

# AMR a Funding Interdisciplinary Approach

**Dr Adam Staines**

BBSRC

October 2017



# UK research funding

HM Treasury (HMT)

Department of Business, Energy and Industrial Strategy (BEIS)



Science Budget £18.3 billion  
(\$30Bn) 2011-2015



Arts & Humanities  
Research Council

MRC

Medical  
Research  
Council



Science & Technology  
Facilities Council



**BBSRC £417M**  
**2016-17**

\*Includes additional capital

EPSRC

Engineering and Physical Sciences  
Research Council

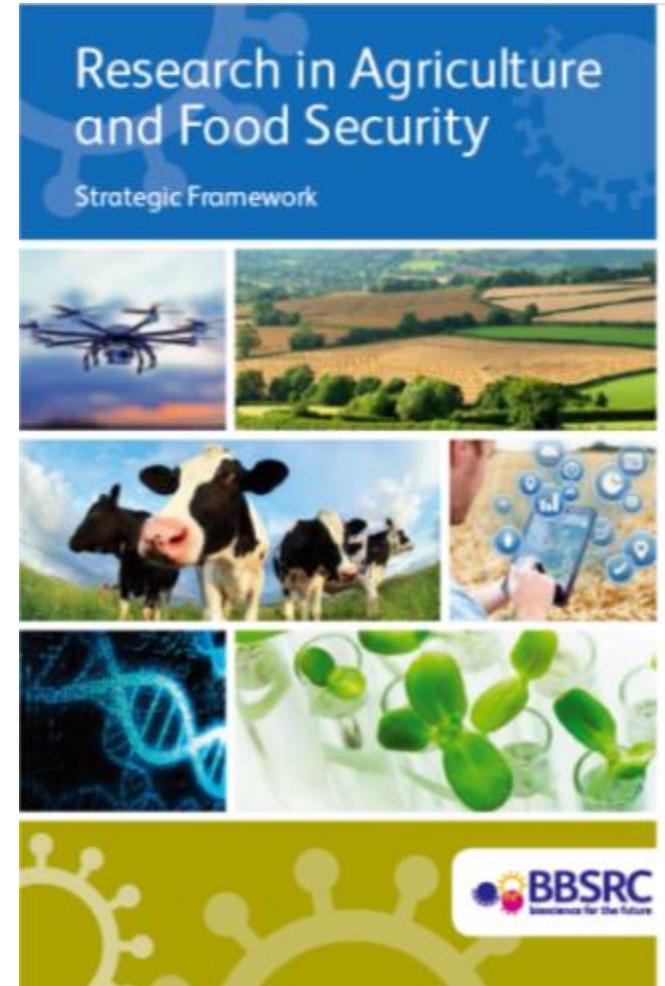


## BBSRC – what we do

- Invest in **world-class bioscience research** in UK Universities and Institutes
- Invest in **bioscience training and skills** for the next generation of bioscientists
- Drive the widest possible **social and economic impact** from our bioscience in industry, policy and public goods
- Promote **public dialogue** on bioscience

# BBSRC Agriculture and Food Security - Strategic Framework

- The aim is to expand on, and provide further details of, BBSRC's strategic priorities in AFS.
- It identifies areas where the BBSRC will **focus efforts** and expects to deliver the most impact over the next five years.



<http://www.bbsrc.ac.uk/research/food-security/>

# Crop and farmed animal health

- Developing novel breeding targets and management strategies by understanding how pests/pathogens **interact with their hosts**
- Tackling **resistance** by understanding the underpinning biology of agriculturally-relevant pests, pathogens and weeds
- Improving **control regimes** by developing novel approaches to farmed animal health and crop protection



# Food safety and nutrition

- Delivering health benefits for humans and farmed animals by integrating novel **crop and nutritional research**
- Making **food safer** by reducing the levels of pathogens in primary production and along the food chain
- Improving human and farmed animal health by **reducing toxins** and infectious agents in the food system



# Combating Antimicrobial Resistance

## AIM:

to support research aimed at **combating AMR**, and Research that underpins the **development of strategies to mitigate** the effects e.g. through novel alternatives to antimicrobials.



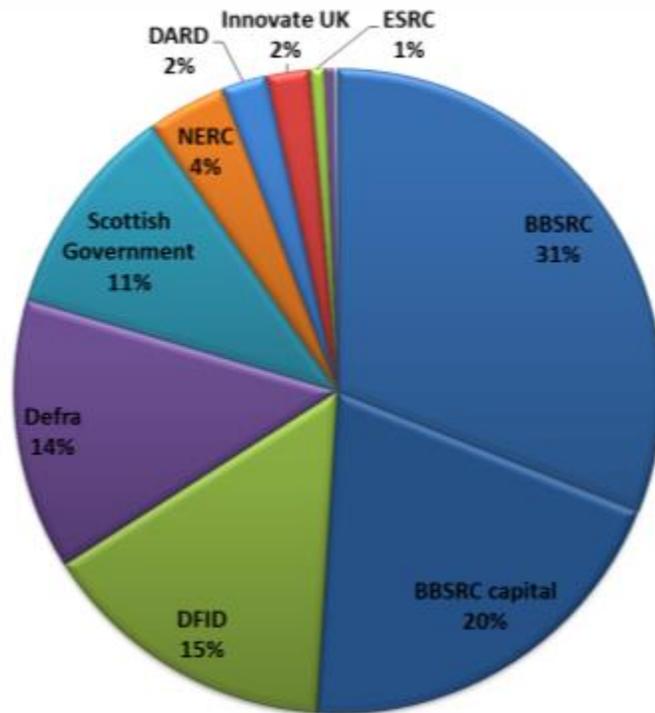
Image: © Thinkstock 2014

## SCOPE:

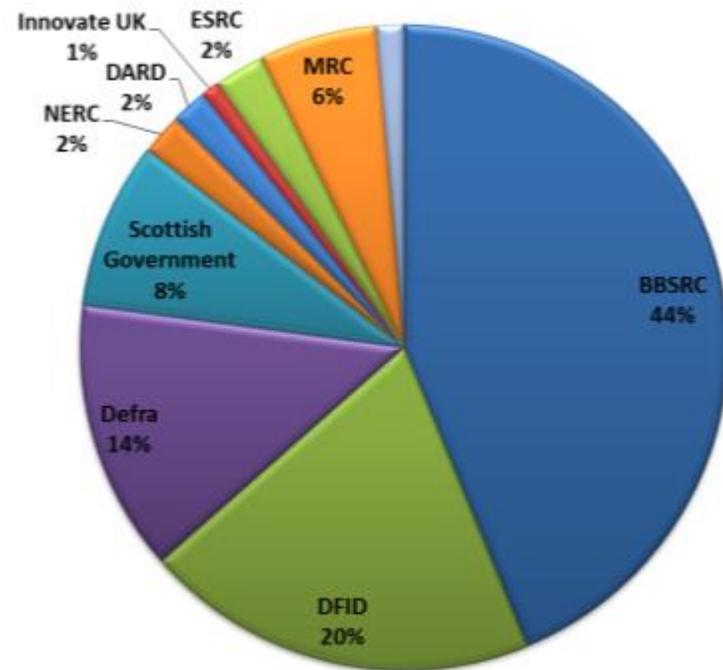
- Fundamental microbiology behind the development, and maintenance of resistance
- Selection pressures and dynamics of transmission (genetic, organism and host level)
- Mitigation strategies to prevent the development resistance or control its spread
- Development of novel antimicrobials and alternatives to antimicrobials
- Develop novel diagnostics to enable rapid identification of organisms or resistance genes

# UK Public funders data for agri-food

## UK Agri-tech 12/13



## UK Agriculture & Food 11/12





## North America

- USA: ARB causes majority of **99,000 deaths/yr** from infections acquired in hospitals.<sup>56</sup>
- USA: Health care costs of ARB are **US\$21-34 bn/yr**.<sup>56</sup>

## South America

- **Peru, Bolivia:** **>51%** of hospital infections caused by ARB.<sup>57</sup>
- **Brazil:** Rates of ARB are up **>60%**.<sup>58</sup>

## Europe

- EU: ARB costs society **~ €1.5 bn/yr**<sup>59</sup> & **600 million** days of lost productivity.<sup>59</sup>
- Russia: ARB a major concern<sup>60</sup> with **83.6%** of families imprudently use antibiotics at home.<sup>61</sup>

## Middle East & North Africa

- **Egypt:** **38%** of blood infections contracted by young cancer patients are from ARB.<sup>55</sup>
- **Israel:** ARB found fatal in **~50%** cases when resistant to our strongest antibiotics.<sup>63</sup>

## Sub-Saharan Africa

- Tanzania: Death rate of ARB infected children are **double** that of malaria.<sup>65</sup>
- Nigeria: Rapid spread of ARB that came to Africa from Asia.<sup>62</sup>

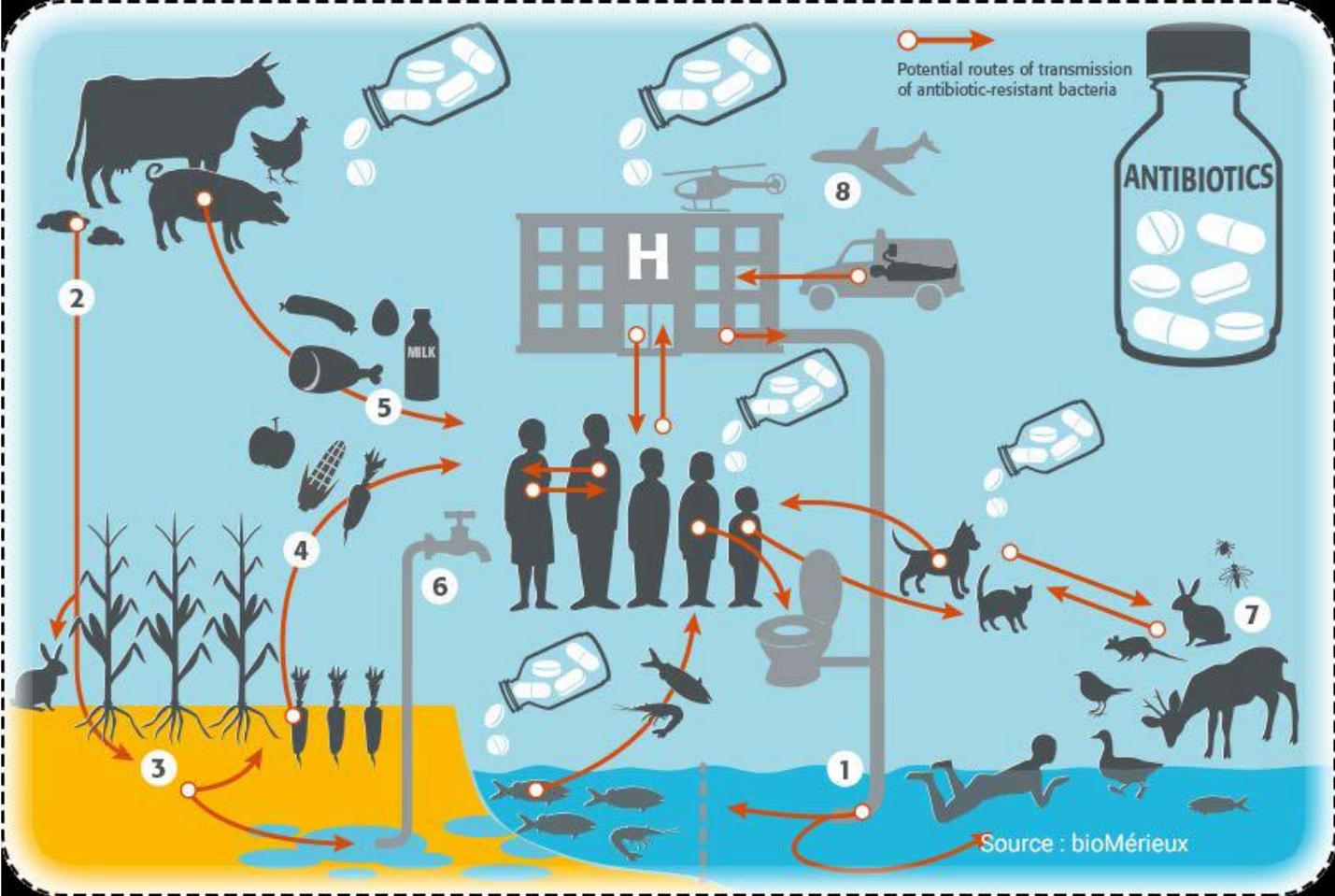
## Asia

- **Thailand:** **>140,000** ARB infections/yr and **>30,000/yr** patients die; **2 bn** in productivity losses/yr.<sup>49</sup>
- Japan: Extensive levels of ARB found in Tokyo's urban watershed.<sup>50</sup>
- China: Extreme over-prescription of antibiotics<sup>51</sup> and rapid growth rate of ARB.<sup>52</sup>
- India: Within 4 years (02-06) ARB went from being resistant to 7, to **21 drugs**.<sup>53</sup>
- Vietnam: Farming practices contributing to spread of ARB through environmental contamination.<sup>54</sup>
- Pakistan: **71%** of infections in newborns are from ARB.<sup>55</sup>

## Antarctica

- ARB found in Antarctic animals & water samples.<sup>64</sup>

# Complex system



# Government strategy

---

Published in late 2013, key aims:

- improve the knowledge and understanding of antimicrobial resistance
- conserve and steward the effectiveness of existing treatments
- stimulate the development of new antibiotics, diagnostics and novel therapies

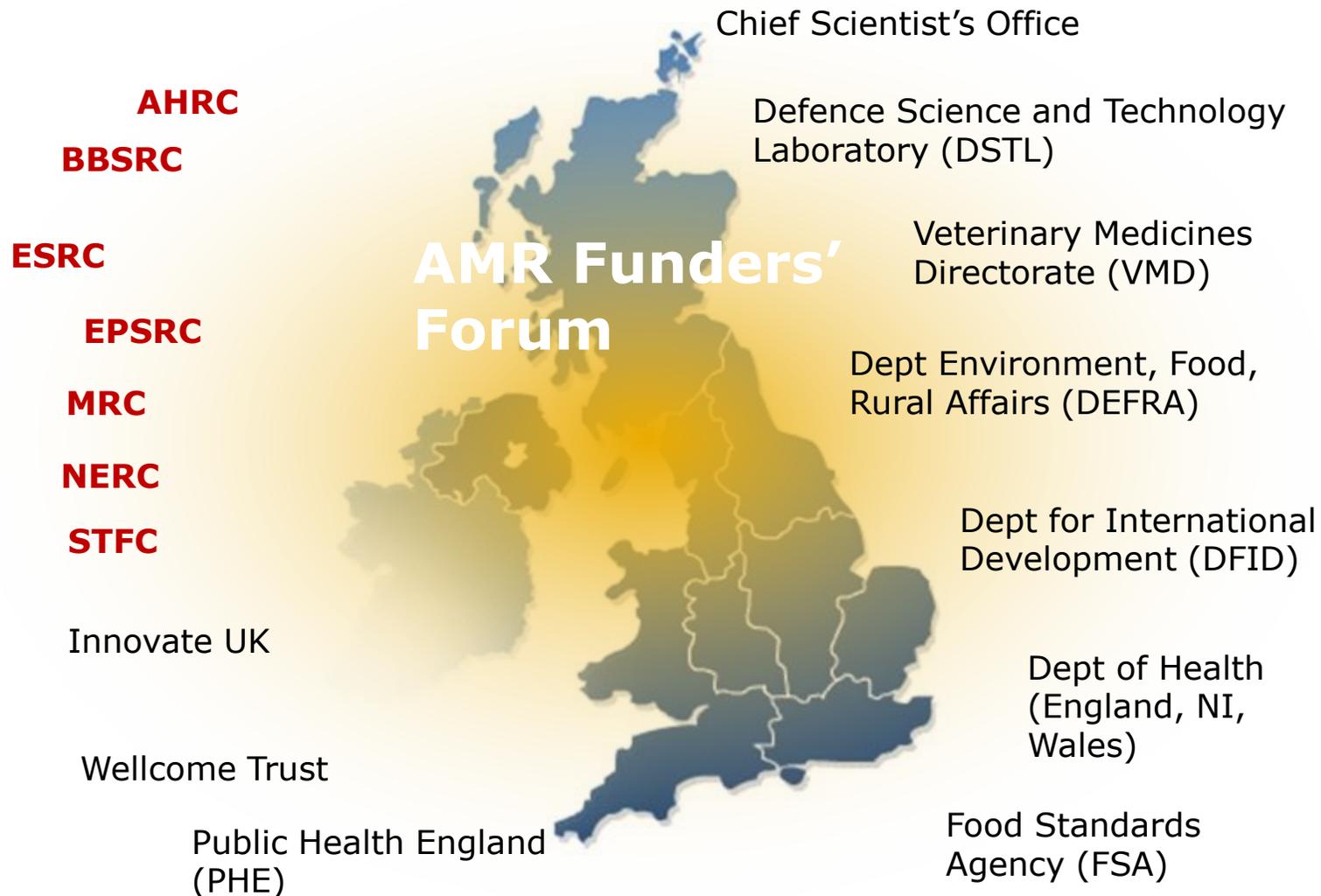


## UK Five Year Antimicrobial Resistance Strategy 2013 to 2018



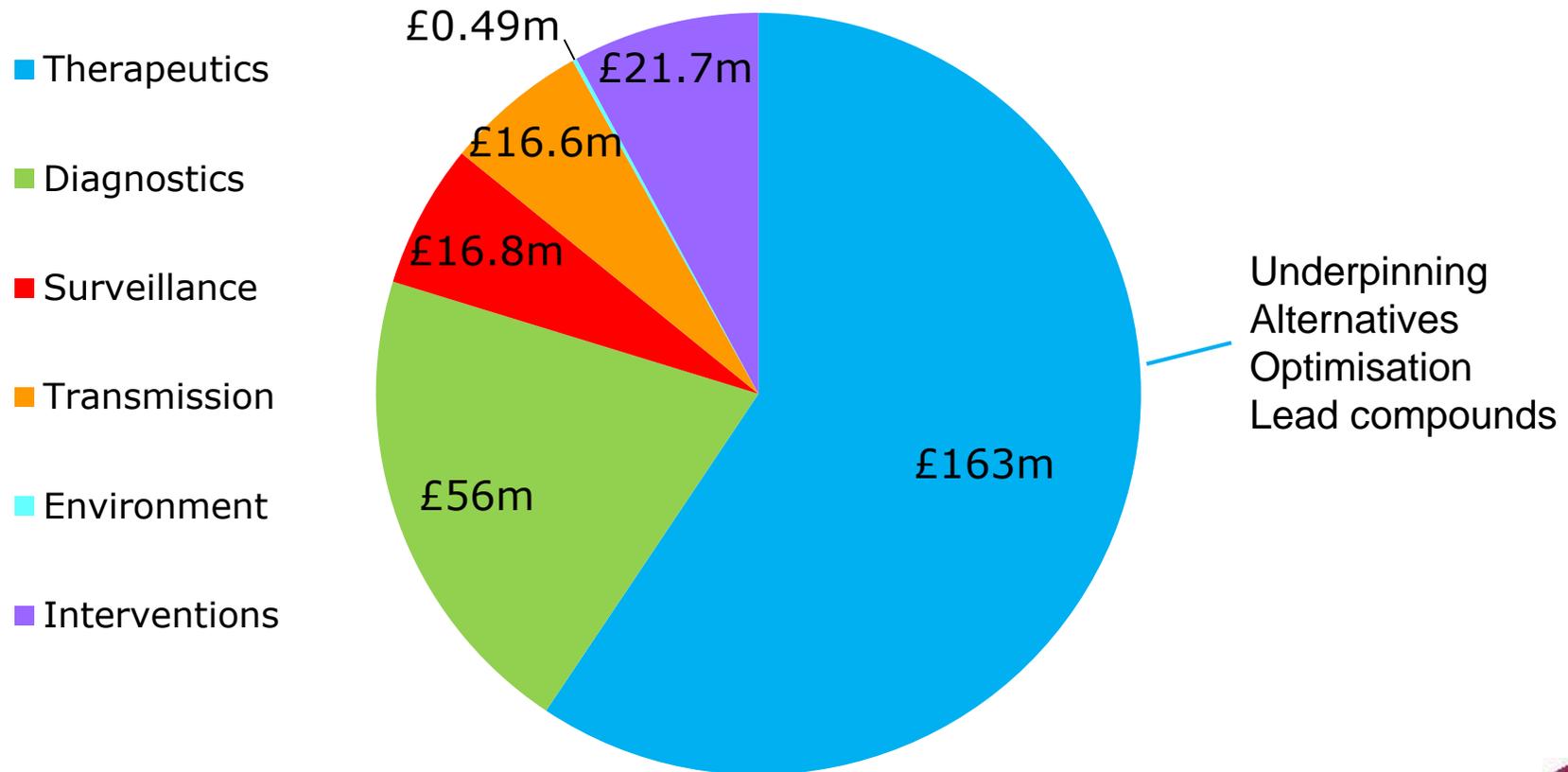
# The UK: A rich network of funders and researchers

---

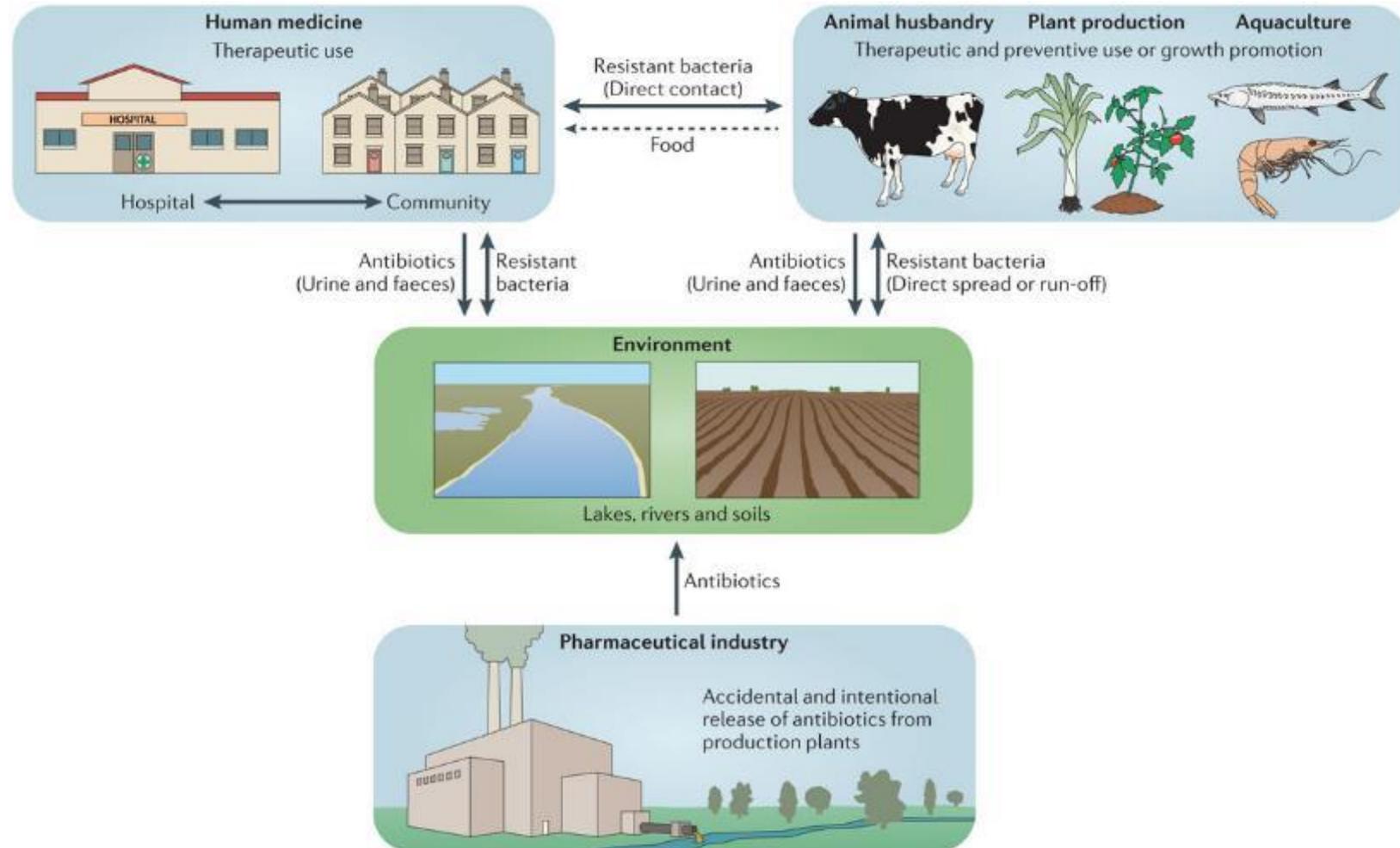


# UK Research spend on AMR (2007-2013)

Total funding: £275m



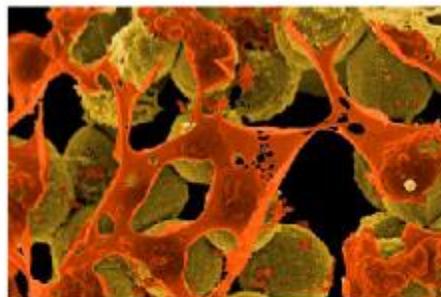
# AMR – an ecological /systems level perspective



# AMR Cross-council Initiative



- Launched June 2014
- All Research Councils
- Bacterial resistance in the first instance
- Challenge led approach



## 'War cabinet' on drug resistance brings councils together

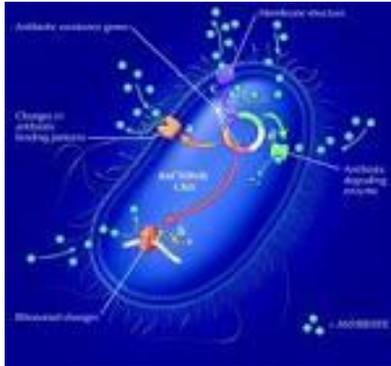
Greg Clark, the newly appointed science minister, has launched a major cross-government push to tackle antimicrobial resistance.



# AMR: Cross Council Initiative themes



## 1. Understanding resistant bacteria



## 2. Accelerating therapeutic and diagnostic development



## 3. Understanding real world interactions



## 4. Behaviour within and beyond the health care setting



# Theme 1: Funded Grant



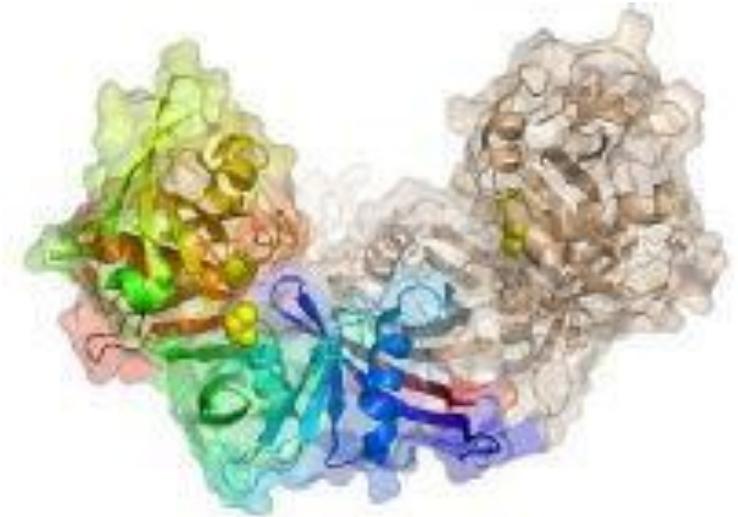
---

Mechanistic understanding of cell wall biosynthesis to combat antimicrobial resistance

**PI:** Chris Dowson, Warwick  
**Other ROs:** Sheffield, Newcastle, Southampton, Oxford  
**Award value:** £3,236,690  
**Award period:** Sept 2015 - Aug 2020

## **Aims:**

To explore interactions of Penicillin Binding Proteins (PBPs) with landmark beta-lactams, recently developed novel non-lactam PBP inhibitors, and control proteins.



# Theme 1: Funded Grant



Determination of the dynamics of antimicrobial resistance genes in the animal gut microbiome.

**PI:** Mark Holmes, Cambridge

**Other ROs:** Edinburgh

**Award value:** £1,598,830

**Award period:** Dec 2015 – Nov 2018

## **Aims:**

To define the nature and frequency of transfer of antimicrobial resistance (AMR) genes between pathogenic and commensal bacteria within hosts under varying selection pressures.



# Theme 3: Antimicrobial Resistance in Agricultural Manures and Slurries



How farm practice could lead to AMR in animal and human pathogens. Will help farmers and vets find new ways to reduce AMR, without harming their animals or their businesses.

Slurry contains antibiotics (e.g. through milk and cleaning waste), and is used as fertilizer.

Project will investigate:

- Nature of bacteria in the slurry
- What happens when spread on fields
- How farmers, vets and scientists interpret evidence about AMR

Working with farmers, vets and policy makers to ensure results make a difference.



# Theme 4: Prof Heffernan University of Bristol

## Supporting Evidence-Based Policy: study of AMR risk behaviours among livestock keeping communities in India and Kenya

- Explore inter-relationship between poverty and AMR in relation to animal agriculture.
- 2/3 of the global poor are livestock keepers
- very little is known about the factors facilitating AMR among this population.



# What have we achieved

---

- More than 60 projects funded
- Total of £46m invested
- Working together across disciplines and sectors
- Rally the community around AMR
- UK based and international links
- Links with industry and policy makers, line of sight to impact

# O'Neill review

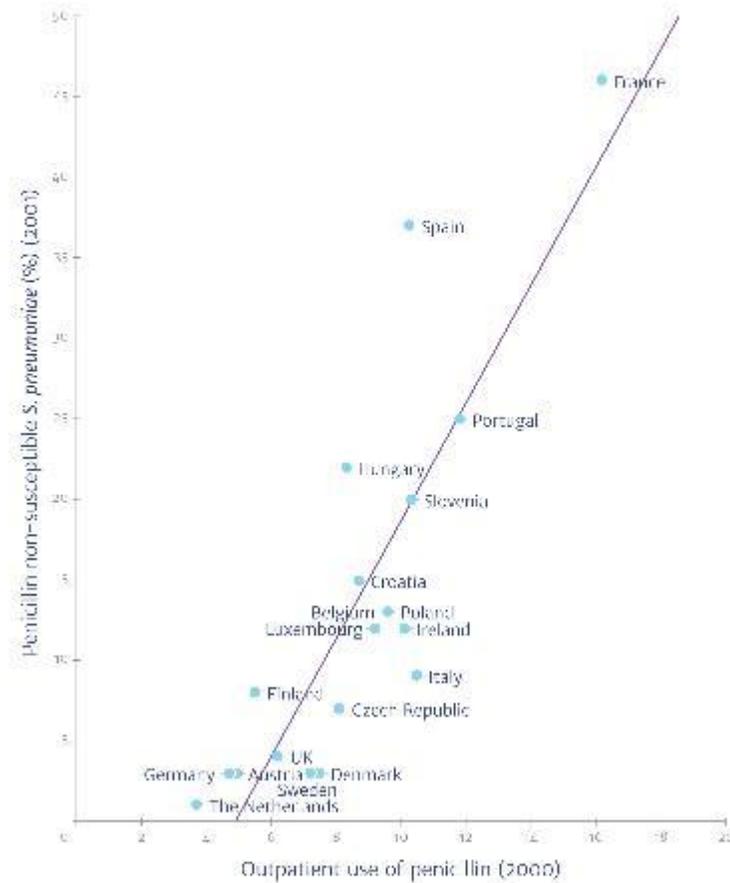
---

- 11th February 2016- [Vaccines and alternative approaches: reducing our dependence on antimicrobials](#)
- 21 January 2016 - [Tackling drug-resistant infections globally: An overview of our work](#)
- 8 December 2015 - [Antimicrobials in agriculture and the environment: reducing unnecessary use and waste](#)
- November 20, 2015 - [Safe, Secure and Controlled: Managing the Supply Chain of Antimicrobials](#)
- October 23, 2015 - [Rapid Diagnostics: Stopping unnecessary use of antibiotics](#)
- May 14, 2015 - [Securing New Drugs for Future Generations – the Pipeline of Antibiotics](#)

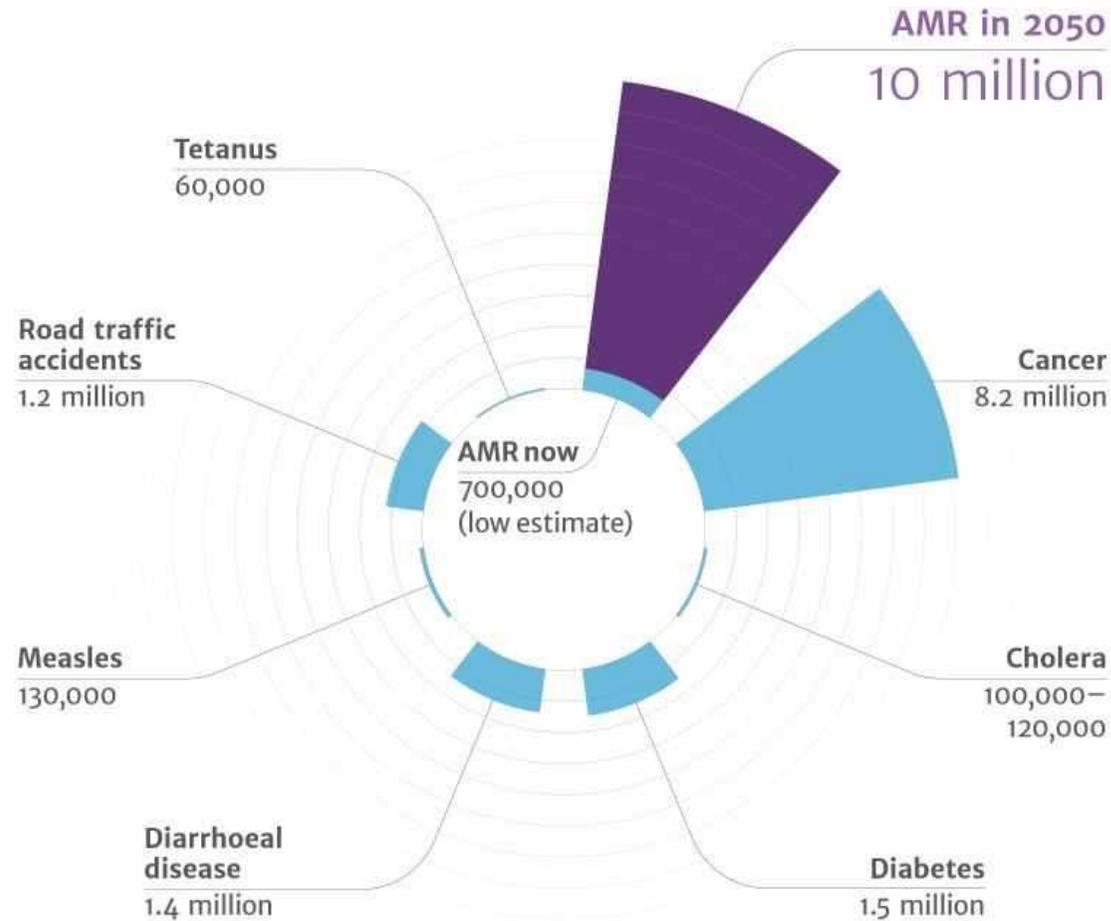
These papers can be found at:

*<http://amr-review.org/Publications>*

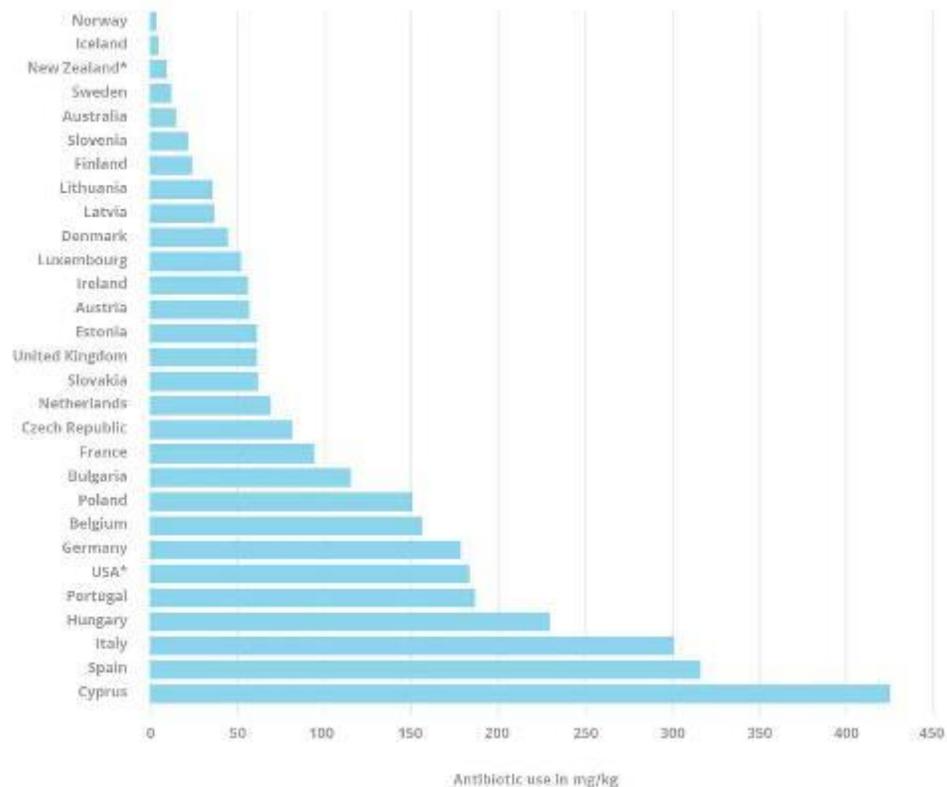
# THERE IS A HIGH CORRELATION BETWEEN ANTIBIOTIC USE AND RESISTANCE



Source: Coussens J, Ferich M, Vanden Stichele P, et al. Do patient antibiotic use in Europe and association with resistance in *S. pneumoniae* study. *Lancet* 2003; 361(9301): 570-87.



# ANTIBIOTICS USE IN AGRICULTURE VARIES GREATLY BY COUNTRY

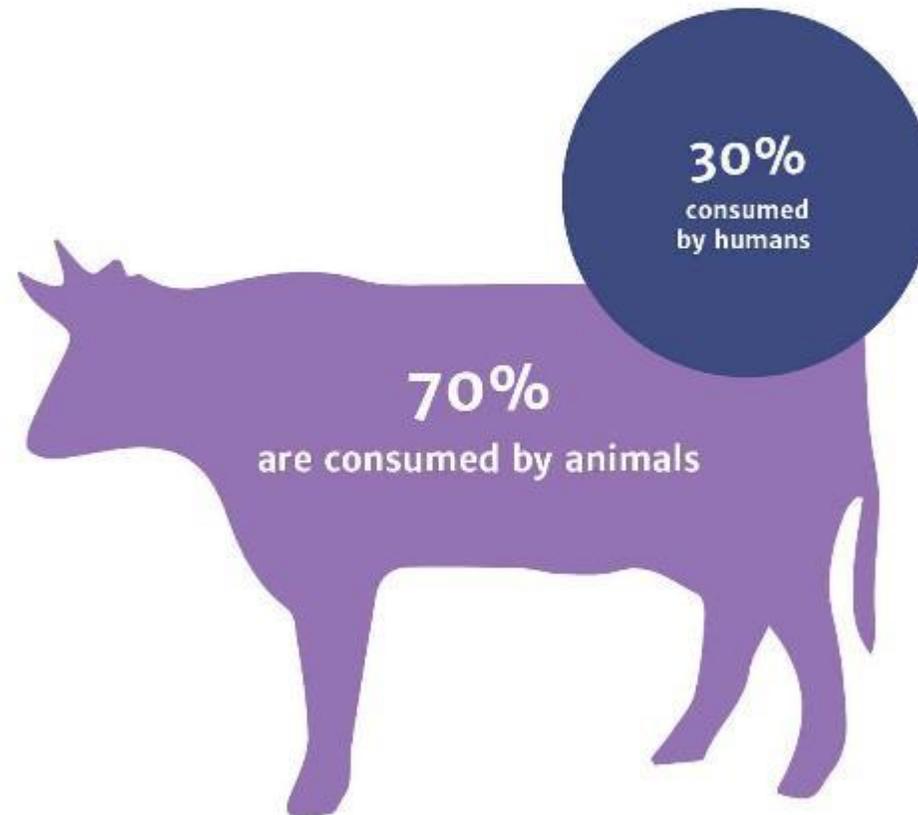


Source: European Medicines Agency (2011) and the national governments of the US, Australia and New Zealand.

\* Animal biomass estimated based on number of animals.

NB: All figures are given in milligram (mg) purchased for every kilogram (kg) of livestock biomass and do not include ionophores and oligosaccharides.

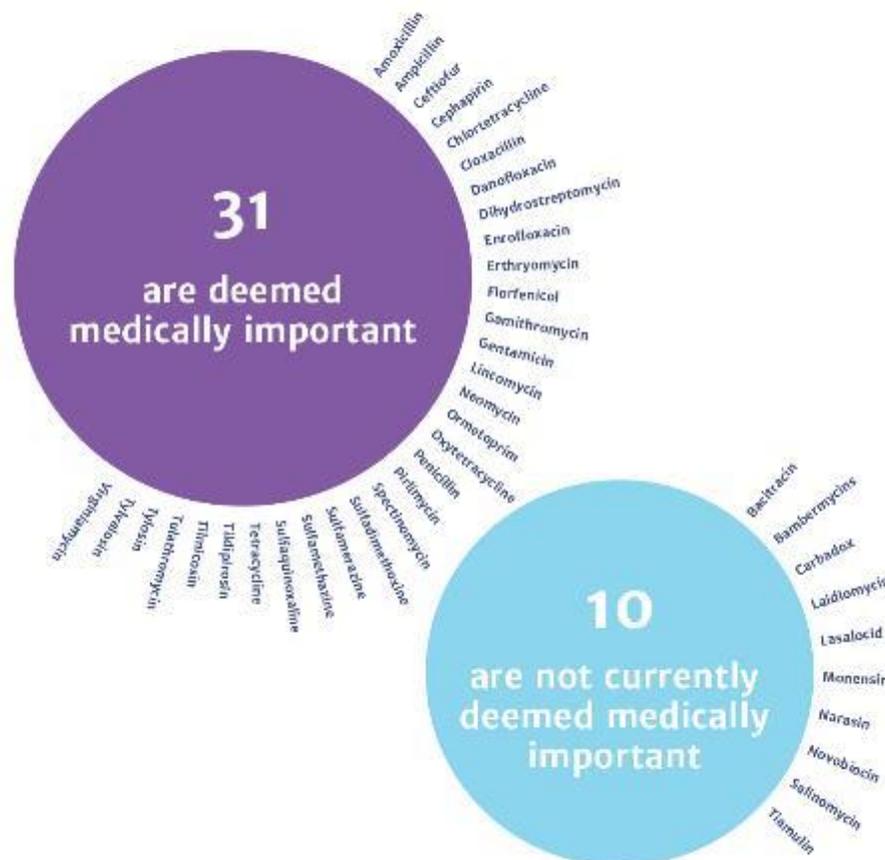
# ANIMALS IN THE USA CONSUME MORE THAN TWICE AS MANY MEDICALLY IMPORTANT ANTIBIOTICS AS HUMANS



Source: Animal consumption figure of 8,893,103kg from FDA, 2012. Human consumption of 3,379,226kg in 2012 based on calculations by IMS Health. The figures are rounded from 72.5% used in animals and 27.5% used in humans.

# MOST ANTIBIOTICS USED IN ANIMALS ARE MEDICALLY IMPORTANT FOR HUMANS

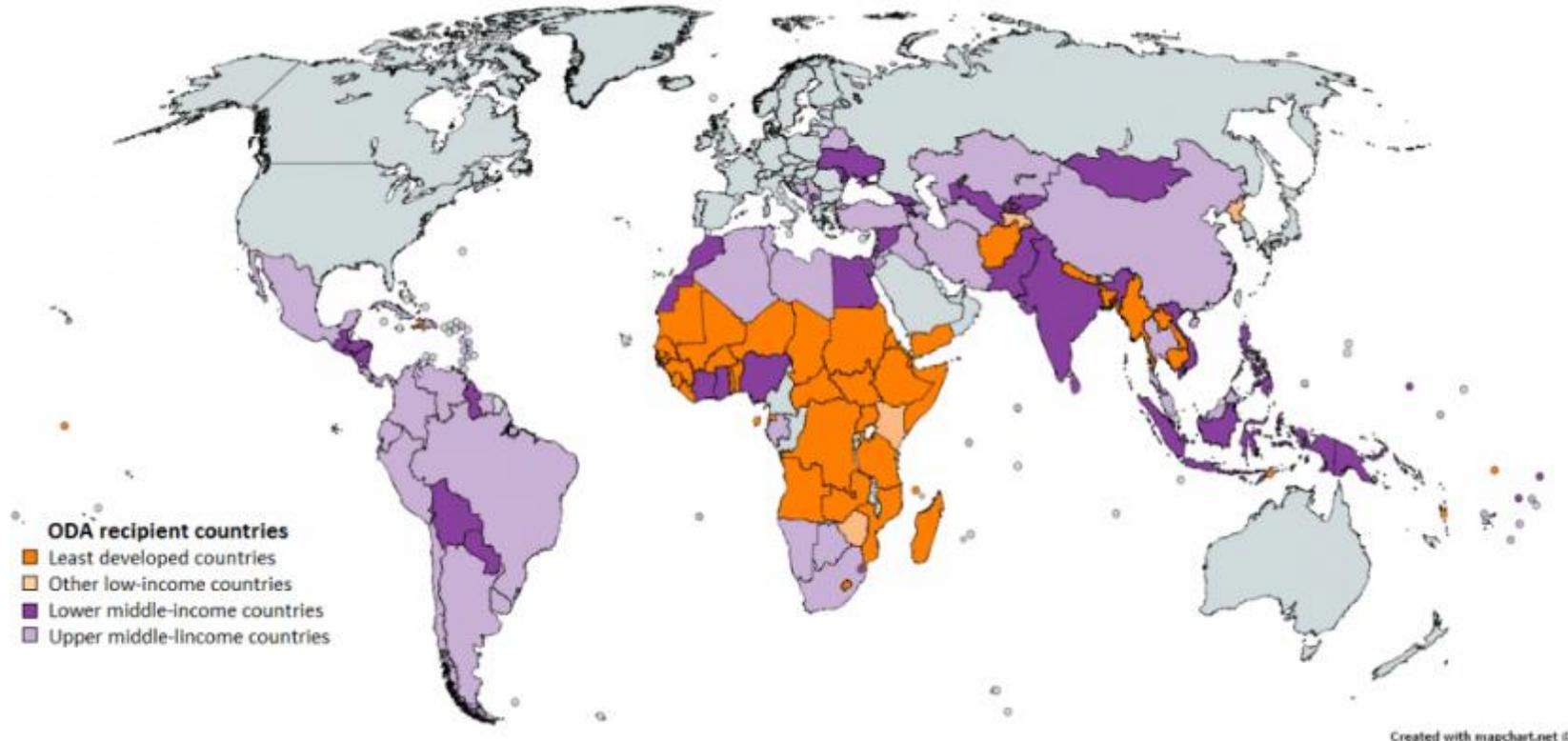
Of the 41 antibiotics\* that are approved for used in food producing animals by the FDA, 31 are categorised as being medically important for human use.



Source: FDA, 2012 Summary report on Antimicrobials sold or distributed for use in Food-producing animals.

\* Includes ionophores

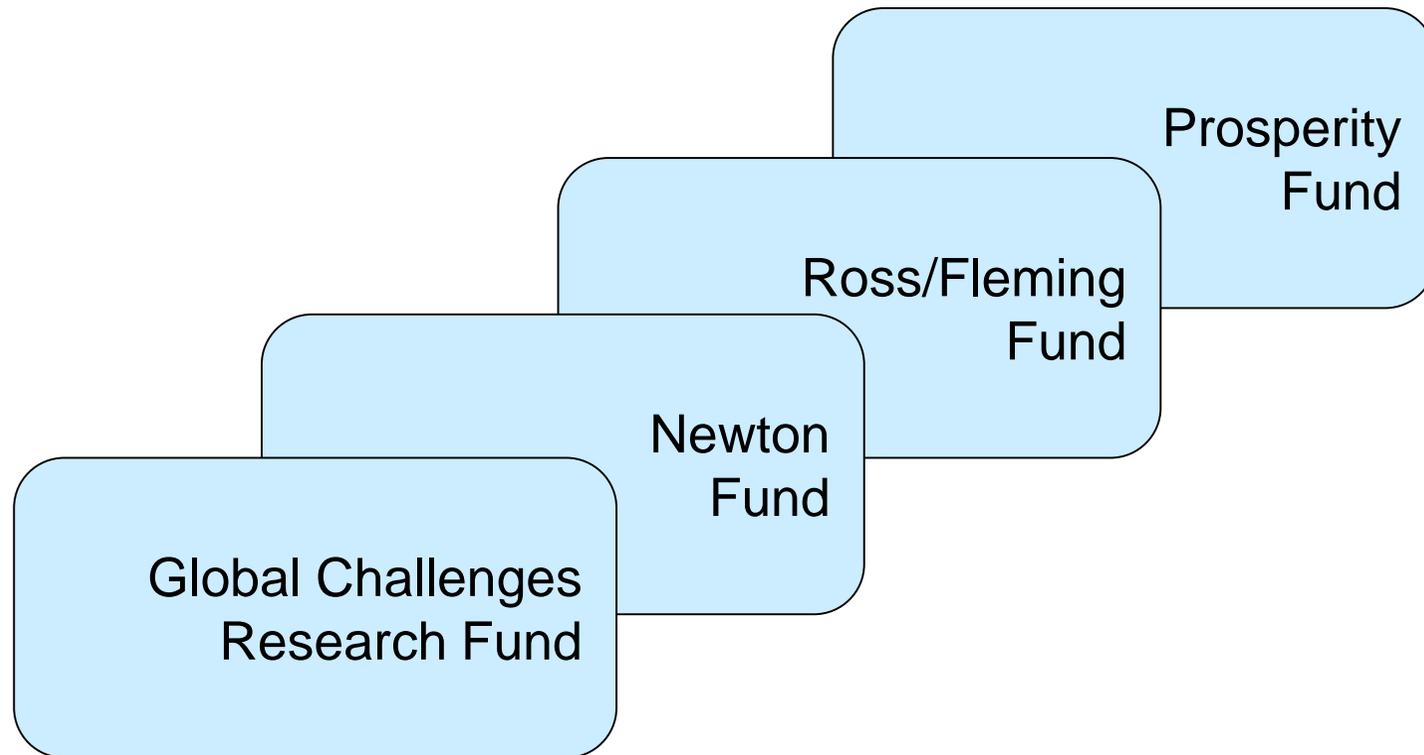
# AMR is Global – a shared problem with differing local priorities



- A global portfolio of ecological studies could help develop a shared sets of tools and provide additional insight through comparisons between different country groupings

# International ODA: AMR research agenda

---



# Background to GCRF

---



*Cutting edge research which addresses the problems faced by developing countries*

- ❑ Address global challenges through disciplinary and interdisciplinary research
- ❑ Strengthening capability for research and innovation, within developing countries and the UK
- ❑ Agile response to emergencies and opportunities

---

The Newton Fund uses science and innovation partnerships to **promote economic development and social welfare of partner countries**. It does this through collaboration with partner countries and working with 15 UK delivery partners.

The Newton Fund is also part of the UK's official development assistance (ODA).

The Newton Fund was launched in 2014 and now has a total UK investment of £735 million to 2021, with partner countries providing matched resources within the fund.

# Ross Fund

## Ross Fund

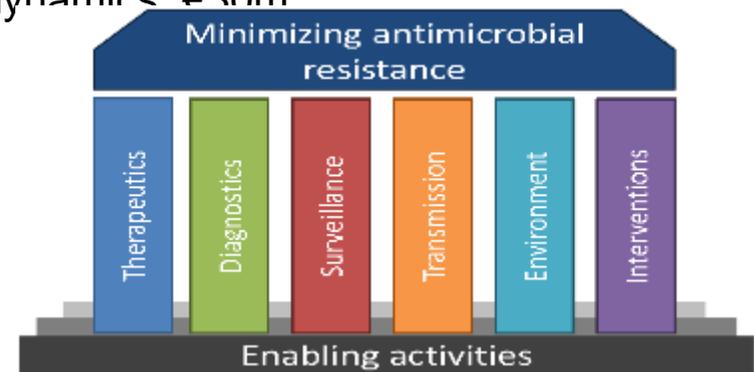
### Summary

- In November 2015 the government announced:
  - £100 million for research and development for infectious diseases
  - £90 million for malaria implementation
  - £115 million to develop new drugs, diagnostics and insecticides for diseases of emerging resistance (including malaria and TB)
- 
- £315 million **fighting AMR** including:
    - Investing £265m in the **Fleming Fund** to strengthen surveillance of drug resistance and laboratory capacity in developing countries
    - Delivering the new Global **AMR Innovation Fund**, launched with China for research and innovation to tackle AMR



# Other activity: JPIAMR

- Collaboration across European funders (and beyond)
- MRC represents the UK & are members of the Steering Group
- To date, 19 members (17 EU countries, Canada & Israel), 3 observers (Argentina, Estonia and Japan) – expanding globally
- Links with WHO, EC, IMI, EPFIA, TATFAR, NIH
- Strategic Research Agenda highlights 6 priority topics – aligns to UK AMR Cross Council Initiative
- ‘One Health’ approach
- Activities beyond calls
- Transnational calls and workshops
  - Open: ERA Net co-fund call on transmission dynamics €30m
  - Launching: Call for Networks in April 2016



# What is needed to address AMR?

---

- Global effort
- Collaborative working
- Coordination of key disciplines
- Coordinating research funding – government and other research funders including industry
- Ensuring integration with healthcare and agriculture