contribution of arts and humanities led approaches within healthcare generally, and the field of AMR particularly, consider the extent to which this project may have value as an exemplar.

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A digital version of this report is available to download from:
http://radar.gsa.ac.uk/5642/1/HAIVAIRN_Final_online.pdf

Appendices

APPENDIX 1

Workshop 1: Glasgow School of Art
30 September 2016

ATTENDEES AND CONTRIBUTORS

Investigators

- Prof Alastair Macdonald, Senior Researcher School of Design, The Glasgow School of Art.
- Dr Colin Macduff, Senior Research Fellow, The Glasgow School of Art.

Network Members

Present

- Prof Stephanie Dancer, Dept. of Medical Microbiology, Lanarkshire Acute Hospitals NHS Trust; and Edinburgh Napier University. Expertise: microbiology.
- Prof Brett Mitchell, Avondale College Faculty of Nursing & Health, Sydney Campus. Expertise: nursing.
- Dr David Pearson, Reader, Anglia Ruskin University, Cambridge Campus. Expertise: psychology, cognitive science, brain and cognition.
- Dr Sarah-Anne Munoz, University of Highlands and Islands. Expertise: rural health, health geography, community engagement and coproduction.
- Dr Catherine Stones, School of Design, University of Leeds. Expertise: graphic design and visualisation.
- Dr Gavin Miller, Senior Lecturer in Medical Humanities, Director, Medical Humanities Research Centre, University of Glasgow. Expertise: English literature/medical humanities.
- Dr Dilum Dissanayake, Lecturer in Transport Modelling, Planning & Management, University of Newcastle. Expertise: transport modelling.
- Kostas Tsattalios, PhD student, Robert Gordon University.

Apologies

- Prof Paul Crawford, Professor of Health Humanities, Faculty of Medicine & Health Sciences, University of Nottingham. Expertise: health humanities.
- Prof Joyce Tait, Director, Innogen Institute, University of Edinburgh. Expertise: interdisciplinary working; innovation.
- Audrey Bell, Acting Head of Facilities Management NHS Grampian. Expertise: facilities management including domestic services.
- Dr Eric Laurier, Reader in Geography & Interaction, Institute of Geography and the Lived Environment, University of Edinburgh. Expertise: human geography, ethnomethodology.

Attending

- Susan Wan, Research assistant, The Glasgow School of Art.
- Frances Kennedy, Research and Graduate Studies, The Glasgow School of Art, Admin support.

APPENDIX 2

Workshop 2: Newcastle University 23 March 2017

ATTENDEES AND CONTRIBUTORS

Investigators

- Prof Alastair Macdonald, Senior Researcher School of Design, The Glasgow School of Art.
- Dr Colin Macduff, Senior Research Fellow, The Glasgow School of Art.

Network Members

Present

- Prof Daniyal Zuberi: RBC Chair and Associate Professor of Social Policy at the School of Public Policy and Governance, with a Joint Appointment to the Factor-Inwentash Faculty of Social Work at the University of Toronto.
- Dr David Pearson, Reader, Anglia Ruskin University, Cambridge Campus. Expertise: psychology, cognitive science, brain and cognition.
- Dr Sarah-Anne Munoz, University of Highlands and Islands. Expertise: rural health, health geography, community engagement and coproduction.
- Dr Catherine Stones, School of Design, University of Leeds. Expertise: graphic design and visualisation.
- Dr Gavin Miller, Senior Lecturer in Medical Humanities, Director, Medical Humanities Research Centre, University of Glasgow. Expertise: English literature/medical humanities.
- Dr Dilum Dissanayake, Lecturer in Transport Modelling, Planning & Management, University of Newcastle. Expertise: transport modelling.
- Prof Paul Crawford, Professor of Health Humanities, Faculty of Medicine & Health Sciences, University of Nottingham. Expertise: health humanities.
- Audrey Bell, Head of Domestic and Support Services NHS Grampian. Expertise: facilities management including domestic services.
- Midge Rotherham, Support Services Manager, NHS Fife.
- Dr Mark Powell, Civil Engineering Department, Newcastle University. Expertise: anthropology.
- Dr Phil James, Urban Observatory, Newcastle University. Expertise: systems programmes, software development, (attended only part of meeting).
- Kostas Tsattalios, PhD student, Robert Gordon University.

Apologies

- Prof Stephanie Dancer, Dept. of Medical Microbiology, Lanarkshire Acute Hospitals NHS Trust; and Edinburgh Napier University. Expertise: microbiology.
- Prof Joyce Tait, Director, Innogen Institute, University of Edinburgh. Expertise: interdisciplinary working; innovation.
- Dr Eric Laurier, Reader in Geography & Interaction, Institute of Geography and the Lived Environment, University of Edinburgh. Expertise: human geography, ethnomethodology.
- Prof Brett Mitchell, Avondale College Faculty of Nursing & Health, Sydney Campus.

Attending

- Frances Kennedy, Research and Graduate Studies, The Glasgow School of Art, Admin support.

APPENDIX 3

Workshop 3: University of Nottingham

26 October 2017

ATTENDEES AND CONTRIBUTORS

Investigators

- Prof Alastair Macdonald, Senior Researcher School of Design, The Glasgow School of Art.
- Dr Colin Macduff, Senior Research Fellow, The Glasgow School of Art.

Network members

Present

- Dr David Pearson, Reader, Anglia Ruskin University, Cambridge Campus. Expertise: psychology, cognitive science, brain and cognition.
- Dr Mark Powell, Civil Engineering Department, Newcastle University. Expertise: anthropology.
- Dr Catherine Stones, School of Design, University of Leeds. Expertise: graphic design and visualisation.
- Prof Paul Crawford, Professor of Health Humanities, Faculty of Medicine & Health Sciences, University of Nottingham. Expertise: health humanities.
- Kostas Tsattalios, PhD student, Robert Gordon University.

AHRC-led AMR Theme 3 leads or representatives (not included above)

- Prof Tim Sharpe, Mackintosh School of Architecture, The Glasgow School of Art.
- Dr Kerstin Sailer, The Bartlett School of Architecture, University College London.
- Dr Emmanuel Tsekles, ImaginationLancaster, Lancaster University.
- Mr Richard Beckett, The Bartlett School of Architecture, University College London.
- Dr Elta Smith (for Dr Emma Pitchforth), RAND Europe.
- Prof Nik Brown, Department of Sociology, University of York.
- Prof Sue Walker, Department of Typography and Graphic Communication, University of Reading.

Apologies

- Prof Alan Short, Department of Architecture, University of Cambridge.

Attending

- James Dracott, Strategy and Development Manager, AHRC.
- Frances Kennedy, Research and Graduate Studies, The Glasgow School of Art, Admin support.

APPENDIX 4

STAGE 2: NHS Grampian

February 2017

ADDITIONAL INTERIM ACTIVITY

A consultation session with hospital cleaners was developed, exploring a range of aspects around visualisation that emerged during Workshop 1. It was felt that this would be useful to inform subsequent considerations and the investigators provided a brief presentation on this at the start of Workshop 2. The main themes explored and related discussions are summarised below:

- **Visibility of your own work?** This varied with role, location/setting, time of the day. There was discussion of “*cleaning dirty*” (where surfaces are visibly dirty) and “*cleaning clean*” (where there is no visible dirt but a known need to clean regularly), and naturally this affected who noticed it. Overlap of shifts with other staff can enhance visibility of cleaning work for staff and public/patients
- **Do you get feedback?** Yes, from public, patients, letters, cards. It is also sought formally on a monthly basis from other professional colleagues in order to inform practice and routine reporting but this is not always forthcoming
- **Is the notion of sixth sense relevant in cleaning work?** Yes, many participants felt this was relevant and gave some examples. These mostly described responding to a mix of visual cues and being guided by intuition/experience (often to prevent something bad happening or to help in a situation)
- **What stories do cleaners tell?** A range of stories told in the workplace but often, not necessarily about cleaning
- **Can (and how can) visualisation approaches help?** There was much enthusiasm for more visuals generally: e.g. “Massively”; “to be aware of infection/germs and how they multiply”. Visualisation was felt to be good for training in induction and in refresher sessions: e.g. “visualisations can be useful (at this point), get visual to see where germs are”. They were also felt to be useful for in-situ help in clinical settings: e.g. “use of interactive displays – at the moment used for hospital surveys, can be used to give information on germs, where they are”; “having their work schedule in that form (points at tablet) would be attractive to look at, while still explaining the essentials”; “might give someone more confidence”.

‘HAIVAIRN has encouraged and provoked new thinking about visualisation of the broadly invisible world of healthcare infection. It has developed active communities of scholars to consider the complexity of microbial impacts which has led to notable follow-on projects. Colin and Alastair are to be congratulated for inspiring diverse academics to share in critical and creative debates on this important topic.’

Prof Paul Crawford, Professor of Health Humanities, Faculty of Medicine & Health Sciences, University of Nottingham.