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Antimicrobial Stewardship at the Point of Veterinary Decision-Making: Integrating Diagnostic Certainty, Time-to-Harm, Host Vulnerability, Treatment Burden, Resistance Risk, and Reassessment Into Clinically Defensible Prescribing

Hans Müller[1]*, Anna Schmidt[1], Thomas Weber[2]

[1]Department of Veterinary Antimicrobial Stewardship and Clinical Pharmacology, Faculty of Veterinary Medicine, University of Bonn, Bonn, Germany.
[2]Department of Veterinary Infectious Diseases and Diagnostic Medicine, Faculty of Veterinary Medicine, LMU Munich, Munich, Germany.

***E-mail** ✉ hans.mueller@uni-bonn.de

ABSTRACT

Veterinary antimicrobial prescribing frequently requires action before all relevant uncertainties are resolved. Decisions must reconcile the probability that bacterial disease is present, the consequences of delaying effective therapy, host vulnerability, infection-site pharmacology, treatment feasibility, and the wider resistance implications of antimicrobial exposure. Existing stewardship guidance addresses many of these considerations, but they are often encountered as separate recommendations rather than as a unified point-of-care decision problem. This original non-empirical article develops a proposed multidimensional stewardship architecture for clinically defensible prescribing across companion-, farm-, and mixed-animal practice. The synthesis treats diagnostic certainty, time-to-harm, host vulnerability and disease severity, expected antimicrobial exposure at the infection site, treatment burden and practical feasibility, and individual-versus-population resistance risk as analytically distinct but interacting domains. It further argues that empirical treatment should be considered a revisable state rather than a terminal decision, with culture, susceptibility, clinical response, and new diagnostic information capable of supporting continuation, modification, de-escalation, escalation, or discontinuation. The architecture deliberately avoids converting heterogeneous evidence into an unsupported numerical score. Instead, it emphasizes noncompensatory constraints, conditional strategies, explicit uncertainty, and mandatory reassessment. Its intended contribution is conceptual organization rather than prospective prediction or proof of improved clinical, welfare, or public-health outcomes. Validation will require disease-, species-, and setting-specific prospective testing, attention to diagnostic access and treatment feasibility, and evaluation of both animal-level outcomes and stewardship consequences.

Keywords: Antimicrobial stewardship, Veterinary prescribing, Diagnostic uncertainty, Antimicrobial resistance, Treatment reassessment, One Health

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Introduction

Veterinary antimicrobial prescribing is often framed as a choice of agent once infection is suspected, yet the point-of-care decision is broader. Companion-animal veterinarians report weighing interacting considerations when choosing drug, dose, and duration, including clinical presentation, expected pathogen, antimicrobial properties, practical administration, and stewardship concerns [1]. The problem is therefore not simply whether an antimicrobial has activity, but whether treatment is justified now, in this animal, at this site, under the available evidence and practical constraints.

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Stewardship guidelines can structure this reasoning, but international survey data show heterogeneous awareness and use, and guideline access does not eliminate variation in prescribing practice [2]. Treatment is also implemented through owners or animal keepers: communication preferences, trust, and practical capacity can influence whether a prescribed regimen is actually workable [3]. At the same time, decisions about highly important antimicrobials extend beyond the immediate animal because expert consensus frameworks explicitly incorporate broader stewardship and One Health considerations [4].

This article therefore proposes a decision architecture that keeps six domains separate long enough to adjudicate them: diagnostic certainty, time-to-harm without effective treatment, host vulnerability and disease severity, infection site and expected exposure, treatment burden and feasibility, and individual benefit versus population-level resistance risk. Reassessment is treated as a temporal requirement across all domains. The aim is not to create a universal score, but to make the logic of defensible prescribing explicit, revisable, and testable.

Why veterinary antimicrobial decisions are multidimensional

A stewardship decision can be clinically inappropriate even when one component appears favorable. A plausible pathogen does not establish that antimicrobial treatment is needed; an in-vitro susceptible isolate does not establish adequate exposure at the disease site; and an effective drug may remain impractical if administration cannot be achieved reliably. Conversely, low diagnostic certainty may be tolerable when the consequence of waiting is small, but much less tolerable when deterioration could be rapid.

Taken together, contemporary studies show that veterinary prescribing is not reducible to a single microbiological variable but is embedded in broader clinical, informational, and relational contexts [1–3]. This creates a noncompensatory problem: strength in one domain cannot always offset failure in another. For example, caregiver convenience cannot compensate for a weak indication, whereas severe illness may justify empirical treatment before diagnostic certainty is complete.

The proposed architecture therefore distinguishes evidence domains before integrating them. This separation also protects against category errors: stewardship is not synonymous with antimicrobial avoidance, and clinical urgency is not synonymous with bacterial certainty. The decision question is whether the expected benefit of a particular strategy is defensible under the current evidence, constraints, and foreseeable harm of error, with an explicit plan for updating the decision as information changes.

Diagnostic certainty and pathogen plausibility

Diagnostic certainty begins with a clinical question: how plausible is bacterial disease as the explanation for the observed syndrome? Microbiological evidence can increase or decrease that plausibility, but its interpretation is conditional. Veterinary diagnostic laboratories do not always apply antimicrobial susceptibility breakpoints uniformly, and valid interpretation can depend on organism, species, drug, dose, and infection site [5]. A categorical susceptibility result should therefore be treated as one evidential component rather than as a self-sufficient treatment mandate.

Diagnostic timing also matters. Rapid 16S rRNA nanopore sequencing in suspected bovine mastitis demonstrated that clinically relevant organism identification can be available substantially earlier than conventional workflows in a defined setting [6]. The stewardship value of such information, however, depends on whether the animal can safely wait and whether the result changes the treatment decision.

Feasibility further constrains diagnostic-first strategies. Work with Irish dairy farmers and veterinarians shows that acceptance of animal-health testing depends on usability, workflow, perceived value, and practical requirements [7]. Accordingly, the proposed architecture treats diagnostic certainty as dynamic rather than binary. It can rise, fall, or remain unresolved as clinical progression, sampling quality, laboratory interpretation, and new information alter pathogen plausibility.

Urgency and time-to-harm without effective treatment

The cost of waiting is not constant across veterinary patients. Respiratory disease guidance for dogs and cats distinguishes presentations in which suspected bacterial involvement, systemic illness, or disease severity may justify antimicrobial treatment from conditions in which antimicrobials are not routinely indicated [8]. The relevant stewardship question is therefore not only “How certain is infection?” but also “What is the likely harm if effective treatment is delayed while uncertainty is reduced?”

Emergency and critical-care practice makes this tension particularly visible because antimicrobials may be started before diagnostic certainty is complete when clinicians judge that delay could be consequential [9]. Yet critical illness itself does not prove bacterial disease, and urgency should not erase the need for diagnostic sampling, exposure reasoning, or later reassessment.

At the opposite end of the spectrum, companion-animal veterinarians describe deliberate decisions to withhold or delay antimicrobials when perceived bacterial need is low and the animal can be observed safely [10]. The architecture therefore treats time-to-harm as a conditional decision variable, not a universal clock. Immediate therapy becomes more defensible as the expected harm of delay rises; diagnostic-first or delayed strategies become more defensible when deterioration is unlikely, monitoring is reliable, and a clear trigger for reassessment exists.

Host vulnerability and disease severity

Two animals with similar diagnostic uncertainty may warrant different actions because their capacity to tolerate delay differs. Host vulnerability includes the clinically relevant features that alter the consequence of undertreatment: physiological reserve, disease severity, systemic involvement, recurrence or chronicity, and concurrent conditions that may narrow the margin for observation. The evidence supports severity-sensitive treatment reasoning in respiratory and emergency settings [8], while critical-care prescribing patterns illustrate how perceived risk changes empirical decisions [9].

Vulnerability should not be converted into an unvalidated universal score. Species, age, immune status, production stage, comorbid disease, welfare implications, and the feasibility of close monitoring can matter differently across syndromes and settings. What the architecture adds is a distinct question: if bacterial disease is present, how vulnerable is this animal to harm before effective treatment can be established?

This distinction prevents two opposite errors. High vulnerability should not be used to claim bacterial certainty where none exists; instead, it may lower the acceptable threshold for temporary empirical treatment while diagnostics proceed. Low vulnerability should not be equated with “no treatment”; it may simply permit a longer diagnostic window. Host vulnerability therefore modifies the acceptable uncertainty and timing of action, while remaining subject to reassessment as clinical severity changes.

Infection site and expected antimicrobial exposure

A microbiologically active drug is clinically meaningful only if an appropriate exposure can be achieved where disease is occurring. Veterinary PK/PD scholarship emphasizes that antimicrobial activity depends on the relationship among dose, disposition, organism susceptibility, and the relevant pharmacodynamic target [11]. Site therefore changes the interpretation of both susceptibility and regimen adequacy.

Urinary disease illustrates why diagnosis and site cannot be separated. Companion-animal UTI guidance distinguishes clinically meaningful infection from states such as subclinical bacteriuria and links sampling, culture, recurrence, and treatment decisions to the clinical syndrome [12]. A positive culture alone is not equivalent to a treatment indication. Dermatologic disease provides a different boundary: the depth and extent of pyoderma influence whether topical, systemic, or combined approaches are defensible, and resistance concerns cannot be interpreted independently of disease localization and severity [13].

The proposed architecture therefore asks two sequential questions: is there a clinically relevant infection at the identified site, and is the proposed regimen expected to produce an interpretable exposure there? Discordance between laboratory susceptibility and plausible target-site exposure should reduce confidence rather than be averaged away.

Table 1 separates the clinical evidence for infection from the exposure question created by each site, so that susceptibility is not mistaken for either diagnosis or deliverability.

Table 1. How infection site separates clinical indication, achievable exposure, and the least-burdensome defensible route

Clinical site or syndrome	Evidence needed to establish clinical relevance	Exposure question	Least-burdensome defensible approach	Misclassification to avoid
Symptomatic lower urinary tract infection	Compatible signs plus an interpretable culture	Can the regimen achieve relevant urinary exposure?	Treat with a site-appropriate regimen when infection is supported	Treating culture positivity alone as the indication
Bacteriuria without compatible disease	A matching clinical syndrome is absent	Exposure may be achievable but unnecessary	Observe unless the clinical state changes or a bounded host-specific reason emerges	Equating microbial recovery with disease

Superficial skin disease	Localized superficial lesions and compatible clinical assessment	Can local exposure address the involved tissue?	Prefer the least burdensome effective route	Managing superficial disease as though it were deep infection
Deep or extensive pyoderma	Deep or widespread disease with diagnostic support	Is adequate systemic exposure plausible for the organism and site?	Consider systemic therapy within a site- and organism-specific plan	Assuming route and regimen are independent of depth and susceptibility
Susceptible isolate with uncertain site exposure	Clinical infection and target site remain incompletely linked	In-vivo adequacy is unresolved despite the in-vitro category	Reconsider dose, regimen, or the treatment rationale	Equating susceptibility with effective target-site exposure

Treatment burden and practical feasibility

A clinically appropriate antimicrobial plan can fail if it cannot be delivered. Treatment burden includes dosing frequency, route, duration, handling requirements, adverse-effect monitoring, caregiver or farmer capacity, financial cost, and the opportunity cost of repeated visits or diagnostics. Owner-focused evidence shows that communication, trust, and understanding influence how antimicrobial decisions are received and enacted [3]. In farm settings, diagnostic tools likewise require compatibility with routine workflow and perceived usefulness if they are to shape treatment decisions [7].

Feasibility belongs inside stewardship reasoning but should not dominate it. Convenience can help choose among clinically defensible options; it cannot create an indication where the probability of bacterial disease is too low. Similarly, a cheaper or easier regimen is not necessarily the better stewardship choice if it sacrifices expected exposure, narrows the opportunity for reassessment, or encourages unnecessarily broad antimicrobial use.

The proposed architecture therefore treats treatment burden as a constraint on implementable benefit. A theoretically optimal regimen that is unlikely to be administered correctly may provide less real-world value than a feasible alternative with adequate expected exposure. Where no feasible option preserves the required clinical standard, the problem should be recognized explicitly as a constraint requiring adaptation, additional support, or a change in management strategy rather than concealed within the drug choice.

Individual benefit versus population-level resistance risk

Stewardship becomes most difficult when the action most convenient for an individual animal is not automatically the action that best limits unnecessary antimicrobial exposure. Selective dry-cow therapy provides a useful empirical analogue: commercial-herd studies have evaluated reductions in antimicrobial use alongside udder-health, production, and culling outcomes rather than treating reduced use as sufficient success [14]. This matters because stewardship cannot be ethically or clinically reduced to minimizing prescriptions.

Evidence also indicates that selective strategies can remain workable across studied milk-production strata, although such findings do not establish that production level is irrelevant in every herd or management system [15]. Reviews of selective treatment for clinical mastitis similarly support targeting antimicrobials to cases most likely to benefit while preserving explicit eligibility and monitoring conditions [16].

The proposed architecture therefore treats resistance risk as a population-level constraint that must be reconciled with, rather than substituted for, expected individual benefit. The strongest stewardship decision is not necessarily "do not treat," but "use the narrowest, most evidence-defensible exposure compatible with timely animal benefit." Selective dairy strategies illustrate this conditional reconciliation under defined management conditions [14–16]. Transfer to companion- or mixed-animal practice requires caution because disease prevalence, caregiver roles, diagnostic access, and consequences of treatment failure differ substantially across settings.

Immediate therapy, delayed therapy, and diagnostic-first strategies

Immediate treatment is most defensible when bacterial disease is plausible and the expected harm of waiting is high. Delayed therapy fits stable cases with reliable monitoring, while diagnostic-first management fits cases in which timely testing can meaningfully discriminate likely benefit before important harm occurs.

Selective dry-cow therapy illustrates how explicit selection algorithms can replace automatic blanket antimicrobial exposure in defined herd settings [17]. Biological monitoring remains necessary because reducing antimicrobial exposure can coincide with changes in udder-health or microbiological outcomes that require interpretation rather than assumption [18]. Implementation fidelity also matters: early-adopter dairy experience

shows that a selective strategy can be undermined when the management conditions on which it depends are not followed consistently [19].

Table 2 compares the timing strategies directly, showing that each requires a different clinical configuration, safeguard, and event that reopens the decision.

Table 2. Four antimicrobial timing strategies compared by the clinical conditions and safeguards that make each defensible

Decision criterion	Immediate therapy	Delayed therapy	Diagnostic-first	Selective herd treatment
Clinical configuration	Plausible bacterial disease with high expected harm from delay	Stable case with low immediate risk	A timely test can discriminate benefit before important harm	Defined herd context with explicit eligibility criteria
What makes it defensible	Severity or vulnerability narrows the safe diagnostic window	Reliable monitoring preserves the option to start treatment	Turnaround and sample quality make the result actionable	Protocolized selection can replace blanket exposure
Condition that makes it unsafe or invalid	Urgency is allowed to substitute for bacterial plausibility	Follow-up or caregiver monitoring is unreliable	Testing delays necessary treatment or cannot answer the clinical question	Eligibility or implementation conditions are not maintained
Minimum safeguard	Obtain diagnostics when feasible and define the review condition	Predetermine deterioration triggers and access to reassessment	Interpret the result in syndrome and site context	Audit biological outcomes and protocol fidelity

A proposed multidimensional stewardship architecture

The proposed architecture treats point-of-care prescribing as conditional adjudication rather than additive scoring. Six evidence domains enter the decision separately: diagnostic certainty; time-to-harm; host vulnerability and disease severity; infection site and expected exposure; treatment burden and feasibility; and individual benefit versus population-level resistance risk. None is assigned a universal numerical weight.

Three noncompensatory boundaries organize the architecture: convenience cannot repair a weak indication; urgency may justify temporary empirical action without creating diagnostic certainty; and in-vitro susceptibility cannot compensate for implausible infection or inadequate expected exposure. Delayed and diagnostic-first pathways remain available when the animal can safely tolerate additional information gathering [10]. Selective treatment evidence in dairy practice shows that antimicrobial reduction is most defensible when eligibility and monitoring conditions remain explicit [16].

The central output is therefore a revisable prescribing state: treat now, delay with safeguards, pursue diagnostics before treatment, or withhold while monitoring. Movement among states is proposed to occur when new evidence changes one or more domains. The figure compresses this logic while preserving the distinction between evidence-informed inputs and the article's proposed cross-domain adjudication **(Figure 1)**.

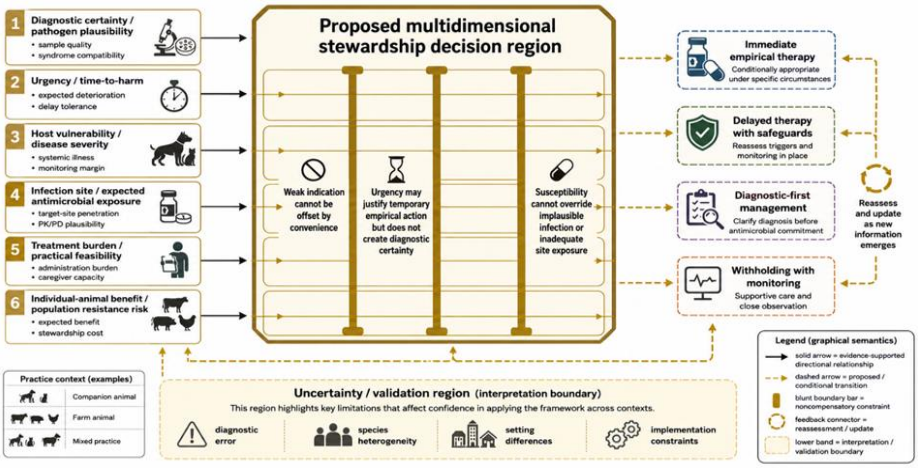

Figure 1. Clinically defensible prescribing emerges where urgency, infection plausibility, exposure, feasibility, and resistance constraints remain jointly visible

Empirical treatment as a revisable state

Empirical therapy is frequently necessary because treatment decisions precede complete microbiological certainty. Stewardship weakens when that provisional choice becomes inertial. An institutional companion-animal study found that non-adherence to antimicrobial guidance often involved absent culture/susceptibility testing or use of unnecessarily high-tier agents, supporting the need to revisit initial choices when additional evidence can be obtained [20].

Practice systems also influence reassessment. A large-scale companion-animal stewardship evaluation showed that practice-level implementation does not automatically produce uniform prescribing change [21]. Prescribing feedback can make treatment behavior visible and revisable, although durable effects should not be assumed [22]. The architecture therefore defines empirical treatment as a temporary state with an explicit review condition. At initiation, the clinician should identify what would justify continuation, narrowing, escalation, shortening, or discontinuation, making reassessment part of the original prescription logic. The concept is proposed; the selected evidence supports the importance of culture, guidelines, and feedback but does not validate a universal veterinary reassessment interval.

Culture, susceptibility, and diagnostic feedback

Culture and susceptibility results can substantially reduce uncertainty, but they do not replace clinical interpretation. Breakpoints are meaningful only when the organism, species, drug, regimen, and infection context are appropriately represented [5]. Similarly, urinary guidelines distinguish symptomatic infection from bacteriuria that may not warrant treatment despite microbial recovery [12]. Diagnostic feedback must therefore answer two separate questions: does the new result change confidence that clinically relevant bacterial infection exists, and does it change confidence that the current regimen is appropriate?

The second question includes spectrum, exposure, duration, and continuing need. Institutional evidence shows that culture/susceptibility can expose avoidable higher-tier antimicrobial use and create an opportunity to revise therapy [20]. A susceptible result can support continuation or narrowing only when the clinical syndrome remains compatible; a resistant result may support modification, but interpretation still depends on breakpoint validity and achievable exposure.

Table 3 separates the infection meaning of microbiological feedback from its regimen meaning, preventing one result from answering both questions automatically.

Table 3. What culture and susceptibility can revise in the infection rationale and in the regimen rationale

Culture and susceptibility configuration	Meaning for the infection hypothesis	Meaning for the current regimen	Legitimate revision	Inference still prohibited
Compatible syndrome; pathogen recovered; current agent susceptible	Strengthens a clinically coherent bacterial explanation	Supports adequacy only if site exposure is also plausible	Continue or narrow and revisit duration	Susceptibility does not prove that prolonged treatment is necessary
Pathogen recovered; current agent non-susceptible	May support bacterial disease when sampling and syndrome are interpretable	Raises concern about regimen adequacy	Re-evaluate drug, dose, breakpoint, site, and clinical course	An in-vitro category is not identical to clinical failure
Positive culture without compatible disease	May represent colonization or bacteriuria rather than clinical infection	Does not create a regimen requirement	Avoid automatic initiation; monitor the clinical state	Culture positivity alone is not a treatment indication
No pathogen recovered	Lowers or leaves bacterial plausibility unresolved depending on sampling conditions	Provides no direct proof that the current regimen is unnecessary or effective	Reassess diagnosis; repeat testing only when justified	A negative result does not exclude prior therapy, poor sampling, or fastidious organisms
Laboratory result conflicts with clinical response	Reopens the infection explanation	Reopens exposure, adherence, spectrum, and duration	Re-adjudicate the entire prescribing state	Neither laboratory feedback nor clinical response automatically dominates

Because microbiological feedback can strengthen, weaken, or redirect the original rationale, its most useful representation is as a state-update system rather than a one-way “culture then treat” sequence **(Figure 2)**.

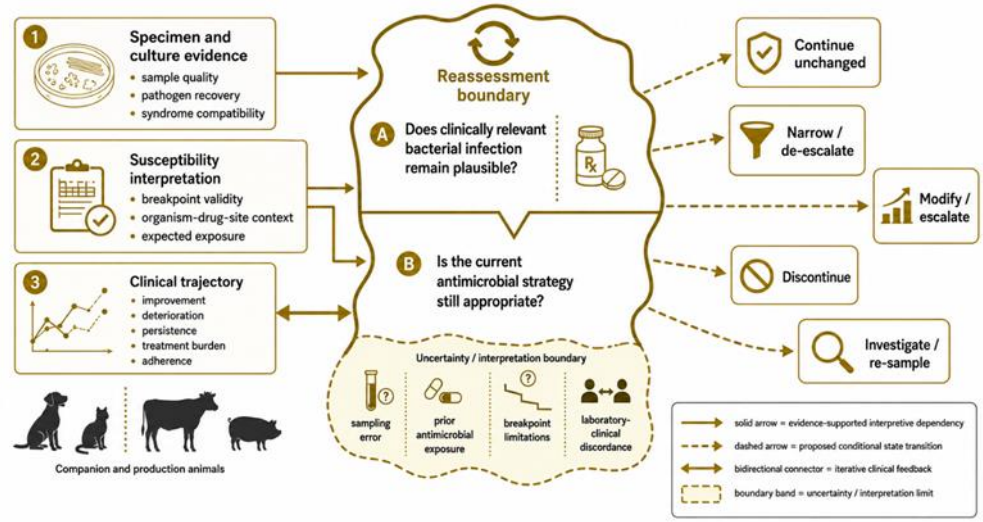

Figure 2. Microbiological feedback changes prescribing only after infection meaning, exposure, and clinical trajectory are re-adjudicated

De-escalation, escalation, and treatment discontinuation

Reassessment has value only if it can change treatment. In dogs with uncomplicated bacterial pneumonia, a small randomized pilot directly tested shorter against longer antimicrobial courses, supporting duration as a revisable variable while leaving substantial uncertainty about generalization beyond the selected population [23]. Prospective work in presumptive canine urinary infection likewise demonstrates that treatment duration can be tested rather than inherited as a fixed convention [24].

Stewardship interventions also show that change may occur in antimicrobial class selection without an equivalent reduction in total prescribing, cautioning against defining de-escalation solely as “less use” [25]. De-escalation may mean narrowing spectrum, shortening duration, changing route, or discontinuing when bacterial disease becomes less plausible. Escalation may be defensible when deterioration, new diagnostic evidence, or inadequate expected exposure increases the risk of treatment failure.

Long-acting cefovecin use illustrates a different tension: convenience can reduce administration burden but may also reduce reversibility after the drug is given [26]. The proposed architecture therefore treats reversibility itself as a stewardship property. When two regimens are otherwise defensible, the capacity to reassess and modify exposure may legitimately influence choice.

Stewardship failure modes

Failure can occur before, during, or after prescribing. Survey evidence from companion-animal veterinarians confirms substantial variation in prescribing practices and the factors clinicians report using [27]. Small- and mixed-animal veterinarians additionally identify client finances, ability to medicate, drug availability, resistance concerns, and variable confidence interpreting susceptibility information as influences on decisions [28]. Farm-practice work shows that even well-intended stewardship initiatives may fail when veterinarians judge them poorly matched to routine practice [29].

These findings support several recurring failure modes without proving universal causal weights: treating diagnostic uncertainty as evidence of infection; allowing convenience to substitute for indication; selecting unnecessarily broad or high-tier therapy; failing to obtain interpretable diagnostics when they would change management; and failing to revisit empirical treatment. Across companion and farm contexts, prescribing is shaped by practical, interpretive, and implementation constraints rather than by microbiology alone [27–29]. Behavioural analysis in dairy practice further indicates that capability, opportunity, and motivation can constrain stewardship behaviour [30].

The proposed architecture adds one failure category that is especially important: **domain collapse**, in which one salient consideration—urgency, susceptibility, convenience, or resistance concern—is allowed to determine the decision without re-adjudicating the remaining clinically relevant domains.

Implementation across companion-, farm-, and mixed-animal practice

Implementation should preserve the architecture's questions while allowing context-specific answers. Companion-animal practice often places substantial weight on owner communication, home administration, follow-up access, and financial constraints [3]. Farm-animal practice more often embeds decisions within herd protocols, production cycles, medicine records, diagnostic logistics, and population-level exposure. Mixed practice may combine both sets of constraints while offering less specialized stewardship infrastructure.

Accordingly, the architecture should not be implemented as a single mandatory checklist with universal thresholds. Its transferable unit is the reasoning sequence: establish infection plausibility; consider harm of delay and vulnerability; determine whether site-specific exposure is credible; test whether the plan is feasible; reconcile individual benefit with resistance-sensitive stewardship; and specify reassessment. Practice systems can support this sequence through guidelines and diagnostic access [20], practice-level interventions [21], and prescribing feedback [22].

Implementation also requires avoiding false standardization. An approach that is feasible in an early-adopter dairy herd may not transfer to ambulatory mixed practice, and a companion-animal hospital with rapid laboratory support may tolerate different diagnostic-first strategies from a remote farm setting. Context therefore modifies pathways, not the need for explicit justification.

Validation priorities

The architecture should be treated as a testable organizational hypothesis, not as a validated decision instrument. Farm-level medicine records and farmer attitudes show that antimicrobial use is embedded in management systems that can be measured alongside prescribing [31]. Systematic synthesis of dairy farmer and veterinarian behaviour further indicates that stewardship determinants span multiple behavioural and contextual domains [32]. Mixed-methods veterinary research has also identified diagnostic cost, client expectations, governance, and resource availability as barriers or enablers of stewardship implementation [33]. Companion-animal prescribing studies similarly demonstrate that clinician, client, and practice context can shape antimicrobial decisions [34].

Prospective validation should therefore occur at multiple levels. At the decision level, studies should test inter-clinician agreement, whether domain documentation changes treatment choices, and whether reassessment actually changes initial states. At the clinical level, evaluations should stratify by species, syndrome, disease severity, and diagnostic access while tracking animal outcomes and unintended delay. At the stewardship level, studies should measure spectrum, duration, high-importance antimicrobial use, diagnostic utilization, and treatment modification without assuming that lower use is inherently better.

External validation should deliberately include companion-, farm-, and mixed-animal settings. Failure to transport would be informative: it would identify which elements are general decision principles and which require species-, disease-, or system-specific reconstruction.

Conclusion

Veterinary antimicrobial stewardship at the point of care is best understood as management of competing uncertainties rather than simple antimicrobial restriction. The proposed architecture makes six decision domains explicit and links them to immediate, delayed, diagnostic-first, or withholding states that remain open to reassessment. Its central safeguard is noncompensatory reasoning: urgency does not create diagnostic certainty, susceptibility does not guarantee adequate clinical exposure, convenience does not create an indication, and population resistance concerns do not erase legitimate individual-animal need.

The framework is intentionally non-numeric and evidence-bounded. It organizes existing veterinary evidence into a clinically interpretable decision structure but does not establish prospective accuracy, outcome benefit, or universal transferability. Its value must therefore be tested rather than assumed. Species-specific validation, syndrome-specific boundaries, implementation studies, and explicit monitoring of animal outcomes, treatment burden, diagnostic use, and antimicrobial exposure are required before the architecture could support standardized decision tools.

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