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Building Laboratory Support for Antimicrobial Stewardship in a District Hospital With Limited Diagnostic Capacity: A Proposed Workflow

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Abstract

Antimicrobial stewardship guidance assumes a microbiology laboratory that returns identification and susceptibility results quickly enough to influence treatment. Many district hospitals have no such service: blood cultures may be unavailable or seldom requested, susceptibility testing may be limited to a few disc agents, and results may arrive after the patient has been discharged. Stewardship in those hospitals is therefore built on syndromic guidance and pharmacy data rather than on individual culture reports. This article proposes a workflow by which a laboratory with restricted capacity can nonetheless support stewardship, by shifting its contribution from the single report to the aggregate picture. The workflow covers deciding which specimens to prioritise, standardising and documenting susceptibility testing to a recognised method, deduplicating isolates and compiling a cumulative antibiogram even from small numbers, converting that antibiogram into empirical guidance aligned to the WHO Access, Watch and Reserve categories, auditing prescribing against the guidance, and feeding results back to prescribers on a fixed cycle. The workflow is assembled from published guidance and from the literature on stewardship in low-resource settings. It is proposed and has not been implemented or evaluated here.

Keywords: Antimicrobial stewardship, Cumulative antibiogram, District hospital, Laboratory capacity, AWaRe classification, Antimicrobial resistance

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1. Introduction

Antimicrobial resistance causes a large and unevenly distributed burden of death, and the burden falls most heavily on regions where diagnostic microbiology is weakest (Murray et al., 2022). The policy response has been consistent since the global action plan was adopted: strengthen surveillance, improve infection prevention and optimise the use of antimicrobials (WHO, 2015). The third of these is stewardship, and the guidance that defines it was written largely in hospitals with full laboratory support (Barlam et al., 2016).

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That assumption does not hold in a district hospital with a small laboratory. Blood culture may be unavailable or restricted by bottle supply; susceptibility testing may use a short and irregular panel of discs; quality control organisms may be unavailable for months; and a result that takes four days reaches a prescriber who committed to a regimen on the day of admission. The literature on clinical bacteriology in low-resource settings describes these constraints in detail and argues that they are structural rather than a matter of effort ([Ombelet *et al.*, 2018](#)).

A laboratory in that position can still contribute, but through a different route. Its value lies less in the individual report than in the aggregate: what organisms are isolated from which syndromes, and what they are susceptible to. That information shapes empirical therapy, which is what almost every patient in such a hospital actually receives. This article proposes a workflow for producing and using it. The workflow is drawn from published guidance and from the stewardship literature in low- and middle-income settings. It is a proposal, has not been implemented in any hospital for the purposes of this article, and reports no results.

2. Background

Three bodies of work inform the design. Systematic review evidence shows that stewardship interventions change prescribing behaviour, and that persuasive and restrictive approaches both work, with enablement components improving the effect ([Davey *et al.*, 2017](#)). Evidence also links stewardship to reduced colonisation and infection with resistant organisms ([Baur *et al.*, 2017](#)). What these reviews describe, however, are programmes with microbiological feedback at their centre.

The second body of work addresses adaptation. Commentators on stewardship in low- and middle-income countries have argued that the core principles transfer but the instruments do not: prospective audit and feedback presumes a dedicated pharmacist, formulary restriction presumes a formulary that is enforced, and de-escalation presumes a result to de-escalate on ([Cox *et al.*, 2017](#)). A consensus exercise subsequently defined core elements and checklist items intended to be applicable globally rather than only in well-resourced hospitals ([Pulcini *et al.*, 2019](#)), and the World Health Organization published a practical toolkit along the same lines ([WHO, 2019](#)). National programmes in high-income countries have published comparable core elements that remain a useful checklist ([CDC, 2019](#)).

The third is the technical standards that make a local antibiogram interpretable: a recognised susceptibility testing method with defined breakpoints, whether the CLSI performance standards ([CLSI, 2023](#)) or the EUCAST tables ([EUCAST, 2023](#)), a documented quality management system for the laboratory ([ISO, 2022](#)), and a classification of antibiotics that supports prescribing policy. The last of these is the Access, Watch and Reserve framework, adopted within the WHO Model List of Essential Medicines, which groups agents by their place in therapy and their resistance potential and gives a hospital a target that can be monitored without a laboratory at all ([WHO, 2021](#)).

3. The Proposed Workflow

The workflow is a repeating monthly cycle of six steps, shown in Figure 1. Table 1 states what each step requires and what it yields, with the minimum version that a laboratory with very limited capacity can still perform. The cycle is monthly because that is short enough to retain the attention of prescribers and long enough to accumulate isolates in a hospital that processes few.

Step one is capture. Before any analysis, the laboratory needs to know what it received and from whom. A register recording date, ward, patient identifier, specimen type and the clinical syndrome suspected turns a pile of results into data with a denominator. The syndrome field matters more than it appears: an antibiogram that mixes urinary, respiratory and wound isolates cannot guide empirical therapy for any of them.

Step two is cleaning. Repeat isolates from the same patient distort a small dataset severely, since one patient with a prolonged infection and three cultures can shift an apparent resistance rate. The standard

convention, retaining the first isolate per patient per species per period, should be applied and recorded. Contaminants should be excluded by an explicit rule rather than by the judgement of whoever compiles the table.

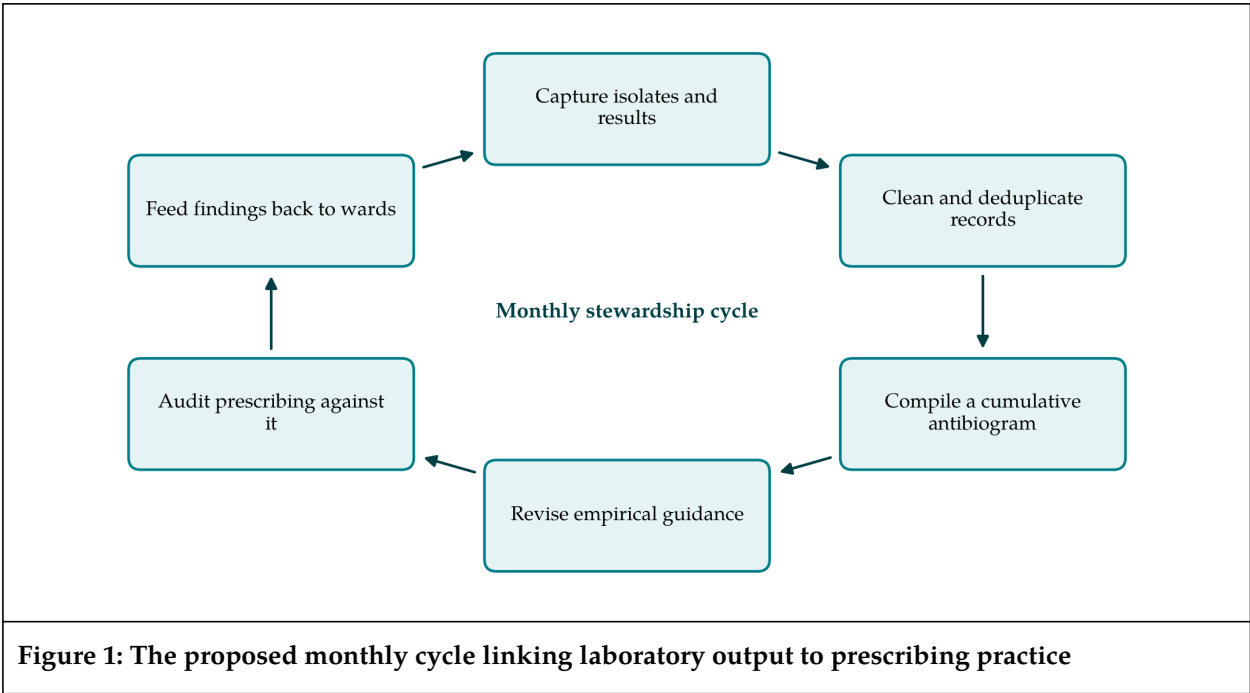


Figure 1: The proposed monthly cycle linking laboratory output to prescribing practice

Table 1: Steps of the proposed workflow, their requirements and their outputs			
Step	What it requires	What it yields	Minimum viable version
Capture	A specimen register with syndrome recorded	A denominator for every result	Paper register reviewed weekly
Clean	Deduplication to first isolate per patient per species	An unbiased isolate set	Manual check against the register
Compile	Standard method and breakpoints CLSI, 2023	A cumulative antibiogram	Annual rather than monthly table
Revise	A prescriber group that meets and decides	Syndromic empirical guidance	One page per common syndrome
Audit	A short point prevalence survey of prescriptions	Concordance and AWARe mix WHO, 2021	Twenty charts on one day
Feed back	A standing slot in an existing meeting	Changed prescribing and new questions	Ward noticeboard summary

Step three is compilation. The cumulative antibiogram is a table of species against agents showing the proportion of isolates susceptible, prepared to a recognised method with breakpoints stated and the version recorded, so that a table from one year can be compared with the next ([EUCAST, 2023](#)). Where isolate numbers are small, two adaptations are needed. Counts should be given beside every proportion, and combinations with few isolates should be reported as counts alone, since a susceptibility expressed as a percentage of five isolates invites misreading. The guidance that follows should also be framed in terms of what to avoid as much as what to use, which is more robust to small numbers.

Step four is revision of empirical guidance. A small group of prescribers, the laboratory lead and a pharmacist if one exists reviews the antibiogram and agrees first-line and second-line empirical therapy for the common syndromes of that hospital. Guidance should favour Access-group agents wherever local susceptibility allows and should name the circumstances for a Watch-group agent explicitly ([WHO,](#)

2021). The product is short: one page per syndrome, with doses, duration and the condition for review.

Step five is audit. A point prevalence survey on a single day records every patient on an antimicrobial, the agent, the indication and whether it matches the guidance. The exercise takes a few hours and yields two numbers that prescribers recognise: the proportion of prescriptions concordant with the local guidance, and the share drawn from each AWARe category. Both can be tracked over time without any laboratory input, which is what makes them sustainable in a hospital whose laboratory capacity varies with supply.

Step six is feedback. The results go to prescribers through a standing item in a meeting that already happens, not a new committee. The feedback should be specific and non-punitive, reporting aggregate figures by ward rather than by individual, and it should close the loop by stating what changed since the last cycle. Feedback also generates the questions that direct the next cycle, which is why the workflow is drawn as a loop rather than a line.

4. Fitting the Workflow to Constrained Settings

The workflow is designed to degrade gracefully. If susceptibility testing is interrupted by a stock shortage, steps five and six continue on prescribing data alone. If no pharmacist is available, the audit can be done by a clinical officer or a senior nurse with a one-page form. If isolate numbers never support a monthly table, the antibiogram becomes annual while the audit stays monthly. What should not be abandoned is the register, because without a denominator none of the later steps mean anything.

Two points of sequencing are worth stating. Laboratory quality comes before laboratory volume: a small number of results produced by a documented method is more useful than a larger number produced inconsistently, and a laboratory without quality control organisms should say so in its reports rather than issue susceptibilities it cannot stand behind. And prescriber engagement comes before data. A hospital that begins by circulating an antibiogram nobody asked for will find it ignored; a hospital that begins by asking clinicians which empirical decisions they find hardest will know what the first table should contain ([Pulcini et al., 2019](#)).

5. Limitations and What Remains to Be Shown

This is a proposal. It has not been implemented, and three questions would need answering before it could be recommended generally. Whether a laboratory of this size can sustain the register and deduplication alongside its routine work is the first, and it is a question about staff time rather than about method. Whether the resulting guidance changes prescribing is the second, and the point prevalence survey built into the workflow is the natural instrument for measuring it. Whether changed prescribing improves outcomes is the third and the hardest, since district hospitals rarely have the mortality data and case mix adjustment that such an analysis needs.

Two limits are inherent. A cumulative antibiogram describes the organisms that reach the laboratory, and in a hospital where blood cultures are seldom taken those organisms are a biased sample of the organisms causing disease; the guidance derived from it inherits that bias and should be read with it in mind. And stewardship cannot compensate for the drivers that sit outside the hospital, including unregulated community access to antibiotics and the use of antimicrobials in agriculture, which were identified as central to the problem long before the current programmes began ([Laxminarayan et al., 2013](#)).

6. Conclusion

A district hospital laboratory that cannot deliver timely individual susceptibility reports can still support stewardship by producing a reliable aggregate picture and by taking part in a short, fixed cycle of guidance, audit and feedback. The workflow proposed here sets out that cycle in six steps, each with a minimum version that survives interruptions in supply and staffing. Its feasibility and its effect on prescribing are open questions, and both can be examined with the register and the point prevalence survey that the workflow already builds in.

Conflict of interest

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