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DISCERNMENT OF ANTIMICROBIAL RESISTANCE AMONG HEALTH PROFESSIONALS AT A MEDICAL COLLEGE IN KOZHIKODE DISTRICT, INDIA - A QUALITATIVE STUDY

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Abstract:
Context: Overuse and misuse of antibiotics are imparting factors to the rising global public health epidemic known as antimicrobial resistance (AMR).
Aims: To determine the stumbling block to antimicrobial stewardship procedures and to yield methods for reducing antimicrobial resistance (AMR) in the organization.
Settings and Design:A teriary medical college hospital in Northern Kerala,India and Cross scetional study
Methods and Material: Key informant interviews were condcuted among expert practitioners from the Department of Internal Medicine,Pharmacology and and Microbiology from a tertiary medical college in Kozhikode, Kerala.
Statistical analysis used:The data were transcribed and subjected to thematic analysis.
Results: Two main themes emerged from the key
findings: (1) The factors affect antibiotic stewardship: pharmacokinetic problems, overuse, lack of surveillance, and environmental contamination; and (2) solutions to improve stewardship programs, emphasizing tactics like clinical audits, surveillance programs and utilizing advanced molecular diagnostics.

Conclusions: Combating AMR necessitates a multifaceted strategy that includes better surveillance systems, appropriate diagnostic use and improved antibiotic stewardship. AMR can be considerably reduced by institutional commitment to education and policy changes.

Keywords: Antimicrobial resistance, Antibiotic stewardship, Healthcare professionals, Qualitative study

Introduction:

Antimicrobial resistance (AMR) is a normal evolutionary process. [1]. Globally per annum 7,00,000 fatalities and 10 million deaths by 2050 are forecasted attributing to AMR 2]. Meanwhile the expenses exceeding $100 trillion is also economically astounding [3]. Rise of infectious diseases, poor access to quality healthcare, inadequate sanintation hygiene practices and uncontrolled antibiotic usage contributes to AMR [4,5].Challenges in India is accounted being the largest consumer, extensive application in agriculture, animal husbandry and lack of regulatory control as per Indian Council of Medical Research (ICMR) [6,7,8]. The purpose of the study is to investigate the reasons for AMR and finding solutions for the same. [9].

Materials and Methods:

The study was conducted at a Medical College Hospital in Kozhikode District by using Key Informant interviews;a qualitative technique that included 3 expert faculty from departments comprising of Pharmacology, Microbiology and Internal medicine. Urposive sampling was used for the recruitment of healthcare professionals from the previously specified departments. The structured interviews were held between September to November 2024 time period using appropriate interview guide. The interview was recorded using a tape recorder and notes were taken appropriately. The verbatim transcriptions of the audio recordings were anonymized and thematic analysis was done. The results were grouped into two major themes factors and solutions related to antimicrobial resistance. All participants gave their informed consent and the Institutional Ethics Committee granted ethical approval to conduct the study.

Results:

The results of this qualitative study provided importantinformation about the problems and possible remedies related to antimicrobial resistance (AMR) .Two main themes emerged from these observat ions.First, a complex web of interrelated concerns that contributed to the increasing threat of antimic robial resistance (AMR) and was identified as Factors attributed for Antibiotic Stewardship. One subdomain identified was related to pharmacokinetics, where medical experts have pointed out that insufficient medication concentrations at the infection site, which are frequently caused by long-term low dosages or poor drug penetration which could have encouraged the emergence of resistance. Expert pharmacologist believe that pharmacokinetic and pharmacodynamic parameters are crucial in determining the effectiveness of antimicrobial therapy and in the development of resistance. And she quoted that " insufficient drug concentration at the infection site might lead to sub-therapeutic levels, which do not eradicate bacteria and enable resistant strains to endure and multiply". Long-term low-dosage antibiotic exposure gives bacteria the chance to progressively adapt, frequently by phenotypic or genetic alterations, which promotesresistance. Therapeutic efficacy depends on achieving appropriate medication concentrations in tissue and plasma.She added that antibiotics must sufficiently reach the infection site, inadequate tissue penetration might result in treatment failure and promote infection persistence. Additionally, medication combinations that change antibiotics are metabolized either by increasing or decreasing their clearance and may unintentionally lower therapeutic levels or raise toxicity, which could impact the effectiveness of treatment. Antibiotic selection is based on the idea of Minimum Inhibitory Concentration (MIC), which is the lowest concentration of an antibiotic required to prevent observable bacterial growth. She qouted "Antibiotics like beta-lactam, penicillin, cephalosporin, monobactam, carbapenem have to maintain a

drug level above the MIC for an aggregate duration and if MIC is not achieved this will allow the bacteria to recover and potentially mutate.She qouted "Emerging resistance is characterized by a gradual rise in MIC values. MIC-value-based antibiotic therapy customization improves treatment accuracy and slows the emergence of resistance. Antibiotics can also be categorized according to how quickly they kill bacteria opined expert pharmacologist. For example, time-dependent antibiotics, like beta-lactams, need constant concentrations above the minimum inhibitory concentration (MIC), while concentration-
dependent drugs, like aminoglycosides, work better at high peak concentrations. She continued that dosing techniques and resistance prevention are also influenced by the post-
antibiotic effect (PAE), which is the ongoing inhibition of bacterial growth following medication cle arance.She added "The drug concentration must be high enough to eliminate the pathogen, but below the levels that cause toxicity. We need high peak concentration, but then the side effect is there, which is nephrotoxicity."

Table 1 depicting factors of Antimicrobial resistance related to Pharmacokinetics

Factors for Antimicrobial Resistance	
	Inadequate Drug Concentration
	Prolonged Low Dose
	Plasma/Tissue Drug Concentration
	Drug Penetration to Infection Sites
	Drug Interactions Affecting Metabolism
	Minimum Inhibitory Concentration (MIC)
	Antibiotic Selection Based on MIC
	Time-Dependent Killing
	Concentration-Dependent Killing
Issues related to Pharmacokinetics	Post-Antibiotic Effect (PAE)
	Balance of Efficacy and Safety
	Sub-Therapeutic Exposure
	Overexposure and Collateral Damage
	Adaptation to Low Exposure
	Multiple Pathways Targeting
	Use of Multiple Antibiotics

Antimicrobial resistance is significantly influenced by improper use of antibiotics, including abuse, overuse, and illogical prescription practices opined by the expert physician . He added maintaining efficacy while reducing toxicity requires a careful balance, excessive use raises the poss ibility of side effects and resistance, while insufficient use may lead to treatment failure.
Incomplete treatment regimens or improper dosage can expose patients to subtherapeutic levels, whi ch enables infections to adapt and endure.Likewise, overexposure to antibiotics may harm commens al flora, which promotes the selection of resistant organisms.Chronic low-
level antibiotic exposure can cause microorganisms to develop genetic or epigenetically based survi val strategies. Expert pharmacologist said "Resistant genes spread rapidly among bacteria populations through plasmids and other mobile genetic elements."She continued
“While taking numerous antibiotics at once, unless clinically justified, can raise selective pressure o n microbial populations, medicines that target multiple bacterial pathways may lower the likelihood of resistance development.”
Clinical overprescription combined with pervasive agricultural abuse speeds up the emergence of re sistance.The widespread prescription of antibiotics for viral diseases, for which they are ineffective, is a particularly worrying problem since it unintentionally contributes to resistance.The

phramcology expert added that the issue is exacerbated by redundant prescriptions, which are written for the same or comparable antibiotics without a therapeutic reason. Unregulated and frequently illogical prescribing practices arise from the lack of fundamental antimicrobial stewardship concepts. The essential need for organized stewardship systems to direct the use of antibiotics is highlighted by this systemic deficit.

The Microbiologistconcluded by acknowledging the importance of environmental contamination, sp ecifically antibiotic residues in pharmaceutical manufacture and hospital wastewater, as well as the extensive use of antibiotics in agriculture. She also added these environmental factors influence human, animal health and the wider spread of resistance genes.

The second key theme, "Solutions to Strengthen Stewardship Programs," offered possible tactics for the institution's internal fight against AMR. The experts prepended application of molecular diagnostics, which includes the use of quick diagnostic instruments like MALDI-TOF mass spectrometry, was one of the main solutions mentioned. By enabling quicker and more precise pathogen detection, these technologies lessen the need for broad-spectrum antibiotics and enable focused antibiotic therapy. Improving monitoring and cooperation was another essential remedy, with a focus on the significance of developing local antibiograms to inform empirical treatment choices and taking part in international surveillance networks to monitor new resistance risks was appended. The importance of pharmacists in maximizing antibiotic dosage, tracking therapeutic drug levels and avoiding drug interactions that can jeopardize antibiotic efficacy was also highlighted adjunct with the interventions of clinical pharmacology cohort.Se also added "No pharma is coming forward to invest in antibiotic development due to the low profitability compared to chronic disease medication." The theme concluded by pointing out that regulatory actions necessary to encourage the proper use of antibiotics.

This entails putting in place prescription audits to find and correct problematic antibiotic use as well as antimicrobial stewardship committees made up of doctors, pharmacist
and microbiologists to supervise antibiotic prescribing procedures.

These diverse approaches are thought to be essential for encouraging appropriate antibiotic use, slo wing the development of resistance and enhancing patient outcomes and satisfaction. The physician added “Pharmacologists work with microbiologists to track resistance patterns and trends. By analyzing data together, they can identify risk factors for resistance and help inform public health strategies."

Antimicrobial resistance calls for a multipronged approach that includes public involvement, clinica l practice, policy-making, and diagnostics.

By using sophisticated molecular diagnostics, such as quick and culture-
independent assays, focused treatment is made possible and the need for empirical broad-
spectrum antibiotics is decreased.

Coordinated therapies and timely tracking of resistance trends can be made easier by fortifying surv eillance networks and encouraging cooperation among stakeholders, from physicians to legislators. "Establish comprehensive systems to track resistant trends and antibiotic use globally to WHO levels." Comments Microbiologist

The reasonable use of antibiotics is encouraged by strong infection control procedures and frequent audits of clinical prescriptions said expert microbiologist. While back-end tactics like pre-authorization systems offer institutional supervision, front-end stewardship approaches give prescribers the authority to defend antibiotic selections using clinical and microbiological data said Pharmacologist.

The establishment of municipal antibiotic usage rules and the creation of specialized antibiotic stew ardship committees are crucial institutional steps in managing resistance.

The expert Microbiologist opined that the Corrective and Preventive Action (CAPA) systems promote continuous quality improvement in prescribing practices, while local antibiograms offer useful susceptibility data that guide empirical therapy. Addressing the complex causes of resistance

requires a One Health approach, which recognizes the interconnectedness of environmental, animal, and human health.
Additional tactics to reduce needless antibiotic exposure include the preferential use of narrow-spectrum drugs, rational surgical prophylaxis, and avoiding treatments that interfere with normal flo ra.
She added that strict infection control procedures and customized treatment plans are necessary for the management of multi-drug resistant organisms (MDROs). In order to treat polymicrobial infections, broad-spectrum initial coverage and de-escalation are required. Based on microbiological findings, empirical treatments need to be evaluated and modified on a frequent basis. Particularly in critical care situations, therapeutic drug monitoring guarantees ideal drug levels and prevents toxicity.
Encouraging clinical pharmacologists improves stewardship efforts, especially when it comes to mo nitoring drug interactions and adjusting dosage.
Certain combination treatments have shown promise in improving effectiveness and getting around resistance mechanisms.
Inhibiting the propagation of resistance genes, particularly those carried by plasmids, is another way to maintain the efficiency of antibiotics.
Promising approaches include the use of quick diagnostic technologies, strict adherence to prescripti on recommendations, and research into alternative treatments such vaccinations, phage therapy, and antimicrobial peptides.
Lastly, it is critical to communicate behavior change to the public and healthcare providers.
A culture of prudent antibiotic usage can be promoted through awareness campaigns, professional d evelopment, and educational initiatives.

Discussion:

The results of this study are consistent with AMR research conducted worldwide. Our work offers useful suggestions suited to regional situations in contrast to WHO's Global Action Plan (2015), research by Laxminarayan et al. (2013) and Saleem et al. (2019) [5]. Stricter antibiotic regulations, greater physician awareness and One Health initiatives were stressed in paramount work[6]. Prior research has shown that a major factor was the incorrect use of antibiotics and the healthcare providers' ignorance. Klein et al.'s (2020) study highlighted the need of educational interventions in enhancing prescribing practices [7]. In a similar vein, study by Chokshi et al. (2019) emphasized the significance of regulatory actions and the economic impact of AMR in India 9].
Dadgostar (2019) conducted a systematic review that highlighted the significance of behavioral ther apies and multidisciplinary methods in the fight against AMR [10].
Furthermore, it is impossible to overestimate the importance of hospital infection control procedures Improved infection control practices dramatically slowed the spread of multidrug-resistant pathogens, according to a study done in many European hospitals. Rapid susceptibility testing and point-of care diagnostics have also been demonstrated to enhance antibiotic prescribing procedures and shorten the time to successful treatment.
By providing particular recommendations like regular antibiotic audits, empirical treatment strategis and the use of modern molecular diagnostics, our findings both support and expand upon these ideas [11].This paper overtax the collaboration between the community, policy makers and healthcare experts necessary for the execution of these policies. Monitoring AMR developments and guiding public health measures also need strengthening surveillance systems and encouraging data sharing [12].
Lastly, combating AMR necessitates a comprehensive strategy that takes into account the behavioral, societal and economic aspects that affect antibiotic usage. Campaigns for public awareness and educational initiatives can encourage ethical stewardship practices and enable people to make knowledgeable decisions on the use of antibiotics [12]. Establishment of Antibiotic Stewardship Programs and mobilizing organized groups to supervise the prudent use of antibiotics may also help to bring better outcomes[13,14]. Improving AMR data collection, implement appropriate surveillance

and introducing quick molecular diagnostics is the right path forward[8,14].Implementation of more stringent guidelines for the prescribing of antibiotics in agriculture and healthcare [4,6] and informing the public and healthcare professionals about the dangers of AMR is imperative [7,9].

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