

# Feeding time(s): Patient urgency and the careful temporalities of antimicrobial resistance

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## Abstract

This paper seeks to understand how caring for new-born livestock is made possible, which practices of care are privileged and to what effect? These aims are situated in attempts to promote the prudent use of antibiotics amongst livestock farmers to prevent antimicrobial resistance. In focusing on the rearing of new-born calves on dairy and beef farms in England and Wales, the paper reveals how care is configured by different temporal orders, the tensions between different temporalities of care, the reasons for them and the strategies employed by calf rearers to manage these tensions. Drawing on the concept of the 'timescape', the paper shows how calf care temporalities are relationally enacted and configured by materials, infrastructures and technologies. Common (productivist) agricultural temporalities of care emphasise speed, urgency and efficiency. However, by analysing the practice of feeding colostrum and 'tubing' – the forced feeding of calves via a tube inserted into the oesophagus – we highlight how these rapid caring temporalities conflict with the slower, patient skills of calf rearing. At the same time, however, we show how care is rendered fluid as calf rearers find ways of accommodating seemingly discordant temporalities – what we call 'patient urgency' – allowing different temporalities to co-exist within agricultural timescapes. Nevertheless, we show how these practices of accommodation are themselves the result of a productivist temporal order that marginalises calves and calf rearers. We argue that these timescapes point to the need for broader structural and cultural changes within agriculture to reduce the use of antibiotics.

## Keywords

Time, antimicrobial resistance, care, timescape, agriculture

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## Introduction



'Hi baby!', Amber cheerfully announces as she walks into the calf shed. There are reasons to be positive: two new calves have been born. 'Baby' will do for now: individual names might come later. Amber hopes her job of getting both calves to feed from the bottle will be straightforward. This is an urgent time: drinking colostrum – the cow's first milk thick with immunoglobulin – now will help build a calves' immune system and help fight possible infections. She can tell the first one is healthy: it is alert but quiet. Climbing into the pen, Amber squirts some milk onto her fingers and inserts it into the calf's mouth, slowly guiding the calf towards the bottle held in her other hand, before quickly swapping her fingers with the bottle's teat. The calf starts sucking noisily and soon she can take her hand away completely. But the other calf in the pen is less vigorous and less inquisitive when Amber approaches. It doesn't know what to do, or how to suck: the teat rubs against her mouth, but doesn't stay in. Patience is required, otherwise problems will unfold down the line. But Amber is also running out of time: there are other urgent jobs to be done. After one last try, she turns to a small whiteboard attached to the pen and notes that this calf needs further care and attention.

Feeding new-born calves like this is a routine practice of care found across dairy and beef farms. During this neonatal stage of life, careful practices are vital to aiding long-term health and a productive life. But routine care is not straightforward on farms, nor is it a neutral practice. Care, as Reisman (2021: 403) suggests, is situated within a 'politics of relational maintenance' that 'sustains particular forms of agrarian political economy that benefit some at the expense of others'. Careful practices are established within 'biosocial collectivities' (Holloway et al., 2023) in which materialities, people and the lively more-than-human relationally choreograph the possibilities for care, and the possibilities for a range of 'somatic sensibilities' (Greenhough and Roe, 2011). The aim of this paper is to understand the underlying politics of care in productivist agriculture: how calf care is made possible, which practices of calf care are privileged and to what effect?

The need to answer these questions is situated within ongoing attempts to promote the responsible use of antimicrobial medicines in agriculture as a result of concerns about a future in which antimicrobial resistance (AMR) renders these treatments ineffective and dangerous to public health

(O'Neill, 2016). Approximately half of the global use of antimicrobials is accounted for by livestock farming (Van Boeckel et al., 2015), their use having rapidly diffused into productivist agriculture (Kirchhelle, 2018) and sustained through practices that precipitate greater use in an unvirtuous circle (Allen and Lavau, 2014). Warnings surrounding AMR invoke dark consequences for agriculture and an atmosphere of future uncertainty. As the repercussions of antimicrobial overusage rebound within the fields and sheds of productivist farms, farmers must find ways of countering this threat, as much as responding to evidence of antibiotic resistance itself (Helliwell et al., 2019). Calls for the prudent use of antimicrobials and antimicrobial stewardship have therefore been accompanied by attempts to regulate or educate farmers about the dangers of AMR (Hinchliffe et al., 2018).

As AMR warnings have intensified, so the everyday has become as important as the exceptional. Daily farming routines and foundational husbandry principles have become reframed by the AMR agenda as key activities to preventing resistance. In the case of calf rearing, feeding practices have been given renewed importance which, if done properly, promote a healthy metabolism and help prevent common ailments such as diarrhoea (often known as scour) and pneumonia, and thereby reduce the need for antimicrobials (Bartram et al., 2017; RUMA, 2018). However, calves have historically been marginalised on farms. As one vet told us, calves are just not 'sexy' enough to be a priority: they are not of immediate economic value, nor do they necessarily capture the attention of tech-orientated agri-businesses. This ontology enacts what calves are thought to be, how they should be cared for, and who they are cared by (cf. Mee, 2013; Vaarst and Sørensen, 2009), one mirrored within the AMR agenda. In the United Kingdom, for example, numerical forms of medicinal governance, such as the use of targets, are focused on productive adult cattle (RUMA, 2020). Calves, in contrast, appear to escape these forms of medicinal surveillance, not least because their relative marginality means data is hard to come by and patterns of antibiotic use difficult to discern. Meanwhile, academic study focusing on adult cattle, pathologising the bodily sites of production, and focusing on farm owners rather than all farm workers (such as calf rearers) further enacts this marginalisation. In this context, calf AMR has hitherto been framed around more nebulous concepts of welfare, and practices such as cleanliness, feeding and ventilation (Helliwell et al., 2020). In this calf ontology, what can be done about the use of antibiotics in calf care, or what counts as careful rearing, is not straightforward, presenting dilemmas of care that calf rearers must somehow resolve.

We explore these dilemmas and tensions of care through the lens of time. Compared to spatialities, the temporalities of animal health and biosecurity, or agriculture in general (Mincyté et al., 2020), have received less attention (for exceptions, see: Allen and Lavau, 2014; Hinchliffe et al., 2016; Phillips, 2020b). As Henry et al. (2022) argue, despite farming's inherent exposure to different temporalities – the role of the seasons, and the life cycle of birth, growth and decay – spatialities overshadow temporal analyses, reducing them to 'matters of fact', naturalising speed and eliding multiple temporalities. Instead, to explore the range and significance of temporalities in calf care, we draw on Adam's (1998) concept of the 'timescape', in which temporalities are choreographed in relation to configurations of materials, biologies and technologies that are spatially distributed (cf. Law and Lien, 2014). In this context, we follow literature conceptualising 'care' to explore how calf care temporalities are relationally enacted and configured by materials, infrastructures and technologies (Puig de la Bellacasa, 2015). These agricultural timescapes commonly specify temporalities of care that emphasise speed, urgency and efficiency (Allen and Lavau, 2014). By focusing on the practices of feeding colostrum and 'tubing' – the forced feeding of calves via a tube inserted into the oesophagus – we highlight how rapid and urgent temporalities of care conflict with slower, patient skills of calf rearers. At the same time, however, we show how time is rendered fluid as careful practices find ways of

accommodating seemingly opposite temporalities – what we call ‘patient urgency’ – enabling different temporalities to co-exist within agricultural timescapes, and allowing calf rearers to live between these worlds. Nevertheless, we also consider how these practices of accommodation are emergent from a productivist temporal order that marginalises calves and calf rearers. We argue that these timescapes point to the need for broader structural and cultural changes within agriculture to reduce the use of antibiotics. Drawing attention to these human and nonhuman marginalities is an important part of highlighting unjust intersections within agriculture, AMR agendas and their politics of care.

The paper is structured as follows: firstly, we describe the relationship between care and time, introducing the concept of the timescape and its relevance to animal health and biosecurity. Secondly, we describe the temporalities of calf care, the tensions between different temporalities of care, the reasons for them and the strategies employed by calf rearers to manage these tensions. Finally, we conclude by highlighting the way different caring temporalities can accommodate each other, whilst also highlighting the need for AMR initiatives to pay attention to the systemic and structural dimensions of timescapes, rather than rely on individual behaviour change.

## **The timescapes of animal health**

Despite the interweaving of time and space in everyday life (May and Thrift, 2003), recent geographies of biosecurity and animal health have largely focused on spatial imaginaries – such as the border and borderlands (Hinchliffe et al., 2013) – rather than its temporalities. Just like space, time is made through ‘socio-technical arrangements and everyday practices’ (Puig de la Bellacasa, 2015) which form what Adam (1998) refers to as a ‘timescape’. Timescapes provide a temporal order to a landscape, establishing temporal expectations, routines, and appropriate conduct. Understood thus, the timescape of productivist agriculture seeks to create a smooth, rapid flowing network of relations that maximise productivity, transporting animals between different sites of production and converting them into food in the quickest and most efficient ways possible. The excesses of this temporality, however, come at the cost of environmental protections (Franklin et al., 2021) and animal welfare (Haggerty et al., 2009). A biosecurity timescape is allied to this logic of productivism, imagining a future temporality in which veterinary technoscience promises disease freedom, so long as farmers follow appropriate medicinal practices in the present time. Biosecurity timescapes are therefore characterised by an urgent temporality to facilitate the rapid growth of crops and livestock by pre-empting and overcoming frictions – like disease outbreaks – that slow down livestock production and food processing, and disturb their synchronisation. On the farm, this timescape summons an ‘affective atmosphere’ (Anderson, 2010) that commonly prescribes prophylactic and pre-emptive medical interventions, and orients farmers’ anticipatory senses to signs of ill health and the unexpected (Phillips, 2020a; Wang, 2022). Elsewhere in the food system, practices are developed to overcome systemic temporal frictions, but which may ironically increase the consequences of productive excess. For example, Allen and Lavau (2014) describe how the rapid temporalities of ‘just-in-time’ food systems heighten the risk of animal disease. In this tightly coupled timescape, chickens transported to slaughter must arrive at dedicated timeslots. If delivery lorries stand idle by arriving early, they risk a build-up of bacteria due to a lack of airflow. Instead, early arriving lorries continue to drive to ensure sufficient ventilation.

However, suggesting that these temporalities are merely marked by speed and urgency belies the complexity and precarity of temporal relations. Whilst dominant temporal paradigms may emerge, timescapes are ‘restless temporal regimes’ (Puig de la Bellacasa, 2015) whose flows, rhythms, cycles, and tempos are not fixed (Law and Lien, 2014), nor entirely predictable (Broz et al., 2021;

O'Mahony, 2022). These instabilities are reflected in the rebounding temporality of AMR, frequently enacted by an imagined future of biological breakdown and crisis as a result of the present-day excesses and malpractices of productivist agriculture. This rebounding timescape is common across narratives of productivist agriculture (Adam, 1998) but leads to 'the everyday experience of time [as] one of permanent precariousness: an on-going sense of urgency and crisis [which] calls to act 'now'' (Puig de la Bellacasa, 2015: 694). Dominant technoscientific timescapes are called into question by such breakdowns: action in the present time by farmers and vets is demanded to prevent a future in which animal and human health is compromised. However, whilst the urgency to do something about AMR highlights the creation and contest over how a timescape should be organised (cf. Helliwell et al., 2022), it also hints at the tensions and accommodations between a diversity of temporalities within the productivist biosecurity timescape. Thus, if productivist biosecurity timescapes direct attention to the sites and practices at which time is sped up (Henry et al., 2022), they can also lead to a focus on marginal sites and practices in which these temporalities are contested through slower practices of care (Puig de la Bellacasa, 2010). Here, the emphasis has been on exploring a feminist ethics of care in which more-than-human temporalities are identified, nurtured, and accommodated (Mol, 2008). These actions highlight the existence of alternative more-than-human temporalities that operate at a different pace to those programmed by productivist timescapes. Avoiding the kinds of ecological and biological breakdowns in productivist timescapes requires different forms of conduct: more-than-human temporalities are enacted through practices of attentiveness (Krzywoszynska, 2019) and play (Ellis, 2022) by learning to be affected by more-than-human temporality (Brice, 2014).

These embodied practices and 'somatic sensibilities' (Greenhough and Roe, 2011) are not necessarily alien to sites of productivism: they are routinely found in the laboratory (Anderson and Hobson-West, 2023; Giraud and Hollin, 2016) as well as the modern farm (Holloway et al., 2023), or in times of crisis (Gibbs, 2020; Law, 2010). However, paying attention to caring temporalities problematises the notion of care, revealing its tension and co-existence in the timescapes of technoscience and modern agriculture (Cusworth, 2023). For Haraway (2016) the solution to these tensions lies in 'staying with the trouble': adopting an ethics of care that seeks to make animals less 'killable' (Greenhough and Roe, 2011), developed through practices of attention and care-giving that demonstrate 'response-ability' to others' needs (Haraway, 2008). In doing so, the temporalities of care become fluid: transitioning between fast and slow to become neither one nor the other. Thus, as Puig de la Bellacasa (2015: 692) concludes in relation to the temporalities of soil care, 'care time, in practice and experience, is neither a slowed mode of, nor outside, the timescales of technoscientific futurity. Focusing on making care time does, however, offer glimpses into a diversity of timelines that, despite being made invisible or marginalised in the dominant timescape, can challenge traditional notions of technoscientific innovation'.

This kind of temporal fluidity, situated through the tensions of care is evident, at least implicitly, in recent relational and ecological conceptualisations of the management of animal health (Broom and Doron, 2022). Firstly, Holloway et al. (2023) identify biosocial collectivities as 'intentional groupings that come together because members have a shared concern for a fundamentally biological issue' (Morris and Holloway, 2014: 152). In analysing endemic livestock disease, they show how they are connected to farm-specific environments and priorities that have become embedded by productivist modes of agriculture. In seeking to maintain welfare, practices of care, such as breeding resilience, ensure that the systemic causes of ill-health go 'largely unquestioned' (Holloway et al., 2023). As Holloway et al. (2023: 1293) suggest, this makes 'relations of care troubling because they can be associated with an acceptance of harm being caused to animals'. Moreover, in managing animal disease, practices of care involve making animals 'killable' to reduce individual or collective suffering, such as the continued transmission of disease within the herd. Secondly, other relational approaches to animal disease

understand the farm as a set of heterogeneous relations that prescribes a spatio-temporal order for livestock from birth to productive life and death (Law, 2006). Maintaining the rapid temporalities of these productivist systems casts farmers as ‘fluid engineers’ (Higgins et al., 2018) who seek to prevent relations from ‘overflowing’ or breaking down in ways that reconfigure temporal orders. One way of preventing overflows such as disease outbreaks is by using standardised practices such as protocols and hygienic routines. However, the complexity of these relations is such that systems are never likely to be perfect and overflows are inevitable (Enticott and Little, 2023). Practices of accommodation – care and ‘tinkering’ (Law, 2010) – allow these systems to continue to function (Singleton and Law, 2013) as a form of ‘local universality’ (Enticott, 2012): making standardised systems workable in challenging environments using lived experience (Krzywoszynska, 2016) to guide on-going experimental practices in order to find ways of living with uncertainty (cf. Atchison, 2015). This is reliant on different practices of care in which vets and farmers care for themselves, care for their colleagues through informal learning practices, and for the herd and farmers by deploying situated judgement rather than standardised procedure. These practices of accommodation, choreographed through space *and* time (Law, 2010), show how care extends beyond its traditional understanding, and is implicated in promoting ‘ongoingness’ (Puig de la Bellacasa, 2017) – the work of sustaining and maintaining interdependencies in all their forms. In this way, as Reisman (2021: 421 emphasis in original) argues in relation to disease management, care ‘is not a solution but a perpetually open and deeply political question of *how* relational maintenance takes place ... it is a call to see the web of *relations* ... as the site of politics where the ongoingness of specific configurations of existence is negotiated’.

Efforts to reduce the use of antibiotics should therefore direct us to a consideration of the complex timescapes of livestock agriculture. Paying attention to these intersecting temporalities is essential to understand how practices of care enable the maintenance of animal health, but also the material politics of care and its inclusions and exclusions more widely. In this sense, care, like time, is not normative: it is differentiated, troubling and evolves in relation to the situation at hand. Yet, it is at these sites of contest that it is possible to witness the fluid temporalities of care, and find ways for different times to live with each other. In what follows, we explore how the future threat of AMR is folded into everyday practices of calf rearing. Rather than specific instances of AMR, we examine how its different temporalities are revealed through the on-going, quotidian practices of care which respond to its more nebulous threat by minimising antimicrobial intervention. In doing so we discuss the tensions between caring practices, who cares and how it is valued; and the fluidity that allows different temporalities to co-exist and form a paradoxical temporality, one we call ‘patient urgency’. Our analysis is based on qualitative methods that were themselves temporal in nature. Disrupted by the 2019 coronavirus disease pandemic, we conducted online interviews with 25 calf rearers in England and Wales, and a further 13 interviews with industry specialists (vets, advisers, nutritionists and equipment suppliers). Reflecting the structure of the industry, all but one of the calf rearers interviewed was female. Interviews employed a biographical narrative method to elicit descriptions through time of significant challenges and changes to calf care in the careers of calf rearers, and their evolution in relation to the threat of AMR. In developing research relations with these calf rearers, and the ebbs and flows of lockdowns, we were able to conduct participant observation on three farms where we observed the feeding of calves, and other routine calf rearing practices. This was supplemented with video ethnography in which calf rearers were asked to wear Go-Pro cameras to film practices they felt were important to maintaining calf health and preventing AMR. This technique facilitated particular insights into the temporal practices of care in absentia of researchers. Further information on the characteristics of research participants can be found in the supplementary material and in Enticott et al. (2022).

## Feeding rapid temporalities



There are two calves in the pen. To me, they look the same, with their brown and white coats, and over-sized ear tags. But Amber, their calf rearer, tunes in to subtle differences: the one on the right seems livelier than the other. She assesses whether the calf's coat is shinier, her ears more alert? The differences are made noticeable when Amber starts to feed them. Slowly, she pours a bucket of freshly mixed milk into a 'milk bar' – a large plastic trough with three rubber teats. Rather than move on to the next calves, she waits and watches. The calf on the right is straight in, sucking strongly, noisily on the teat. The other struggles: it doesn't know what to do, the teat rubbing against its mouth, but not into it. It tries to get the other calf's teat, then the spare one but with no success. Amber knows that if the calf doesn't learn to suck soon, problems will follow that could require antibiotics. She leans into the pen, offering her hand to the calf, trying to guide it into the teat. The calf is interested at first, but then wanders off, unfed, leaving Amber to ponder what to do next.

When new life emerges on farms, so it becomes enrolled into everyday practices that are partially guided by the future threat of AMR. Feeding fluids to calves – as Amber does here – is one such example, revealing the fluid temporalities of calf care and the politics of AMR. Specifically, here we refer to the practices of feeding milk to new-born calves, and pathologising of the conduct of feeding at different bodily sites and through different kinds of milk. The neonatal phase of a calf's life sees them born into the rapid timescape of bovine productivism. Calves must be carefully (but also quickly) enrolled into this timescape because their future is defined by their response to attempts to accelerate the development of their rumen. Rumen development is initially achieved by using concentrated feed (a coarse pellet known as calf starter) which stimulate microbes to allow grass and forage to be fermented within the rumen (for more details see: AHDB, Undated). The process befits the logic of productivist agriculture, replacing a calf's mother's milk as a feed source. However, as Glen a calf vet told us, the acceleration of rumen development is not easy and needs careful management:

[calves] are designed to be weaned at six months of age when they're ruminants. We're trying to turn a baby pre-ruminant ... a simple-stomached animal into a ruminant in a space of eight weeks. That takes a

lot of skill, and you need to get a lot of nutritional aspects right there. You need to feed a lot of milk, but you also need to be improving ... increasing their starch intake from day one in order to develop the rumen so that when you wean them at eight weeks, they don't suffer a setback, and that that weaning period coincides with a high risk for pneumonia.

Productivist temporalities therefore mean that the first feeds are vital to help develop a calf's immune system, as well as avert a future of AMR. The healthier the calf, the more productive and resilient it will be in later life. Pneumonia and scour, the conditions that calves are susceptible to, can have long-lasting consequences (Bartram et al., 2017) and require urgent intervention to prevent transmission within the herd. These are also conditions that antibiotics could be used to treat, particularly pneumonia which is understood to require rapid medical interventions due to the rapid speed and intensity of infection: neonatal time is therefore an urgent moment in seeking the prudent use of antibiotics and prevent the rebounding of AMR. As part of these efforts, farm advisory organisations promote the use of colostrum. Colostrum has been labelled 'liquid gold' (RUMA, 2018) because of the antibodies (immunoglobulin) it contains. As one farm advisor told us: "colostrum [is] the root of [preventing] all disease really. If the calf has not had decent colostrum, then it's going to need a lot of antibiotics to get it to adulthood" (Laura). Urgency also arises through the decreasing ability of calves to absorb immunoglobulin over time: calf rearers are advised to feed three litres in the first two hours of life, followed by a similar feed within twelve hours (AHDB, 2020). Farm assurance schemes in the United Kingdom specify that calves must be fed colostrum within six hours.

The urgency of feeding colostrum, coupled with the acceleration of weaning outlined above by Glen the calf vet, reflects an urgent productivist timescape. However, this timescape can be disrupted by undesirable more-than-human temporalities that might be bred into productivist systems. Specifically, dairy productivist systems value the genetic ability to do some things quickly – become pregnant, give birth and grow – and maximise milk production, often at the expense of health and welfare (see: Holloway et al., 2023). In block calving systems – when breeding is organised so calving ordinarily occurs *en masse* in spring and/or autumn – this rapid temporality is referred to as being 'in sync': if a cow's reproductive system fails to match the desired productivist flow, they are likely to be culled to maintain the herd's synchronicity. The consequence of these temporal orders is a transformation of bovine sensibilities in which qualities of rapid growth and adaption are bred into cows, whilst slower practices of mothering and natural feeding are bred out:

I think traditionally you would have left the calf on the cow to suckle, or maybe left the calf with a cow for a few days. But I think you're really putting a lot of faith in the mothering ability of the cow, particularly with the genetics in the Holstein's now. A lot of that mothering has been bred out of them. So, I wouldn't feel comfortable now just leaving calves just to work out how to suckle (Katherine).

there's something wrong with the Holstein breed in my view, they seem to have lost the will [to suck]. You know, they're not very ... They're not very vigorous (Pauline).

The excesses of these rapid productivist bovine sensibilities, ones contributing to rather than resolving health problems, are also witnessed at calving. Calf rearers talk of an appropriate speed at which calves should be born in which they are 'more likely to be born happy and healthy and take a good stomach full of colostrum' (Laura). By contrast, calvings that are 'too slow' (resulting from calves being born backward or with twins) or 'too quick' are associated with abnormalities such as fluid on



their lungs, or mineral deficiencies that require urgent medical intervention. Other aspects of productivism may also affect how calves are fed colostrum. Endemic diseases like paratuberculosis (known as Johne's disease) can be transmitted to calves by consuming infected colostrum. Separating calves from cows at birth may thus ensure the long-term care of the herd, and potentially reduce the antibiotic treatment of sick cows, but means that the cow's teat is off limits for calves, necessitating other feeding practices. Thus, if feeding colostrum enacts a productivist timescape, one that closely couples logics of care with concerns about AMR rebound, these bovine sensibilities present more-than-human frictions to the calf-rearing timescape.

While rearers understand the importance of feeding colostrum, they also face decisions over which colostrum to feed. The best is often thought to be straight from the mother, partly because it is readily available, perceived as natural, and provides longer term immunity that is matched to the local environment. In doing so it reduces the future need for antibiotics. However, getting this colostrum into the calf is problematic because cows' teats are pathologised as hazardous bodily sites. Their cleanliness is called into question by their living conditions, but also the use of antibiotic tubes of dry cow therapy, inserted into the teat to prevent infection in the weeks before giving birth. The danger is that if a calf does suckle, its first mouthful will be contaminated with dirt, bacteria, and antibiotic residue. As Katherine told us, the best way for a calf to get its 'fill' of colostrum is to feed the calf yourself.

Doing so, however, also requires caring for colostrum. Importantly, uncareful colostrum practices – often compromised by the urgencies and time constraints of competing on-farm temporalities – can compound or contribute to ill health. Unclean bottles, dirty buckets, or inadequately heated colostrum become vectors mobilising risky pathogens to susceptible calves. Some cows may fail to produce colostrum of sufficient quality – something common with first time mothers – whilst others can produce enough for more than one calf. Commonly, careful rearing practices mean the excess colostrum of healthy cows is frozen, stored, and defrosted for subsequent births. As such, the care of future immunity produced by healthy cows is diffused throughout the herd, and choreographed through practices enacted with multiple temporalities in mind. Alternatively, some rearers purchase colostrum powder which can be mixed with water which should, time permitting, be mixed warm. Either way, colostrum quality is important, something commonly measured and calculated by using a Brix refractometer. Reflecting Holloway et al. (2023), these temporalities of calf care can be seen to enact a biosocial collective whose geography stretches around and beyond the farm gate, incorporating humans, animals and materials.

## **Feeding protocols and patient urgency**

As a way of reigning in the productivist excesses of these bovine temporalities, calf rearers often deploy two colostrum-related feeding practices. Both practices sustain productivist timescapes but in ways that reduce the likelihood of AMR rebound. The first of these is the use of feeding protocols, such as the monitoring of colostrum quality before feeds, or at least at regular periods throughout the year. This allows calf rearers to eliminate poor quality colostrum being the cause of ill-health in growing calves. Most protocols relate to the amount of colostrum to be fed to calves, the temperature to which it should be heated, and when it should be fed. Other protocols encompass routine hygiene procedures including cleaning feeding equipment such as buckets, or sterilising rubber teats. Similarly, many calf-rearers establish protocols, often with their vets, to guide and monitor the use of medicines, whether anti-inflammatories and painkillers, or antibiotics.

The use of protocols provides a further way of standardising the timescape, choreographing behaviour and eliminating the causes of ill-health to maximise efficient productivist flows, whilst

avoiding its excesses that contribute to AMR. Implementing and following protocols therefore enacts specific practices of care that are consistent with desirable timescapes of calf rearing, and their outcomes. Here, care is not just for calves, but applies to the labour force and the reputation of the farm as a producer of strong healthy calves. For example, Michelle describes how she had won awards for her calf rearing, which had led to her selling calves to another farmer because they valued their health status. Central to this reputation within the industry was a set of protocols that were used to monitor how effectively staff cared for calves, as much as the health of calves themselves:

if someone doesn't follow the protocol, with new-born calves, for example, or with the animals and feeding, and then and then there's some kind of problem down the line, I might be able to know if someone's sort of making the record up or hasn't done it properly ... we have such high standards, for example, with cleanliness and cleaning, and our other protocols, and he [calf rearer] couldn't really go any further. He found it hard to fulfil all the expectations of the job and, it sounds really ruthless, but we had to let him go.

In this sense, Michelle's use of protocols demonstrates how care can be multi-faceted and collective, not limited to just an animal or plant, but to other people and the farm as a business. Establishing and implementing protocols in response to the threat of AMR therefore enacts a professional identity for calf rearers, and the skills they should possess such as attention to detail and thoroughness. Thus, calf rearers who do not follow such protocols or who fail to pay full attention to how they feed calves can be cast as unloving and uncaring. For example, referring to a former colleague, Amber said:

I don't think she cared about the calves as much as what we did, she kind of came in and did it as a job whereas I do it for the love of calves ... I know we had a couple of Heifers shot down at the other unit [I used to work at] because they weren't growing properly because they hadn't had the right start. So, we want to get at least four litres of colostrum into them in the first feed so she'd say she'd put four litres in and they'd still be [some left] in the bottom and she'd go oh, yeah, it's had 4 litres, take the rest away ... Whereas to me that is crucial to get that four litres in so every last bit has to go in. (Amber)

Say if it was if it was born just after milking in the morning, it wouldn't get fed till milking time in the afternoon, till four or five o'clock or six o'clock, it could be about that time until my uncle could get to it. Well, I'm like it has always got to have colostrum. You know, I'd go in if I needed to, if it was born in the middle of day I'd have to get in the parlour to go and get some milk off it. (Abbie)

Nevertheless, just as others have shown elsewhere in animal disease management (Enticott, 2012), care or tinkering (Law and Mol, 2011) is also integral to the application of protocols. This means feeding colostrum ought to be a carefully unfolding practice, rather than one that blindly follows a pre-set protocol. Whilst calf rearing protocols offer the promise of standardisation consistent with productivist timescapes, in practice, different forms of care are inherent to them. Indeed, as Andrea a calf vet pointed out, the point of protocols is not just to specify specific practices, but also explain how those practices should be performed:

If everything's organised, and they've got protocols in place, it's not to complicate things, it's actually to make things simpler so that there is no panic about, 'Oh, gosh, what do I do? Oh, how much colostrum do I give it? Oh, gosh, what am I supposed to do? Where's the milk?' You know? Everything's done in a sort of less hassly manner ... the aim is to do things in the best way possible. And the best welfare-friendly ways. And that's got to be calmly and gently (Andrea).

Careful feeding practices that go beyond the protocol draw on other skills of calf rearing, notably patience and taking time. The veterinary profession has been instrumental in ingraining the importance of feeding protocols amongst calf rearers, but there was also concern about the effects of 'becoming hooked' (Pauline) on protocols and not knowing what to do when, for example, equipment breaks. For some calf-rearers, however, feeding protocols were not set in stone and represented an object of experimentation, as shown in the following examples highlighting how calf-rearers adapt colostrum feeding practices over time, and challenge 'old' ways of rearing calves:

It's making wee tweaks to your protocols along the way. So, yeah, I mean it was four times a day and it's now just at either end as long as they take something in. You know, even if it is just a litre, it's enough to keep them hydrated to the next feed, and then hopefully they've made an improvement, that they want to drink themselves, and I think that's always quite a good sign (Fiona).

We started changing the protocol around looking after the calves and the routines of calf-rearing. For example, previously we didn't use to give new-born calves any water. I think it's because old farmers worry if they give calves water, the calves wouldn't drink the colostrum and milk so they don't want to give them water. But water is so important. And even if they drink water, they will still drink milk. Now all the calves are given water and corn in the first twelve to twenty-four hours to help them through. So, this is one of the protocols we brought in (Michelle).

These adaptations appear to be antithetical to the urgency of feeding. Instead, patience slows the farm timescape down to the times of calves. Patience enables rearers to become calf as far as possible: to develop a sensuous understanding of a calf's life and recognise through multi-sensory attunements when individual calves are 'not right'. Spending time in the calf shed watching calves play, listening to their breathing, understanding their posture, and noticing 'good and bad poo', are connected to the patient sensibilities of skilled rearing. As Lucy described:

As soon as you go in a pen of calves, they think they're going to be feed, so it's a race to the front. You will always get one, if it's poorly sat at the back and a bit slow to come, that's one sign. And maybe an ear that's slightly drooped that's another, maybe mycoplasma ... Just breathing, tifting we call it: just breathing slightly fast. And sometimes it can take you ten minutes to sit there and watch your calf because it will breathe fast and then breathe normally, and then breathe fast. Catching things like pneumonia at that stage is far better than six hours later, you know, because the damage can already be done. And yeah, smell is another along with scour. Like you can just smell that straightaway ... [it has] a real pungent like rotten smell.

The importance of patience and attention to detail therefore reveals a complicated relationship between different temporalities of farming and AMR prevention. Protocols enact both fast and slow timescapes, showing how different temporalities of care intra-act with one another on a farm. Taking care can mean engaging in slower practices, but also those associated with the urgency of productivism, or what we refer to as 'patient urgency'. As the following section shows, patient urgency is a critical skill to acute dilemmas of care, but these temporal accommodations are not without their own politics or tensions.

### **Tubing colostrum and the tensions of patient urgency**

If productivist timescapes simultaneously accommodate urgency and patience, this is not without tension. This is exposed in the second feeding practice that helps avert future threats of AMR. Tubing involves force-feeding colostrum to a calf to ensure it has the necessary volume in the

first hours of its life. Tubing may also be used to provide other fluids, such as electrolytes, to help a



Back in the calf shed, the calf has still not drunk. It's time for emergency care. Amber had been dreading this: the only way to save her now is to force feed her using a tube. She's done this before when every calf was tubed following an outbreak of rotavirus. She didn't think they liked it and worried about hurting them, but reasoned that it is for the best. Two of her colleagues are helping. One prepares a bag of colostrum, whilst Amber places the tube against the calf to gauge how far it should be inserted into oesophagus. The other holds the calf upright – it's too weak to stand. The calf is wearing a fleece jacket to keep her warm, and there's fresh bedding to give the calf the best chance of avoiding bacteria. Slowly, Amber inserts the tube to the length she had measured. Initially, the calf does not object, and the colostrum begins to pour in. But soon the calf begins to wriggle and emits a loud belch, sounding more like a sheep than a calf. Amber whispers to the calf, "it's alright, it's alright". More belching follows, the calf throwing her head upwards and sideways. Jane says she can't hold her up much longer. Just as Amber says, 'that'll do', the calf collapses onto her side and into the bedding. 'She fell' says Jane, 'I couldn't keep her up'. Amber laughs nervously, not sure whether tubing the calf will provide the care it needs or not.

calf recover from illness. In practice, tubing involves preparing a bag of colostrum (hence tubing may also be referred to as 'bagging'), gripping a calf securely between the calf rearer's legs, and then inserting a tube into the oesophagus and pouring the colostrum directly into the stomach. This is a skilled task that should be conducted by trained staff (AHDB, 2020). Dangers include inserting the tube into the windpipe and lungs, and killing a calf by drowning. In this way, tubing reflects a productivist timescape in which care is enacted as rapid and urgent, if not violent and dangerous:

I just tubed this calf like normal, and next thing it started coming out of its nose and it dropped dead ... This calf was just like choking on the floor, and I just didn't know what to do. I just stood there and I thought shit, I can't believe it. And all I could say was, it was in the right hole, I could feel it. It was in the right hole because I felt it go down, I would not have tipped the milk in if I didn't feel the thing go

through my fingers.... You feel so bloody bad because you are responsible for their life, and you've just snuffed it out in five minutes. And it was a good calf as well (Hayley).

Tubing provides urgent care as well as the ability to monitor the intake of colostrum, unlike feeding from the teat. This could also be achieved by bottle feeding, but this slows down care. Bottles must be sterilised and cleaned before their next use, all of which disturbs the flow of productivist time. Patience in bottle feeding is also required because not all calves readily take to sucking and need to be taught. As noted above, this can be attributable to poor mothering by the cow, or the fact that the calf may not have learnt to suck because they were separated at birth in order to prevent the transmission of disease. The solution to these challenges within productivist timescapes lies in tubing as part of a neonatal feeding protocol which may routinely specify tubing when calves are 'slow' following difficult births:

I have plenty of calves, especially this year, when they've had this Selenium and iodine thing and they're all very slow. And, and if they are, if we're not sure now, if we're not sure that they have drunk properly, we will just tube them automatically, that's what we'll do. And then they'll get the full bag (Hayley).

A routine reliance on tubing can be choreographed by the temporal order of the farm (Law and Lien, 2014), especially the lack of time or human labour available to constantly monitor how much colostrum has been consumed, or a desire to be present (or not) when calving occurs during the night. While some farms have individuals whose sole role is to care for calves, the marginal status of calves means that many do not or attending to them is undermined by other on-farm priorities. The wider organisation of calving contributes to this lack of time: farms that use a block calving system, or experience a glut of calvings, may routinely tube calves to help manage the workload during calving. Eleanor, for instance explained her routine approach to tubing in these terms:

So where possible, mother's milk goes to baby, and every calf gets tubed with the milk for the colostrum. Because when you've got 15 to 20 [being born] in a day, you just need to bang that colostrum in. It needs to go in as soon as possible. So, we tube just to save faffing about, and then we know that that calf has had its first couple of litres of colostrum and it's good to go. So that'll be done as soon as possible after calving ... If, you know, it's sucked from its mum, great, and it might not have that much. But generally, everything gets tubed twice before we start feeding it.

Amongst calf rearers, tubing highlights the tensions that productivist time places on care. For some, tubing should be a last resort because of the perceived pain of forcing a tube into a calf's stomach. Such a practice of care, then, can be discomfiting and distressing for both calf and rearer. At the same time, tubing's urgency enacts a future of care, providing the antibodies to fight off infection and reduce the likelihood of future antibiotic interventions. Ellen for example described this contradiction thus:

The one thing I still hate doing to this day, is to tube them. I find that pretty difficult just because the calves don't really like it, and I think they're a little bit sensitive and things like that. And, but sometimes it's got to be done because they won't drink and if they don't have a feed, then they'll get dehydrated ... It just makes me feel a bit sad because I think that I'm hurting them, and I don't want to hurt them ... but I guess it's for the greater good.

Thus, tubing provides a form of care for the calf rearer themselves, providing reassurance and peace of mind that the calf has had the best start to a healthy, resilient life. In this way, tubing can

simultaneously symbolise both good care and lack of care. Tubing ensures the calf is healthy, but the need to tube reflects the excesses of productivism (cf. Haggerty et al., 2009), and potentially the absence of time and practical skills that calf rearers should possess to care less intrusively. Being patient and paying attention to the calf – fostering ‘somatic sensibilities’ – is one way of avoiding tubing. This gives calves time to feed on their own terms by giving them a chance. Patience therefore means deviating from the rapid timescape of productivism and making exceptions to feeding protocols based on the situation at hand. Other caring materialities may also be employed to avoid tubing: calf jackets, for example, can help keep calves warm and remain healthy rather than succumbing to infections and loss of appetite that tubing may help resolve. Whilst these skills and technologies help calf rearers avoid tubing, they can also help calf rearers spot other health problems by virtue of the amount of time they can spend with them:

So as long as they’re making a little effort, they’ve obviously got a little bit of something about them wanting to get better, and forcing stuff into them just maybe isn’t the right thing to do. So, if they’re willing to take a litre, but maybe not going to drink three, at least they’ve got something on board, and nine times out of ten you go back to feed them at the next feed stage and that’s done some good (Lucy).

We take a lot longer to get them going on the bottle and the last resort is to bag them. We realise it takes a lot longer to get going, the lads are like shove the bottle in their mouth and try and get them going, if they’re not they bag them ... [And] because we’re with them all the time we spot when something’s not right, they associate us as being their mum, we’d sit there and play with them whereas the lads are like oh, come on, do some work (Amber).

As Amber notes, patience also conflicts with the productivist ideals of ‘real work’: hugging, playing and just ‘messing around’ with calves appear to have no productive value despite their role in calf health. This is the difference between protocol care, and compassionate care which involves “actually thinking about that animal as a sentient being rather than just an item, a product” (Laura, vet). This is made evident by Amber telling the calf ‘It’s alright’ as she tubes her. Indeed, talking as a practice of care is evident across calf care: when Amber walks into the shed and announces “Hi baby” to the calf, it allows her to check on their reactions. Calves also learn and recognise individual rearers, and communication with new-borns is understood as a means of cultivating mutual trust. Talking to calves often goes hand in hand with naming them which, although calf rearers suggest that they shouldn’t because of the emotional bonds it creates, allows them to learn from their reactions. These caring practices join two temporal worlds, the patient and the urgent, allowing both to live with each other, as well as assuage moral injuries caused by tubing and other acts of productivist time.

In contrast, the dismissal of patient skills reflects how care is embedded in and sustains specific forms of agrarian political economy and labour at the expense of others (Reisman, 2021). In calf care, productivist timescapes are not only difficult to change, but also choreograph the very problems that calf rearers are trying to resolve. The low priority given to calf rearing means that there is commonly neither enough time nor space to look after calves appropriately:

You find that this calf is being left in a dry cow yard, and it’s wandering around trying to find its mum, and they lick the walls, and they follow other cows which are not their mum. And by the time the farmer picks them up in the morning, they could be a bit hungry, but they ... they go off the boil a bit, they ... they’re very keen to suck as soon as they’re born, but twelve hours later, or even six hours later, they’re not. So, the suck reflex just diminishes ... You could even go mad and actually clean the cow’s udder, you know ... just put a wet wipe over their udder so that the first feed the calf gets isn’t a mouthful of muck. But people are reluctant to adopt these regimes because it takes up more space in the dry cow yard (Pauline).

If there is not enough time or space to care for calves, then as Amber alluded, this timescape is ordered by a socio-cultural timescape in which old-fashioned gendered attitudes determine what constitutes 'good farm work' (Leckie, 1996). Instead, calf rearers working with neo-natal and young calves – rather than on bespoke integrated units, for example – are frequently women who often fit rearing around their family and maternal roles and other paid work. They may be expected to return to the farm at times of crisis to rear calves, but also in doing so care for the continuity of the farm and the family (Enticott et al., 2022). In this politics of care, caring for calves cannot be optimal as it involves balancing too many competing interests. Thus, Hayley suggests that accidentally tubing a calf to death was a consequence of her being pregnant and looking after other young children whilst also managing the calves, as well as having limited time to access training to learn how to care:

It's a massive responsibility, especially when you really don't know what you're doing. Like, I don't think any of us know what we're doing, really. You just kind of like make a series of mistakes and it's like each time you don't make that mistake again, and then you make another one and you don't make that mistake again, it's, I don't know, it's quite hard work (Hayley)

Similarly, the systemic basis for tubing is evident in the material and spatial choreography of farms themselves. The legacy of productivist timescapes means that calf sheds are often far from ideal and reflects the prioritisation of productive cows in relation to unproductive calves. Whilst cows occupy the newest sheds, calves must make do with older sheds, with poor ventilation, that are not designed for calf rearing:

Some mornings you'd go in and the beds would be quite damp, even though obviously we were keeping up with the bedding, and the passageway would be quite wet, and that's just purely the rain, like the prevailing wind coming in. I mean it would hammer it with the wind and rain, and it was pretty intense. So, it was blowing in, so it was moist. It wasn't the best, really, environment for fresh air, if that makes sense. So yeah, there was moisture. I mean it was ... yeah, it was an old, old building (Sam).

Hygiene practices such as routine cleaning are compromised: resting sheds is difficult because of the need for continuous use to maintain productivist flow, meaning that bacteria cannot dissipate. Calf care is therefore directed as much to calves as it is to the infrastructure in order for it to best accommodate calves. The consequence of these productivist relations is that practices of care revolve around small incremental adaptations that calf rearers can make. In this form of making do and bricolage, old buildings become retrofitted with old materials – fences and barriers are used to create calf pens, whilst strategically placed hay bales are used to create barriers and wind breaks to help protect create appropriate ventilation for calves to prevent them succumbing to pneumonia:

We've had to put on either sheeted gates, or straw bales inside the pens. Just think of it as a big box and you basically just put a straw bale here, and they can walk around to go in behind their shelter or they can come out the front to feed. So just gives them just somewhere to keep warm, because otherwise, I know you fed them warm milk, but then if you're getting... it's like standing on a hill. If you're not moving, you're just going to get cold. So, we're just trying to give her a little bit of protection (Katie).

## The future timescapes of antimicrobial resistance

If the rapid timescapes of productivist agriculture configure how calves are cared for, tracing their politics of care to understand who benefits at the expense of others (Reisman, 2021) has important implications for attempts to foster the prudent use of antimicrobial medicines across the industry. Firstly, understanding the timescape of livestock farming exposes the systemic challenges facing attempts to reduce the use of antibiotics. The temporalities of calf rearing and the materialities and subjectivities they enact are key to understanding these systemic challenges. Thus, calf rearing can frequently find itself in tension with an ‘old’ or ‘aging’ temporality: it has been beset by traditional cultural attitudes that it is not productive work, and therefore of limited value. These politics of care are reflected in the way calf rearing is perceived to be women’s work, and which can be organised around other maternal and labour roles. Similarly, this old temporality is reflected in the make-shift buildings and facilities calf rearers must often work with. This does not mean that it is the same across all farms, or that new technologies, practices and labour conditions are not being developed and used by calf rearers. Rather, shifts in the cultural timescape of calving are taking shape at different pace on different farms resulting in a differentiated geography of calf care.

Whilst the temporalities of calf rearing come to sustain productivist farming, they have consequences for calf care and AMR: insufficient time is available to care appropriately for calves, the skills of patience and attention to detail are constantly under pressure, and the availability of training opportunities is inadequate. These systemic challenges pose a key problem for the AMR agenda (cf. Bellet, 2018). On the one hand, farming timescapes create conditions in which the use of antibiotics is inevitable: they enact fragile relationships of care that are easily broken by the absence of time and presence of past times. In these systems, the use of antibiotics is therefore a ‘normal accident’ (Perrow, 1999); an overflow waiting to happen (Law, 2006). On the other hand, attempts to encourage behavioural change in relation to AMR on farms conceptualise change as a matter of communication with ‘farmers’ (Bard et al., 2022) and/or the adoption of new technologies. As we have shown, technological solutions like tubing do not address systemic challenges, rather they seek to strengthen existing systems enacting a technoscience future temporality of hope (Puig de la Bellacasa, 2015). Yet, adding new materialities to old systems makes them more complex, more vulnerable and more likely to overflow (Perrow, 1999). At the same time, these methods fail to reflect the complex relations that comprise farming timescapes. Indeed, as other research on calf rearing and animal health demonstrates, systemic change is emotionally driven (Bassi et al., 2019) or by other social factors in the family (such as succession) (Enticott et al., 2022; Sutherland et al., 2012), rather than a simple response to communicative stimuli. Thus, in understanding farming timescapes, we suggest for AMR initiatives to be successful, attention is turned to these systemic challenges, rather than the future timescapes of technology.

Secondly, the timescapes of calf rearing provide insight into the constitution and nature of care in agriculture. Care in calf rearing is similar to other agricultural practices. As in soil management (Krzywoszynska, 2019; Puig de la Bellacasa, 2015), care in calf rearing is marked by distinct but intersecting temporal practices: of slow, patient care versus fast, technoscience care. Similarly, as in the management of animal health (Singleton and Law, 2013), so in calf rearing is care reflected in the patchwork, bricolage tinkering practices of retrofitting and adaption of calf sheds to ensure that systems work. And, just as (Reisman, 2021: 404) notes, care is multi-faceted, going beyond simply eliminating bacterial pathogens, and focuses on ‘a politics of relational maintenance: what relations are being sustained, and to what ends?’. As the calf rearers in this study revealed, their care was constituted by the relations of political economy and their related timescapes. Thus, whilst their care was focused on calves, where was the care for calf rearers: who cared for them? Their references to lack of time, being fearful of making mistakes whilst juggling over responsibilities, and their use of tubing to make themselves as well as the



calf feel better, point to an absence of care for them. Moreover, calf rearers expressed care not just for the calves, but also through their multiple roles as care givers for the farming family and farm.

At the same time, in following the relations of care in farming timescapes, it is also possible to see tensions between different temporalities of care, but which can nevertheless be accommodated within an overall timescape. The dominant timescape of productivist agriculture and its excesses that lead to AMR emphasise speed, efficiency and urgency. Protocols and feeding technologies like tubing seek to enact this timescape whilst also seeking to avoid the rebounding risks of AMR. It is easy to put this caring temporality in opposition to the slower skills of patience and attention to detail. Yet, this is not an easy opposition, rather these different temporalities find themselves as part of the same system. Caring temporalities are neither fast or slow, but both, the balance of which changes in context and the situation at hand. Thus, the prudent usage of anti-microbials was commonly associated by our rearers as relating to patience, time and waiting; as well as being attentive enough to respond when necessary. Conversely, responding to infection, particularly something with its own rapid temporalities (such as pneumonia) requires urgency, but an urgency that comes from patience: spending time and noticing symptoms, or listening to the calves and picking up on wheezing or a cough. Crucial to the attempts to encourage the prudent use of antibiotics is, therefore, the development of these different temporal sensibilities – what we have referred to as ‘patient urgency’ –, the recognition and accommodation of the tensions between competing temporalities, and finding ways for calf rearers to experiment and find the balance between them.

Finally, Haraway (2008) suggests that recognising the presence of care in unlikely settings (such as laboratories) is important in developing an ethics of care and ‘response-ability’ through slower practices such as attention and patience. Whilst there may be similarities between the ethics of care in laboratories and productivist farms (Greenhough and Roe, 2011: 55), a final question our research raises is why are these ethics of care found on some farms and not others? What stimulates their presence? The experimentation with protocols to avoid tubing was not present on all farms. Similarly, where tubing protocols were present, tubing could be conducted reluctantly with calf rearers concerned about the reasons for its use. This signifies the presence of a different range of farming timescapes and affective atmospheres that are important to understand in attempts to manage AMR. Previous studies of AMR in farming and calf care either focus solely on intensive agriculture (Helliwell et al., 2020) or fail to differentiate between different farming systems (Palczynski et al., 2022). Paying greater attention to the differentiated evolution of the timescapes of care – or care-full timescapes – may therefore help understand the breeding of patient urgency – and other temporal tensions and accommodations – that are better placed to ensure responsible calf care.

## Conclusion

To ask how to feed a calf is to ask, what is it to care in livestock agriculture? Feeding calves enacts the timescapes of modern livestock farming, reminding us of its excesses and rebounding risks. Promoting the use of colostrum to reduce the use of antibiotics asserts a timescape in which feeding is configured by standardisation, consistency, and urgency. Feeding practices such as tubing entrench productivist temporalities, enacting urgent care as a means to ensure the productivist flow of calf to cow in the smoothest way possible. At the same time, feeding colostrum symbolises temporal fluidity: urgent feeding practices can give way to slower, patient and situated practices of care that have been developed in situ (Hinchliffe et al., 2021). In this way, different caring temporalities come to co-exist as ‘patient urgency’, making protocols workable, and performing care for calf rearers themselves by allowing them to live with the emotional and practical demands of agricultural work. In doing so, understanding the timescapes of calf rearing highlights how the reduction of AMR may be less about individual actions, and more about the material, social

and biological relations that configure them. If calf rearers are defined by attention to detail and patience, then so should efforts to contain AMR pay attention to systemic practices that have become embedded and require longer term change (Bellet, 2018). The cultural status of calves and calf rearers, the genetic evolution of bovids, and their material living conditions all demand attention. Thus, if feeding calves is to understand care within livestock farming, then it is to also direct attention to what sustains systems of agriculture, and how best to repair them.

## Highlights

- Livestock care on farms is configured by different temporal orders known as a timescape.
- Urgent temporalities specify productivist technologies to reduce the use of anti-microbial medicines
- Patient temporalities specify slower embodied and situated practices to prevent disease outbreaks
- In livestock farming, these different temporalities co-exist within agricultural timescapes rendering time as fluid.
- The concept of “Patient Urgence” is developed to show how discordant temporal orders are accommodated in farm animal care.

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## Supplemental material

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## References

- Adam B (1998) *Timescapes of Modernity. The Environment and Invisible Hazards*. London: Routledge.
- AHDB (2020) *Calf Management*. Stoneleigh: AHDB.
- AHDB (Undated) Rumen development in dairy calves. Available at: <https://ahdb.org.uk/knowledge-library/rumen-development-in-dairy-calves> (accessed 9th October, 2023).
- Allen J and Lavau S (2014) ‘Just-in-Time’ disease. *Journal of Cultural Economy* 8(3): 342–360.
- Anderson A and Hobson-West P (2023) Animal research, ethical boundary-work, and the geographies of veterinary expertise. *Transactions of the Institute of British Geographers* 48(3): 491–505.
- Anderson B (2010) Preemption, precaution, preparedness: Anticipatory action and future geographies. *Progress in Human Geography* 34(6): 777–798.

- Atchison J (2015) Experiments in co-existence: The science and practices of biocontrol in invasive species management. *Environment and Planning A* 47(8): 1697–1712.
- Bard AM, Main DCJ, Haase AM, et al. (2022) Veterinary communication can influence farmer change talk and can be modified following brief motivational interviewing training. *PLoS ONE* 17(9): e0265586.
- Bartram DJ, Hogan C and Penny CD (2017) Estimating the lifetime total economic costs of respiratory disease in beef and dairy calves in the UK. *Value in Health* 20(9): A643.
- Bassi EM, Parkins JR and Caine KJ (2019) Situating emotions in social practices: Empirical insights from animal husbandry in the cow-calf industry. *Sociologia Ruralis* 59(2): 275–293.
- Bellet C (2018) Change it or perish? Drug resistance and the dynamics of livestock farm practices. *Journal of Rural Studies* 63: 57–64.
- Brice J (2014) Attending to grape vines: Perceptual practices, planty agencies and multiple temporalities in Australian viticulture. *Social and Cultural Geography* 15(8): 942–965.
- Broom A and Doron A (2022) Resistant bugs, porous borders and ecologies of care in India. *Social Science and Medicine* 292: 114520.
- Broz L, Arregui AG and O'Mahony K (2021) Wild boar events and the veterinarianization of multispecies coexistence. *Frontiers in Conservation Science* 2.
- Cusworth G (2023) Metabolic agricultural ethics: Violence and care beyond the gate. *Progress in Environmental Geography* 2(1–2): 58–76.
- Ellis R (2022) Social reproduction, playful work, and bee-centred beekeeping. *Agriculture and Human Values* 39(4): 1329–1340.
- Enticott G (2012) The local universality of veterinary expertise and the geography of animal disease. *Transactions of the Institute of British Geographers* 37(1): 75–88.
- Enticott G and Little R (2023) (Dis)Entangling livestock marketplaces: Cattle purchasing, fluid engineering and market displays. *Environment and Planning E: Nature and Space* 6(3): 2029–2046.
- Enticott G, O'Mahony K, Shortall O, et al. (2022) 'Natural born carers'? Reconstituting gender identity in the labour of calf care. *Journal of Rural Studies* 95: 362–372.
- Franklin A, Udall D, Schmutz U, et al. (2021) 'Hell or high water': Good farming and environmental care as contested practices in the implementation of nitrate vulnerable zones in Wales. *Journal of Rural Studies* 83: 146–154.
- Gibbs L (2020) Animal geographies II: Killing and caring (in times of crisis). *Progress in Human Geography* 45(2): 371–381.
- Giraud E and Hollin G (2016) Care, Laboratory Beagles and Affective Utopia. *Theory, Culture & Society* 33(4): 27–49.
- Greenhough B and Roe E (2011) Ethics, space, and somatic sensibilities: Comparing relationships between scientific researchers and their human and animal experimental subjects. *Environment and Planning D: Society and Space* 29(1): 47–66.
- Haggerty J, Campbell H and Morris C (2009) Keeping the stress off the sheep? Agricultural intensification, neoliberalism, and 'good' farming in New Zealand. *Geoforum; Journal of Physical, Human, and Regional Geosciences* 40(5): 767–777.
- Haraway D (2008) *When Species Meet*. London: University of Minneapolis Press.
- Haraway D (2016) *Staying with the Trouble: Making Kin in the Chthulucene*. Durham, NC: Duke University Press.
- Helliwell R, Morris C and Jones S (2022) Assembling antimicrobial resistance governance in UK animal agriculture. *Sociologia Ruralis* 62: 587–610.
- Helliwell R, Morris C and Raman S (2019) Can resistant infections be perceptible in UK dairy farming? *Palgrave Communications* 5(1): 12.
- Helliwell R, Morris C and Raman S (2020) Antibiotic stewardship and its implications for agricultural animal-human relationships: Insights from an intensive dairy farm in England. *Journal of Rural Studies* 78: 447–456.
- Henry M, Rosin C and Edwards S (2022) Governing taste: Data, temporality and everyday kiwifruit dry matter performances. *Agriculture and Human Values* 40: 519–531.

- Higgins V, Bryant M, Hernández-Jover M, et al. (2018) Devolved responsibility and on-farm biosecurity: Practices of biosecure farming care in livestock production. *Sociologia Ruralis* 58(1): 20–39.
- Hinchliffe S, Allen J, Lavau S, et al. (2013) Biosecurity and the topologies of infected life: From borderlines to borderlands. *Transactions of the Institute of British Geographers* 38(4): 531–543.
- Hinchliffe S, Bingham N, Allen J, et al. (2016) *Pathological Lives: Disease, Space and Biopolitics*. Oxford: Wiley Blackwell.
- Hinchliffe S, Butcher A and Rahman MM (2018) The AMR problem: Demanding economies, biological margins, and co-producing alternative strategies. *Palgrave Communications* 4(1): 142.
- Hinchliffe S, Butcher A, Rahman MM, et al. (2021) Production without medicalisation: Risk practices and disease in Bangladesh aquaculture. *Geographical Journal* 187(1): 39–50.
- Holloway L, Mahon N, Clark B, et al. (2023) Living with cows, sheep and endemic disease in the North of England: Embodied care, biosocial collectivities and killability. *Environment and Planning E: Nature and Space* 6(2): 1278–1298.
- Kirchhelle C (2018) Pharming animals: A global history of antibiotics in food production (1935–2017). *Palgrave Communications* 4(1): 96.
- Krzywoszyńska A (2016) What farmers know: Experiential knowledge and care in vine growing. *Sociologia Ruralis* 56(2): 289–310.
- Krzywoszyńska A (2019) Caring for soil life in the anthropocene: The role of attentiveness in more-than-human ethics. *Transactions of the Institute of British Geographers* 44(4): 661–675.
- Law J (2006) Disaster in agriculture: Or foot and mouth mobilities. *Environment and Planning A* 38(2): 227–239.
- Law J (2010) Care and killing. Tensions in veterinary practice. In: Mol A, Moser I and Pols J (eds) *Care in Practice. On Tinkering in Clinics, Homes and Farms*. Bielefeld: Transcript Verlag, pp.57–71.
- Law J, Lien ME (2014) Animal architectures. In: Harvey P, Casella E, Evans G, et al. (eds) *Objects and Materials*. London: Routledge, pp.329–337.
- Law J and Mol A (2011) Veterinary realities: What is foot and mouth disease? *Sociologia Ruralis* 51(1): 1–16.
- Leckie GJ (1996) ‘They never trusted me to drive’: Farm girls and the gender relations of agricultural information transfer. *Gender, Place & Culture* 3(3): 309–326.
- May J and Thrift N (2003) *Timespace: Geographies of Temporality*. London: Routledge.
- Mee JF (2013) Why do so many calves die on modern dairy farms and what can we do about calf welfare in the future? *Animals* 3(4): 1036–1057.
- Mincytė D, Bartkienė A and Bikauskaitė R (2020) Diverging temporalities of care work on urban farms: Negotiating history, responsibility, and productivity in Lithuania. *Geoforum; Journal of Physical, Human, and Regional Geosciences* 115: 44–53.
- Mol A (2008) *The Logic of Care: Health and the Problem of Patient Choice*. London: Routledge.
- Morris C and Holloway L (2014) Genetics and livestock breeding in the UK: Co-constructing technologies and heterogeneous biosocial collectivities. *Journal of Rural Studies* 33: 150–160.
- O’Mahony K (2022) Inhabiting forest of dean borderlands: Feral wild boar and dynamic ecologies of memory and place. *Emotion, Space and Society* 45: 100902.
- O’Neill J (2016) *Tackling Drug-Resistant Infections Globally: Final Report and Recommendations*. London: HM Government.
- Palczynski LJ, Bleach ECL, Brennan ML, et al. (2022) Youngstock management as “The key for everything”? Perceived value of calves and the role of calf performance monitoring and advice on dairy farms. *Frontiers in Animal Science* 3.
- Perrow C (1999) *Normal Accidents: Living with High Risk Technologies*. Princeton, NJ: Princeton University Press.
- Phillips C (2020a) The force of varroa: Anticipatory experiences in beekeeping biosecurity. *Journal of Rural Studies* 76: 58–66.
- Phillips C (2020b) Telling times: More-than-human temporalities in beekeeping. *Geoforum; Journal of Physical, Human, and Regional Geosciences* 108: 315–324.
- Puig de la Bellacasa M (2010) Matters of care in technoscience: Assembling neglected things. *Social Studies of Science* 41(1): 85–106.

- Puig de la Bellacasa M (2015) Making time for soil: Technoscientific futurity and the pace of care. *Social Studies of Science* 45(5): 691–716.
- Puig de la Bellacasa M (2017) *Matters of Care. Speculative Ethics in More Than Human Worlds*. Minneapolis: University of Minnesota Press.
- Reisman E (2021) Plants, pathogens, and the politics of care: *Xylella fastidiosa* and the intra-active breakdown of Mallorca's Almond Ecology. *Cultural Anthropology* 36(3): 400–427.
- RUMA (2018) #COLOSTRUMISGOLD CAMPAIGN AIMS TO SLASH ANTIBIOTIC USE. Available at: <https://www.ruma.org.uk/colostrumisgold-campaign-aims-slash-antibiotic-use/> (accessed 17 December, 2022).
- RUMA (2020) *Targets Task Force Report 2020: Responsible use of Antibiotics in UK Farming. Progress Against 2020 Targets. New Targets 2021–2024*. London: RUMA.
- Singleton V and Law J (2013) Devices as rituals. *Journal of Cultural Economy* 6(3): 259–277.
- Sutherland L-A, Burton RJF, Ingram J, et al. (2012) Triggering change: Towards a conceptualisation of major change processes in farm decision-making. *Journal of Environmental Management* 104: 142–151.
- Vaarst M and Sørensen JT (2009) Danish dairy farmers' perceptions and attitudes related to calf-management in situations of high versus no calf mortality. *Preventive Veterinary Medicine* 89(1): 128–133.
- Van Boeckel TP, Brower C, Gilbert M, et al. (2015) Global trends in antimicrobial use in food animals. *Proceedings of the National Academy of Sciences* 112(18): 5649–5654.
- Wang CM (2022) Securing the pig farmgate? Biosecurity, affects and pathological atmospheres. *Transactions of the Institute of British Geographers* 47(4): 1152–1164.