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Patient Education and Behavioural Change in Antimicrobial Stewardship: A Narrative Review of Gaps, Challenges and Opportunities

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Background: Antimicrobial resistance (AMR) is a rapidly escalating global public health threat driven largely by inappropriate antibiotic use, including misuse, overuse, self-medication, and poor adherence. In Nigeria, inappropriate antibiotic use is estimated at 20–50%, with low public understanding of antimicrobial resistance despite widespread awareness of antibiotics. Antimicrobial stewardship (AMS) programmes aim to optimise antibiotic use and reduce resistance; however, patient education and behavioural change remain underutilised components.

Objectives: To explore the gaps, challenges and opportunities in patient-centred education and behavioural interventions within antimicrobial stewardship.

Methods: A narrative literature review was conducted using PubMed, Scopus, Web of Science, and Cochrane Library databases. Articles written in the English language published between 2010 and 2025 were searched using keywords including antimicrobial stewardship, patient education, behaviour change, antibiotic use, and antimicrobial resistance. Peer-reviewed studies, guidelines and landmark reports were prioritised.

Results: Evidence indicates significant gaps in patient knowledge, high rates of self-medication, misconceptions about antibiotic use, and poor adherence to prescribed regimens, particularly in low and middle-income countries like Nigeria. Patient education interventions were associated with improved antibiotic knowledge, reduced inappropriate demand, enhanced adherence and decreased self-medication. Behavioural strategies such as shared decision-making, counselling and community engagement strengthened stewardship outcomes.

Conclusion: Integrating patient education and behavioural change strategies into antimicrobial stewardship programmes is essential for combating AMR. Patient-centred, culturally appropriate and multidisciplinary approaches present key opportunities for strengthening stewardship efforts in Nigeria and similar settings.

Predictors of outcomes of Paediatric Diphtheria in Sub-Saharan Africa: A systematic review and meta-analysis

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Background: Diphtheria is a disease of public health significance with disproportionate childhood morbidity and mortality. A systematic review of the literature on predictors of outcomes of paediatric diphtheria in Sub-Saharan Africa was conducted.

Methods: We conducted a systematic search of PubMed, Embase, Scopus, Web of Science, Google Scholar, and grey literature from January 1990 to October 2025. Eligible studies included children ≤15 years with laboratory-confirmed or clinical or epidemiologic diphtheria reporting outcome data. Two reviewers independently screened articles, extracted data, and assessed study quality using a modified Newcastle–Ottawa Scale. We pooled data using random-effects meta-analysis, where two studies

reported comparable outcomes and assessed heterogeneity with I^2 statistics.

Results: Of the 1,732 records screened, 23 studies from 12 Sub-Saharan countries (n = 5,480 paediatric cases) met the inclusion criteria. Reported Case Fatality Rates (CFR) ranged from 4.9% to 24.3% with a pooled CFR of 14.7% (95% CI 11.3–18.7%; I^2 = 56%). Meta-analysis synthesis showed the predictors of poor outcome to include delayed presentation (>72hours) (Pooled OR 2.89, 95% CI 1.95–4.29, I^2 = 38%), delayed or absent diphtheria antitoxin (Pooled OR 4.12, 95% CI 2.45–6.93, I^2 = 29%), lack of vaccination (Pooled OR 2.73, 95% CI 1.84–4.06, I^2 = 24%), and severe airway obstruction (Pooled OR 3.47, 95% CI 2.16–5.57, I^2 = 33%).

Conclusions: Diphtheria remains a major cause of mortality in Sub-Saharan Africa. Lack of diphtheria antitoxin and vaccination are predictors of adverse outcomes in children. There is a need to strengthen vaccine coverage.

Combating Paediatric Antimicrobial Resistance Through Microbiome Modulation: Emerging Bioinformatic and Biotechnological Approaches.

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Background: Antimicrobial resistance is a significant public health challenge, especially in Sub-Saharan Africa, with huge childhood morbidity and mortality. Traditional antimicrobial therapies often disrupt the host microbiome with consequences such as multi- and pan-drug resistance. Emerging evidence suggests that the host microbiome, through bioinformatics and biotechnology, offers a promising target for innovative interventions to manage antimicrobial resistance.

Objectives: To explore current knowledge on paediatric microbiome-based interventions targeting antimicrobial resistance, highlighting bioinformatic and biotechnological innovations, associated challenges and recommendations.

Methods: We conducted a narrative review of peer-reviewed articles from 2015 to 2025 in PubMed, Scopus, Google Scholar, and Web of Science using keywords and MeSH terms such as “Paediatric microbiome”, “antimicrobial resistance”, “bioinformatics”, and “biotechnology”. We analysed relevant studies thematically and contextually.

Results: This review identified multiple microbiome-based strategies against antimicrobial resistance, which include probiotics, prebiotics, synbiotics, engineered antimicrobial peptides, nanoparticles, bacteriophage therapy, CRISPR-based approaches and faecal microbiota transplantation. Integrative metagenomics, metatranscriptomics and metabolomics through computational bioinformatics and machine learning algorithms allow for high-resolution mapping of antimicrobial genes, predictive analytics, personalised therapeutics, drug repositioning, resistome profiling and surveillance. Challenges found were inter-individual microbial heterogeneity, poor tolerability in children, poor biotechnological infrastructure, poor health-data literacy among healthcare workers and regulatory constraints on health data ethics. Identified recommendations included human capacity building, research funding, improved health-data infrastructure, and ethical data governance.

Conclusion: Microbiome-based bioinformatics and biotechnology is the next frontier to combating antimicrobial resistance. There is an urgent need for capacity building and trans-disciplinary research, especially in Sub-Saharan Africa.

Antibiotic Use in Hospitalised Children at the University College Hospital, Ibadan: Appropriateness and Associated Factors

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Background: The abuse and misuse of antibiotics have contributed to the emergence and spread of antimicrobial resistance. Evaluating antibiotic use is a crucial step for antimicrobial stewardship interventions.

Objectives: To determine the prevalence and pattern of antibiotic use in hospitalised children at the University College Hospital in Ibadan, as well as the appropriateness of these antibiotics.

Methods: It was a descriptive longitudinal study of 418 children aged 0-15 years, hospitalised and commenced on antibiotics. Patients were followed up until discharge and Day 28 post-discharge. The review for appropriateness in accordance with the existing

antibiotic handbook in the department was done by the investigator and verified by a paediatric infectious disease specialist. Antibiotics used were classified using the WHO AWaRe classification 2021 into Access, Watch or Reserve groups.

Results: The prevalence of antibiotic use was 95.9 %, with ceftriaxone being the most prescribed, while cefuroxime plus gentamicin was the most common combination. Pneumonia was the most common indication for antibiotics. Only 49.2% of the prescribed antibiotics were from the Access Group, while 50.0% were from the Watch Group, and 0.8% were from the Reserve Group of antibiotics. Only 5.7% of the patients had targeted therapy. Adherence to antibiotic treatment guidelines was 40.7%, with most antibiotics prescribed empirically. Factors associated with inappropriate antibiotic use were a diagnosis of presumed early onset neonatal sepsis (aOR: 10.42, 95% CI: 2.08–52.31, p=0.004), acute diarrhoeal disease (aOR: 5.72, 95% CI: 1.43–22.93, p=0.014), prescriptions involving "Watch only" (aOR: 29.78, 95% CI: 4.99–177.72, p<0.001) and "Access + Watch" (aOR: 14.00, 95% CI: 3.29–59.56, p<0.001) category antibiotics. Low socioeconomic class was, however, associated with less risk of inappropriate antibiotic use.

Conclusion: The prevalence of antibiotic use was high, with a high usage of broad-spectrum "Watch" group antibiotics. Widespread implementation of an antimicrobial stewardship programme is recommended.

In-silico Multi-Omic Characterisation of Viral versus Bacterial Paediatric Pneumonia: A Machine-Learning–based Approach

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Background: Childhood pneumonia remains a leading infectious cause of morbidity and mortality. Multi-omic approaches through in-silico machine learning can identify biomarkers for viral-bacterial differentiation.

Objectives: The study aimed to identify biomarkers that differentiate viral from bacterial pediatric pneumonia through bioinformatics.

Methods: Transcriptomic, proteomic and metabolomic datasets from children with confirmed pneumonia were curated by applying standard preprocessing steps. Differential expression analysis identified omic features associated with viral or bacterial infection, while supervised machine learning algorithms generated classification models. We used multi-omic integration to identify cross-layer molecular modules and conducted biological interpretation using pathway enrichment analysis from established databases.

Results: Transcriptomics revealed that viral pneumonia was strongly associated with upregulation of IFIT1, MX1, ISG15, OAS1, and RSAD2, reflecting canonical interferon-driven antiviral pathways. Bacterial pneumonia, on the other hand, showed higher expression of LCN2, MMP8, CEACAM8, S100A8/A9, and IL1B, consistent with neutrophil activation and acute inflammatory responses. Proteomics highlighted elevated myeloperoxidase (MPO), calprotectin and complement C3 fragments in bacterial cases, whereas viral cases showed increases in interferon-inducible proteins such as IFI16 and STAT1-associated signalling proteins. Metabolomics revealed that viral pneumonia demonstrated increased levels of kynurenine and nicotinamide metabolites, while bacterial pneumonia exhibited higher concentrations of lactate, succinate and amino acid–derived inflammatory metabolites. Integrated machine-learning models achieved consistent separation of viral and bacterial infections across datasets.

Conclusion: In silico multi-omic approach revealed biologically meaningful biomarkers with viral-bacterial differentiation in paediatric pneumonia. This offers an opportunity for developing precision diagnostics and improving antimicrobial stewardship.

Antibiotic Stewardship in a Paediatric Practice: Experience from a Secondary-Level Facility – The Oni Memorial Children's Hospital, Ibadan

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Background: Antimicrobial resistance (AMR) disproportionately affects children, especially in low- and middle-income countries. The Oni Memorial Children's Hospital (OMCH), Ibadan, established an

Antibiotic Stewardship (AMS) programme in 2025 to improve rational antibiotic use and align with the Nigeria AMR National Action Plan 2.0.

Objective: To improve rational antibiotic use and align with the Nigeria AMR National Action Plan 2.0.

Methods: Using a hub-and-spoke model, the CwPAMS Ibadan–Sheffield AMS Partnership supported assessments at OMCH. Global Point Prevalence Surveys (GPPS) in July and December 2025 informed and evaluated interventions, including a "Culture-First" policy, mandatory stop/review documentation, and WATCH antibiotic restrictions.

Results: Baseline data (July 2025) showed 32.1% Access and 67.9% Watch antibiotic use among inpatients, with 0% culture rates and 0% stop/review documentation. Following AMS interventions, December 2025 results showed significant improvement: Inpatient Access group use rose to 70.6%, while Watch group use fell to 29.4%. Under the "Culture-First" policy, laboratory cultures sent for inpatients increased from 0% to 97.1%. Notably, stop/review date documentation reached 100% compliance. For outpatients, access to antibiotics increased from 50% to 84.6%, and guideline compliance reached 92.3% from 40%. While sepsis remained the primary inpatient indication (68.2%), reliance on broad-spectrum empiric therapy was replaced by targeted, diagnostic-led prescribing and scheduled reviews.

Conclusion: Data-driven AMS interventions can be successfully implemented in secondary-level paediatric hospitals, resulting in 100% documentation compliance and universal culture rates. OMCH successfully surpassed the WHO 60% Access group target, supporting national AMR objectives.

Keywords: Antimicrobial stewardship, Global-PPS, paediatrics, AWaRe, antimicrobial resistance, secondary-level hospital.

Burden of Bacterial Antimicrobial Resistance Among Hospitalised Children at The University College Hospital, Ibadan

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Background: Antimicrobial resistance (AMR) is a rapidly emerging global health crisis that disproportionately affects children and is thus a pressing threat to childhood survival**.** Assessing the burden of AMR is essential to determine the magnitude of this problem, to set priorities, and guide policy interventions

Objective: The study sought to evaluate the burden of bacterial antimicrobial resistance among hospitalised children at the University College Hospital, Ibadan.

Methods: It was a descriptive longitudinal study of children with suspected infections aged 0-15 years, hospitalised between February 2024 and June 2024 and commenced on antibiotics. Blood cultures and other clinical samples were tested using standard microbiological processes. Patients were followed up daily until discharge and on Day 28 post-discharge.

Results: Over 5 months, 436 children were admitted across twelve paediatric units, of which 418 children were enrolled, with a mean (SD) age of 3.9 (1.9) years, and 284 (59.3%) were males. The commonest infection was community-acquired pneumonia 103/418 (24.6%), followed by sepsis 68/418 (16.4%). The commonest empiric antibiotics used were ceftriaxone 203 (20.5%) and gentamicin 197 (19.9%). There were 97 isolates from 331 blood cultures, with 49 (50.5%) Gram-positive organisms and 48 (49.5%) Gram-negative organisms. The commonest isolates were *Staphylococcus aureus* 29 (29.9%), *Klebsiella pneumoniae* 11 (11.3%), *Escherichia coli* 9 (9.3%), *Pseudomonas aeruginosa* 8 (8.2%), *Acinetobacter baumanii* 7 (7.2%) and *Salmonella typhi* 4 (4.1%). Among the *Staphylococcus aureus* isolates, 35% were *MRSA*. Furthermore, 66.7% of the *Klebsiella pneumoniae isolates* were extended-spectrum β-lactamase producers, while 28.6% were carbapenem-resistant. In all, 86.4% of patients were discharged, 10.3% died, 3.3% left against medical advice and 4.5% were re-admitted after discharge.

Conclusion: There was a high local burden of antimicrobial resistance. The need to improve infection prevention and control practices, antibiotic stewardship, sustain AMR surveillance, and update of evidence-based treatment guidelines should be encouraged.

Hepatic Hydatidosis with Pyogenic Liver Abscess in a Child: A Case Report from Federal Teaching Hospital Gombe, Northeast Nigeria

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Background: Hydatid disease, caused by *Echinococcus* species, is a neglected tropical disease of public health relevance. It primarily affects the liver with attendant complications such as secondary infection and abscess formation.

Objective: To highlight the clinical presentation and multidisciplinary management of paediatric hepatic hydatidosis in a resource-limited setting.

Case Report: AA**,** 9-year-old male presented with recurrent high-grade fever of 1/12; dull abdominal pain and poor appetite of 3/52; weight loss of 3/52 and bilateral leg swelling of 1/52. He has a significant contact with sheep and is from a low socioeconomic background. Examination revealed a wasted child with pallor, bilateral pitting oedema and hepatomegaly. Laboratory investigations showed PCV 24%, WBC 8.0×10⁹/L, platelets 560×10⁹/L, elevated ALP, hypoalbuminemia, and ESR 125mm/hr. Serological test for hydatid disease was, however, unavailable. Abdominal ultrasound revealed multiple thick-walled hepatic cystic masses with septations, the largest 8.0×6.8cm. Abdominal CT confirmed large multiseptated hepatic masses with contrast-enhancing septations. Stool microscopy was unremarkable. Diagnosis was Hepatic hydatidosis with pyogenic liver abscess. He received oral albendazole, intravenous ceftriaxone, metronidazole, hydrocortisone, and nutritional support. He was transfused with packed cells and had an exploratory laparotomy resulting in drainage of eight abscess pockets totalling~800ml; the largest cyst contained about 400ml of chocolate-brown collection, with a daughter cyst superiorly. Aspirate culture yielded no growth, and cytology showed lymphocytic infiltrates. He recovered well and was discharged eight days post-operation.

Discussion/Conclusion: Hydatid disease may progress to secondary bacterial abscesses. Early imaging, prompt antiparasitic therapy and timely multidisciplinary management are essential to reduce morbidity and ensure favourable outcomes.