Department of Health
Public Health England
Department for Environment Food & Rural Affairs
Veterinary Medicines Directorate

Antimicrobial Resistance (AMR) Systems Map

Overview of the factors influencing the development of AMR and the interactions between them

December 2014

Antimicrobial Resistance (AMR) Systems Map

Description

Purpose

The aim of producing an antimicrobial resistance (AMR) systems map is to provide a broad overview of the factors influencing the development of antimicrobial resistance and the interactions between them rather than detailed consideration of individual factors or infectious agents. We hope this will increase awareness of the diverse factors that influence AMR, aid research groups in identifying issues for investigation and aid in policy development.

We recognise that the map would benefit from further development. By publishing our first iteration of this map we hope that others can suggest improvements and/or develop particular aspects in more detail, either independently or in collaboration with us.

Description

The systems map provides a visual representation of the various influences on the development of AMR and the interaction between them. The aim is to provide a qualitative insight into the issues around antimicrobial resistance from a United Kingdom perspective. This includes both understanding the pathways that spread infection and resistance that could cause increased mortality and morbidity and identifying interventions (e.g. antibiotic stewardship programmes, behaviour change, infection control measures, etc.) that may impact on these pathways. This has been done by identifying reservoirs of infection and the pathways that link these reservoirs. By reservoirs of infection we mean any person, animal, plant, soil, substance or place in which an infectious agent normally lives and multiplies. The reservoir may harbour the infectious agent without injury to itself and serves as a source from which other individuals can be infected.

Please note that the map adopts a generic approach; it does not represent pathways for a particular infectious agent. The particular pathways which are applicable will depend on the infectious agent. There is no attempt, at this stage, to identify the relative importance of different pathways or prioritise the interventions. Interventions will require investigation of their impact, associated risk:benefit, and cost effectiveness. The size of boxes in the map does not reflect scale or significance.

Structure of the map and sub maps

A top level map shows the high level pathways that infections may take between animals, the environment and humans. High level interventions and influences act on these pathways to have four key outcomes:

1. Reduce burden of disease
2. Conserve and steward the effectiveness of existing outcomes
3. Slow down the emergence and spread of AMR
4. Stimulate the development of new antimicrobials, diagnostics and novel therapies

These in turn drive the ultimate desired outcome of **minimising mortality and morbidity due to AMR** which sits at the centre of the map.

From the top level map more detailed sub maps are layered. These more detailed sub maps cover:

1. Animals & Environment
2. Hospital
3. G.P. Care & the Community
4. Pharmaceuticals, diagnostics and vaccinations

These seek to show the interventions and actions within each of these areas which can influence the key outcomes (these are the same as those shown in the Top Level map). Relevant links are also made between the different areas (e.g. the influence of transmission of infections between humans and animals) through the rectangular boxes on the side of each sub map. The elements within each of maps are:

1. Reservoirs for microbes/infection
2. Influences on risk of infection
3. Influences on development of resistance
4. Interventions (that either impact the reservoirs or the influences)
5. Outcomes.

Across all the maps, mentions are made of the potential international interactions that may influence the development of AMR.

Methodology

The systems mapping approach itself is described below. The map and sub maps were developed in a series of facilitated workshops through a process of first identifying the reservoirs, then the pathways linking them and finally the interventions. The maps were then constructed on Visio. Some individual contributions were received after the workshops and have been incorporated.

The Top Level map and the Animals & Environment sub map were developed in joint workshops involving participants from DEFRA, DH and Public Health England. The Hospital and the G.P. Care & the Community sub-maps were developed in a workshop of invited experts. A list of participants is at the end of this document.

Systems Mapping

Systems mapping is the process of conceptually representing a system (a set of elements and the relationships between them) and illustrating how events in one part of it affect other parts. Whole systems generally exhibit properties or behaviours that cannot be predicted from the properties of the individual parts.

A key purpose in building systems maps is to gain insight in the underlying structure of a messy, complex situation. A systems map shows how the elements interrelate and where there are opportunities to intervene in the modelled system to influence its behaviour. The essential contribution of systems maps is to summarise and communicate current trends, relationships and constraints that may influence the future behaviour of a system.

Systems mapping is a precursor to more detailed modelling. The map can be used to identify feedback effects, as a structure for the evidence base and in the longer term provide a basis for quantitative systems modelling.

Further Development

We intend to establish a panel to review and update the map on an (at least) annual basis. If you wish the panel to consider any additions or changes to the map please submit your suggestions to AMRmaps@dh.gsi.gov.uk.

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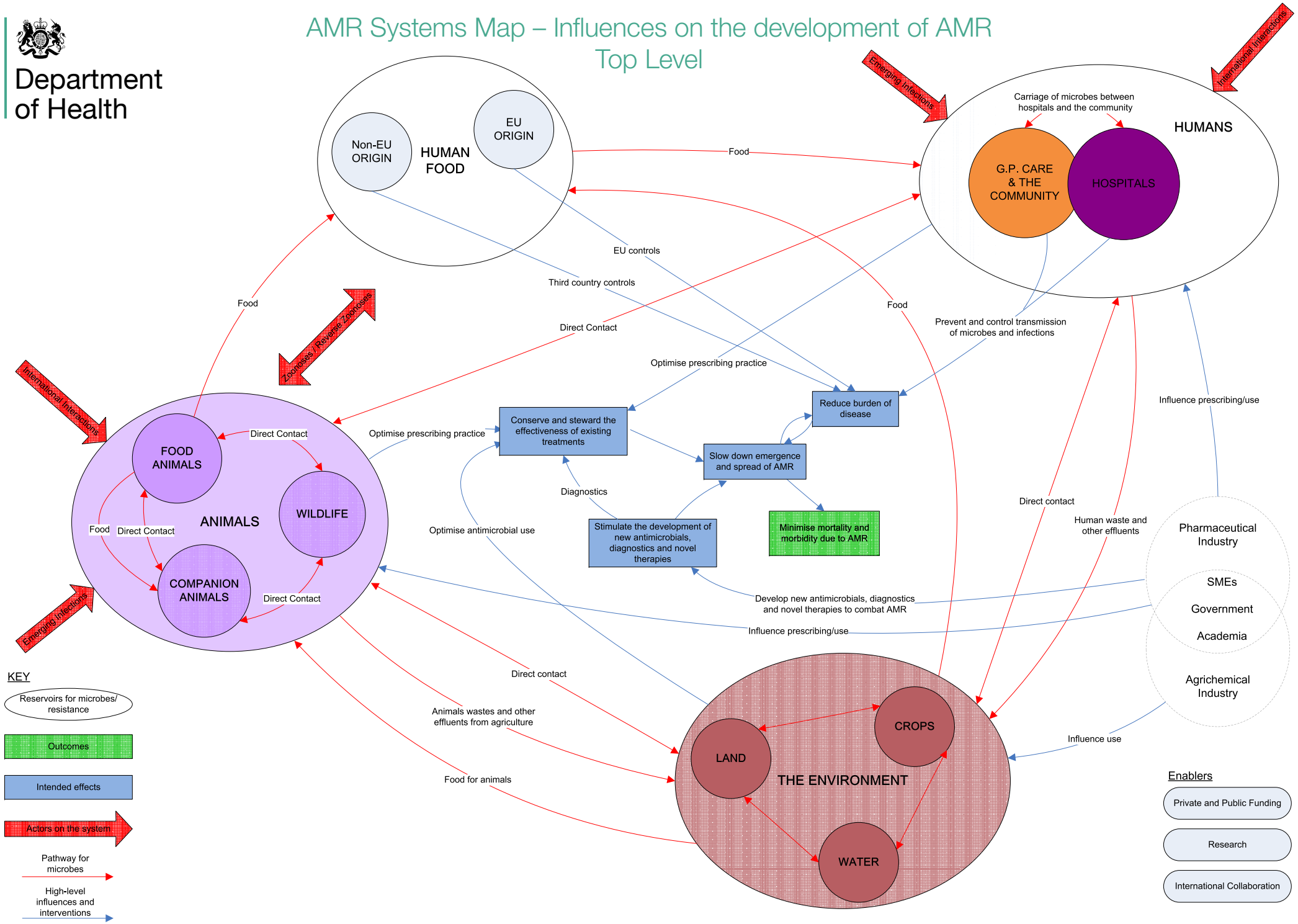
AMR Systems Map – Influences on the development of AMR
Top Level



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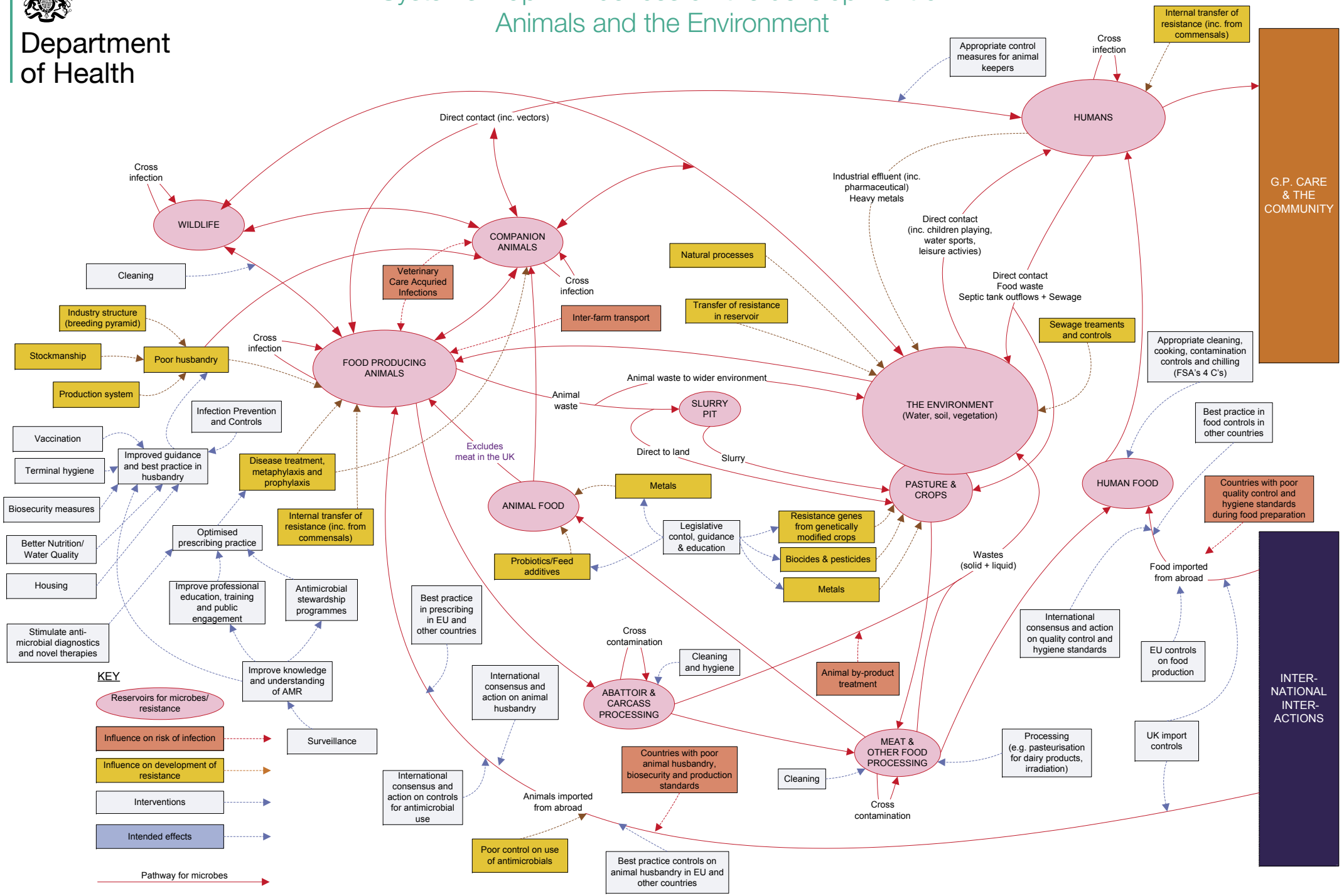
AMR Systems Map – Influences on the development of AMR
Animals and the Environment



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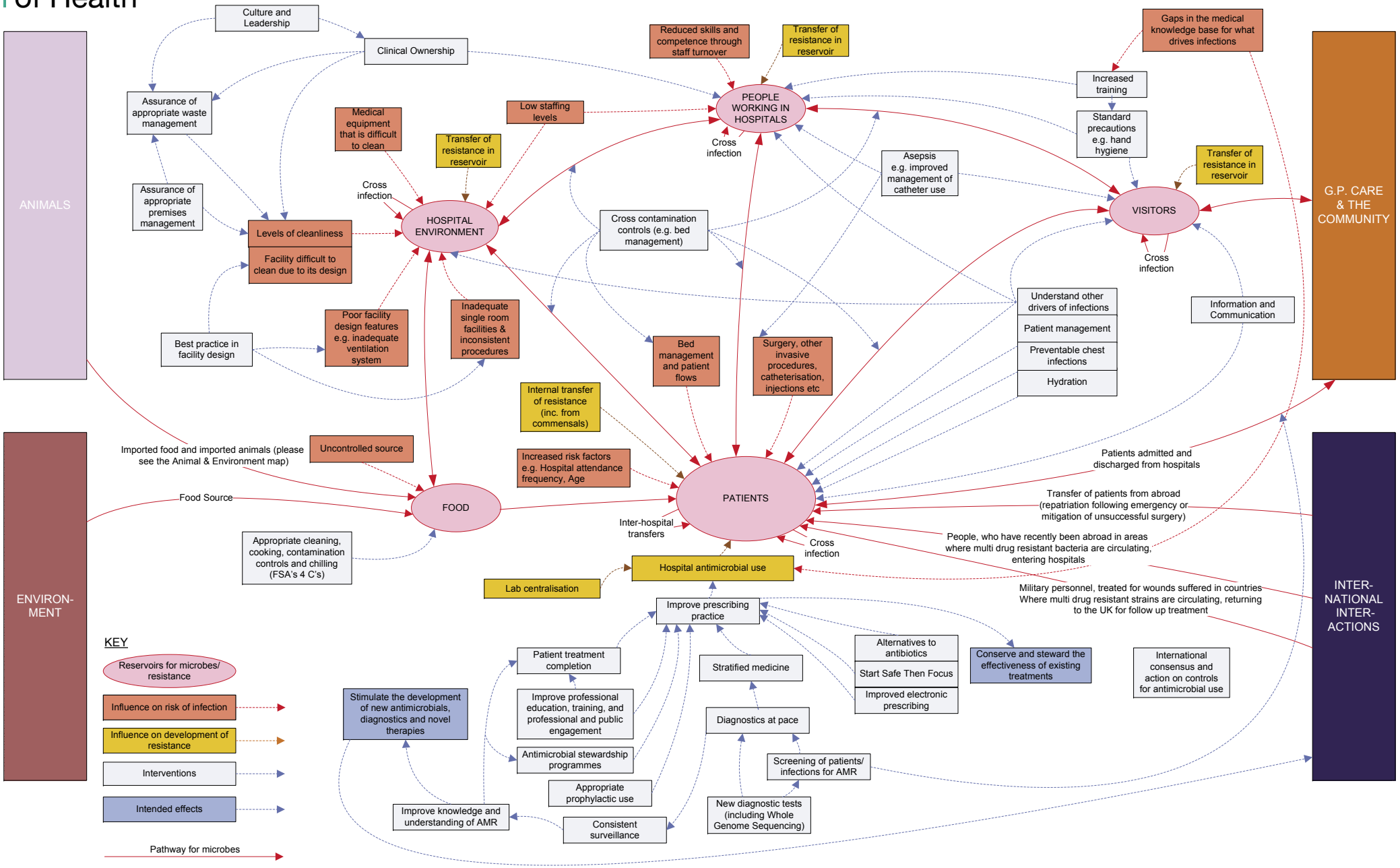
AMR Systems Map – Influences on the development of AMR
Hospital



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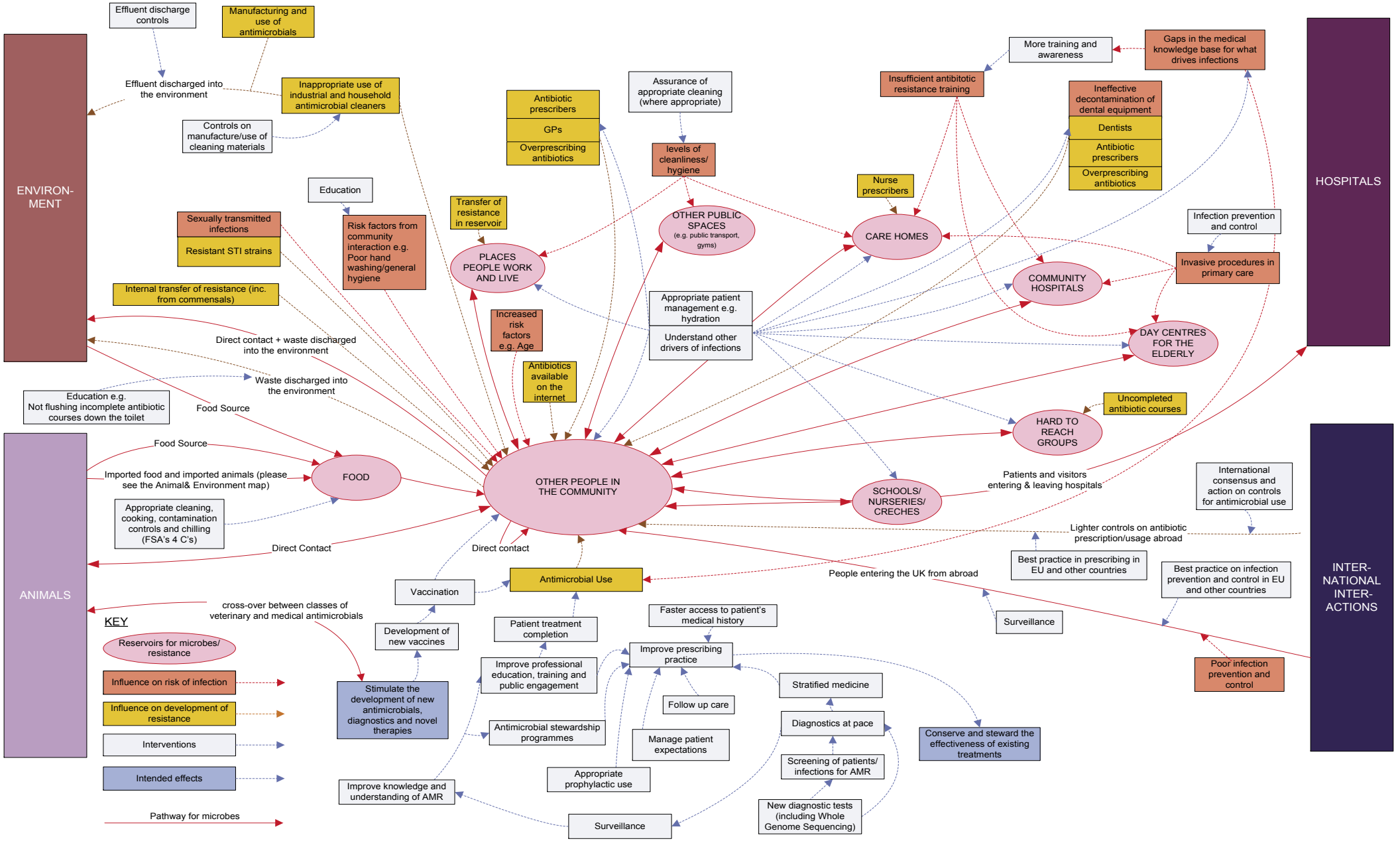
AMR Systems Map – Influences on the development of AMR
G.P. Care and the Community



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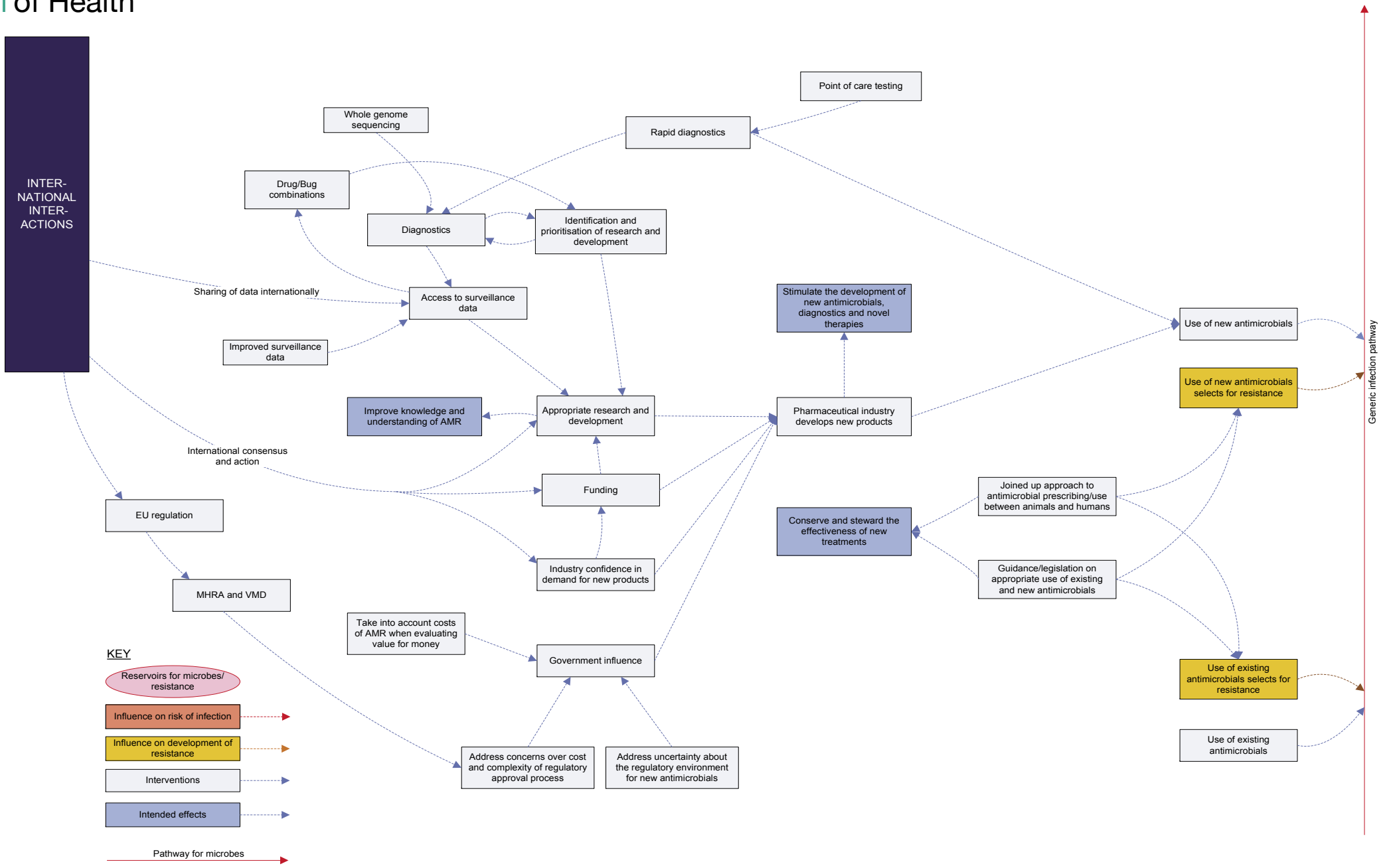
AMR Systems Map – Influences on the development of AMR Pharmaceuticals Diagnostics and Vaccination



Acknowledgements

AMR Systems Map Design

Stephen Dobra & Peter Johnston – Department of Health

Further developed by:

Matthew Baugh, Christina Barfoot, Peter Bennett, Stephen Dobra – Department of Health
Suzanne Eckford – DEFRA

Created on Microsoft Visio 2010 by Peter Johnston, Matthew Baugh & George Chappelle

Thank you to the following for participation in workshops developing the initial map and the Animals & the Environment Map sub map:

From DEFRA:

Suzanne Eckford	Head of Antimicrobial Resistance Team, Veterinary Medicines Directorate (VMD)
Helen Jukes	Head of General Assessment and Research Team, VMD
Ken Stapleton	Human and Environmental Safety Assessor, VMD
Chris Teale	Head of AMR, Animal Health and Veterinary Laboratories Agency (AHVLA)
Emma Snary	Head of Risk Analysis, AHVLA

From DH:

Dr Peter Bennett	Head of Analysis, Health Protection, Public and International Health Directorate (PIHD)
Stephen Dobra	Analytical Programme Manager, PIHD
Michael Fleming	Analytical Programme Manager, PIHD
Peter Johnston	Operational Research Analyst, PIHD
Ross Leach	Economic Advisor: Medicine, Pharmacy and Industry
Sally Wellsteed	Antimicrobial Resistance and HCAI Team Leader, PIHD

From Public Health England:

Dr Andre Charlett	Head of Statistics, Modelling and Economics Department
Professor Alan Johnson	Head, Department of Healthcare Associated Infection and Antimicrobial Resistance
Dr Julie Robotham	Mathematical Modeller/Health Economist

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Dr Nicholas Brown – Consultant Medical Microbiologist at Addenbrooke's Hospital in Cambridge and Clinical Services Director. President of the British Society for Antimicrobial Chemotherapy (BSAC)

Dr Kumara Dharmasena – Consultant Microbiologist, Walsall Hospitals NHS Trust

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