

MINI REVIEW



Antibiotic de-escalation as a hospital stewardship strategy in adults with Pneumonia: A mini review

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ABSTRACT

Broad-spectrum antibiotics are frequently initiated in hospitalized adults with pneumonia before a pathogen is identified. Antibiotic de-escalation is the subsequent narrowing or simplification of therapy when clinical and diagnostic information indicates that broader coverage is no longer required. This review examines whether de-escalation is associated with reduced antibiotic exposure without a consistent increase in treatment failure or mortality.

Relevant clinical studies, one randomized trial of rapid molecular testing, one published systematic review, and major stewardship guidelines were reviewed. Sources were selected for relevance to adult pneumonia rather than through a registered systematic search, and findings were compared qualitatively.

Observational evidence associates de-escalation with fewer days of antibiotic therapy and, in some cohorts, with lower rates of *Clostridioides difficile* infection and shorter hospitalization. Treatment failure has not differed significantly in the largest nosocomial-pneumonia cohort reviewed. Rapid molecular testing increases the frequency of de-escalation by shortening time to a microbiologic result, although overall antibiotic duration may not decline. A meta-analysis of culture-negative pneumonia reported lower in-hospital mortality with de-escalation, but the estimate is heterogeneous and derived from observational studies.

The available literature supports routine reassessment of empiric broad-spectrum therapy. De-escalation is appropriate when the patient is clinically stable and the available data permit narrowing. It should not be applied automatically. Differences in pneumonia classification, de-escalation definitions, and study design limit generalization.

KEYWORDS

Antibiotic stewardship; Antibiotic de-escalation; Pneumonia, Broad-spectrum antibiotics; Antimicrobial resistance

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Introduction

Antibiotics remain indispensable for bacterial pneumonia, but unnecessary or excessively broad exposure contributes to antimicrobial resistance, *Clostridioides difficile* infection, and avoidable drug-related harm. Resistance reduces the number of reliable treatment options and raises the stakes of every empiric choice made in hospital practice. Stewardship programs were developed to address that tension. Their purpose is not simply to reduce antibiotic counts. It is to improve selection, timing, duration, and reassessment so that effective therapy is preserved while superfluous exposure is limited [1].

Pneumonia is a persistent test of that model. Treatment is commonly started before a pathogen is known, and delay can be harmful in severe disease. Community-acquired pneumonia (CAP) develops outside the hospital. Hospital-acquired pneumonia (HAP) develops during hospitalization. Ventilator-associated pneumonia (VAP) is HAP in patients receiving mechanical ventilation [2,3]. Across these syndromes, clinicians may begin broad-spectrum regimens when the etiology is uncertain or when resistant organisms such as methicillin-resistant *Staphylococcus aureus* or *Pseudomonas aeruginosa* are a concern.

Initiation of broad-spectrum therapy is not the same as its continuation after additional information becomes available. Antibiotic de-escalation is the narrowing or simplification of a regimen when clinical progress, culture results, or other diagnostic data indicate that broader coverage is no longer required [2]. The intent is continued treatment with a more targeted regimen, not withdrawal of care. Guidelines already endorse this reassessment in HAP and VAP and support stopping extra coverage for resistant pathogens in CAP when microbiologic

studies do not justify that coverage [2,3].

The supporting evidence is less settled than the guideline language suggests. De-escalation is defined differently across studies. Most outcome data are observational and vulnerable to confounding by indication, because clinicians ordinarily narrow therapy in patients who are improving. Randomized trials more often evaluate diagnostic strategies than de-escalation itself. Prior syntheses have examined intensive-care pneumonia or culture-negative disease rather than the full range of hospitalized adults with pneumonia [4,5]. A focused mini review remains useful because those bodies of evidence need to be read together, not as interchangeable proof of a single effect.

This review examines whether de-escalation of broad-spectrum antibiotics in hospitalized adults with pneumonia is associated with reduced antibiotic exposure without a consistent increase in treatment failure or mortality. Subsequent sections define de-escalation as used in the source studies, compare evidence on exposure and safety, consider rapid diagnostics as a facilitator of narrowing, and outline implications for hospital stewardship.

Methods

This article is a mini review to interpret a focused body of clinical and guideline literature rather than to produce an exhaustive, reproducible inventory of every eligible study.

English-language publications from 2015 through 2024 were considered, together with guidelines that remain in clinical use. Candidate sources were identified using combinations of the terms antibiotic de-escalation, antimicrobial de-escalation, hospitalized pneumonia, broad-spectrum antibiotics, antibiotic stewardship, rapid molecular testing, and culture-negative pneumonia. Sources were retained when they addressed adults with pneumonia and reported

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de-escalation, antibiotic exposure, diagnostic information used to guide narrowing, or related clinical outcomes. Sources were excluded when they did not concern pneumonia, did not involve adults, or did not inform antimicrobial decision-making.

Seven sources formed the core evidence set: a retrospective cohort of nosocomial pneumonia; a randomized trial of molecular point-of-care testing in intensive-care pneumonia; observational studies of de-escalation in CAP and bacteremic CAP; a systematic review and meta-analysis of culture-negative pneumonia; ATS/IDSA guidelines for HAP and VAP; and CDC guidance on hospital stewardship programs. The 2019 ATS/IDSA CAP guideline provided additional clinical context. A prior systematic review of de-escalation in intensive-care pneumonia was consulted for comparison and was not reanalyzed [1-9].

For each clinical study, population, setting, operational definition of de-escalation, comparison, outcomes, and principal limitations were extracted. Results were compared qualitatively. No new pooled effect estimate was calculated, because pneumonia syndromes and de-escalation definitions were not uniform. Observational findings were interpreted as associations. The randomized trial was treated as evidence for the effect of rapid diagnostic testing, not as a direct trial of de-escalation. The clinical studies and the published systematic review are summarized in Table 1.

Table 1. Characteristics of included clinical evidence.

Source	Population	Setting	Intervention/Exposure	Comparison	Study Design	Outcomes	Main Findings	Limitations	Relevance
Ilges et al. [6]	1,812 adults	Hospital-acquired and ventilator-associated pneumonia	Antibiotic de-escalation	No de-escalation	Retrospective cohort study	Antibiotic duration, treatment failure, <i>C. difficile</i> infection, hospital stay	Median antibiotic duration was 9 days with de-escalation vs. 11 days without de-escalation.	Retrospective, single-center design; cannot fully establish cause and effect	Directly examines antibiotic de-escalation and antibiotic exposure in hospitalized adults with pneumonia.
Poole et al. [7]	200 critically ill adults	ICU patients with pneumonia	Rapid molecular point-of-care testing	Standard diagnostic testing	Randomized controlled trial	Time to results, de-escalation, antibiotic duration, clinical and safety outcomes	De-escalation occurred in 42% of the rapid-testing group vs. 8% of the standard-testing group.	Focused on rapid diagnostic testing as a method to support de-escalation; ICU population may limit generalizability.	Shows how faster diagnostic information may support more targeted antibiotic decisions.
Yama et al. [9]	Adults with community-acquired pneumonia	Community-acquired pneumonia	De-escalation of empirical antimicrobial therapy	Continued empirical therapy	Observational study	Mortality and clinical outcomes	De-escalation was not associated with worse mortality outcomes.	Observational design; focused on community-acquired pneumonia.	Provides evidence about the safety of de-escalation in community-acquired pneumonia.
Carugati et al. [8]	261 adults	Bacteremic community-acquired pneumonia	Culture-directed de-escalation	Continued treatment	Observational study	Mortality and clinical outcomes	De-escalation was not associated with increased mortality.	Observational design; focused on bacteremic community-acquired pneumonia.	Provides evidence about de-escalation when culture information is available.
Song & Lee [5]	11,933 patients across 6 studies	Culture-negative pneumonia	Antimicrobial de-escalation	No de-escalation/continued therapy	Systematic review and meta-analysis	In-hospital mortality, antibiotic duration, hospital stay	De-escalation was associated with lower in-hospital mortality and shorter antibiotic treatment.	Variation among included studies; evidence included observational studies.	Provides broader evidence about de-escalation in culture-negative pneumonia.

Defining De-escalation in Pneumonia

De-escalation may consist of substitution of a narrower-spectrum agent, discontinuation of one agent within a combination regimen, or another reduction in antimicrobial spectrum [2]. Cessation of all antibiotics is not required for the maneuver to qualify as de-escalation.

Published studies operationalize this concept differently. Ilges et al., defined de-escalation as a reduction in a calculated antibiotic

regimens according to antimicrobial spectrum and number on day 4 [9]. Carugati et al., required a change from an appropriate broad-spectrum regimen to a narrower, culture-directed regimen within seven days after admission [8]. Poole et al., recorded de-escalation as a clinical decision after rapid or conventional test results [7]. Apparent consistency across studies is therefore informative, but it does not indicate that a single intervention was tested under a common protocol.

Evidence on Antibiotic Exposure

The most reproducible finding is an association between de-escalation and reduced antibiotic exposure.

Ilges et al., examined 1,812 adults with HAP or VAP at a single academic center [6]. Therapy was classified as de-escalated in 786 patients and as not de-escalated in 1,026. Median duration of antibiotic treatment was 9 days and 11 days, respectively. Patients in the de-escalation group also had fewer episodes of *C. difficile* infection (2.2% versus 3.8%) and shorter hospital stays (median 20 versus 22 days). The design was retrospective. Patients who were improving may have been more likely to have therapy narrowed, so shorter exposure cannot be attributed solely to the stewardship maneuver. Table 2 summarizes the principal findings from the key studies. Median antibiotic duration in the nosocomial-pneumonia cohort is shown in Figure 1.

Table 2. Principal findings from key studies.

Source	De-escalation group	Comparison group	Principal finding
Ilges et al. [6]	786 patients	1,026 patients	Median antibiotic duration 9 versus 11 days
Poole et al. [7]	42 of 100 patients	8 of 98 patients	De-escalation 42% versus 8%
Yamana et al. [9]	De-escalation	Continued empirical therapy	Noninferior mortality in pathogen-identified CAP; in-hospital mortality not shown to be noninferior in culture-negative CAP
Carugati et al. [8]	165 patients	96 patients	After adjustment, no increase in 30-day mortality
Song & Lee [5]	1,152 patients	10,781 patients	Pooled risk ratio for in-hospital mortality 0.60 (95% CI 0.38–0.93)

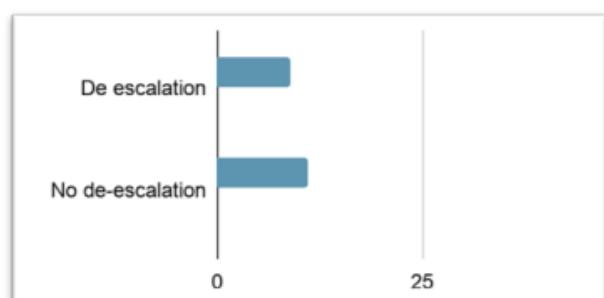


Figure 1. Median duration of antibiotic therapy with and without de-escalation in nosocomial pneumonia.

Song and Lee likewise observed shorter total antibiotic treatment among patients with culture-negative pneumonia who underwent de-escalation. That result is directionally consistent with Ilges et al but rests on observational data [5,6].

Poole et al., complicates a simple exposure narrative. Rapid testing increased the proportion of patients whose antibiotics were narrowed, yet overall antibiotic duration did not differ substantially between trial arms [7]. An earlier change in spectrum is not equivalent to a shorter course.

Evidence on Clinical Outcomes and Safety

A reduction in antibiotic use is clinically acceptable only if it is not

accompanied by excess treatment failure or death.

In the cohort reported by Ilges et al., composite treatment failure occurred in 35.0% of patients after de-escalation and in 33.8% of patients without de-escalation. The difference was not statistically significant [6]. On adjusted analysis, de-escalation was not associated with treatment failure (hazard ratio 1.13, 95% confidence interval 0.96–1.33). The interval is compatible with no difference and with a modest increase in risk; it does not establish benefit. Selected outcomes from that cohort are presented in Table 3.

Yamana et al., analyzed a nationwide administrative sample of adults with CAP and used propensity-score matching. Among patients with an identified pathogen, de-escalation was noninferior to continued empirical therapy for 15-day mortality (5.3% versus 4.3%) and in-hospital mortality (8.0% versus 8.8%). Among culture-negative cases, de-escalation was noninferior for 15-day mortality but not for in-hospital mortality. The authors concluded that de-escalation appeared safe when etiology was known and that safety in culture-negative disease remained less certain [9].

Carugati et al., studied 261 adults with bacteremic CAP; de-escalation was performed in 165 (63.2%). Unadjusted 30-day mortality was lower after de-escalation (15.1% versus 25.0%). Patients who continued the initial regimen were more severely ill at admission. After adjustment for confounders, de-escalation was not associated with increased 30-day mortality. The crude mortality difference is therefore consistent with confounding by indication rather than with a proven survival effect [8].

A systematic review of intensive-care pneumonia, distinct from the studies above, found shorter hospitalization after de-escalation but no clear mortality difference and judged the evidence to be of low quality [4]. That appraisal argues against treating observational mortality reductions as causal.

Table 3. Selected Outcomes in Ilges et al. (2021).

Outcome	De-escalation	No de-escalation	Interpretation
Median antibiotic days	9	11	Less antibiotic exposure
Treatment failure	35.0%	33.8%	No significant difference
<i>C. difficile</i> infection	2.2%	3.8%	Lower rate after de-escalation
Median hospital days	20	22	Shorter stay

Note. Associations from a retrospective single-center cohort. De-escalation was defined as a reduction in spectrum score from day 1 to day 3.

Rapid Diagnostic Testing as a Facilitator of De-escalation

Poole et al., randomly assigned 200 critically ill adults with pneumonia to molecular point-of-care testing or standard diagnostics. Median time to a result was 1.7 hours with rapid testing and 66.7 hours with standard testing. A pathogen was identified in 71% of patients in the rapid-testing group and in 51% of patients in the control group. De-escalation occurred in 42 of 100 patients assigned to rapid testing and in 8 of 98 patients assigned to standard testing. Time to de-escalation was correspondingly shorter. Clinical and safety outcomes did not differ in a major way between groups, and total antibiotic duration was similar [7].

The trial supports the inference that faster diagnostic information enables earlier targeted changes. It does not isolate de-escalation as the randomized intervention and does not show that rapid testing shortens the complete antibiotic course. The difference in

de-escalation rates is shown in Figure 2.

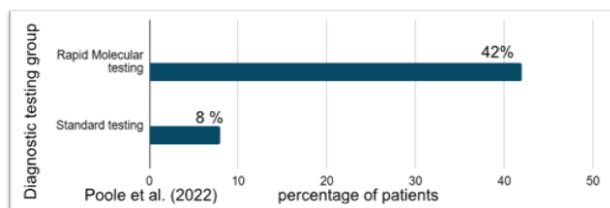


Figure 2. Antibiotic de-escalation after rapid molecular testing versus standard diagnostic testing.

Evidence From Culture-Negative Pneumonia

Culture-negative pneumonia leaves the clinician with less microbiologic guidance and therefore poses a more difficult de-escalation decision. Song and Lee synthesized six studies comprising 11,933 patients, of whom 1,152 received antimicrobial de-escalation. De-escalation was associated with lower in-hospital mortality (risk ratio 0.60, 95% confidence interval 0.38–0.93), shorter antibiotic treatment, and shorter hospital stay. Heterogeneity was substantial ($I^2 = 66\%$). The authors advised cautious interpretation and called for randomized trials [5].

A risk ratio of 0.60 indicates that the observed risk of in-hospital death was 40% lower in the de-escalation group within that pooled analysis. It does not establish a 40% mortality reduction for an individual patient. The finding should be read alongside Yamana et al, who could not demonstrate noninferiority of de-escalation for in-hospital mortality in culture-negative CAP [9]. Those results are complementary, not identical.

Guideline and Stewardship Context

ATS/IDSA guidelines recommend de-escalation for selected adults with HAP or VAP, while noting that the quality of evidence supporting some recommendations is very low [2]. CAP guidance similarly supports withdrawal of extra coverage for methicillin-resistant *Staphylococcus aureus* or *Pseudomonas aeruginosa* when risk assessment and negative studies do not justify continued use [3]. CDC's Core Elements locate such reassessment within a hospital program that includes leadership, accountability, intervention, tracking, reporting, and education [1]. These documents explain the rationale for de-escalation. They do not replace outcome studies.

Discussion

Three conclusions can be drawn with reasonable consistency. First, de-escalation is associated with reduced antibiotic exposure in hospital cohorts [5,6]. Second, when narrowing is undertaken in clinically selected patients, the studies reviewed here do not demonstrate a consistent increase in treatment failure [6,8,9]. Third, more rapid diagnostic information increases the frequency of de-escalation [7].

Causal inference remains limited. Most outcome data are observational. Clinicians ordinarily de-escalate patients who are improving and continue broad therapy in patients who are deteriorating; this confounding by indication can make de-escalation appear safer or even survival-promoting. Pneumonia syndromes are not interchangeable. CAP, HAP, VAP, intensive-care disease, and culture-negative infection differ in pathogen mix, severity, and the amount of microbiologic information available. Definitions of de-escalation also differ, which weakens any claim that the literature evaluates one standardized practice.

The randomized evidence is strongest for diagnostics rather than for de-escalation as a stand-alone intervention. In Poole et al, earlier narrowing did not produce a shorter overall course [7]. Stewardship programs should therefore treat time to a useful result, spectrum of the ongoing regimen, and total days

of therapy as related but distinct measures.

De-escalation is not appropriate for every patient. Persistent instability, risk factors for resistant organisms, or absence of reliable diagnostic information may justify continued broad coverage. Clinical judgment remains part of stewardship rather than an exception to it [2,3]. Strengths and limitations of the included evidence are outlined in Table 4.

Table 4. Strengths and limitations of the evidence.

Source	Strength	Limitation
Ilges et al. [6]	Large hospital cohort with detailed antibiotic outcomes	Retrospective design; confounding by indication
Poole et al. [7]	Randomized comparison	Tests rapid diagnostics, not de-escalation itself
Song & Lee [5]	Pooled estimate across six studies	Substantial heterogeneity; observational primary studies
Yamana et al. [9]	Large real-world CAP sample with matching	Administrative data; weaker safety signal in culture-negative disease
Carugati et al. [8]	Culture-directed definition in bacteremic CAP	Observational; non-de-escalated patients were sicker
Kalil et al. [2]; Metlay et al. [3]	Clinical recommendations	Some recommendations based on low-quality evidence
CDC [1]	Practical hospital framework	Does not test de-escalation as an intervention

Implications for Hospital Practice

The evidence supports a reassessment sequence rather than a uniform protocol.

Empiric therapy should be started promptly when severity and risk factors warrant broad-spectrum coverage [2,3]. Indicated cultures and other diagnostic tests should be obtained at the outset. Where available, rapid molecular testing can reduce time to a result [7]. At 48 to 72 hours, or when new results return, the care team should

Table 5. Proposed reassessment sequence.

Stage	Action	Purpose
Initial treatment	Start indicated antibiotics promptly	Treat infection without delay
Testing	Obtain cultures and other indicated diagnostics	Identify a target for therapy
Reassessment	Review clinical course and results at 48–72 hours	Determine whether broad therapy remains necessary
De-escalation	Narrow or simplify the regimen when appropriate	Reduce unnecessary exposure
Monitoring	Continue observation	Detect deterioration after narrowing
Tracking	Record antibiotic use and outcomes	Evaluate the stewardship program

determine whether the patient is improving, whether a pathogen has been identified, whether coverage for resistant organisms remains necessary, and whether combination therapy is still justified. Therapy may then be narrowed if the clinical course and the available data support that change. Monitoring should continue after de-escalation so that treatment can be broadened again if the patient deteriorates. Hospitals can track de-escalation rates, days of therapy, *C. difficile* infection, and treatment failure as program measures [1]. Table 5 restates this reassessment sequence.

Limitations

As a mini review, this article is subject to selection bias. The search was not comprehensive, screening was not performed in duplicate, and neither a formal risk-of-bias instrument nor a GRADE assessment was applied. Other reviewers might have included additional studies, including earlier intensive-care syntheses [4].

The primary literature has corresponding limits. Observational designs predominate. Pneumonia categories and de-escalation definitions are heterogeneous. Culture-negative infection is particularly difficult to study because no organism is available to guide narrowing. Resistance patterns vary by hospital, so a regimen that can be narrowed in one institution may remain appropriate in another. Guideline recommendations rest in part on low-quality evidence [2]. Direct randomized trials of de-escalation in pneumonia remain scarce; the principal randomized study reviewed here evaluated a diagnostic strategy [7].

Conclusion

In hospitalized adults with pneumonia, de-escalation is best understood as a stewardship maneuver rather than as a universal rule. When clinical progress and available diagnostic information support a narrower regimen, the literature associates that change with less antibiotic exposure and does not show a consistent increase in treatment failure. Faster diagnostic testing can make the decision earlier, but it does not replace clinical judgment. Broad-spectrum therapy should be reassessed routinely and narrowed only when the patient's course and the data allow it.

Author contributions

Research planning and study design: Neariah Koreka, Anju Bhasin;

Literature synthesis: Neariah Koreka, Anju Bhasin;

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Critical revision and technical assistance: Neariah Koreka, Anju Bhasin;

Project leadership and supervision: A.B. All authors have reviewed, approved the final manuscript, and agree to be accountable for the work.

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Conflict of Interest

The authors declare no competing financial, personal, or professional interests.

Ethics Declaration

Not Applicable

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