Scholars Academic Journal of Pharmacy
Abbreviated Key Title: Sch Acad J Pharm
ISSN 2347-9531 (Print) | ISSN 2320-4206 (Online)
Journal homepage: http://saspublishers.com

OPEN ACCESS

Drug Sciences

Rational Antibiotic Use and Stewardship at the Avicenne Military Hospital of Marrakech: Integrating the WHO Aware Framework into Clinical Practice

Y Baztami[1*], Y Atbib[1,2], I Jebrane[1,2], O Ziraoui[1,2], Z Lachhab[1,2]

[1]Department of Drug Sciences, Faculty of Medicine and Pharmacy, Cadi Ayyad University, 40000 Marrakech, Morocco
[2]Laboratory of Excellence for Innovations in Biotechnology, Pharmaceutical Bioengineering, and Artificial Intelligence, Faculty of Medicine and Pharmacy, Cadi Ayyad University, 40000 Marrakech, Morocco

DOI: https://doi.org/10.36347/sajp.2025.v14i08.001 | **Received:** 08.09.2025 | **Accepted:** 21.10.2025 | **Published:** 24.10.2025

***Corresponding author:** Y Baztami
Department of Drug Sciences, Faculty of Medicine and Pharmacy, Cadi Ayyad University, 40000 Marrakech, Morocco

Abstract **Original Research Article**

Antimicrobial resistance (AMR) has emerged as one of the most pressing challenges to global health. In 2019 alone, infections caused by resistant pathogens were directly responsible for approximately 1.27 million deaths, and linked to nearly 5 million more worldwide. If this trend continues unchecked, projections suggest that AMR could claim up to 10 million lives annually by 2050, surpassing the toll of many current leading causes of death. This alarming rise stems largely from the misuse and overuse of antibiotics in human medicine, veterinary practice, and agriculture practices that hasten the selection and spread of resistant microorganisms. The situation is especially dire in low- and middle-income countries, where limited access to clean water, sanitation, and diagnostic tools amplifies the problem. Recognising the magnitude of this crisis, the World Health Organization (WHO) has classified antimicrobial resistance among the top ten global public health threats. In 2015, it launched the Global Action Plan on AMR, urging all health systems to optimise antimicrobial prescribing and strengthen stewardship efforts. Within this context, rational antibiotic use in hospitals has become a cornerstone of infection control. This article based on the *«Hospital Guide for the Rational Use of Antibiotics»* developed at the Avicenne Military Hospital in Marrakech summarises the key principles of responsible antimicrobial therapy and demonstrates how the WHO AWaRe classification can be applied in daily clinical decision-making.

Keywords: Antimicrobial resistance (AMR), deaths, antibiotics, WHO, Global Action Plan, hospitals.

INTRODUCTION

Antibiotics remain among the most powerful medical discoveries in history, transforming once-lethal infections into curable conditions. Yet, their very success has bred complacency. The widespread availability of these drugs, coupled with years of injudicious prescribing, has gradually eroded their effectiveness. Bacteria have evolved mechanisms to evade even the most potent treatments, creating a silent but rapidly advancing pandemic of resistance.

The numbers are sobering. By conservative estimates, AMR already kills over a million people each year and contributes to millions more deaths indirectly (Murray *et al.,* 2022; O'Neill, 2016). If global prescribing practices do not change, experts warn that resistant infections may soon outpace cancer and cardiovascular disease as leading causes of mortality. The impact extends beyond human health: resistant pathogens threaten surgical safety, cancer chemotherapy, neonatal care, and organ transplantation, where antibiotic prophylaxis is essential.

At the root of this crisis lies the inappropriate use of antibiotics. From viral upper respiratory infections treated with broad-spectrum drugs, to the routine prophylaxis of livestock, the result is the same—sustained selective pressure that accelerates resistance development (Van Boeckel *et al.,* 2015; Van Boeckel *et al.,* 2014). In many low- and middle-income regions, including parts of Africa, additional factors worsen the problem: the over-the-counter sale of antibiotics, the absence of diagnostic testing, and limited infection prevention infrastructure (Collignon *et al.,* 2018).

Recognising this escalating threat, the World Health Organization declared AMR a top global priority (Walsh *et al.,* 2023). Its 2015 Global Action Plan set out five key objectives: to improve awareness, strengthen surveillance, reduce infection incidence, optimise antimicrobial use, and invest in new tools and diagnostics (mondiale de la Santé, 2015).

Among these priorities, rational antibiotic use in hospitals stands out as both achievable and essential. Hospitals are high-intensity settings where antimicrobials are used most frequently and where resistant organisms often emerge and spread. Implementing sound prescribing practices therefore offers an immediate opportunity to reduce misuse and preserve antibiotic efficacy.

This article presents the work undertaken at the Avicenne Military Hospital of Marrakech, where a comprehensive *«Hospital Guide for the Rational Use of Antibiotics»* was developed. The guide not only outlines principles of evidence-based prescribing but also integrates the WHO AWaRe classification—a practical framework categorising antibiotics into *Access*, *Watch*, and *Reserve* groups—to guide clinicians toward safer, more sustainable choices.

The following sections review the methodology used to analyse this guide, its key recommendations for common infections, and its broader significance within the global fight against antimicrobial resistance.

METHODS

A brief anonymous in-hospital survey of prescribers was conducted to contextualize stewardship practices (N=113; voluntary participations). Descriptive statistics are reported as item percentages.

The *«Hospital Guide for the Rational Use of Antibiotics»* from the Avicenne Military Hospital in Marrakech was carefully reviewed and its main recommendations synthesised.

Each chapter — covering the fundamental principles of antibiotic prescribing, infection-specific treatment protocols, and pharmacological appendices (dosage adjustments, treatment durations, contraindications) — was analysed in detail.

To situate these recommendations within a broader context, an extensive literature review was conducted. Searches included World Health Organization (WHO) publications, guidelines from leading medical societies, and recent antibiotic-stewardship studies indexed in PubMed and Scopus. The goal was to compare the Marrakech guide's content with internationally accepted best practices and to identify areas of convergence or contextual adaptation.

No new clinical or patient data were collected; this work represents a descriptive synthesis and contextual analysis of an institutional guideline.

RESULTS

1. General Principles of Rational Prescribing

The hospital guide begins with a simple but powerful assertion: every antibiotic prescription must be both justified and optimised.

Antimicrobial therapy should never be started without a clear indication of bacterial infection. For instance, antibiotics should be avoided in viral illnesses such as influenza or uncomplicated bronchitis.

When treatment is warranted, the chosen agent must be as targeted as possible, covering the likely pathogen while sparing the commensal microbiota. Broad-spectrum coverage should be reserved for severe or high-risk cases and reassessed promptly once microbiology results are available. Each prescription must balance individual benefit with collective responsibility—minimising ecological pressure and delaying the emergence of resistance (Carlet & Herida, 1998).

2. Microbiological Sampling and Early Reassessment

The guide stresses that diagnostic sampling should precede therapy whenever feasible—for example, obtaining blood cultures or site-specific samples before the first antibiotic dose. This approach allows empirical regimens to be refined once results are known.

A therapeutic review at 48–72 hours is mandatory. Within this window, clinicians should evaluate the patient's clinical response and preliminary culture findings to decide whether to:

- Narrow the antibiotic spectrum,
- Stop therapy if infection is unconfirmed, or
- Broaden coverage when necessary (Barlam *et al.,* 2016).

3. Duration of Treatment

Long courses do not necessarily translate into better outcomes. The guide summarises robust evidence showing that shorter regimens are equally effective for many community-acquired infections while reducing adverse events and selective pressure.

Examples include:

- **Community-acquired pneumonia:** 5–7 days
- **Uncomplicated cystitis:** 3 days
- **Exceptions:** prolonged therapy for endocarditis or osteomyelitis (Spellberg & Rice, 2023).

4. Dose Optimisation

Proper dosing ensures adequate drug concentrations at the infection site while avoiding under- or overdosing.

- **Renal impairment:** requires dosage reduction or extended intervals for aminoglycosides, vancomycin, and many β-lactams.
- **Severe infections (e.g. sepsis):** may require a **loading dose** to reach therapeutic levels rapidly.

5. Route of Administration and Combination Therapy

Intravenous therapy is reserved for severe infections or when oral administration is not possible. As soon as the patient stabilises, a switch to oral therapy is recommended to reduce line-related complications and hospital stay.

Unnecessary antibiotic combinations are discouraged. Empirical combinations—such as amoxicillin-clavulanate + gentamicin for abdominal sepsis—may be justified initially but should be reassessed early. Redundant dual coverage (for example, two β-lactams) must be avoided.

6. Infection-Prevention Measures

Antibiotic stewardship is inseparable from infection prevention. The guide reiterates the importance of hand hygiene, standard precautions, and vaccination of healthcare workers and at-risk patients (influenza, pneumococcal) (Pittet *et al.,* 2000).

For surgical prophylaxis, antibiotics should be administered within one hour before incision and stopped within 24 hours post-operation in most cases. Similar principles apply to prophylaxis in immunocompromised patients.

Together, these recommendations form a coherent framework for responsible antibiotic use, balancing efficacy, safety, and sustainability.

Integration of the WHO AWaRe Classification

❖ **Survey of Prescriber Practices at Avicenne Hospital**

A brief in-hospital survey (N=113; item-level denominators varied) supported the stewardship priorities reported above. Most respondents prescribe antibiotics several times per week (69.6%), report having a local prescribing guide (65.2%), and use decision-support tools at least occasionally (80.4%; 15.2% systematically). When available, the antibiogram was cited as the principal decision criterion (84.1%), and 48–72 h reassessment was reported by 70.2%. De-escalation was practiced systematically by 44.4% and considered by an additional 33.3%. Only 31.1% reported knowing and actively using the WHO AWaRe classification in prescribing. The most frequently cited information sources were recent scientific literature and society consensus (38.8%), followed by experienced colleagues (17.9%), local recommendations (14.9%), and national guidelines (14.9%). Main perceived challenges included choosing the appropriate agent (30.0%), managing adverse effects (25.0%), and defining optimal duration (21.7%). Documentation was predominantly via detailed notes in the medical record (75.6%). Free-text priorities for improvement emphasized training, updated local protocols, decision-support tools, faster microbiology/diagnostics, and audit-and-feedback.

A major strength of the *«Hospital Guide for the Rational Use of Antibiotics»* is its explicit adoption of the WHO AWaRe classification — *Access*, *Watch*, and *Reserve* — as a practical tool for antibiotic selection and stewardship.

Developed by the WHO Expert Committee in 2017 and updated biennially (Sharland *et al.,* 2018), the AWaRe model groups antibiotics according to their activity spectrum, resistance potential, and importance as last-resort options. The WHO encourages countries to ensure that at least 60% of all antibiotic consumption derives from the *Access* group (Klein *et al.,* 2021).

❖ **Access Group**

First-line options for common infections: narrow-spectrum, affordable, and safe (Spellberg & Rice, 2023).

Examples: amoxicillin (± clavulanate), ampicillin, benzylpenicillin, cefazolin, cephalexin, gentamicin, doxycycline, metronidazole, and nitrofurantoin (Metlay *et al.,* 2019).

These drugs cover typical community pathogens and should be preferred whenever possible to preserve more potent agents.

❖ **Watch Group**

Broader-spectrum agents with higher resistance risk (Sharland *et al.,* 2018).

Examples: third-generation cephalosporins (ceftriaxone, cefotaxime, cefixime), fluoroquinolones (ciprofloxacin, levofloxacin), carbapenems, macrolides, vancomycin, and piperacillin–tazobactam (Metlay *et al.,* 2019).

Their use should be restricted to specific indications (e.g., severe sepsis, meningitis) and supported by microbiological evidence. The hospital conducts regular audits to track Watch antibiotic use.

❖ **Reserve Group**

Last-resort agents reserved for infections caused by highly resistant organisms (Sharland *et al.,* 2018).

Examples: colistin, polymyxin B, tigecycline, daptomycin, linezolid, teicoplanin, and ceftazidime–avibactam (Metlay *et al.,* 2019).

Use of these agents requires specialist approval and close clinical monitoring.

At Avicenne Hospital, every antibiotic in the formulary is labelled by its AWaRe category on prescription sheets. Clinicians are prompted to justify or seek expert input when prescribing Watch or Reserve drugs such as fluoroquinolones or carbapenems.

This strategy aligns with WHO objectives and encourages a rebalancing of antibiotic consumption toward the safer Access group. Monitoring indicators—including the proportion of Access antibiotics and Reserve-class use—are incorporated into the hospital's stewardship dashboard.

❖ **Empirical Treatment Protocols for Common Infections**

The *«Hospital Guide for the Rational Use of Antibiotics»* proposes empiric regimens for frequently encountered infections, adapted to local resistance data and always prioritising Access antibiotics when feasible.

1. Community-Acquired Pneumonia (CAP)

- For adults without comorbidities: high-dose oral amoxicillin is first-line, targeting *Streptococcus pneumoniae (Sharland et al., 2018)*.
  Alternatives for penicillin allergy include azithromycin or doxycycline.
  If atypical pathogens are suspected, a macrolide is added.
- Moderate-to-severe CAP requiring hospitalisation: IV amoxicillin–clavulanate or ceftriaxone + macrolide.

In ICU cases or ventilated patients, broader coverage (piperacillin–tazobactam ± vancomycin) may be required (Gupta *et al.,* 2011; Kalil *et al.,* 2016).

All regimens require reassessment at 48–72 hours and de-escalation when cultures permit. Typical duration: 5–7 days; longer (up to 10) for *Legionella* or complicated cases.

2. Urinary Tract Infections (UTIs)

- **Uncomplicated cystitis:** Access antibiotics such as fosfomycin-trometamol (single dose), trimethoprim–sulfamethoxazole (3 days), or nitrofurantoin (5–7 days) (Solomkin *et al.,* 2010).
  Fluoroquinolones are discouraged.
- **Pyelonephritis:** oral cefixime (7–10 days) or co-trimoxazole (14 days if susceptible); severe cases → IV ceftriaxone.
  If ESBL risk is high, ertapenem may be used empirically but must be de-escalated after cultures.
- **Prostatitis:** fluoroquinolone for 4–6 weeks (if tolerated).
- **Catheter-associated infections:** replace the catheter and treat based on culture; avoid quinolones as first-line.

3. Intra-Abdominal Infections

Empirical coverage targets enteric Gram-negatives and anaerobes.

- **Appendiceal peritonitis:** IV amoxicillin–clavulanate + gentamicin; alternative = ceftriaxone + metronidazole for penicillin-allergic patients.
- **Cholangitis:** third-generation cephalosporin + metronidazole.
- **Nosocomial/high-risk cases:** piperacillin–tazobactam or carbapenem (Reserve).

Source control and early de-escalation are mandatory.
Recommended duration: 5–7 days after surgical control (Stevens *et al.,* 2014).

4. Skin and Soft-Tissue Infections (SSTIs)

- **Cellulitis/erysipelas:** penicillin G (IV) or amoxicillin (oral) for 7 days (Tunkel *et al.,* 2004).

If allergic: clindamycin.
For *S. aureus* infections: oxacillin (cloxacillin) or cefazolin; oral switch possible.
If MRSA suspected: vancomycin or daptomycin.

- **Necrotising fasciitis:** urgent surgery + piperacillin–tazobactam + vancomycin + clindamycin (to inhibit toxin production).

Narrow therapy once pathogen identified.

5. Other Severe Infections

- **Acute bacterial meningitis:** cefotaxime or ceftriaxone + vancomycin; add ampicillin >50 years (Listeria coverage).
- **Infective endocarditis:** multidisciplinary management; β-lactam + gentamicin or vancomycin if MRSA suspected (Baddour *et al.,* 2015; Macy & Contreras, 2014).
- **Bone and joint infections:** surgery + 6 weeks of targeted therapy.

Across all conditions, the same guiding ethos applies: start with evidence-based empiric therapy, favour Access drugs, and refine early once cultures are available.

❖ **Cross-Cutting Principles for Optimising Antibiotic Therapy**

Beyond infection-specific regimens, the *«Hospital Guide for the Rational Use of Antibiotics»* identifies several overarching principles that apply to all antimicrobial prescriptions. These principles are central to the concept of rational antibiotic use and are designed to ensure safe, effective, and sustainable therapy.

1. Optimal Treatment Duration

The guide strongly advocates for shortest-effective treatment durations, supported by a growing

body of evidence demonstrating that shorter courses are equally efficacious for many infections while reducing adverse events and the emergence of resistance (Spellberg & Rice, 2023).

For example:

- 5 days may suffice for moderate community-acquired pneumonia;
- 7 days for uncomplicated pyelonephritis;
- Longer regimens (10–14 days or more) are reserved for deep-seated or uncontrolled infections such as endocarditis or osteomyelitis.

Excessively prolonged treatment adds no benefit and exposes patients to toxicity and dysbiosis. Conversely, premature discontinuation in critically ill or immunocompromised patients is discouraged without expert input. The overarching rule is simple: long enough to cure, but never longer than necessary.

2. Dose Adjustment in Renal or Hepatic Impairment

Because under- or overdosing can lead respectively to therapeutic failure or toxicity, the guide provides precise dosing tables for patients with organ dysfunction.

Examples include:

- For creatinine clearance < 30 mL/min, extend aminoglycoside intervals to 36–48 hours.
- Adjust β-lactam dosing (penicillins, cephalosporins, carbapenems) to prevent accumulation.
- Guide vancomycin therapy through serum-level monitoring to avoid nephrotoxicity.

In contrast, cloxacillin, macrolides, and tetracyclines usually require no renal adjustment, as they are mainly cleared hepatically. For hepatic impairment, dose reduction may be indicated for metronidazole or rifampicin. In complex cases, consultation with an infectious-disease or clinical-pharmacy specialist is recommended.

These tailored adjustments maintain therapeutic levels and prevent iatrogenic complications, reinforcing the notion that precision in dosing is an integral part of stewardship.

3. Adverse Effects and Monitoring

All antibiotics carry potential side effects that clinicians must anticipate and monitor.

The guide lists the most relevant examples:

- *Clostridioides difficile* colitis linked to fluoroquinolones, cephalosporins, and clindamycin;
- Nephrotoxicity with aminoglycosides or vancomycin;
- Hepatotoxicity with rifampicin or isoniazid;
- Bone-marrow suppression with chloramphenicol;
- Disulfiram-like reactions with metronidazole;
- Photosensitivity under fluoroquinolones or tetracyclines;
- QT prolongation and tendon rupture with fluoroquinolones.

Patients should receive clear counselling—e.g. avoid alcohol while taking metronidazole, limit sun exposure under doxycycline—and undergo periodic laboratory monitoring when courses are long or high-risk (liver tests for hepatotoxic drugs, renal function for aminoglycosides, complete blood count for linezolid beyond two weeks).

4. Allergies and Drug Tolerance

A thorough allergy history is indispensable before prescribing.

True β-lactam allergy is typically immediate (anaphylaxis, angio-oedema, or generalised urticaria). In such cases, penicillins are contraindicated and cephalosporins should be used with caution.

However, studies show that over 90 % of reported penicillin allergies are inaccurate (Patterson & Stankewicz, 2017)—often based on childhood rashes or intolerance rather than true hypersensitivity.

Therefore, the guide encourages confirmatory testing or desensitisation when β-lactam therapy is optimal (for instance, penicillin G for neurosyphilis or oxacillin for MSSA endocarditis). This prevents unnecessary use of broader or more toxic alternatives.

Simple measures can also improve tolerance: taking oral antibiotics with food, splitting doses to reduce gastric discomfort, and in some cases using probiotics to mitigate antibiotic-associated diarrhoea.

DISCUSSION

These local survey findings align with stewardship pillars implemented at Avicenne (48–72 h reassessment, de-escalation) yet reveal opportunities to strengthen AWaRe-guided prescribing (only 31.1% report active use). Combined with perceived difficulties (agent selection, adverse-event management, duration), the results justify targeted clinician education, refreshed local protocols, and point-of-care decision support, alongside efforts to expedite microbiology turnaround and institutionalize audit-and-feedback.

❖ **Alignment with International Stewardship Standards**

The *«Hospital Guide for the Rational Use of Antibiotics»* mirrors the core tenets of global antimicrobial-stewardship frameworks. Its insistence on justified prescriptions, early microbiological sampling,

48–72 h reassessment, and minimal effective duration reflects the same pillars promoted by WHO, CDC, and ECDC initiatives (Barlam *et al.,* 2016; Kalil *et al.,* 2016).

Similar approaches across Europe and North America demonstrate that such structured review processes consistently lower antibiotic exposure and resistance rates.

The emphasis on first-line, narrow-spectrum "Access" antibiotics is likewise in line with international recommendations and represents a pragmatic balance between efficacy and ecological safety.

❖ Integration of the WHO AWaRe Framework

Perhaps the guide's most innovative aspect is the seamless integration of the WHO AWaRe classification into local practice. This framework not only simplifies prescribing decisions but also standardises national surveillance by providing measurable consumption indicators (Sharland *et al.,* 2018).

At the Avicenne Military Hospital, categorising every formulary drug by AWaRe group turns an abstract concept into a daily decision-support tool.

Comparable systems exist in several European centres where Watch or Reserve antibiotics (e.g. carbapenems, colistin) require infectious-disease authorisation. Evaluations have shown such restrictions significantly reduce misuse and slow the dissemination of multi-resistant organisms(Giamarellou *et al.,* 2023).

However, enforcement alone is insufficient. Success depends on clinician engagement. Continuous education, feedback, and transparent data sharing are vital so that prescribers perceive stewardship not as an administrative constraint but as a

Collective Safety Mechanism.

In Morocco, diagnostic resources can sometimes be limited. The guide prudently stresses that stewardship must never delay urgent therapy: in life-threatening infections, empirical treatment should start immediately, with subsequent adjustment once results are available.

❖ Comparison with International Guidelines

When compared to the WHO AWaRe Antibiotic Book (2022) and the IDSA recommendations, the *«Hospital Guide for the Rational Use of Antibiotics»* protocols appear both aligned and locally adapted.

Empirical regimens follow WHO standards for common infectious syndromes but integrate regional data:

- The relatively high prevalence of ESBL-producing Enterobacterales in Morocco justifies earlier resort to carbapenems in selected high-risk situations.
- Conversely, sustained penicillin susceptibility of *S. pneumoniae* permits the continued use of amoxicillin monotherapy for community-acquired pneumonia—a strategy no longer viable in many Western countries.

These adaptations underline the importance of ongoing collaboration between clinicians and microbiologists to ensure empiric choices evolve with local resistance trends.

❖ Implementation Challenges

Designing a guide is only the first step; ensuring real-world adherence is more complex. At Avicenne Military Hospital, dissemination efforts included continuing-education sessions for physicians and nurses, focused on specimen collection, therapy review, and IV-to-oral switch protocols. To enhance accessibility, the team created concise wall charts, an intranet version, and a mobile app summarising key recommendation.

Yet common obstacles persist: ingrained prescribing habits, patient expectations for antibiotics "just in case," and defensive medicine driven by fear of under-treatment.

Here, the role of the Antibiotic Committee is crucial—conducting audits, providing feedback, and reinforcing evidence-based practice.

A less obvious but equally important challenge is drug availability. Paradoxically, some inexpensive Access antibiotics occasionally face supply shortages, while broad-spectrum alternatives remain plentiful. Securing a reliable supply of first-line agents is therefore essential for stewardship to succeed.

❖ Public-Health Implications

This hospital initiative aligns with Morocco's national strategy against AMR, which now includes surveillance networks, action plans, and stewardship programmes.

A 2018 local audit at Avicenne Military Hospital had already revealed high antibiotic consumption rates (Lahouidri, 2017), echoing broader national patterns .

By 193ormalizing stewardship, the guide aims to improve prescription quality, reduce multidrug-resistant infections, and curb *C. difficile* and ESBL incidence through reduced use of fluoroquinolones and third-generation cephalosporins.

International meta-analyses confirm that hospital stewardship programmes lower antibiotic consumption, decrease resistance rates, and improve clinical outcomes.

The *«Hospital Guide for the Rational Use of Antibiotics»* of Avicenne Military Hospital of Marrakech experience contributes to this growing evidence base, illustrating that effective stewardship is attainable even in resource-constrained settings.

❖ **Contextual Priorities**

While the guide aligns globally, contextual emphasis differs.

In high-income countries, stewardship often targets community over-prescription (e.g. antibiotics for viral bronchitis).

In Moroccan hospitals, the priority lies in optimising ICU prescriptions, ensuring timely microbiological sampling, and reducing prolonged empirical therapy.

The *«Hospital Guide for the Rational Use of Antibiotics»* of Avicenne Military Hospital of Marrakech experience demonstrates that knowledge exchange between institutions—nationally and internationally—enhances progress.

By sharing these lessons, the guide can inspire other hospitals to tailor and adopt similar initiatives, reinforcing the global fight against AMR.

CONCLUSION

Antimicrobial resistance has already reached crisis proportions, responsible for millions of deaths each year and threatening to render modern medicine defenceless against once-treatable infections(ALABI, 2024; Salehi *et al.,* 2022).

Rational antibiotic use is therefore both an ethical duty and a global public-health necessity.

The *«Hospital Guide for the Rational Use of Antibiotics»* developed by the Avicenne Military Hospital of Marrakech exemplifies how stewardship principles can be translated into practical, context-sensitive hospital policy.

By insisting on:

- justified prescriptions,
- careful selection and dosing of agents,
- integration of the WHO AWaRe framework, and
- systematic review of therapy based on microbiological and patient factors, the guide offers clinicians a concrete roadmap for preserving antibiotic efficacy.

Its message is clear: most infections can be treated successfully with narrow-spectrum Access antibiotics, reserving powerful agents for true last-resort scenarios.

Attention to treatment duration, dose adjustment, and monitoring underscores that good stewardship is not restriction but

PRECISION

Implementing such guidance requires multidisciplinary collaboration—physicians, pharmacists, microbiologists, nurses, and hospital administrators working together supported by policy makers and continuous education. Real-time surveillance of antibiotic consumption, regular feedback, and expanded access to rapid diagnostics are vital complements.

In conclusion, promoting the rational use of antibiotics in hospitals is a vital investment for the future. Each hospital, by adapting these principles to its own context, contributes to the global effort to combat antimicrobial resistance. As the well-known saying goes: “Antibiotics are not automatic.” It is our collective responsibility to bring this message to life every day, so that future generations may continue to benefit from the life-saving power of antibiotics. The *«Hospital Guide for the Rational Use of Antibiotics»* is a concrete expression of this commitment, rooted in the local context, and its experience may inspire other institutions around the world to help preserve this shared therapeutic heritage.

The experience of the Avicenne Hospital stands as a practical, evidence-based example of how local leadership can support a global cause: the preservation of antimicrobial efficacy for all.

REFERENCES

- ALABI, O. E. (2024). *ONE HEALTH PUT INTO PRACTICE? AN ANALYSIS OF THE NIGERIAN ANTIMICROBIAL RESISTANCE POLICY, STRATEGIES AND PRACTICES* Thammasat University].
- Baddour, L. M., Wilson, W. R., Bayer, A. S., Fowler Jr, V. G., Tleyjeh, I. M., Rybak, M. J., Barsic, B., Lockhart, P. B., Gewitz, M. H., & Levison, M. E. (2015). Infective endocarditis in adults: diagnosis, antimicrobial therapy, and management of complications: a scientific statement for healthcare professionals from the American Heart Association. *Circulation*, *132*(15), 1435-1486.
- Barlam, T. F., Cosgrove, S. E., Abbo, L. M., MacDougall, C., Schuetz, A. N., Septimus, E. J., Srinivasan, A., Dellit, T. H., Falck-Ytter, Y. T., & Fishman, N. O. (2016). Implementing an antibiotic stewardship program: guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. *Clinical Infectious Diseases*, *62*(10), e51-e77.
- Carlet, J., & Herida, M. (1998). Le bon usage des antibiotiques à l'hôpital: Recommandations pour maîtriser le développement de la résistance bactérienne. *La Presse médicale (1983)*, *27*(33), 1687-1693.

- Collignon, P., Beggs, J. J., Walsh, T. R., Gandra, S., & Laxminarayan, R. (2018). Anthropological and socioeconomic factors contributing to global antimicrobial resistance: a univariate and multivariable analysis. *The Lancet Planetary Health*, *2*(9), e398-e405.
- Giamarellou, H., Galani, L., Karavasilis, T., Ioannidis, K., & Karaiskos, I. (2023). Antimicrobial stewardship in the hospital setting: a narrative review. *Antibiotics*, *12*(10), 1557.
- Gupta, K., Hooton, T. M., Naber, K. G., Wullt, B., Colgan, R., Miller, L. G., Moran, G. J., Nicolle, L. E., Raz, R., & Schaeffer, A. J. (2011). International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women: a 2010 update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases. *Clinical Infectious Diseases*, *52*(5), e103-e120.
- Kalil, A. C., Metersky, M. L., Klompas, M., Muscedere, J., Sweeney, D. A., Palmer, L. B., Napolitano, L. M., O'Grady, N. P., Bartlett, J. G., & Carratalà, J. (2016). Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 clinical practice guidelines by the Infectious Diseases Society of America and the American Thoracic Society. *Clinical Infectious Diseases*, *63*(5), e61-e111.
- Klein, E. Y., Milkowska-Shibata, M., Tseng, K. K., Sharland, M., Gandra, S., Pulcini, C., & Laxminarayan, R. (2021). Assessment of WHO antibiotic consumption and access targets in 76 countries, 2000–15: an analysis of pharmaceutical sales data. *The Lancet Infectious Diseases*, *21*(1), 107-115.
- Lahouidri, R. (2017). La prescription des antibiotiques en réanimation: expérience du service de réanimation chirurgicale de l'hôpital militaire AVICENNE Marrakech.
- Macy, E., & Contreras, R. (2014). Health care use and serious infection prevalence associated with penicillin "allergy" in hospitalized patients: a cohort study. *Journal of Allergy and Clinical Immunology*, *133*(3), 790-796.
- Metlay, J. P., Waterer, G. W., Long, A. C., Anzueto, A., Brozek, J., Crothers, K., Cooley, L. A., Dean, N. C., Fine, M. J., & Flanders, S. A. (2019). Diagnosis and treatment of adults with community-acquired pneumonia. An official clinical practice guideline of the American Thoracic Society and Infectious Diseases Society of America. *American journal of respiratory and critical care medicine*, *200*(7), e45-e67.
- mondiale de la Santé, A. (2015). Plan d'action mondial pour combattre la résistance aux antimicrobiens. In *Plan d'action mondial pour combattre la résistance aux antimicrobiens*.
- Murray, C. J., Ikuta, K. S., Sharara, F., Swetschinski, L., Aguilar, G. R., Gray, A., Han, C., Bisignano, C., Rao, P., & Wool, E. (2022). Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *The lancet*, *399*(10325), 629-655.
- O'Neill, J. (2016). Tackling drug-resistant infections globally: final report and recommendations.
- Patterson, R. A., & Stankewicz, H. A. (2017). Penicillin allergy.
- Pittet, D., Hugonnet, S., Harbarth, S., Mourouga, P., Sauvan, V., Touveneau, S., & Perneger, T. V. (2000). Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *The lancet*, *356*(9238), 1307-1312.
- Salehi, B., Abu-Darwish, M., Tarawneh, A., Cabral, C., Gadetskaya, A., Salgueiro, L., Hosseinabadi, T., Rajabi, S., Chanda, W., & Sharifi-Rad, M. (2022). Antimicrobial resistance collaborators global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *Lancet*, *399*, 629-655.
- Sharland, M., Pulcini, C., Harbarth, S., Zeng, M., Gandra, S., Mathur, S., & Magrini, N. (2018). Classifying antibiotics in the WHO Essential Medicines List for optimal use—be AWaRe. *The Lancet Infectious Diseases*, *18*(1), 18-20.
- Solomkin, J. S., Mazuski, J. E., Bradley, J. S., Rodvold, K. A., Goldstein, E. J., Baron, E. J., O'Neill, P. J., Chow, A. W., Dellinger, E. P., & Eachempati, S. R. (2010). Diagnosis and management of complicated intra-abdominal infection in adults and children: guidelines by the Surgical Infection Society and the Infectious Diseases Society of America. *Surgical infections*, *11*(1), 79-109.
- Spellberg, B., & Rice, L. B. (2023). The shorter is better movement: past, present, future. *Clinical Microbiology and Infection*, *29*(2), 141-142.
- Stevens, D. L., Bisno, A. L., Chambers, H. F., Dellinger, E. P., Goldstein, E. J., Gorbach, S. L., Hirschmann, J. V., Kaplan, S. L., Montoya, J. G., & Wade, J. C. (2014). Practice guidelines for the diagnosis and management of skin and soft tissue infections: 2014 update by the Infectious Diseases Society of America. *Clinical Infectious Diseases*, *59*(2), e10-e52.
- Tunkel, A. R., Hartman, B. J., Kaplan, S. L., Kaufman, B. A., Roos, K. L., Scheld, W. M., & Whitley, R. J. (2004). Practice guidelines for the management of bacterial meningitis. *Clinical Infectious Diseases*, *39*(9), 1267-1284.
- Van Boeckel, T. P., Brower, C., Gilbert, M., Grenfell, B. T., Levin, S. A., Robinson, T. P., Teillant, A., & Laxminarayan, R. (2015). Global trends in antimicrobial use in food animals. *Proceedings of the National Academy of Sciences*, *112*(18), 5649-5654.
- Van Boeckel, T. P., Gandra, S., Ashok, A., Caudron, Q., Grenfell, B. T., Levin, S. A., & Laxminarayan, R. (2014). Global antibiotic consumption 2000 to 2010: an analysis of national pharmaceutical sales data. *The Lancet Infectious Diseases*, *14*(8), 742-750.
- Walsh, T. R., Gales, A. C., Laxminarayan, R., & Dodd, P. C. (2023). Antimicrobial resistance: addressing a global threat to humanity. In (Vol. 20, pp. e1004264): Public Library of Science San Francisco, CA USA.