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RESEARCH ARTICLE

Association of Corticosteroid Utilisation with Amoxicillin-Resistant Diarrhoeagenic *Escherichia coli* Among Children Under Five in Nakuru, Kenya: A Matched Case-Control Study

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ABSTRACT

Diarrhoeagenic *Escherichia coli* (DEC) causes childhood diarrhoea, while antimicrobial resistance limits treatment. Systemic corticosteroids are used for paediatric asthma and allergy, but their relationship with resistant enteric infection in African children is unclear. We assessed the association between corticosteroid utilisation and amoxicillin-resistant DEC among children under five years in Nakuru County, Kenya. A hospital-based case-control study with 1:1 matching at recruitment was conducted from November 2017 to October 2018. Of 1,124 children screened, 384 had laboratory-confirmed DEC: 192 amoxicillin-resistant cases and 192 susceptible controls. Caregivers reported allergy/asthma medication use in the preceding 12 months. Susceptibility was determined by Kirby-Bauer disc diffusion. Medication associations were estimated from observed exposure counts as crude odds ratios (cORs) with 95% confidence intervals (CIs). Among cases, co-resistance occurred to ampicillin in 168/192 (87.5%) and erythromycin in 156/192 (81.3%). Corticosteroids were reported for 177/384 (46.1%) children and antihistamines for 127/384 (33.1%). Relative to the do-not-know/none category, corticosteroid utilisation was associated with higher odds of resistant DEC (cOR 2.71, 95% CI 1.57-4.66; p<0.001), whereas antihistamine utilisation was associated with lower odds (cOR 0.53, 95% CI 0.30-0.95; p=0.023). Corticosteroid utilisation was associated with amoxicillin-resistant DEC, but the crude observational estimate does not establish causality. Corticosteroids should remain limited to clear clinical indications. Prospective studies should capture indication, dose, duration, concurrent antibiotic use and pair-level data for matched analysis.

Keywords: *antimicrobial resistance; paediatric diarrhoea; matched case-control study; pharmacoepidemiology; corticosteroids; drug utilisation*

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INTRODUCTION

Diarrhoeal illness remains an important cause of sickness and death in children younger than five years, with the heaviest burden in low- and middle-income settings. Recent global estimates and African evidence show that the burden is shaped by household, environmental and socioeconomic conditions (GBD 2021 Diarrhoeal Diseases Collaborators, 2025; Azanaw et al., 2024). Diarrhoeagenic *Escherichia coli* (DEC) is one of the bacterial causes of both acute and persistent childhood diarrhoea. Across Africa, most DEC studies have been hospital based, and resistance to clinically important antibiotics is repeatedly reported, although surveillance is uneven (Kalule et al., 2024).

Antimicrobial resistance (AMR) makes bacterial diarrhoea harder to manage because commonly used empirical treatments may no longer be effective. A recent review of Enterobacterales infections in children in sub-Saharan Africa found particularly high resistance to ampicillin among *Escherichia coli* isolates (Kowalski et al., 2024). Similar concerns have been reported in Zambia, Egypt and South Africa, where multidrug resistance and extended-spectrum beta-lactamase phenotypes have been documented in enteric *Escherichia coli* from children (Chiyangi et al., 2017; Khairy et al., 2020; Heine et al., 2024). These findings sit within wider regional gaps in AMR surveillance and antimicrobial stewardship (Kariuki et al., 2022).

Kenyan studies point in the same direction. DEC and resistance to frequently used antimicrobials have been described among children with diarrhoea in Thika and Nairobi (Kanyina et al., 2016; Iijima et al., 2017; Webale et al., 2020). More recent studies have identified resistant enteric bacteria in children living in Nairobi informal settlements and antimicrobial-resistant DEC at the child-food-livestock interface (Kiiru et al., 2024; Okumu et al., 2025). Whole-genome sequencing of multidrug-resistant *Escherichia coli* from Kenyan children has also shown diverse lineages and clinically relevant resistance determinants (Kiiru et al., 2025).

Antibiotic exposure is an obvious source of selection pressure, but resistant infection may also cluster with patterns of healthcare use and other medicines. Antibiotic prescribing remains highly variable across low- and middle-income countries, and overuse is common (Sulis et al., 2022). Children who have recurrent illness may receive more prescriptions, have more contact with health facilities and experience several drug exposures within the same period. For pharmacoepidemiological studies of AMR, these related exposures need to be separated as far as the available data allow.

Systemic corticosteroids are routinely used when clinically indicated for asthma, allergic reactions and other inflammatory conditions. Their benefits are well established, but systemic exposure can suppress immune responses and has been associated with increased infection risk in several populations (Chaudhary et al., 2017; Aljebab et al., 2016; Waljee et al., 2017). In early childhood, immune maturation may further influence susceptibility to infection (Simon et al., 2015). Any association between corticosteroid use and resistant infection could therefore reflect altered host defence, repeated healthcare contact, co-prescribed antibiotics, severity of the underlying illness, or a combination of these factors; it should not be interpreted as evidence that corticosteroids directly generate bacterial resistance.

Non-antibiotic medicines may also be associated with bacterial outcomes, although the clinical meaning is uncertain. Laboratory studies have described antibacterial or antibiofilm activity for some antihistamines (Richter et al., 2017; Lagadinou et al., 2020), but such observations do not establish a therapeutic role in enteric infection. Direct epidemiological evidence on corticosteroid utilisation and resistant DEC in children under five years remains limited. This study therefore examined the association between caregiver-reported corticosteroid use for allergy or asthma and amoxicillin-resistant DEC among children under five years in Nakuru County, Kenya, while describing selected resistance patterns and antihistamine exposure.

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METHODS

Study Design

A hospital-based case-control study with 1:1 matching at recruitment was conducted from November 2017 to October 2018. Cases were children with laboratory-confirmed DEC that was phenotypically resistant to amoxicillin; controls were children from the same source population and study period with laboratory-confirmed DEC susceptible to amoxicillin. One control was selected for each case using age (within approximately three months), sex, place of residence and diarrhoea type as matching variables. The matching was applied during participant selection; the medication effect estimates reported in this manuscript are crude exposure odds ratios rather than conditional matched-pair estimates.

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Study Setting

The study was undertaken in the inpatient and outpatient paediatric services of the referral hospital in Nakuru County, Kenya, currently referred to in this manuscript as Nakuru County Referral Hospital. The contemporaneous 2017 site-authorisation letter identifies the same study site as Rift Valley Provincial General Hospital. The facility served as the clinical recruitment and primary microbiology site. Laboratory work included bacterial isolation, identification and antimicrobial susceptibility testing; DEC pathotyping was undertaken using polymerase chain reaction methods.

Study Population

The source population comprised children aged 0-59 months presenting with diarrhoea. Inclusion criteria were: (1) age below five years; (2) attendance at the study hospital during the study period; (3) DEC identified from a stool or anal-swab specimen; (4) case status defined by amoxicillin resistance or control status defined by amoxicillin susceptibility; and (5) written caregiver or legal-guardian consent. Exclusion criteria were: (1) *E. coli* recovered from non-stool specimens such as blood, urine or wounds; and (2) documented antibiotic use during the preceding two weeks. The final analytical population comprised 384 children, organised into 192 matched case-control pairs.

Sampling Procedure

All under-five children presenting with diarrhoea during recruitment were systematically screened for eligibility. Clinicians identified potentially eligible children and trained research personnel obtained consent, collected specimens and confirmed DEC status. The study recruitment flow recorded 1,124 children screened: 740 were DEC-negative and 384 were DEC-positive. The 384 DEC-positive children formed the analytical cohort and were classified into 192 amoxicillin-resistant cases and 192 susceptible controls. Controls were selected from the same hospital population and time period and matched to cases on the predefined matching variables.

Sample Size Determination

The parent study, conducted from November 2017 to October 2018, specified a two-sided alpha of 0.05 (Zalpha/2=1.96), 90% power (Zbeta=1.282), an anticipated odds ratio (OR) of 2.0 and an exposure prevalence of 50% among controls. A conservative case-control two-proportion approximation was applied (Schlesselman, 1982). With p0=0.50, the expected exposure proportion among cases was p1=(OR x p0)/(1-p0+OR x p0)=0.6667, and the average exposure proportion was pbar=(p0+p1)/2=0.5834. The required sample per group was n={Zalpha/2 x sqrt[2 x pbar x (1-pbar)] + Zbeta x sqrt[p0 x (1-p0) + p1 x (1-p1)]}^2/(p1-p0)^2. Substitution gave n=181.9, rounded to 182 participants per group. To allow for incomplete or non-evaluable records, the recruitment target was increased to 192 per group, giving 384 participants (192 case-control pairs).

Data Collection Tools

The parent study was conducted from November 2017 to October 2018. A structured interviewer administered questionnaire collected socio-demographic information, allergy/asthma history, medication exposure during the preceding 12 months and relevant clinical characteristics. The instrument was available in English and Kiswahili and was pre-tested at Kabarnet County Referral Hospital. Reliability testing in the parent study reported acceptable internal consistency for the corticosteroid exposure domain (Cronbach alpha=0.78). Medication history was based mainly on caregiver report and was checked against prescriptions or clinical records where these were available. Laboratory materials included sterile stool/anal-swab collection supplies, transport media, buffered peptone water, Eosin Methylene Blue agar, biochemical identification media and Mueller-Hinton agar for susceptibility testing.

Data Collection Procedure

Trained clinic staff identified potential participants, after which the study was explained to caregivers and written informed consent was obtained. Stool specimens were collected when available; otherwise, sterile anal swabs were obtained aseptically, labelled with a unique study code and transported in appropriate media under cold-chain conditions. Specimens were enriched in buffered peptone water and cultured on Eosin Methylene Blue agar. Presumptive *E. coli* isolates were purified and confirmed using standard biochemical procedures including IMViC tests (Cheesbrough, 2006). DEC pathotypes were characterised using PCR targets described by Shetty et al. (2012) and Fujioka et al. (2013). Antimicrobial susceptibility was determined by the Kirby-Bauer disc-diffusion method on Mueller-Hinton agar (Bauer et al., 1966) and interpreted using Clinical and Laboratory Standards Institute criteria (Clinical and Laboratory Standards Institute, 2020). The antimicrobial panel included amoxicillin, ampicillin, erythromycin, cefoxitin and nalidixic acid.

Data Quality Control

Content validity was reviewed by subject specialists and the questionnaire was pre-tested before field use. In the parent study, the overall instrument had good internal consistency (Cronbach alpha=0.82), while the corticosteroid-exposure domain had alpha=0.78. Standardised training, unique participant identifiers, cold-chain transport, defined culture conditions and reference organisms were used to support data

quality. Completed forms were checked for completeness and logical consistency before entry. Questionnaire reliability was interpreted in accordance with established guidance for Cronbach alpha and repeatability measures (Tavakol & Dennick, 2011; Koo & Li, 2016).

Data Management and Analysis

Completed questionnaires and laboratory forms were checked for completeness and consistency. Data were entered into a structured database, subjected to validation and range checks, and exported to IBM SPSS Statistics version 28. Frequencies and percentages summarised participant characteristics, resistance patterns and medication exposure. Statistical significance was set at a two-sided $p<0.05$. Although controls were matched to cases during recruitment, the medication estimates reproduced in this manuscript were obtained from the complete case-control exposure table rather than from a conditional matched-pairs model. They are therefore reported as crude odds ratios (cORs) with 95% confidence intervals, with the "do not know/none" medication category as the reference. All 192 cases and 192 controls contributed to this comparison. A conditional matched-pair reanalysis would require the original pair-level identifiers and should be undertaken where those data are available.

Ethical Considerations

Ethical approval was granted by the Kenyatta National Hospital-University of Nairobi Ethics and Research Committee (KNH-UoN ERC), Ref. KNH-ERC/A/216, Protocol P163/03/2017, dated 12 July 2017. Administrative authorisation for the study site was granted on 3 November 2017 under Ref. RII/VOL I/08; the contemporaneous letter identifies the facility as Rift Valley Provincial General Hospital (currently -Nakuru County Referrals Hospital). Research licence was obtained from the National Commission for Science, Technology and Innovation. Caregivers received information on the study purpose, procedures, risks, benefits, confidentiality, voluntary participation and the right to withdraw before written informed consent was obtained. Study records and specimens were coded, physical records were secured, and electronic data were password protected.

RESULTS

Participant Recruitment and Characteristics

Of 1,124 children with diarrhoea screened during the study, 740 were negative for DEC and 384 (34.2%) had laboratory-confirmed DEC and entered the case-control analysis. The 384 participants comprised 192 children with amoxicillin-resistant DEC and 192 children with susceptible DEC. Matching produced identical distributions of age, sex, residence and diarrhoea type between cases and controls. The largest age group was 13-24 months (168/384, 43.8%); 248/384 (64.6%) participants were male, 248/384 (64.6%) were from urban areas, and 248/384 (64.6%) presented with acute diarrhoea.

Four DEC pathotypes were identified among the 384 isolates: enteroaggregative *E. coli* (EAEC) was most frequent (176/384, 45.8%), followed by enteropathogenic *E. coli* (EPEC; 92/384, 24.0%), enterotoxigenic *E. coli* (ETEC; 68/384, 17.7%) and enteroinvasive *E. coli* (EIEC; 48/384, 12.5%). Pathotype distribution differed by sex (chi-square=13.31, $p=0.004$), age group (chi-square=87.37, $p<0.001$), residence (chi-square=35.15, $p<0.001$), diarrhoea duration (chi-square=11.39, $p=0.010$) and season (chi-square=51.13, $p<0.001$). The four reported pathotypes accounted for all 384 DEC-positive isolates included in this analysis; no additional pathotype category was used in the medication comparison. These pathotype differences were descriptive in the present medication-focused analysis and were not used to redefine case-control status. Because case-control status in this manuscript was defined by amoxicillin susceptibility, all 192 cases were amoxicillin resistant by design. Substantial co-resistance to other agents was also observed among the case isolates.

Beyond the matching variables, caregiver characteristics showed a broad socioeconomic distribution. Of the 384 caregivers, 144 (37.5%) had tertiary education, 140 (36.5%) secondary education, 60 (15.6%) primary education and 40 (10.4%) no formal education. Employment status was reported as self-employment for 180 (46.9%), unemployment for 120 (31.3%) and formal employment for 84 (21.9%). These characteristics provide context for medication access and caregiver recall but were not interpreted as independent determinants in this focused analysis. Approximately 70% of study presentations occurred during the rainy-season category recorded in the study dataset

Table 1: *Baseline Characteristics of Cases and Matched Controls*

Characteristic	Category	Cases (n=192), n (%)	Controls (n=192), n (%)
Age (months)	0-12	28 (14.6)	28 (14.6)
	13-24	84 (43.8)	84 (43.8)
	25-36	44 (22.9)	44 (22.9)
	37-48	20 (10.4)	20 (10.4)
	49-60	16 (8.3)	16 (8.3)
Sex	Male	124 (64.6)	124 (64.6)
	Female	68 (35.4)	68 (35.4)
Residence	Urban	124 (64.6)	124 (64.6)
	Rural	68 (35.4)	68 (35.4)
Diarrhoea type	Acute	124 (64.6)	124 (64.6)
	Chronic	68 (35.4)	68 (35.4)

Cases and controls were matched on age, sex, residence and diarrhoea type; identical distributions therefore reflect the matched design.

DEC Pathotypes and Antimicrobial Resistance

Among the 192 resistant case isolates, 168 (87.5%) were resistant to ampicillin and 156 (81.3%) to erythromycin. Resistance to cefoxitin and nalidixic acid was lower but was still present in 72 (37.5%) and 64 (33.3%) isolates, respectively. The pattern demonstrated that amoxicillin-resistant DEC frequently carried additional phenotypic resistance. This analysis did not establish the clinical indication for each antimicrobial and does not imply that each agent had been used to treat the diarrhoeal episode.

Table 2: *Antimicrobial Resistance Among the 192 Amoxicillin-Resistant DEC Case Isolates*

Antimicrobial	Resistant, n (%)	Susceptible, n (%)
Amoxicillin	192 (100.0)	0 (0.0)
Ampicillin	168 (87.5)	24 (12.5)
Erythromycin	156 (81.3)	36 (18.8)
Cefoxitin	72 (37.5)	120 (62.5)
Nalidixic acid	64 (33.3)	128 (66.7)

***Note**: Amoxicillin resistance was the case-defining criterion and is therefore 100% by design.*

Allergy/Asthma Medication Exposure

Caregiver-reported allergy/asthma medication use was common. Across the full cohort, 177/384 (46.1%) children were reported to have used corticosteroids as the medication most commonly used for allergy/asthma, 127/384 (33.1%) used antihistamines and 80/384 (20.8%) were recorded as "do not know" or could not identify the medication. A history of allergy or asthma was reported for 104/384 (27.1%) children, while 184/384 (47.9%) caregivers were uncertain about such a history. The high proportion of uncertain responses was treated as an important source of potential exposure misclassification rather than being reassigned to an exposed or unexposed category.

When caregivers were asked about the frequency of asthma/allergy symptoms, 224 (58.3%) selected "most of the time", 140 (36.5%) selected "rarely" and 20 (5.2%) could not specify the frequency. These responses were analysed as caregiver-reported clinical history rather than physician-confirmed diagnoses. The discrepancy between certainty about an allergy/asthma diagnosis and responses to symptom-frequency questions reinforces the likelihood of recall and classification error. Consequently, the primary inferential analysis focused on the medication category itself, for which the underlying case and control counts were complete and internally consistent.

Association Between Medication Category and Resistant DEC

The distribution of the principal allergy/asthma medication differed between resistant cases and susceptible controls. Corticosteroid use was reported in 120/192 (62.5%) cases and 57/192 (29.7%) controls. Antihistamine use was reported in 37/192 (19.3%) cases and 90/192 (46.9%) controls; the do-not-know/none category contained 35 cases and 45 controls. Relative to that reference category, corticosteroid utilisation was associated with higher crude odds of resistant DEC (cOR 2.71, 95% CI 1.57-4.66; p<0.001). Antihistamine utilisation was associated with lower crude odds (cOR 0.53, 95% CI 0.30-0.95; p=0.023).

Table 3: *Allergy/Asthma Medication Category and Odds of Amoxicillin-Resistant DEC*

Medication category	Cases (n=192)	Controls (n=192)	Crude OR (95% CI)	p-value
Do not know/none	35 (18.2)	45 (23.4)	1.00 (reference)	-
Antihistamine	37 (19.3)	90 (46.9)	0.53 (0.30-0.95)	0.023
Corticosteroids	120 (62.5)	57 (29.7)	2.71 (1.57-4.66)	<0.001

cOR, crude odds ratio; CI, confidence interval. The "do not know/none" group was the reference category. Estimates were derived from the complete exposure table and do not represent a conditional matched-pairs analysis.

The exposure counts followed the same pattern as the crude estimates: corticosteroid exposure was reported more often among cases than controls (62.5% versus 29.7%), while antihistamine exposure was reported less often among cases (19.3% versus 46.9%). The reference category accounted for 18.2% of cases and 23.4% of controls. These values describe associations from the observed case-control table and should not be interpreted as matched-pair effects, treatment effects or evidence of antibacterial activity.

DISCUSSION

In this case-control study, which used 1:1 matching during recruitment, caregiver-reported corticosteroid utilisation for allergy or asthma was more common among children with amoxicillin-resistant DEC than among susceptible controls. Resistant isolates also showed frequent co-resistance to ampicillin and erythromycin. Antihistamine use was less common among cases. Because the effect estimates available for this manuscript were calculated from the overall exposure counts rather than a conditional matched-pair model, they should be read as crude associations and not as matched or adjusted effects. The findings nevertheless identify a clinically relevant medication-history signal that merits further study in paediatric AMR surveillance.

The high co-resistance observed among the amoxicillin-resistant cases is consistent with the broader African literature. A recent meta-analysis of Enterobacterales infections in sub-Saharan African children found high resistance to commonly used antibiotics, including ampicillin, and highlighted substantial between-study heterogeneity (Kowalski et al., 2024). Studies in Zambia and Egypt have likewise documented substantial resistance among bacterial enteropathogens and DEC isolated from young children (Chiyangi et al., 2017; Khairy et al., 2020). More recent South African data demonstrate extensive multidrug resistance and a high prevalence of extended-spectrum beta-lactamase phenotypes in *E. coli* from children with diarrhoea (Heine et al., 2024). The African DEC systematic review by Kalule et al. (2024) similarly concluded that resistance to clinically important agents is widespread while surveillance remains uneven. The resistance to ampicillin and erythromycin in the present study therefore fits within a regional pattern in which older first-line agents have progressively lost activity.

The Kenyan context strengthens the relevance of these findings. Earlier studies demonstrated high DEC prevalence and resistance to commonly used antimicrobials in Kenyan children (Kanyina et al., 2016; Iijima et al., 2017; Webale et al., 2020). More recent surveillance from Nairobi has identified resistant enteric bacteria among children in informal settlements (Kiiru et al., 2024), while One Health work in Dagoretti South has documented antimicrobial-resistant DEC across children, livestock and food (Okumu et al., 2025). Genomic analysis of multidrug-resistant *E. coli* from Kenyan children has also shown diverse resistance determinants and lineages (Kiiru et al., 2025). These studies indicate that resistant DEC is sustained by

multiple clinical, community and environmental pathways rather than a single exposure.

Several explanations could account for the higher crude odds observed with corticosteroid use. Systemic corticosteroids alter inflammatory and immune responses, and previous observational work has linked steroid exposure with infection and sepsis (Chaudhary et al., 2017). Short systemic courses in children can also produce adverse effects (Aljebab et al., 2016), and infection-related harms have been reported after short oral courses in population studies (Waljee et al., 2017). These observations make a host-susceptibility pathway plausible, particularly in young children whose immune systems are still developing (Simon et al., 2015). At the same time, corticosteroid use may simply identify children with more severe allergic or respiratory disease, more healthcare encounters or greater antibiotic exposure. Confounding by indication and co-medication therefore remains an important alternative explanation.

The lower crude odds observed with antihistamine use should be interpreted even more cautiously. Some antihistamines have shown antibacterial or antibiofilm activity in laboratory studies (Richter et al., 2017; Lagadinou et al., 2020), but these experiments do not establish a protective clinical effect against DEC. Differences in illness severity, prescribing practices, healthcare-seeking behaviour and concurrent medicines could readily produce the observed pattern. The present data therefore do not support using antihistamines as antimicrobial adjuncts. A prospective study that records indication, dose, duration, timing and concurrent antibiotics would be needed before any mechanistic interpretation is justified.

The study has practical strengths. Cases and controls came from the same referral-hospital population, all participants had laboratory-confirmed DEC, and recruitment accounted for the 1,124 children screened. The study also used standard culture and susceptibility procedures and retained a clearly defined amoxicillin-resistance outcome. Matching at recruitment produced comparable distributions of age, sex, residence and diarrhoea type. These features support the value of the findings for hypothesis generation, although they do not remove the analytical limitations described below.

From a pharmacoepidemiological perspective, the result is best viewed as a reason to collect medication history more carefully in AMR studies. Corticosteroid exposure may influence host susceptibility, but it may also be a marker of disease severity, repeated clinical contact or concurrent antibiotic treatment. Future work should therefore use time-resolved exposure data and explicitly measure indication, previous antibiotics and severity of allergic disease. Those data would help distinguish a medication-related effect from an association created by shared clinical circumstances.

Distribution of obesity types and diagnostic criteria

Type I obesity predominated (56.67%), followed by types II (26.67%) and III (16.67%), consistent with international data showing moderate forms of obesity to be more common than severe forms, which nonetheless carry disproportionately higher morbidity (Flegal et al., 2016; Fleming et al., 2014). The three diagnostic criteria for abdominal obesity yielded markedly different prevalence estimates IDF (92.78%) > the threshold used in this study (87.78%) > NCEP-ATP III (80.56%), reflecting differing waist-circumference thresholds (Alberti et al., 2009; Grundy et al., 2005). Since abdominal obesity is a recognized independent predictor of cardiovascular disease and type 2 diabetes (Després, 2012), these disparities underscore the need to harmonize clinical thresholds and adapt reference criteria to the population studied, in order to standardize epidemiological comparisons and optimize screening.

LIMITATIONS

Several limitations should be considered. First, corticosteroid and antihistamine histories relied largely on caregiver recall over the preceding 12 months, and a substantial proportion of caregivers could not identify the medication used; exposure misclassification is therefore possible. Second, cumulative corticosteroid dose, route, duration and timing relative to the DEC episode were not measured, limiting assessment of temporality and dose-response. Third, the study could not separate corticosteroid exposure from the underlying allergic/asthmatic condition, healthcare contact or concurrent antibiotic use. Fourth, although matching was used during participant selection, the medication odds ratios reported here were calculated from the overall case-control exposure counts rather than a conditional matched-pairs analysis; residual confounding may therefore remain, and pair-level reanalysis is warranted if the original matched identifiers are available. Fifth, case status was defined by amoxicillin resistance, so the findings should not automatically be generalised to all resistance phenotypes. Finally, this was a single-facility study and may overrepresent children with illness severe enough to reach referral-level care.

CONCLUSION

Among children under five years with laboratory-confirmed diarrhoeagenic *Escherichia coli* in Nakuru County, caregiver-reported corticosteroid utilisation for allergy or asthma was associated with higher crude odds of amoxicillin-resistant DEC. Resistant cases also had substantial co-resistance to ampicillin and erythromycin. Antihistamine utilisation showed an inverse association, but this should not be interpreted as evidence of antimicrobial benefit. Because the study was observational, relied on retrospective medication history and did not use a conditional matched-pairs model for the reported medication odds ratios, the findings are hypothesis-generating rather than causal. Clinically indicated corticosteroids should not be withheld on the basis of these data; instead, the findings support rational prescribing and better integration of medication-exposure data with paediatric AMR surveillance.

RECOMMENDATIONS

Clinicians should continue to use systemic corticosteroids only for clear evidence-based paediatric indications and at the lowest effective dose and duration, while avoiding unnecessary co-prescribing of antibiotics. Antimicrobial stewardship programmes should incorporate medication-history review and counselling for caregivers of children with recurrent asthma or allergic disease. Hospitals and surveillance programmes should routinely monitor resistance among paediatric enteric isolates and link microbiology data with recent antibiotic and corticosteroid exposure. Where feasible, electronic or structured clinical records should capture the indication, formulation and duration of systemic steroid courses to improve future safety and AMR analyses. Future multicentre studies should prospectively capture corticosteroid dose, route, duration, clinical indication, temporal relationship to diarrhoeal illness, concurrent antimicrobials and markers of disease severity. Such studies should use matched or otherwise appropriately controlled analytical methods and evaluate whether associations differ by DEC pathotype and resistance mechanism. The present inverse association with antihistamine use should be treated as hypothesis-generating only and should not change clinical treatment recommendations without confirmatory mechanistic and prospective evidence. Caregiver education should continue to emphasise appropriate antibiotic use and prompt clinical review for persistent or severe diarrhoea.

Conflict of Interest

Authors declare no conflict of interest.

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Authors' Contributions

The sole author conceptualised the manuscript, curated and analysed the data used for this analysis, interpreted the findings, prepared the original draft, critically revised the manuscript and approved the final version.

Data Availability

The data underlying this analysis are available from the corresponding author on reasonable request and subject to applicable ethical and institutional requirements.

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