

Institution: University of Liverpool		
Unit of Assessment: UoA6		
Title of case study: Reducing antimicrobial use in food supply chains		
Period when the underpinning research was undertaken: 2010-2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Robert Smith	Professor	Throughout
Lucy Coyne	Research Assistant	2017-2020
Robert Christley	Professor	to January 2019
Susan Dawson	Professor	Throughout
Helen Higgins	Senior Lecturer	2015 - current
Sophia Latham	Lecturer	Throughout
Gina Pinchbeck	Reader	Throughout
Nicola Williams	Professor	Throughout
Period when the claimed impact occurred: August 2013 – December 2020		
Is this case study continued from a case study submitted in 2014? No		
<p>1. Summary of the impact</p> <p>Reducing antimicrobial use in animals is key to tackling the increasing public health threat posed by antimicrobial resistance (AMR). University of Liverpool (UoL) research on the drivers of antimicrobial use directly informed new pig and dairy industry guidance on antimicrobial use changing farming practices across both industries. Our work underpinned a 2017 Tesco policy requiring their farmers, who supply 9% of UK milk, to avoid use of high priority critically important antimicrobials unless justified by prior testing of antibiotic sensitivity in culture. This policy change resulted in a 97% reduction in high priority critically important antimicrobial use and a 46% overall drop in use without affecting animal health or welfare. In 2018, the Red Tractor Farm Assurance Standards adopted this policy extending the impact to 95% of UK dairy herds. Together, this improved antibiotic stewardship will sustain antimicrobial efficacy in both human and veterinary contexts, with health, welfare and economic impacts.</p>		
<p>2. Underpinning research</p> <p>Antimicrobial use (AMU) in food animals has been intolerably high and more prudent antimicrobial prescribing is essential to minimise development of AMR. In addition to reducing all unnecessary AMU, antimicrobial classes designed as "Highest Priority Critically Important Antimicrobials (HP-CIA)" should be reserved solely for treatment of infections identified as being multidrug resistant.</p> <p>UoL researchers identified a crucial lack of objective data concerning the prescribing habits of veterinary surgeons (vets) for key production animals. In 2010, research funded by government quantified for the first time, and on a large scale, the actual AMU by vets within the UK dairy industry and highlighted several issues around responsible antimicrobial prescribing [3.1]. The research discovered that only 4.7% of vets regularly carried out bacterial culture and antibiotic sensitivity testing and only half stated they sometimes did, despite 20% being able to perform this diagnostic test in their in-house laboratories. Additionally, only 7.1% of vets always carried out culture and sensitivity testing when a suspect bacterial infection failed to respond to an antibiotic. Over 90% of vets reported using HP-CIAs in the 12-month period, with half using them regularly. Acute mastitis (udder infections) was the main clinical scenario where 63% prescribed HP-CIA as first line treatments.</p> <p>Research led by Pinchbeck extended this approach to the pig industry. A study involving vet and farmer focus groups across England identified eight major themes influencing AMU in the pig industry [3.2]. This analysis informed a further qualitative study that revealed a complex and</p>		

diverse set of drivers, ranging from animal welfare and societal responsibility to economic factors, behind prescribing decisions made by pig vets [3.3]. These studies underpinned the design of a census survey that quantified for the first time the AMU practices, attitudes and responsibilities of UK pig vets [3.4]. Results showed that, in keeping with the dairy industry, diagnostic testing was rarely utilised to support prescribing. Pig vets also blamed other health professionals for AMR over themselves. They consulted a wide spectrum of resources on AMU, sometimes with contradicting advice, highlighting the urgent need for evidence-based guidance on AMU. These findings were pivotal in the approach adopted to influence AMU in the Tesco supply chain.

Building on this work, Higgins developed a research programme investigating cattle vets' prescribing decisions. Initial work focused on the prophylactic use of antibiotics for prevention of new udder infections prior to calving (dry cow therapy), a scenario for which antibiotics have been prescribed on a mass scale. Cost-effective, efficacious non-antibiotic alternatives have been available since 2002, yet uptake had been poor. Results identified three key barriers to change [3.5] and emphasised the importance of a widespread commitment to non-antibiotic alternatives across veterinary practices. Further work involving farmers and vets identified 'other-blaming' as a major barrier to reducing AMU [3.6]. It provided evidence for a culture of blame and denial between the veterinary, farming and medical professions, echoing the findings from the pig industry. A social identity approach to reduce 'other-blaming' was proposed, facilitating a common 'in-group identity' between vets and farmers that focuses on common fates and goals.

UoL research has identified key obstacles to reducing AMU in cattle and pigs, provided pathways to overcome them, set priorities for addressing AMU in specific scenarios, and proposed communication strategies to maximise impact and AMU reduction.

3. References to the research

[3.1]. **Professor Susan Dawson** (Contract manager)

Antibiotic Use in Food-producing animals in the UK – Project VM02211. Veterinary Medicines Directorate. 2010- 2012. £69,400.

Final Report: <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=Non e&Completed=2&ProjectID=17336>

[3.2]. **Coyne LA, Pinchbeck GL, Williams NJ, Smith RF, Dawson S, Pearson RB, Latham SM.** Understanding antimicrobial use and prescribing behaviours by pig veterinary surgeons and farmers: a qualitative study. *Veterinary Record*. 2014 Dec 13;175(23):593.
[doi: 10.1136/vr.102686](https://doi.org/10.1136/vr.102686).

[3.3]. **Coyne LA, Latham SM, Williams NJ, Dawson S, Donald IJ, Pearson RB, Smith RF, Pinchbeck GL.** Understanding the culture of antimicrobial prescribing in agriculture: a qualitative study of UK pig veterinary surgeons. *Journal of Antimicrobial Chemotherapy*. 2016 Nov; 71(11):3300-3312. [doi: 10.1093/jac/dkw300](https://doi.org/10.1093/jac/dkw300).

[3.4]. **Coyne LA, Latham SM, Dawson S, Donald IJ, Pearson RB, Smith RF, Williams NJ, Pinchbeck GL.** Antimicrobial use practices, attitudes and responsibilities in UK farm animal veterinary surgeons. *Preventative Veterinary Medicine*. 2018 Dec 1;161:115-126.
[doi: 10.1016/j.prevetmed.2018.10.021](https://doi.org/10.1016/j.prevetmed.2018.10.021).

[3.5]. **Higgins HM, Golding SE, Mouncey J, Nanjiani I, Cook AJC.** Understanding veterinarians' prescribing decisions on antibiotic dry cow therapy. *Journal of Dairy Science*. 2017 Apr;100(4):2909-2916. [doi: 10.3168/jds.2016-11923](https://doi.org/10.3168/jds.2016-11923).

[3.6]. Golding SE., Ogden J, **Higgins HM** (2019) Shared Goals, Different Barriers: A Qualitative Study of UK Veterinarians' and Farmers' Beliefs About Antimicrobial Resistance and Stewardship. *Frontiers in Veterinary Science*. 6. 132 [doi: 10.3389/fvets.2019.00132](https://doi.org/10.3389/fvets.2019.00132).

4. Details of the impact

Antimicrobial resistance (AMR) threatens human and animal health, food security and economic prosperity. Currently, drug-resistant diseases are estimated to cause at least 700,000 human deaths globally each year. In a worst-case scenario this burden may rise as high as 10,000,000 deaths per year by 2050 if no action is taken. Reduced antimicrobial use (AMU) and resistance selection pressure in food producing animals is critical to reducing AMR risk in both veterinary and human contexts.

Our work to identify and develop strategies to overcome barriers to more prudent AMU in food producing animals has underpinned new policy in both the pig and dairy industries which has been adopted by farmers and the wider food supply chain to change practice, reducing AMU.

Influencing AMU in the Pig Industry

Our work focusing on the pig industry influenced development of AMU policy in the sector. **Coyne** was seconded to the Veterinary Medicines Directorate (VMD, an agency of Defra) for 6 months as a Higher Executive Officer in the AMR team. Knowledge transfer events disseminated findings to stakeholders, including representatives from the government, food industry, veterinary surgeons and farmers. The insight gained was used by industry and policy makers to develop a widespread industry-led movement focused on quantifying antimicrobial use and promoting responsible prescribing behaviours for pigs (Evidence A). The industry has reported a 60% reduction in antibiotic use, from 278 mg/kg (2015) down to 110 mg/kg (2019) (data representing 89% of the industry), demonstrating an increased engagement by the pig sector on the global issue of AMR (Evidence B). These findings were pivotal in the evidence-based approach adopted which directly reduced AMU in the Tesco supply chain.

Reducing AMU in the Dairy Industry

An important vehicle for impact in the dairy industry was the Tesco Dairy Centre of Excellence. This partnership between UoL and Tesco was created in 2010 to provide research, knowledge exchange and technical support to Tesco and the up to 750 UK dairy farmers contracted to supply all Tesco-brand milk and some cheese (Tesco Sustainable Dairy Group, TSDG). VMD have also testified as to the impact this work has had on the wider UK dairy cattle industry (Evidence C).

Raising awareness. In Spring 2011, **Smith** presented at four regional TSDG farmer meetings attended by over 600 farmers on prudent AMU including minimising HP-CIA use. **Smith** advised Tesco on a Livestock Code of Practice which included the requirement to record overall AMU on a central database and differentiate Highest Priority Critically Important Antimicrobials (HP-CIA) use. The code of practice was launched in June 2011 (Evidence D). **Smith** produced a CD farmer guide and subsequently presented the antimicrobial standards section at 11 farmer meetings to over 600 farmers. Awareness was raised within the veterinary community via presentations at British Cattle Veterinary Association (BCVA) conferences (Evidence E) and World Buiatrics Congress from 2012 to 2017 covering Tesco Dairy standards, the previous research study findings [3.1] and use of non-antibiotic alternatives to prevent udder infections [3.5] by both **Higgins** and **Smith**.

Changing Practice in the TSDG.

Standard 1. UoL research underpinned new standards introduced by Tesco in 2015 requiring farmers to record AMU for specific diseases and age groups. A meeting with 45 vets, who supplied services to TSDG group farmers, was hosted by UoL in 2016 to facilitate implementation of the standards. The Review on Antimicrobial Resistance commissioned by UK government (O'Neill and others, 2016) put an onus on supermarket supply chains to reduce AMU in farming. UoL work provided timely underpinning evidence needed for Tesco to drive further change in practice in TSDG farms (Evidence D).

Standard 2. As a result of technical input from UoL, Tesco identified reducing the use of HP-CIA in animals as a key aspect of their social responsibility (in their mission statement). In 2017 Tesco introduced the requirement that HP-CIA could be used only where farmers could provide evidence, via culture and antimicrobial sensitivity testing, that they were the only antimicrobials with efficacy for the particular infection (Evidence F, G and D). This change was driven by our finding that

culture and sensitivity testing was not routinely undertaken, and that a requirement for testing would establish a barrier to improper use of HP-CIAs. To ensure buy-in from stakeholders, **Smith** hosted a meeting for vets and presented at 10 regional meetings to all farmers in the TSDG outlining the rationale for change and alternative options for disease treatment and prevention. This led to a decrease in HP-CIA use by 65% and a decrease of 16% in overall antibiotic use in 12 months within TSDG farms (Evidence G).

Standard 3. A requirement was introduced in 2018 for TSDG farmers to increase the number of animals not receiving dry cow therapy by 10% of the herd per year (Evidence D).

During the subsequent adoption phase, **Latham** held five discussion groups with TSDG farmers which explored the drivers of variation in AMU use at farm level and garner views on the impact of the policy change surrounding the use of HP-CIA. There was evidence from all regional focus groups that the TSDG supplier group policy change on the use of HP-CIAs had been the major reason for behavioural change associated with AMU on their farm; “*...certainly I think Tesco have brought products to the attention with this*” and “*for me it's raised the awareness of it (AMR) and just made me think maybe a little bit more about what we use and why we use it*”). Data from these studies were used to provide positive feedback on the reductions in AMU seen, with no reduction in overall animal health and welfare parameters.

Quantitative analysis of data on over 700 farms from the Tesco Dairy health index database demonstrated a significant and dramatic decrease in HP-CIA and all AMU on Tesco farms (Figure 1 and 2). There is no public access to the database but this reduction is consistent with the 12-month reduction in AMU shown by Evidence G. TSDG farms showed two-fold greater initial reduction in HP-CIA use from 2016 to 17 compared to the UK average reported by VMD and a greater reduction between 2016 and 2019 of 97% vs 83% (Evidence B, Figure 1). Analysis also showed a slight decrease in animal disease, cull and death rates on farms despite reductions in AMU. This enabled positive feedback to farmers on the reductions in AMU seen with no reduction in overall animal health. One major component of reduction in overall AMU was a reduction in dry cow therapy (Figure 2).

Wider Impact. The positive findings on the adoption of culture and sensitivity testing requirements by Tesco was a key factor in incorporation of the policy into the Red Tractor Farm Assurance scheme in 2018 widening the impact to 95% of UK dairy supply (Evidence G). This work has allowed farmers and Tesco to meet the societal expectation of reducing AMU with an expected reduction in risk of development of AMR through the supply chain through to human pathogens.

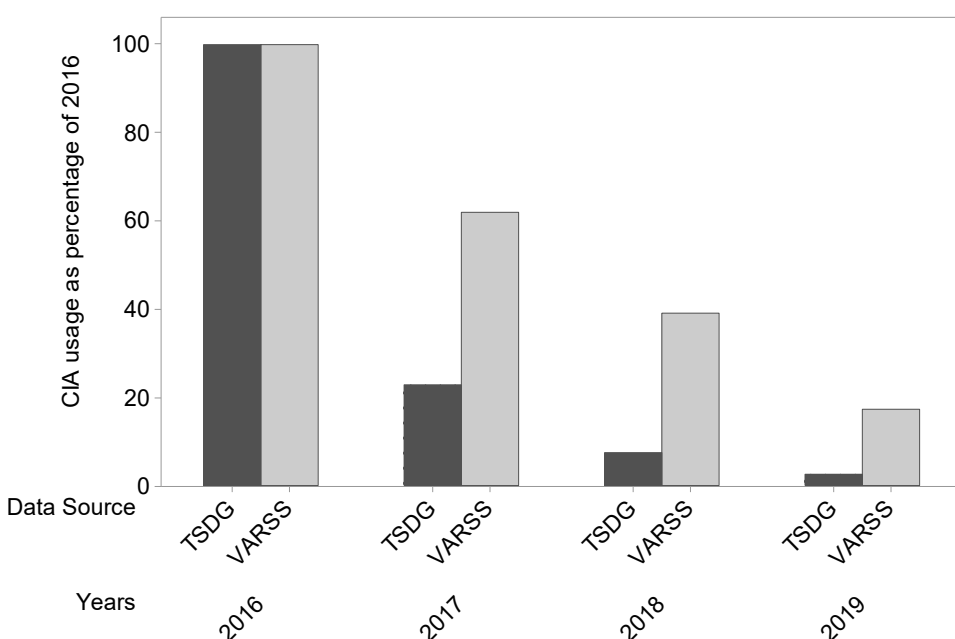


Figure 1. Percentage year on year reduction in HP-CIA use within the TSDG, (courses) compared to that identified in the whole UK dairy industry from the VMD VARSS report (mg/kg PCU). Source Tesco Dairy health index database (corroborated by Evidence G and B).

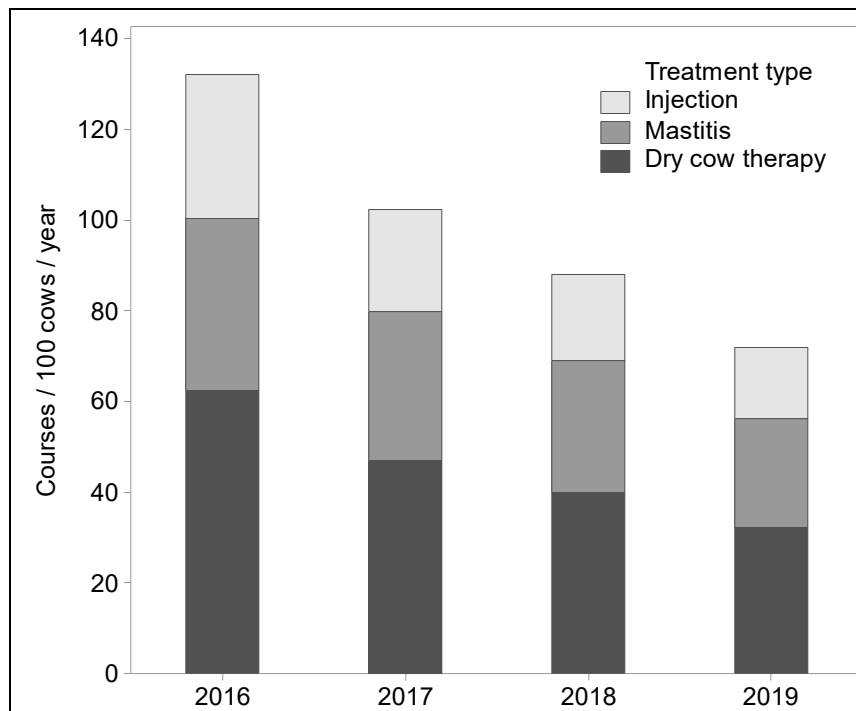


Figure 2. Tesco Sustainable Dairy Group AMU by treatment type for adult cows showing reduction in use, particularly of dry cow therapy (dark grey). Source Tesco Dairy health index database corroborated by Evidence G.

5. Sources to corroborate the impact

A. Letters of support from the Veterinary Medicines Directorate regarding impact of the Pig research project funded by them.

B. Reduction in AMU for pigs on page 32 of UK Veterinary Antimicrobial Resistance and Sales Surveillance Data 2018 and 2019. <https://www.gov.uk/government/publications/veterinary-antimicrobial-resistance-and-sales-surveillance-2019>.

C. Letter of support from the Veterinary Medicines Directorate regarding impact of the Cattle research project funded by them.

D. Tesco Livestock Code of Practice – Contribution of Robert Smith to policy cited within and the role of research at the Tesco Centre of Excellence, and through Knowledge Transfer events delivered by its team, including Prof Robert Smith, University of Liverpool

E. Awareness raising within the veterinary community in conference talks in British Cattle Veterinary Association (BCVA) programmes 2012-2015

F. Article in Farmers Weekly: <https://www.fwi.co.uk/livestock/health-welfare/livestock-medicines/tesco-milk-suppliers-to-cut-use-of-critical-antibiotics>.

G. Letter from Tesco Agriculture Manager (Dairy), Tesco PLC highlighting our pivotal role in the AMU policy development, knowledge transfer and data collection.