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ANTIMICROBIAL RESISTANCE PATTERNS IN CLINICAL ISOLATES OF GRAM-NEGATIVE BACTERIA: A HOSPITAL-BASED STUDY

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ABSTRACT

This paper offers a structured, critical review of a postgraduate thesis investigating the prevalence and antibiotic susceptibility of bacterial isolates — with particular reference to Gram-negative organisms — obtained from surgical site infections (SSIs) and from environmental surfaces in a hospital setting. The reviewed work used a cross-sectional descriptive design, culturing 78 isolates from 58 patients with post-operative wound infections and 59 isolates from 68 environmental swabs, followed by Kirby–Bauer disc-diffusion susceptibility testing. Gram-negative rods accounted for the majority (57.7%) of wound isolates and displayed markedly higher resistance rates than Gram-positive organisms, with Klebsiella pneumoniae (81.3%) and Escherichia coli (74%) showing the highest overall resistance, particularly to ampicillin and cephalosporin-class agents. This review summarises the thesis's rationale, methodology, principal findings and conclusions; situates these findings within the wider antimicrobial-resistance (AMR) literature; and offers a critical appraisal of the study's methodological strengths and limitations, concluding with recommendations for future antibiogram-based surveillance research.

1. INTRODUCTION

Antimicrobial resistance (AMR) among Gram-negative bacteria is one of the most pressing threats to modern clinical medicine, particularly in the context of healthcare-associated infections such as surgical site infections (SSIs). SSIs remain among the most common complications of surgical care worldwide, contributing substantially to morbidity, prolonged hospitalisation and healthcare expenditure, with the burden falling disproportionately on low- and middle-income countries where diagnostic microbiology capacity and antibiotic stewardship infrastructure are often limited.

The thesis under review addresses this problem directly by generating hospital-specific antibiogram data

— evidence on which organisms are causing infection locally and which antibiotics remain effective against them. Rather than relying on assumptions drawn from international literature, the author collected clinical and environmental isolates from a single hospital setting over a defined study period, characterised them using standard microbiological methods, and determined their susceptibility profiles. The stated purpose was to close a local knowledge gap and to generate data that could inform empirical antibiotic prescribing and infection-control policy.

This review is organised as follows: Section 2 outlines the aims and objectives of the reviewed thesis; Section 3 summarises its methodology; Section 4 presents the principal findings; Section 5 offers a critical discussion of these findings in relation to the broader literature and evaluates the study's strengths and limitations; and Section 6 concludes with an overall appraisal and recommendations for future work.

2. Aim and Objectives of the Reviewed Thesis

The general objective of the thesis was to establish the antibiotic susceptibility pattern of bacteria isolated from patients with post-operative wound infections and from the hospital environment (wards and operating room). The specific objectives were to:

- Determine the prevalence of bacteria isolated from patients with surgical site infections.
- Determine the prevalence of bacteria contaminating hospital wards and the operating room.
- Determine the antibiotic sensitivity pattern of bacteria isolated from patients with surgical site infections, with an emphasis on Gram-negative isolates.

These objectives are appropriately scoped for a hospital-based antibiogram study and align well with the study's stated public-health rationale: to inform local antibiotic-prophylaxis guidelines and to support ongoing surveillance of resistance trends.

3. Summary of Materials and Methods

The thesis adopted a cross-sectional descriptive design. Using the Fischer et al. (1998)

formula for proportion-based sample-size estimation, and applying a finite-population correction based on approximately 68 SSI cases recorded over a preceding six-month period, the author arrived at a target sample of 58 patients with confirmed post-operative wound infection. These were recruited by purposive sampling from surgical, maternity and paediatric wards, alongside 68 environmental swabs collected from wards and the operating theatre, giving a combined total of 126 samples.

Wound and environmental swabs were processed by standard Gram staining, aerobic culture and biochemical identification. Antibiotic susceptibility testing was performed by the Kirby–Bauer disc-diffusion method against a panel that included vancomycin, ciprofloxacin, chloramphenicol, doxycycline, ampicillin/cloxacillin, azithromycin and oxacillin (for Gram-positive isolates), together with agents such as amikacin, cefepime, ceftriaxone and cotrimoxazole for Gram-negative isolates. Data were analysed in SPSS version 20, with chi-square testing applied at a 0.05 significance threshold to compare categorical variables such as sex distribution of isolates.

Methodologically, this is a conventional and well-recognised design for generating a local antibiogram: it is inexpensive, requires no specialised molecular infrastructure, and yields directly actionable clinical information. The formal sample-size calculation is a notable strength, lending the prevalence estimates a degree of statistical grounding that is often absent from similar dissertations.

4. Key Findings

4.1 Bacterial prevalence in surgical site infections

Of 78 isolates recovered from wound swabs, Staphylococcus aureus was the single most frequent organism (28.2%), followed by Escherichia coli (15.4%), Acinetobacter species (14.1%), and Pseudomonas aeruginosa, Enterobacter species and Bacillus species (9.0% each). Considered by Gram reaction, Gram-negative rods made up the majority of SSI isolates (57.7%), compared with 42.3% Gram-positive organisms. Female patients accounted for a higher proportion of isolates (73.1%) than males (26.9%), though this difference was not statistically significant ($\chi^2 = 2.221$, $p = 0.136$).

4.2 Environmental (ward and operating-room) contamination

Fifty-nine isolates were recovered from environmental surfaces. Staphylococcus aureus again predominated (55.9%), followed by Bacillus species (30.5%); Gram-negative organisms such as Citrobacter, Enterobacter, Pseudomonas aeruginosa, Acinetobacter and E. coli each contributed only 1.7–3.4% of isolates. Maternity wards yielded the highest proportion of environmental isolates (49.2%), followed by surgical wards (27.1%), paediatric wards (13.6%) and the operating room (10.2%).

4.3 Antibiotic susceptibility and resistance

Among Gram-positive SSI isolates, sensitivity was highest to chloramphenicol (90.9%), vancomycin (87.9%), doxycycline (75.8%) and ciprofloxacin (69.7%). Methicillin-resistant Staphylococcus aureus (MRSA) accounted for 65.4% of Staphylococcus isolates overall — markedly higher than rates reported in some Indian studies but broadly comparable to a Ugandan cohort.

Gram-negative rods were considerably more resistant overall. Cefepime, ceftriaxone, cotrimoxazole and doxycycline were largely ineffective against Gram-negative isolates, while chloramphenicol (53.3%) and amikacin (50%) retained partial activity. Klebsiella pneumoniae and E. coli were the most resistant organisms, with resistance rates of 81.3% and 74% respectively — findings the author attributes to unregulated antibiotic use and the absence of routine ESBL (extended-spectrum β-lactamase) screening at the study hospital. Environmental Gram-negative isolates, though fewer in number, showed high sensitivity to ciprofloxacin, doxycycline, chloramphenicol and vancomycin, but were almost uniformly resistant to ampicillin/cloxacillin (96.6% resistance).

5. Critical Discussion and Appraisal

5.1 Consistency with the wider literature

The predominance of Staphylococcus aureus among wound isolates is consistent with several previously published hospital-based studies, which attribute this pattern to endogenous contamination of the surgical field by skin flora. Conversely, the thesis's finding that E. coli and other Gram-negative organisms were less prevalent than in some comparator studies (which report Acinetobacter or Pseudomonas as leading isolates) illustrates a recurring theme in the AMR literature: local antibiograms vary considerably by hospital, surgical case-mix and infection-control practice, reinforcing the value of site-specific surveillance rather than reliance on regional or national averages.

The high resistance rates observed for Gram-negative organisms — particularly Klebsiella pneumoniae and

E. coli — mirror a well-documented global pattern in which Enterobacteriaceae increasingly harbour ESBL and other resistance mechanisms, eroding the utility of penicillins and, in many settings, cephalosporins. The thesis's observation that the hospital lacked routine ESBL-detection capacity is a clinically important finding in its own right, since it implies that the true burden of extended-spectrum resistance may be under-recognised in day-to-day practice.

5.2 Methodological strengths

- A formally calculated sample size, with an appropriate finite-population correction, lends statistical credibility to the prevalence estimates.
- Parallel sampling of both clinical (wound) and environmental (ward/operating-room) isolates allows the thesis to distinguish endogenous from exogenous sources of infection risk — a design feature not present in many comparable single-source studies.
- Use of a standard, internationally recognised susceptibility-testing method (Kirby–Bauer disc diffusion) and statistical testing of key associations (chi-square) supports reproducibility and comparability with other antibiogram studies.

5.3 Limitations

- The sample size, while statistically derived, remains modest (58 patients; 126 samples in total), and was drawn from a single hospital over a defined period, which limits generalisability to other institutions or regions.
- Purposive (non-random) sampling of patients introduces potential selection bias, and the absence of a comparison arm (e.g., pre- versus post-intervention, or multi-site comparison) restricts the strength of causal inference regarding the drivers of resistance.
- The absence of molecular confirmatory testing (e.g., PCR-based detection of ESBL, carbapenemase or mecA genes) means that phenotypic resistance mechanisms inferred from disc-diffusion results — such as suspected ESBL production in Klebsiella pneumoniae and E. coli, or MRSA status — could not be genetically confirmed, a limitation the author appropriately flags as an avenue for future research.
- As a cross-sectional design, the study captures a single snapshot of resistance patterns and cannot describe temporal trends in resistance emergence, which would require longitudinal or repeated surveillance.

It is also worth noting that the descriptive and discussion sections of the thesis reference a specific hospital context (ward types, bed capacity, and local health-system features) that should be read as the empirical setting of the study; readers should consult the original document for full site-specific detail, as such contextual information is central to interpreting how far the antibiogram findings can be extrapolated to other institutions.

6. CONCLUSION

Overall, this thesis makes a useful, locally grounded contribution to the antimicrobial resistance literature by generating a hospital-specific antibiogram for both clinical (surgical site infection) and environmental bacterial isolates, with particular attention to the resistance burden carried by Gram-negative organisms. Its central finding — that Gram-negative rods, and Klebsiella pneumoniae and E. coli in particular, exhibit substantially higher resistance rates than Gram-positive isolates, especially to first-line and broad-spectrum agents — is consistent with, and reinforces, global concerns about the escalating threat posed by multidrug-resistant Enterobacteriaceae in surgical and hospital settings.

The study's practical recommendations — routine identification of SSI pathogens and their antibiograms, ongoing environmental surveillance of wards and operating rooms, and cautious use of chloramphenicol where susceptibility permits — are reasonable and actionable for the study institution. Future research building on this work would benefit from larger, multi-site samples, molecular characterisation of resistance determinants (including ESBL and mecA genes), and longitudinal surveillance to track how local resistance patterns evolve over time. Notwithstanding its limitations, the thesis achieves its stated objectives and provides a methodologically sound template for hospital-based antibiogram surveillance that could usefully be replicated in other institutions facing similar diagnostic and infection-control constraints.

REFERENCES

1. Aiken, A., Wanyoro, A., Mwangi, J., Mulingwa, P., Wanjohi, J., Njoroge, J., Juma, F., Mugoya, I., Scott, J., & Hall, A. (2013). Surveillance of surgical site infections in Thika Hospital, Kenya. Journal of Hospital Infection, 83(2), 140–145. https://doi.org/10.1016/j.jhin.2012.11.003
2. Allegranzi, B., Nejad, S. B., Combescure, C., Graafmans, W., Attar, H., Donaldson, L., & Pittet, D. (2011). Healthcare-associated infections in developing countries: a systematic review and meta-analysis. The Lancet, 377(9761), 228–241. https://doi.org/10.1016/S0140-6736(10)61458-4
3. Anderson, D. J., Podgorny, K., Berríos-Torres, S. I., et al. (2014). Strategies to prevent surgical site infections in acute care hospitals: 2014 update. Infection Control & Hospital Epidemiology, 35(6), 605–627. https://doi.org/10.1086/676022
4. Bhave, P., Vaidya, V., Ganu, M., & Ganu, A. (2016). Methicillin-resistant Staphylococcus aureus in surgical site infections: an emerging challenge. International

Journal of Research in Medical Sciences, 4(2), 456–460.

5. Dessie, W., Mulugeta, G., Fentaw, S., Mihret, A., Hassen, M., & Abebe, E. (2016). Pattern of bacterial pathogens and their susceptibility isolated from surgical site infections at selected referral hospitals, Addis Ababa, Ethiopia. International Journal of Microbiology, 2016, Article 2418902. https://doi.org/10.1155/2016/2418902
6. Gelaw, A., Gebre-Selassie, S., Tiruneh, M., & Fentaw, S. (2014). Isolation of bacteria and drug susceptibility patterns of surgical site infections in a referral hospital, Northwest Ethiopia. Ethiopian Journal of Health Sciences, 24(2), 141–148.
7. George, P., Ochien, J., Kikuvi, G., & Mutai, J. (2018). The prevalence and antibiotic sensitivity pattern of surgical site infections in a national referral hospital, Uganda. East African Medical Journal, 95(3), 45–52.
8. Khan, M. A., & Rehman, A. (2019). Antimicrobial resistance patterns of gram-negative bacteria isolated from clinical specimens: a hospital-based study. Journal of Clinical and Diagnostic Research, 13(6), DC01–DC05.
9. Kramer, A., Schwebke, I., & Kampf, G. (2006). How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. BMC Infectious Diseases, 6, Article 130. https://doi.org/10.1186/1471-2334-6-130
10. National Collaborating Centre for Women's and Children's Health (UK). (2008). Surgical site infection: prevention and treatment of surgical site infection. RCOG Press.
11. Ngaroua, N., Bola Bibiane, S., & Ngah, J. E. (2016). Nosocomial infections in operating theatre environments: a hospital-based study. Journal of Infection Prevention, 17(4), 178–183.
12. Otter, J. A., Yezli, S., Salkeld, J. A. G., & French, G. L. (2013). Evidence that contaminated surfaces contribute to the transmission of hospital pathogens and an overview of strategies to address contaminated surfaces in hospital settings. American Journal of Infection Control, 41(5), S6–S11.
13. Public Health England. (2015). Surveillance of surgical site infections in NHS hospitals in England, 2013/14. Public Health England.
14. Sawhney, S., Sharma, R. K., & Nagpal, K. (2017). Bacteriological profile and antibiotic susceptibility pattern of surgical site infections in a tertiary care hospital. International Journal of Current Microbiology and Applied Sciences, 6(5), 1520–1528.
15. Seni, J., Najjuka, C. F., Kateete, D. P., Makobore, P., Joloba, M. L., Kajumbula, H., Kapesa, A., & Bwanga, F. (2013). Antimicrobial resistance in hospitalized surgical patients: a silent epidemic in Mulago Hospital, Uganda. BMC Research Notes, 6, Article

298. https://doi.org/10.1186/1756-0500-6-298

16. Tuon, F. F., Cieslinski, J., Ono, A. F. M., Goto, F. L., Machinski, J. M., Mantovani, L. K., Kosop, L. R., & Kraft, L. (2018). Evaluation of Klebsiella pneumoniae and Escherichia coli sepsis outcomes for patients with production of ESBL or carbapenemase. Journal of Infection and Chemotherapy, 24(3), 217–222.
17. World Health Organization. (2021). Global report on infection prevention and control. WHO Press.
18. World Health Organization. (2022). Antimicrobial resistance fact sheet. WHO Press.