What Triggers Change in Antimicrobial Use?

Qu'est-ce qui déclenche un changement dans l'utilisation des antimicrobiens ?

Was löst die Veränderungen beim Einsatz antimikrobieller Mittel aus?

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Reducing antimicrobial use on-farm is crucial for protecting both humans and livestock from antimicrobial resistance. This article provides a way of understanding the processes that lead to farmers reducing the use of antimicrobials. Understanding these processes is important given the interest of governments in changing behaviours through voluntary rather than regulatory methods, reflecting a broader policy engagement with behavioural economics (Thaler and Sunstein, 2008). Behavioural change interventions (BCIs) may take many forms, including attempts to influence the values and attitudes of farmers or veterinary surgeons by using social norms to indirectly change their behaviour (Rees *et al.*, 2021). Developing appropriate BCIs to prevent antimicrobial resistance requires an appreciation of the underlying behavioural influences that cause farmers to adopt or resist new practices. The purpose of this article is to highlight the key 'triggering events' behind transitions in farm practice, and the key 'path-dependencies' that prevent change from occurring.

Triggering change in AMR

The importance of identifying what triggers change in farming transitions is identified in Sutherland *et al.*'s (2012) 'triggering change' model (see Figure 1).

The model identifies five key stages in the life-cycle of innovation adoption. Firstly, the model suggests that farmers' behaviours have become heavily 'path-dependent': inertia within agricultural systems constrains farmers within long-standing economic and social practices such that changing them is almost impossible. Economic examples include the 'technological treadmill' in which there is reliance on initial use of machinery and other technological inputs. Social examples include socio-cultural ideas of what constitutes 'good farming' that reinforce particular ways of working and farming, to the exclusion of new practices, such as environmentally friendly farming (Burton *et al.*, 2021) as well as the adoption of new animal health procedures (Enticott *et al.*, 2021; Shortall *et al.*, 2018).

> "Les réductions de l'utilisation des antimicrobiens se produisent souvent en tandem, ou comme effet secondaire d'une transformation plus large de l'agriculture, et non comme le résultat d'une initiative visant uniquement à réduire l'utilisation des antimicrobiens."

Dramatic system-changing events are required for path-dependencies to be disrupted. These changes, referred to as 'triggering events' may emanate from within the farm – such as disease outbreaks, environmental hazards (e.g. fire or flooding), or changes in personal relationships (such as deaths, marriages and retirement). External triggering events may include dramatic shifts in government policy, such as changes to farm subsidy schemes (e.g. post-Brexit farming schemes in the UK) or social and economic shocks (e.g. Covid, global economic crisis). Importantly, the triggering change model also considers the learning processes that follow a triggering event.

Subsequent stages of the model suggest an iterative approach to the adoption of new practices, in line with other theories of agricultural innovation. Technology adoption or practice change is not immediate, nor does it follow a linear trajectory. Rather, experimentation and trialling innovations occur in an iterative fashion, with potential changes abandoned and re-worked radically or incrementally over time.

Methods

Using the triggering change framework, farmers changing AMR practices were investigated in three countries (France, Sweden and the United Kingdom) in different sectors (pigs, poultry and calf rearing respectively) (see Table 1).

In-depth, qualitative interviews were conducted which addressed the processing of becoming farmers, livestock care, AMU, social norms, triggers for change in AMU and

DOI: 10.1111/1746-692X.12449

barriers to change (including systems and supply chains). These interviews were recorded and transcribed, and then analysed in their native languages using thematic coding.

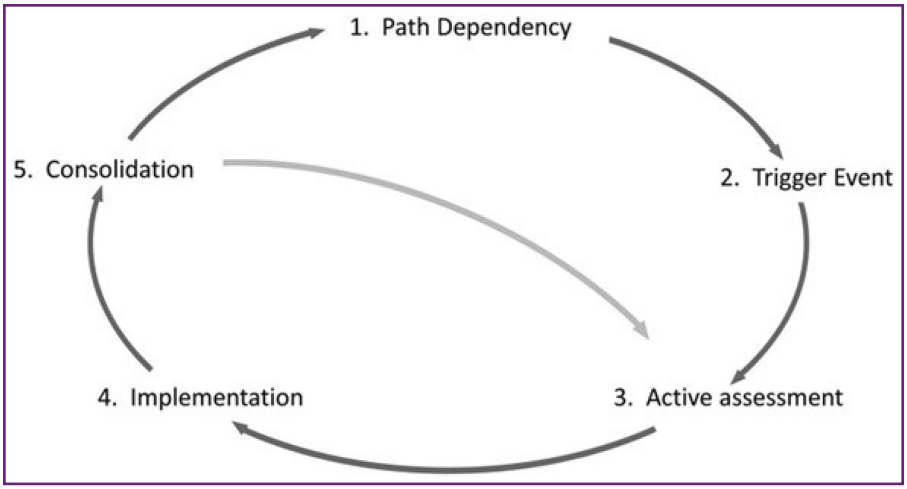
Countries and case studies were selected to reflect a different mix of statutory and voluntary approaches to changing AMR practices. In Sweden, antimicrobial use in intensive poultry holdings is rare; most of the farmers interviewed had never used them. This reflects efforts by producer organisations since the 1980s to reduce AMU in intensive systems through alternative management practices, including culling. In the French case, government restrictions limit antimicrobial use; all farmers require veterinary prescriptions. In addition, joining an AMU-free label presented farmers in the French case study with an opportunity to gain a premium price for their product. AMU-free labels generally did not involve a complete ban on AMU during the production cycle, but rather more use of curative and individual treatments instead of group prophylactic and metaphylactic treatments. In the United Kingdom, the case study focused on dairy calf rearing. Restrictions to AMU are somewhat less stringent in the UK than in the EU, although AMU is still restricted to veterinary prescription. In the calf-rearing sector in the UK, the creation of dairy to beef systems means that calves are moved to dedicated calf-rearing units, either directly or via a 'collection centre' where they are mixed with calves from multiple farms. Antimicrobials are often deployed to control resultant disease outbreaks.

AMR triggering events

The research identified the following events that triggered change in farmers' AMR practices.

Disease outbreaks. In the Swedish and French cases, farmers described how disease outbreaks act as 'triggering events' (Sutherland *et al.*, 2012) that prompt change in relation to animal health management and AMU. For example, a conventional pig farmer in the French case study was prompted to reassess his production system following a significant disease outbreak. This led him to strengthen biosecurity, change the buildings on farm to better accommodate the animals' physiological needs and implement different feeding and vaccination regimes. Swedish farmers described an industry-wide disease crisis when there was a large outbreak of campylobacter in the 1980s. There was a drop in poultry consumption among the public and the sector introduced improvements in biosecurity and hygiene practices.

Figure 1: Triggering change model (Sutherland *et al.*, 2012)



Maintaining farming's social licence. Observation of disease resistance was also a trigger. In a number of case studies in France and the UK, there was observation of and concern about resistant bacteria on the interviewees' own farm across the case studies and in many cases, farmers saw this as a motivation to change their practices and their industry. Interviewees described witnessing what they thought was resistance to treatment on their own farms or hearing stories about resistance. This awareness and these stories in many cases motivated a desire for change.

Like, one of my main reasons against wanting to use antibiotics is more human health and more wanting to not contribute to antibiotic resistance. And trying to make sure that we use antibiotics as little as we can. I don't feel like it's particularly ethical the level of antibiotic use in farming industry, and that has to change in my opinion. (UK, calf rearing)

Across case studies farmers were concerned about the development of resistant bacteria in animals that could in time affect human health. They saw themselves as having a responsibility to society more widely. The perceived threat of antimicrobial resistant bacteria developing on farms and its knock-on effects for society was a motivating factor as it was seen

Table 1: Characteristics of study participants

Country	Sector	Number of Interviews	Gender of interviewees	Age range (years)	Interview length (minutes)
France	Pig – Conventional and antimicrobial free	18 (9 conventional, 9 antimicrobial free)	3 female 15 male	30–63	45 to 105
Sweden	Conventional Poultry	10	5 female 5 male	30–70	30 to 60
United Kingdom	Dairy calf rearing	32	28 female 4 male	20s–60s	40 to 90

to undermine farming's social licence in line with previous food scares and farming controversies. However, there was no discussion of concern for farmers' own exposure to antimicrobial resistant bacteria because they worked on farms. For some, the future of a world without antibiotics was too distant to override the immediate concerns of giving livestock the best care possible.

New regulations. Government and industry regulation can act as prompts for change in AMU practices. Pig farmers with antibiotic-free labels in France drew a direct link between entry into these supply chains and changes in practices. Reducing their use of AMUs involved larger changes to their production system including greater use of vaccines, changes in feeding strategy, buildings, training, biosecurity and the use of alternative products. Entry into these supply chains thus acted as an opportunity for farmers to rethink their systems and make substantial changes.

> "Die reduzierte Nutzung antimikrobieller Mittel erfolgt häufig parallel oder als Nebeneffekt einer umfassenderen Veränderung im Betrieb und nicht als Ergebnis einer Initiative, die ausschließlich auf die Verringerung dieser Mittel abzielt."

Farmers in the Swedish poultry case study on the other hand believed that they had been producing with very low AMU for a long period of time. They were aware that this system had come about because of gradual industry and government efforts to foster more prudent use of antimicrobials over a period of decades. Here, the opportunities that

Farmers in the Swedish poultry case study believed they had been producing with very low AMU for a long time © Carol Kyle.

gave rise to this system were not seen as discrete events but rather as a continuous process of regulatory and cultural change. In doing so, they also articulated a kind of 'disease nationalism' whose status they were motivated to protect. Swedish farmers described being proud of their low antimicrobial use and what they perceived as the high animal welfare and health standards in Sweden were part of their identity as a good farmer. In this sense, aligning the stewardship of antimicrobials with a cultural conception of what a good farmer is can prove to be motivating.

Succession and entry. Farmers in the UK case study reported that farm succession and/or changes to the farm partnership acted as key events that opened up new possibilities and approaches. Through marriage, new voices could be incorporated into the farm partnership, leading to new practices of calf-rearing. Similarly, deaths, illnesses and retirements were connected to the adoption of new calf-rearing practices, but these could also create new challenges for AMR. For example, for some farmers, the decision to scale back farming activities was associated with focussing on contract calf-rearing, as part of the emerging dairy to beef market. Whilst this marked a significant shift in the nature of farming, it also brought new challenges in relation to AMR as it was reliant on rearing calves brought in from multiple farms: this mixing and their arrival on farms were associated with significant disease challenges that had not been present previously. Succession has been identified widely in studies deploying the triggering change as an important trigger for change to farming practices (Sutherland *et al.*, 2012).

Economic factors. Many farmers in the French pig case study were motivated to enter antibiotic-free supply chains because of the economic benefits. This supply chain

was seen as economically beneficial both because of the extra price per kilo they were paid for the pigs and for the reductions in costs from using fewer antimicrobials.

We started looking into this unit here after my father died. So to make this a sort of viable unit, we had to look into, you know, doing something, doing something a lot more with it, which meant our lifetime savings had to be put into it. (UK, calf rearing)

Economic factors also intersected with farm succession processes: recognition of the need to increase the economic viability of the farm, if the successor was to maintain a viable business. Investments in new infrastructure enabled reduced antimicrobial use through better management practices. An important finding of this research is that reductions in AMU often occur in tandem, or as a side-effect of a broader transformation on farm, not as a result of an initiative solely aimed at reducing AMU.

Enabling AMU transition following triggering events

The triggering change model posits that following trigger events, farm decision-makers actively consider their options – change of trajectory only occurs if a more viable option is found. Triggering events therefore did not necessarily over-ride path-dependencies. Financial barriers (e.g. reduced returns from alternative practices, increased labour, costs of up-dating infrastructure) were key obstacles identified.

Farmers' perception that reduction in AMU would lead to more sick or unhealthy livestock was also an issue identified in the French and British cases.

Many breeders today censor themselves on the use of antibiotics; they have heard so much that it was not good that they come to stop caring for their animals, to the point of having reprimands from DDPP [public authorities]. This censorship also exists among veterinarians. (France, AMU free pigs)

Ongoing disease problems could also make it more difficult to make changes. In relation to early treatment, some French poultry farmer interviewees believed it was necessary to treat animals with antimicrobials when they were young, at the first signs of a disease outbreak. This would avoid high mortality and an impact on growth rates as well as reducing the number of treatments needed later in the production cycle. These farmers faced a range of health challenges and so treatment was seen as a necessary way to maintain the economic viability of their farm. Some farmers had experienced very difficult circumstances in the past with disease problems which made them more prepared to treat early. They argued that by treating early, they were actually using fewer antimicrobials than they would need to administer if they let a disease spread throughout the herd.

"Reductions in AMU often occur in tandem, or as a side-effect of a broader transformation on farm, not as a result of an initiative solely aimed at reducing AMU."

In the UK case study, bringing together young calves from multiple herds to fulfill calf rearing contracts represents systemic AMU. This mixing, together with the stress associated with transport means that antimicrobials become ingrained in this system to treat calves soon after they arrive on farms. Contract calf rearers in the UK raising dairy animals for the beef sector are advised by the contract rearing company to use antimicrobials in a metaphylatic way if disease outbreaks are not resolved quickly. They might receive animals from multiple units and so struggle to keep disease outbreaks under control. Treatment is seen as a necessary, ethical practice.

In the UK, the system is structured to bring calves from multiple herds together at a young age, leading to high risk of disease © Gareth Enticott.

Many farmers in the French pig case study were motivated to enter antibiotic-free supply chains because of the economic benefits © Carol Kyle.

In both the UK and French cases, this ideological resistance to reduction in AMU was bound up in study participants' definitions of what it is to be a 'good farmer' (Burton *et al.*, 2021). They prided themselves on their ability to identify sick animals, and did not wish to see animals suffer. 'Good farming' was associated with high hygiene standards, disease prevention, and strong observational skills. In some cases, use of antimicrobials did cause guilt, where farmers believed that their farming skill should mean that they do not need to use antimicrobials.

I'm using something that I shouldn't have to use [medicated feed] because I should be able to manage my way out of it. And at the moment, I can't quite bring myself to take the risk of trying that until we get some better facilities. And it's, and it's such an easy, you know, so easy to order some more medicated feed, and then happy days, but every time I order it, it makes me feel a bit guilty that I'm doing that instead of sorting the problem out. (UK, calf rearing)

In the Swedish case, this idea that good farmers should not need to use antimicrobials was deeply embedded. Although study participants similarly valued hygiene standards, disease prevention and observational skills, AMU was seen as a sign of 'failure': AMU should not be necessary in a well-kept flock.

Should we use, should we breed animals in such a bad environment that we need to use antimicrobials in order to produce them? Then something is fatally wrong. (Farmer 2, Sweden)

Swedish conventional poultry farmers operated in line with the specifications of the slaughterhouse which stipulated how many birds they raised, what weight they should be at slaughter and when they should be slaughtered. This system was not conducive to any AMU because treating individual sick animals might mean they would be different weights at slaughter or might cause delays in the timing of slaughter. Culling is understood as a both a symbolic action necessary for disease control, and difficult action which is indicative of moral virtue (for further detail see Sutherland *et al.*, forthcoming). Social norms surrounding what it is to be a 'good farmer' who cares well for livestock are thus somewhat different in the study sites, reflecting different histories of AMU practices. The cases demonstrate how these social norms can help to consolidate low AMU into a standard of practice.

It is important to note that trigger events can also lead to increased AMU – in the UK, public outcry over the slaughter of male dairy calves at birth led to legislation restricting this practice, and ultimately a system of rearing calves in groups, often some distance from their place of birth. This bringing together of young animals from different herds leads to increased incidence of disease and requirement to treat.

Conclusion and policy implications

If the threat of antimicrobial resistance is to be averted by changing farmers' (and other stakeholders') behaviour, understanding the various influences that shape these behaviours is a prerequisite for policymakers seeking to design effective interventions. The research presented in this article highlights a range of triggering events that could lead to changes in the use of

antimicrobials. Importantly, these triggers often led to broader changes to the farm (e.g. new personnel, new infrastructure). Similarly, reductions in AMU often occurred as a result of these broader changes, rather than as a specific intention. The change to AMU was a component of these broader transitions, rather than a targeted action undertaken by the farmer. This suggests that interventions which enable farmers to 'build back better', e.g. after a disease outbreak, or which specifically support succession processes, are likely to have an indirect but important impact on AMU.

The range of triggers and behavioural influences also means that a one-size fits all approach, or reliance on general interventions is less effective. This points to the need for more targeted and timely behavioural change interventions.

Care for sick livestock is embedded in broader definitions of what it is to be a 'good farmer', which evolve over time. Farmers in Sweden described how AMU is seen as a failure in flock hygiene, a perspective which had evolved over time in tandem with industry efforts to reduce AMU. Swedish poultry farmers described a 'disease nationalism', where they take pride in their limited AMU as a nation. Farmers in all of the cases described what it is to be a 'good farmer' as including good husbandry, high hygiene standards, caretaking and embodied expertise, which are also relevant to AMR.

Information about AMR and educational advice should be framed around these notions of good farming in order to demonstrate the cultural relevance of AMR practices. At the same time, seeking to define and publicise notions of the AMR 'good farmer' can facilitate the adoption of new practices. One way of doing that might be through the greater use of sharing medicine usage through benchmarking at discussion groups, allowing farmers to learn from each other in a trusting environment. Making information available to farmers about their and others' performance is one way to the acceptance and significance of good farming identities in relation to AMR.

Acknowledgements

This study is part of the ROADMAP (Rethinking of Antimicrobial Decision-Systems in the Management of Animal Production) Project and has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 817626. The research outputs can be consult ed here: www.roadmap-h2020.eu.

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Summary

What Triggers Change in Antimicrobial Use?

This article considers how different 'triggers' contribute to changes in the use of antimicrobials. Drawing on the Triggering Change model, the article suggests that the use of antimicrobials is path dependent: economically, socially and culturally invested in maintaining a steady trajectory, with incremental changes. Triggering events – such as farm succession, financial crisis, or disease outbreak – are required to break these dependencies and stimulate transitions to new farming trajectories. The article investigates which triggering events are significant in the context of responsible antimicrobial usage, in three European countries, spanning the beef, dairy, poultry and pig sectors. Results demonstrated that major reductions in antimicrobial use are often part of larger transition processes. Triggers led to major changes on farm which included reduction in antimicrobial use amongst other changes. When antimicrobial change occurred in isolation, it was typically in response to legislation, and progressed incrementally over time. To achieve major changes in antimicrobial use thus requires policies which work with trigger events such as supporting training of successors, and enabling farmers who have experienced major disease outbreaks to 'build back better'. Working to shape what farmers understand as 'good farming' through education, regulations and benchmarking, are also important options.

Qu'est-ce qui déclenche un changement dans l'utilisation des antimicrobiens ?

Cet article examine la manière dont différents 'déclencheurs' contribuent aux changements dans l'utilisation des antimicrobiens. S'appuyant sur le modèle 'Triggering Change', l'article suggère que l'utilisation des antimicrobiens dépend de la trajectoire suivie: il s'agit d'un investissement économique, social et culturel dans le maintien d'une trajectoire stable, avec des changements progressifs. Des événements déclencheurs – tels qu'une transmission de l'exploitation agricole, une crise financière ou une épidémie – sont nécessaires pour briser ces dépendances et stimuler les transitions vers de nouvelles trajectoires agricoles. L'article étudie quels événements déclencheurs sont importants dans le contexte d'une utilisation responsable des antimicrobiens, dans trois pays européens, couvrant les secteurs de la viande bovine, des produits laitiers, de la volaille et du porc. Les résultats ont démontré que les réductions importantes de l'utilisation des antimicrobiens font souvent partie de processus de transition plus vastes. Les déclencheurs ont conduit à des changements majeurs dans l'exploitation agricole, notamment une réduction de l'utilisation des antimicrobiens, entre autres changements. Lorsque le changement concernant les antimicrobiens se produisait de manière isolée, il s'agissait généralement d'une réponse à la législation et il avançait progressivement au fil du temps. Pour parvenir à des changements majeurs dans l'utilisation des antimicrobiens, il faut donc des politiques qui fonctionnent avec des événements déclencheurs tels que le soutien à la formation des successeurs ou des mesures permettant aux agriculteurs qui ont connu des épidémies majeures de 'reconstruire en mieux'. Travailler à façonner ce que les agriculteurs considèrent comme une 'bonne agriculture' par le biais de l'éducation, de la réglementation et de l'analyse comparative constitue également une option importante.

Was löst die Veränderungen beim Einsatz antimikrobieller Mittel aus?

Dieser Artikel befasst sich mit der Frage, wie verschiedene 'Trigger' zu Veränderungen beim Einsatz von antimikrobiellen Mitteln beitragen. Auf der Grundlage des 'Triggering Change' Modells gehen wir davon aus, dass der Einsatz antimikrobieller Mittel pfadabhängig ist: Wirtschaftlich, sozial und kulturell wird in die Aufrechterhaltung eines gleichmäßigen Verlaufs mit schrittweisen Veränderungen investiert. Tiefgreifende Ereignisse ('triggering events') – wie die Hofnachfolge, eine Finanzkrise oder Seuchenausbrüche – sind erforderlich, um diese Abhängigkeiten zu durchbrechen und Entwicklungen in neue landwirtschaftliche Bahnen zu lenken. Wir untersuchen, welche Ereignisse im Zusammenhang mit dem verantwortungsvollen Einsatz von antimikrobiellen Mitteln von Bedeutung sind und betrachten dabei drei europäische Länder und die Sektoren Rindfleisch, Milchprodukte, Geflügel und Schwein. Die Ergebnisse zeigen, dass eine erhebliche Reduktion beim Einsatz antimikrobieller Mittel oft Teil eines größeren Übergangsprozesses ist. Bestimmte Ereignisse führten zu größeren Veränderungen in den Betrieben, zu denen unter anderem auch der reduzierte Einsatz von antimikrobiellen Mittel gehörte. Trat diese Reduzierung isoliert auf, so war sie in der Regel eine Reaktion auf die Gesetzgebung und erfolgte schrittweise im Laufe der Zeit. Um größere Veränderungen bei der Verwendung antimikrobieller Mittel zu erreichen, sind daher politische Maßnahmen erforderlich, die zusammen mit den 'triggering events' stattfinden. Hierzu zählen Beratungsangebote zur Hofnachfolge oder die Förderung der Widerstandsfähigkeit gegenüber Seuchenausbrüchen. Weitere wichtige Maßnahmen betreffen den Bereich 'gute Landwirtschaft' und umfassen Aufklärung, Vorschriften und Benchmarking.