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Editorial

Nipah 2026 in Bangladesh: Lessons from Naogaon and the Urgency of Early Control

Nipah virus is a bat-borne zoonotic pathogen that is not new to Bangladesh but remains highly dangerous due to its high case fatality and potential for wider outbreaks. It can cause severe disease—particularly encephalitis—and may also spread through close contact, especially where infection prevention and control (IPC) practices are suboptimal.[1] In Bangladesh, the most common—and preventable—source of infection is the consumption of raw date palm sap. This sap may be contaminated by bat secretions, and the use of bat-proof skirts over collection pots is a practical and effective preventive measure. Strengthening understanding of Nipah virus and addressing gaps in diagnostics and countermeasures can help keep it out of our hospitals and headlines.[2]

On 3 February 2026, Bangladesh's IHR National Focal Point notified a confirmed Nipah virus case from Naogaon District, Rajshahi. Laboratory confirmation by PCR and ELISA was obtained on 29 January 2026. The patient, a woman aged 40–50 years, developed symptoms on 21 January, initially presenting with fever and other systemic features that progressed to neurological manifestations. She became unconscious on 27 January, was admitted to a tertiary hospital on 28 January, and died on the same day. Following admission, surveillance samples were collected. A history of repeated consumption of raw date palm sap between 5 and 20 January was elicited. A One Health outbreak investigation began on 30 January, identifying 35 contacts across household, community, and healthcare settings. Six symptomatic contacts were tested and found negative. As of 3 February, no additional cases had been detected, and contacts remained under monitoring.[3]

The first recognized human cases of Nipah virus infection in Bangladesh were reported in 2001. Since then, infections have occurred almost annually, including four laboratory-confirmed fatal cases in 2025.[3] International media coverage of recent events, alongside WHO confirmation, underscores how rapidly local outbreaks can gain global attention.[4]

A key lesson from recent outbreaks is the narrow clinical window: Nipah virus infection can deteriorate rapidly. By the time laboratory confirmation is obtained, the primary challenges often include protecting healthcare workers, safeguarding family caregivers, managing patient movement within crowded wards, and initiating timely contact tracing. The WHO emphasizes IPC measures because Nipah virus can be transmitted through close contact, including in healthcare settings.[3] Suspected cases should therefore be managed with immediate isolation—similar to other high-risk infectious syndromes—as delays increase exposure risk to both caregivers and healthcare personnel.

While early isolation and strict IPC measures remain essential for immediate outbreak control, long-term prevention will depend on the development and evaluation of effective vaccines. Bangladesh's role in hosting the world's first Phase II Nipah vaccine trial represents a significant milestone. However, defining "success" in practical terms is critical. The Coalition for Epidemic Preparedness Innovations (CEPI), in collaboration with the Serum Institute of India and the University of Oxford, has established an investigational stockpile of up to 100,000 doses of a Nipah vaccine candidate (ChAdOx1 Nipah B).[5,6] The current trial focuses on healthy adults aged 18–55 years, reflecting an early-phase emphasis on safety and immunogenicity rather than immediate large-scale deployment.[7] Given that Nipah outbreaks are typically small and sporadic, conducting conventional efficacy trials remains challenging. Nevertheless, such trials can strengthen surveillance and response systems alongside generating immunogenicity data.

Understanding the biology of Nipah virus is essential for effective prevention and management, yet significant gaps remain in rapid diagnostics, accessible therapeutics, and vaccine availability.[8] In the context of Bangladesh, the most effective immediate response continues to rely on early clinical suspicion, prompt isolation, and strict adherence to IPC measures.

Preparedness for Nipah virus should begin at triage, particularly in district hospitals during the date palm sap harvesting season. Patients presenting with acute encephalitis syndrome (AES)—characterized by fever with altered consciousness, seizures, or severe headache—or severe unexplained respiratory illness should be promptly evaluated for possible Nipah infection, especially if there is a history of raw sap consumption or contact with a suspected case.[2] Such a "Nipah-aware" pathway does not require advanced technology but depends on disciplined implementation: early isolation or cohorting, restriction of crowding at the bedside, appropriate use of personal protective equipment, and minimization of unnecessary patient movement across departments. Delays in these measures increase the risk of nosocomial transmission.

It must be acknowledged that most hospitals in Bangladesh are designed to manage high patient volumes rather than rare, high-risk infectious diseases. This structural reality

increases vulnerability to in-hospital transmission, as beds are often closely spaced, family members frequently participate in caregiving, and multiple individuals may come into contact with a single patient.[9] Seasonal preparedness should therefore prioritize practical and consistently enforced IPC measures to interrupt transmission.

Operational readiness depends not only on IPC discipline but also on timely recognition and diagnostic action. Early diagnosis can be challenging because Nipah infection may clinically resemble other causes of AES.[2] However, a standardized minimum approach can improve early detection: routine risk screening of AES patients during the sap season for exposure to raw sap or relevant contact history; prompt specimen collection; and rapid transport to designated laboratories.[10] To strengthen preparedness, healthcare facilities should conduct regular operational audits based on national guidelines, focusing on key indicators such as time to isolation, time to specimen dispatch, and time to receipt of test results.

Vaccination may significantly alter the future trajectory of Nipah virus control. Under appropriate regulatory and public health frameworks, emergency vaccine deployment during outbreaks may become feasible. However, even a limited investigational vaccine supply cannot compensate for delays in detection and response. In Bangladesh, avoiding the consumption of raw date palm sap remains the most important preventive measure.

The international attention generated by confirmed cases in Bangladesh highlights the importance of clear and effective communication.[4] Clinicians and healthcare institutions should provide accurate, calm, and consistent information regarding symptoms that require urgent care, relevant exposure risks, appropriate preventive behaviors, and the rationale for measures such as visitor restrictions and patient isolation. Effective communication is not merely a public relations function—it is a critical component of infection control.

In conclusion, Nipah virus will not wait for perfect tools. Although scientific advances, including vaccine development, are encouraging, the recent death in Naogaon underscores that the immediate determinants of outbreak impact remain fundamentally operational: early suspicion, prompt isolation, protection of healthcare workers and caregivers, rapid specimen handling, and clear risk communication. Strengthening these measures—particularly in district hospitals during the sap season—offers the most effective strategy to reduce transmission and prepare for future outbreaks.

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Original article

Socio-demographic Characteristics of Intimate Partner Violence Cases Presenting to a Crisis Centre in Sylhet, Bangladesh

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Abstract:

Background: Intimate partner violence (IPV) is a major public health and human rights concern, particularly in low- and middle-income countries. In Bangladesh, IPV remains highly prevalent, with disproportionate effects on socioeconomically vulnerable women. ***Objectives:*** To describe the socio-demographic characteristics of IPV victims and perpetrators attending a One-Stop Crisis Centre (OCC) in Sylhet city. ***Methodology:*** A descriptive cross-sectional study was conducted using retrospective records from the OCC at Sylhet MAG Osmani Medical College between January 2019 and December 2020. A total of 1,290 female victims of intimate partner violence with complete records were included. Data on socio-demographic characteristics, family context, perpetrator profile, and forms of violence were extracted and analyzed using descriptive statistics. ***Results:*** Among 1,290 victims, 65.2% were aged 16–30 years. Most were married (73.2%), Muslim (74.1%), and resided in rural areas (71.6%). A large proportion were housewives (67.1%) and from low socio-economic backgrounds (76.4%). Early marriage before 18 years was reported in (77.0%) of cases. Husbands were the primary perpetrators (50.5%), followed by former husbands (18.8%) and in-laws (12.4%). Psychological abuse was the most frequently reported form of IPV (85%), followed by physical (64%), sexual (47%), and economic abuse (18%). ***Conclusion:*** IPV in Sylhet predominantly affects young, married women in socioeconomically constrained settings. The findings highlight the need for targeted prevention strategies and strengthened support systems within institutional and community contexts.

Keywords: Intimate Partner Violence; Bangladesh; Socio-demographic factors; One-Stop Crisis Centre; Perpetrators

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Introduction:

Violence is a pervasive social and public health problem worldwide. The World Health Organization (WHO) defines violence as the intentional use of physical force or power, threatened or actual, against oneself or others that results in or has a high likelihood of resulting in injury, psychological harm, or deprivation.[1] Among its many manifestations, violence against women (VAW) stands out as one of the most widespread and enduring violations of human rights across the globe.[2] Despite advances in gender equality in the 21st century, VAW remains highly prevalent. VAW is commonly categorized as interpersonal violence, which includes intimate partner violence (IPV) and non-partner violence (NPV). IPV—violence inflicted by a current or former intimate partner—accounts for the largest share of reported violence against women.[1]

The concept of violence within intimate relationships and the cyclical nature of abuse were first systematically described by Lenore Walker through her formulation of Battered Woman Syndrome.[2] Earlier, such violence was broadly labeled as domestic violence, family violence, spouse abuse, wife abuse, or wife battering, before being more distinctly conceptualized.[3] The term intimate partner violence (IPV) emerged in the late 1980s and was widely adopted in the 1990s to more accurately capture abuse across diverse intimate relationships.[4]

Intimate Partner Violence (IPV) represents the most common form of violence against women and includes physical, sexual, psychological, and controlling behaviors perpetrated by a current or former intimate partner. According to the Centers for Disease Control and Prevention (CDC), IPV encompasses physical violence, sexual violence, stalking, or psychological aggression (including coercive acts) by a current or former intimate partner, whether or not the partner is a spouse.[5] The perpetrator can be the partner within a marriage context, cohabitation or any other formal or informal union. Although IPV can occur across genders and relationship types, this study focuses specifically on violence inflicted by male intimate partners against women in a major city in Bangladesh, reflecting the most prevalent and consequential pattern documented worldwide.

Global data regarding IPV paints an alarming picture. For example, nearly 1 in 3 women experience physical and/or sexual violence by an intimate partner during their lifetime. Violence like this often begins early, with approximately 1 in 4 girls reporting exposure during adolescence. IPV undermines the achievement of Susained Development Goals (SDG) particularly Goal Target 5.2.1, which aims to eliminate all forms of violence against women and girls in both public and private spheres.[6] Even children are indirect victims of IPV, often experiencing long-term psychological and behavioral consequences. It is estimated that 1 in 4 children under five living with their mothers are exposed to IPV. Even without direct abuse, such exposure can have lasting psychological effects and reinforce intergenerational cycles of violence. Every four minutes or so, a child is murdered by violence somewhere in the world.[7]

In Bangladesh, IPV is widely reported as a common form of domestic violence, even in the presence of legal protections such as the Domestic Violence (Prevention and Protection) Act, 2013. Recent statistics show that approximately 76% of women in Bangladesh experience violence by a husband or intimate partner, including physical, sexual, psychological, and economic abuse. Despite this high prevalence, an estimated 62% of survivors do not disclose their experiences to others.[8] Silence surrounding such abuse has detrimental effects on the physical, mental, sexual and reproductive health of women, on their children, and often on the wider family. Multiple studies suggest that IPV remains deeply embedded within patriarchal family structures, early marriage practices, and socio-economic dependency. Although closely related, IPV and DV differ conceptually; DV covers a wider spectrum of abusive behaviors within the household, such as child, elder, or other family member abuse.[9]

Despite the magnitude of the problem, region-specific data—particularly from Sylhet—remain limited. Understanding local socio-demographic patterns of IPV is essential for effective prevention and intervention.

Materials & Methods:

This cross-sectional study was conducted at the One-Stop Crisis Centre (OCC) of Sylhet MAG Osmani Medical College in Sylhet, Bangladesh, covering the period from January 2019 to December 2020. Data were obtained from retrospective OCC records documenting intimate partner violence, including socio-demographic characteristics, incident details, and perpetrator profiles. Out of 1,338 registered cases, 1,290 female victims with complete records were included, while those with incomplete information were excluded. Data were extracted using a pre-designed structured format to capture socio-demographic characteristics, marital and family contexts, perpetrator profiles, and specific forms of violence. Statistical analysis was performed using Microsoft Excel to analyze the data descriptively, with results expressed as frequencies and percentages presented in tables and figures. Institutional ethical approval was obtained prior to data collection, and individual consent was waived due to the retrospective nature of the review; however, victim confidentiality and autonomy were strictly maintained by ensuring no personal identifiers were used.

Several limitations characterize this study, as the use of retrospective data from a single center may introduce selection bias, reflecting only survivors who sought formal support rather than the wider community. Reliance on

secondary records further limited control over data completeness and measurement precision, while the cross-sectional design precludes causal inference. Additionally, underreporting of sexual and psychological violence remains likely due to social stigma and cultural barriers. Finally, as the findings are context-specific, they may not be generalizable beyond the Sylhet region.

Results:

Socio-Demographic Profile of Victims

Table I shows among the 1,290 victims, the majority were aged 16–30 years (65.2%), followed by 31–45 years (27.8%). Most were married (73.2%), Muslim (74.1%), and rural residents (71.6%). Educational attainment was generally low, with (41.3%) completing secondary education and (22.6%) being illiterate. Most victims were housewives (67.1%) and belonged to low socio-economic status (76.4%). Early marriage was common.

Table 1. Socio-demographic characteristics of participants (n = 1290)

Sociodemographic characters	Category	n (%)
Age (years)	<15	75 (5.8)
	16–30	841 (65.2)
	31–45	358 (27.8)
	≥46	16 (1.2)
Marital status	Married	944 (73.2)
	Unmarried	302 (23.4)
	Widow	17 (1.3)
	Divorced	15 (1.2)
	Separated	12 (0.9)
Religion	Islam	956 (74.1)
	Hindu	302 (23.4)
	Others	32 (2.5)
Residence	Rural	923 (71.6)
	Urban	367 (28.4)
Socioeconomic status	Low	985 (76.4)
	Middle	191 (14.8)
	High	114 (8.8)
Education	Illiterate	292 (22.6)
	Primary	338 (26.2)
	Secondary	533 (41.3)
	Higher	127 (9.8)
Occupation	Housewife	865 (67.1)
	Student	72 (5.6)
	Employed (garments/service)	216 (16.7)
	Domestic worker	62 (4.8)
	Others	75 (5.8)

Perpetrators of Violence

Table 2 shows husbands were the primary perpetrators (50.5%), followed by former husbands (18.8%) and in-laws (12.4%). Non-marital partners accounted for (2.7%) of cases.

Table 2. Relationship of perpetrators to victims (n = 1290)

Victim-Perpetrator Relationship	n (%)
Husband/Spouse	652 (50.5)
Former husband	243 (18.8)
Non-marital partner	35 (2.7)
In-laws	160 (12.4)
Parents/Family members	46 (3.6)
Others	154 (11.9)

Family and Marital Characteristics

Table 3 shows among married participants (n = 988), arranged marriages were predominant (80.2%). Early marriage before 18 years was reported in (77.0%) of cases. Most victims had been married for 4–6 years (64.1%) and had an age gap of 6–10 years with their husbands (64.5%). Decision-making authority was largely husband-directed (73.2%).

Table 3. Family and marital characteristics of married participants (n = 988)

Variable	Category	n (%)
Type of marriage	Arranged	792 (80.2)
	Love	196 (19.8)
Age at marriage	<18 years	761 (77.0)
	≥18 years	227 (23.0)
Duration of marriage	≤3 years	69 (7.0)
	4–6 years	633 (64.1)
	7–10 years	188 (19.0)
	≥11 years	98 (9.9)
Age gap (wife–husband)	≤5 years	90 (9.1)
	6–10 years	632 (64.0)
	≥11 years	266 (26.9)
Family type	Nuclear	568 (57.5)
	Joint/Extended	420 (42.5)
Family autonomy	Elder	178 (18.0)
	Husband	723 (73.2)
	Wife	87 (8.8)

Socio-Demographic Profile of Perpetrators

Most perpetrators were aged 16–30 years (49.4%) or 31–45 years (33.2%) shown in Table 4. Primary-level education was most common (29.6%). Agricultural work (33.9%) and informal employment were prevalent. Substance abuse (20.8%), alcohol consumption (18.6%), and controlling behavior (31.8%) were frequently reported contributing factors.

Table 4. Socio-demographic profile of perpetrators (n = 988 married cases)

Sociodemographic characteristics	Category	n (%)
Age (years)	<18	70 (7.1)
	19–30	488 (49.4)
	31–45	328 (33.2)
	≥46	102 (10.3)
Residence	Rural	679 (68.7)
	Urban	309 (31.3)
Education	Illiterate	244 (24.7)
	Primary	292 (29.6)
	Secondary	240 (24.3)
	Higher	212 (21.5)
Occupation	Unemployed	291 (29.5)
	Agricultural	335 (33.9)
	Employed/Business	362 (36.6)
Contributing factors*	Extramarital affair	137 (13.9)
	Substance abuse	205 (20.8)
	Alcohol consumption	184 (18.6)
	Psychological issues	56 (5.7)
	Controlling behaviour	314 (31.8)
	Disaster-prone residence	92 (9.3)
Number of Partners/Spouses	One	693 (70.14)
	Two/more	295 (29.86)

*Multiple responses possible.
***Perpetrators aged <18 years reflected cases involving early or child marriage, which remains prevalent in certain rural settings.

Forms of Intimate Partner Violence

Figure 1 shows different forms of IPV. Psychological abuse was the most prevalent form of IPV (85%), followed by physical (64%), sexual (47%), and economic abuse (18%).

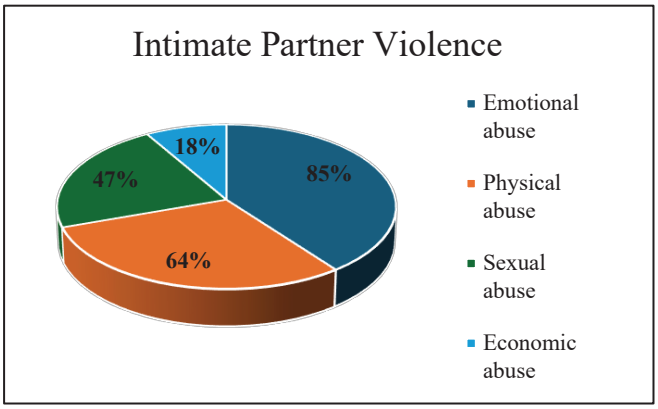

Figure 1: Forms of IPV

Discussion

In patriarchal social settings such as Bangladesh, household decision-making is largely male-dominated, shaping women's access to education, mobility, and economic resources over the life course. Within these domains, violence may serve as a means of maintaining hierarchical power dynamics and control across domestic and social territory. In some communities, wife battering is normalized within family relations, reflecting deeply entrenched gender norms.[10] Women's tolerance of abusive behavior is often linked to overlapping social and economic factors, including feelings of powerlessness, traditional norms emphasizing obedience to male authority, economic hardship and limited awareness of legal protections.[11]

Although national survey data show the highest lifetime prevalence of IPV in Barishal and Khulna (81.5%), Sylhet presents a distinctive regional profile. Despite comparatively lower prevalence (72.1%) and higher literacy levels, IPV remains persistent in Sylhet, likely reflecting the region's predominantly rural context.[12] Within this setting, age emerges as a key determinant of IPV risk. The present study indicates that IPV in Sylhet disproportionately affects young, married, Muslim women, particularly those aged 16–30 years (65.2%), followed by women aged 31–45 years (27.8%). These findings are consistent with earlier Sylhet-based studies and national data demonstrating heightened vulnerability during the early years of marriage, especially among women with low educational background and economic dependency.[11,12,13,14,15,16] Early marriage further reinforces power imbalances, limits educational and economic opportunities, and increases prolonged exposure to abuse. Across South Asia, similar results have been observed in Dalal K et al., Ali PA et al., Giri S et al. and Jayasuriya V et al.[17,18,19,20] This pattern suggests that, despite diverse cultural and religious contexts, women remain vulnerable to IPV. Studies by Kadir SH et al. and Hayati EN et al. suggest that IPV patterns are largely driven by low education and disadvantaged social status.[9,21]

The literature shows that husbands and former husbands

account for nearly 70% of IPV perpetrators, particularly among married women, reinforcing IPV as an intimate partner phenomenon. While non-partner violence accounts for a relatively small proportion of reported cases (2.71%), these finding warrants attention, as social norms and stigma may contribute to underreporting of such incidents. The majority of perpetrators were aged 16–30 years (49.4%), with a substantial proportion aged 31–45 years (33.2%). Educational attainment was generally low, with primary-level education being most prevalent (29.6%), followed by illiteracy (24.7%), secondary-level education (24.3%), and higher-level education (21.4%). Most perpetrators were from rural areas (68.7%) rather than urban settings (31.9%). Occupationally, employment was predominantly in agriculture (33.9%), while (29.5%) were unemployed; a smaller proportion were engaged in service-related or self-employed occupations. In our study, family structures were commonly characterized by early arranged marriages (before the age of 18 years) with common spousal age gaps of 6–10 years. Patrilineal family systems typically institutionalize male dominance in regulating women's behavior, where coercive measures may be rationalized as forms of discipline. Limited family intervention can normalize such practices, fostering a culture of silence that is reproduced across generations. Within this milieu, women's tolerance of abusive behaviour appears to be linked to multiple constraints, such as restricted educational opportunities, economic vulnerability, early marital obligations, and normative gender hierarchies.[10,11,13,22]

Psychological abuse was the most common form of IPV in this study (85%), followed by physical (64%), sexual (47%), and economic abuse (18%), underscoring the often hidden and under-recognized nature of non-physical violence. This pattern is consistent with national evidence indicating that controlling behaviour and emotional abuse the most widespread yet least disclosed forms of IPV in Bangladesh.[12] Although psychological and physical abuse frequently co-occur, the combined prevalence could not be quantified in the present study and is likely underreported. Consistent with earlier research by Dalal K et al., Ali PA et al., Giri S et al., and Jayasuriya V et al., psychological forms of IPV—particularly controlling behaviours—were highly prevalent.[17,18,19,20] In the present study, psychological abuse commonly manifested as verbal threats, humiliation, gaslighting, and shaming, while physical abuse involved acts such as beating, slapping, punching, kicking, pushing, and choking. Interpretation of sexual violence remains particularly challenging in cultural settings such as Bangladesh, where disclosure may be constrained and measurement often relies on limited interview-based assessments.[21] Similar patterns, though with lower reported prevalence, have been observed in studies by Kadir SH et al. and Hayati EN et al. potentially reflecting cultural norms that emphasize family privacy and marital harmony.[9,21]

Several risk factors identified in this study—including substance use, controlling behaviour, economic stress, and entrenched patriarchal norms—have been well documented in earlier Sylhet-based research.[13,14,15] Stake et al. demonstrated strong associations between IPV and husbands' controlling behaviours, lower educational attainment, and intergenerational exposure to violence.[16] The prominence of controlling behaviour, substance abuse, and alcohol consumption among perpetrators in the present study further underscores the multifactorial nature of IPV, reflecting the interplay of individual, relational, and broader societal influences.[19,20] Cases documented at the Sylhet One-Stop Crisis Centre (OCC) likely represent only a fraction of the broader burden of IPV, capturing those instances in which violence reaches a level that compels women to seek formal assistance. This institutional perspective complements earlier qualitative and survey-based studies by shedding light on the severity and consequences of IPV that often remain hidden in community settings. Despite recent expansions in legal frameworks addressing domestic violence, persistent cultural reluctance to disclose abuse continues to limit women's access to justice and health services. The findings from Sylhet reflect this disconnect, highlighting the gap between the formal recognition of IPV and women's lived experiences of constrained protection and support.

Conclusion

In Sylhet city, IPV predominantly affects young, married women from socioeconomically disadvantaged backgrounds and is most often inflicted by intimate partners. While these findings broadly converge with national and global evidence, they also highlight context-specific vulnerabilities related to early marriage, economic dependence, and barriers to reporting. Strengthening institutional responses, promoting early intervention, and addressing underlying social norms remain critical for reducing the burden of IPV.

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Original article

Bacteriological profile and antibiotic susceptibility pattern of uropathogens in patients with Urinary Tract Infection in a diagnostic center in Narayanganj, Bangladesh

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Abstract:

Background: Urinary tract infections are one of the most common bacterial infections and a leading cause for antibiotic prescriptions in the community. The incidence of urinary tract infections caused by multidrug-resistant uropathogens has been increasing at an alarming rate worldwide, especially in developing countries. ***Objectives:*** The study was done to investigate the causative agents of urinary tract infection and recent antibiotic sensitivity pattern in uropathogens in Narayanganj. ***Methodology:*** A cross-sectional descriptive type of study was conducted in S. Alom Digital Diagnostic Centre, Narayanganj. 281 reports of urine culture and sensitivity test, were collected from laboratory and evaluated retrospectively from July 2025 to December 2025. ***Results:*** Among 281 urine culture reports, 137 (48.75%) cases were culture positive for uropathogens. Females 103 (69.60%) were more affected than males 34 (25.56%). Gram-positive organisms accounted for 6.57% of the isolates [Staphylococcus aureus (3.6%) and Enterococci (2.9%)], while Gram-negative organisms made up 93.43% [Escherichia coli (78.8%), Klebsiella (12.4%) and Pseudomonas (2.2%)]. Antibiotic susceptibility testing revealed excellent susceptibility to Imipenem (100% S), Meropenem (100% S), Amikacin (100% S), Tigecycline (98.21% S), Colistin (95.74% S), Cefepime (87.5% S), Nitrofurantoin (82.81% S) and Cefotaxime (80.37% S) but, high resistance to Tetracycline (100% R), Cephradine (98.44% R), Cotrimoxazole (92.8% R), Amoxyclav (87.70% R), Doxycycline (85.85% R), Ampicillin (83.33% R) & Cefuroxime (80.83% R). Among Gram-positive organisms, high resistance to Penicillin, Cefoperazone, Cephradine, Azithromycin, and Clindamycin was observed while, high susceptibility to Linezolid, Nitrofurantoin, Amikacin, Meropenem, Imipenem, and Amoxiclav was observed. ***Conclusion:*** This study reveals the increasing antibiotic resistance to both Gram-positive and Gram-negative uropathogens. As the antibiotic susceptibility of uropathogens is frequently changing, continuous regional surveillance of resistance patterns is necessary.

Keywords: UTI, Uropathogen, Antibiotic, Susceptibility, Resistance.

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Introduction:

Urinary tract infection (UTI) is defined as the invasion of pathogens into urinary tract tissues extending from the renal cortex to the urethra (urethritis), which includes the prostate (prostatitis), urinary bladder (cystitis), and kidney (pyelonephritis).[1] UTIs are the second most prevalent bacterial infection among people of all ages globally.[2] It is estimated that there are approximately 150 million urinary tract infections per year globally.[3] UTIs are a major reason for antibiotic prescriptions in the community particularly in developing countries.[4]

The prevalence of UTI differs due to age, sex, ethnicity, temperature, and circumcision status.[5] Every woman has a lifetime risk of acquiring UTI of 53%, whilst men have a lifetime risk of 14%.[6] By the age of 24, roughly one-third of women will have experienced a UTI that required antibiotics. Approximately 50% of women will have at least one episode of a UTI during their lives, and nearly 20% to 40% will have reoccurring infections.[7]

For proper diagnosis of UTI, clinical signs, symptoms, urinalysis and urine culture play a vital role. UTI is diagnosed by the gold standard urine culture when more than 10^5 CFU/mL of the same species of bacteria are isolated from two consecutive properly collected specimens of midstream urine in women or from a single specimen with one bacterial species in men.[8] Acute bacteriuria, perinephric abscess with sepsis, or even death are all possible outcomes of the condition.[9] There are two types of UTIs: complicated (cUTIs) and uncomplicated (uUTIs). Certain subpopulations are more susceptible to UTIs than others, including infants, women (more so than men), the elderly, people with spinal cord injuries or catheters, people with diabetes or multiple sclerosis, people with AIDS/HIV, and people with underlying urologic abnormalities.[10]

Gram-negative bacteria such as Escherichia coli, Klebsiella pneumoniae, pseudomonas aeruginosa, Citrobacter species, Enterobacter species, and Proteus species are the most common pathogens involved in UTIs in both community and hospital settings. UTIs are typically caused by gram-positive bacteria such as Staphylococcus aureus, Staphylococcus saprophyticus, and Enterococcus species.1 E. coli is the most common cause of community-acquired UTIs.[11] Some studies suggest that anaerobic cocci cause UTIs in >7% of cases.[12] Although bacteria are responsible for more than 95% of UTIs, other microorganisms such as fungus, parasites, and viruses can also cause them.[13]

Since bacteria are the primary cause of UTIs, using broad spectrum antibiotics is the recommended course of treatment. Widespread use of antibiotics is making the treatment challenging as it accelerates the emergence of drug resistant bacteria. It is more common in lower and middle income countries like Bangladesh, where empirical therapy is a routine practice as the laboratory facility for urine culture is not available everywhere.[14] It's interesting to note that uropathogens can occasionally and locally alter their physiological characteristics in order to cause multi-drug resistance (MDR).[15] MDR uropathogens have become more common in recent years, which is a global public health concern.[14] These infections have been found in both hospitalized and community individuals.[16]

Antimicrobial resistance (AMR) occurs when organisms become resistant to previously effective antimicrobial agents.[17] AMR may be developed by random mutations in DNA of the chromosomes, or via transferring and obtaining new genetic materials between bacteria (by plasmids or transposons) from the same or different genera.[18] Gram-negative bacteria can get resistant genes, located on transferable plasmids, that code for extended-spectrum β-lactamases (ESBLs).[19] Limitation of drug absorption, alteration of a drug target, and active pumping out of a drug are additional significant resistance mechanisms of resistance.[20]

The pattern of antibiotic susceptibility among bacteria differs over time, between hospitals and between geographical areas.[21] The Infectious Disease Society of America recommends that regional surveillance should be conducted in a particular area to monitor variations in antibiotic sensitivity patterns.[22] Prior to lab findings from urine culture, physicians need to consider local sensitivity patterns of uropathogens when deciding empirical therapy.[23]

Continuous monitoring of infection etiology and antibiotic resistance patterns is necessary not just for selecting effective antibiotics for empirical therapy, but also for decreasing antibiotic overuse and misuse.[24] We carried out a retrospective record-based cross-sectional study in Narayanganj district, Bangladesh to investigate the prevalence, etiologies of UTI along with antibiotic susceptibility patterns in Uropathogens according to the World Health Organization (WHO) AWaRe classification which may help the clinicians to choose the best empirical treatment.

Materials and Methods

This retrospective cross-sectional descriptive study was conducted in the Department of Pharmacology, Dhaka Medical College, Dhaka, in collaboration with S. Alom Digital Diagnostic Centre, Narayanganj, over a duration of six months from July 2025 to December 2025. A total of 281 urine reports, either positive or negative for culture and sensitivity tests, recorded at S. Alom Digital Diagnostic Centre were included using purposive sampling. The study population comprised patients aged one year and above of either sex, while patients younger than one year were excluded. Data were collected from laboratory records of the diagnostic centre for the specified study period. There was no associated physical or psychological risk to the samples or participants. Ethical approval for the study was obtained from S. Alom Digital Diagnostic Centre, Narayanganj, and informed consent was not taken as the study was conducted retrospectively.

Chemicals and media

HiChrome UTI agar, blood agar and MacConkey agar were used for the selective isolation and identification of microorganisms causing urinary tract infections and Mueller-Hinton Agar (MHA) was used for antibiotic susceptibility test of the selected urinary cultures. Culture was done aerobically at 37^{o}C for 24 hours.

Sample collection

Clinically suspicious UTI patients provided clean catch midstream urine (MSU) samples of approximately 4-5 ml in sterilized, broad mouthed, universal disposable containers, according to the Clinical and Laboratory Standards Institute (CLSI), 2020 guidelines.[25] They were instructed how to collect the correct sample in a clean container aseptically right before collection.

Antimicrobial Susceptibility Testing

Antimicrobial susceptibility test was done by the Kirby-Bauer agar disk diffusion system.[26] Diameters of the zone of inhibition were measured to the nearest millimeter and classified as sensitive or resistant to each antibiotic according to CLSI, 2020 guidelines.[25] Patient "Block samples" (clinical stocks) were used for Antimicrobial Susceptibility Testing quality control. Antibiotics tested for both gram positive and gram negative uropathogens are shown in Table III and Table II respectively.

Data collection, recording, and analysis: Data were collected from laboratory record of S. Alom Digital Diagnostic Centre, Narayanganj. The information was recorded and analyzed. All data were entered, checked, and scrutinized for the following standard procedure and analyzed by using Microsoft Office Excel 2024. Quantitative data were summarized by number and percentages. Appropriate analysis was done to fulfill the objectives of the study. Data was presented by tables and graphs based on the nature of data.

Results

A total of 281 urine culture reports were collected from the laboratory during the study period. Overall, 137 samples (48.75%) tested positive for microbial growth while, 144 samples (51.25%) were culture negative. The rate of growth positive isolates among females was 69.60% (103/148) while, in males it was 25.56% (34/133). Also, the rate of growth positive isolates in the adults was 67.88% (93/137), in the children 16.79% (23/137) and in the elderly 15.33% (21/137), which is shown in Table I.

Table I: Rate of isolation of uropathogens from urine samples (N=281)

Variables			Percentage
1.Based on Culture and Sensitivity result	**Culture positive**		**48.75% (137/281)[a]**
	Based on Gram reaction	Gram positive	6.57% (9/137)[c]
		Gram negative	93.43% (128/137)[c]
	Based on age	Children (1-18Y)	16.79% (23/137)[c]
		Adult (19-59Y)	67.88% (93/137)[c]
		Elderly (≥60Y)	15.33% (21/137)[c]
	Culture negative		**51.25% (144/281)[a]**
2. Based on sex	**Male**		25.56% (34/133)[b]
	Female		69.60% (103/148)[b]

[a]Rate of isolation was determined by total number of positive cases divided by total number of cases (positive+negative).
[b]Rate of isolation was determined by number of same sex positive cases divided by total number of same sex cases (positive+negative).
[c]Rate of isolation was determined by number of positive cases divided by total number of positive cases.

The results of the urine cultures taken from patients revealed that Gram negative bacteria isolated were 93.43% (128/137) and Gram positive bacteria were 6.57% (9/137) as shown in Table I. Among Gram negative organisms, Escherichia coli was isolated **78.83% (108/137),** followed by Klebsiella **12.41% (17/137)** and Pseudomonas **2.19% (3/137).** Among Gram positive organisms, Staphylococcus aureus was **3.65% (5/137),** and Enterococcus was **2.92% (4/137)** as shown in Figure 1.

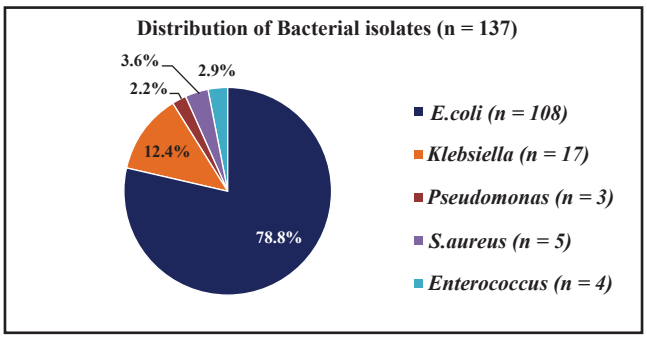

Figure 1: Distribution of various organisms isolated from urine cultures (n=137)

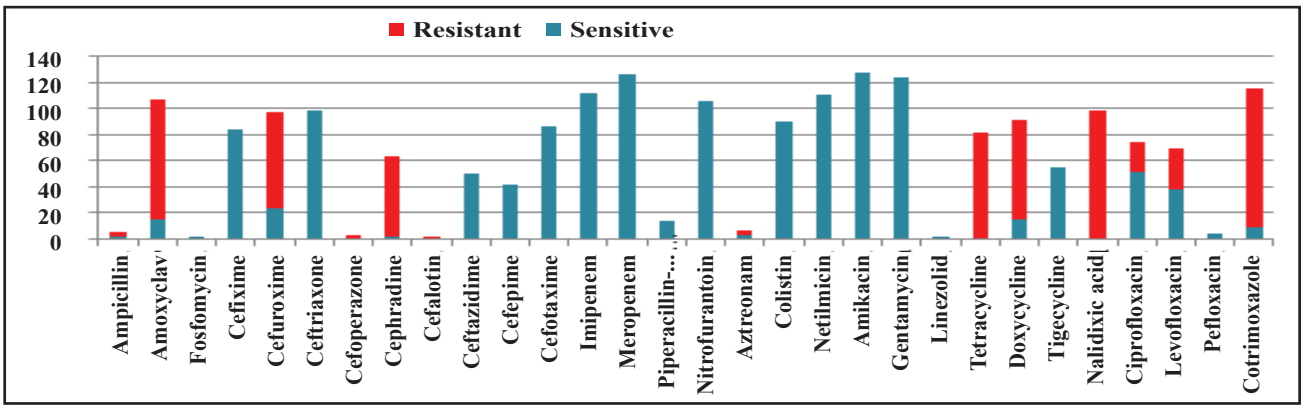

Figure 2: Antibiotic sensitivity and resistance profiles of isolated gram-negative uropathogens (n=128)

Table II: Antibiotic sensitivity and resistance pattern of isolated gram-negative uropathogens (n=128)

	Sensitive (S) n (%)	Resistant (R) n (%)	Total N
WHO Access Group antibiotics			
Ampicillin	01 (16.67%)	05 (83.33%)	06
Amoxyclav	15 (12.30%)	107 (87.70%)	122
Cephradine	01 (1.56%)	63 (98.44%)	64
Cefalotin	00	01 (100%)	01
Nitrofurantoin	106 (82.81%)	22 (17.19%)	128
Amikacin	128 (100%)	00	128
Gentamicin	124 (97.64%)	3 (2.36%)	127
Tetracycline	00	82 (100%)	82
Doxycycline	15 (14.15%)	91 (85.85%)	106
Cotrimoxazole	09 (7.2%)	116 (92.8%)	125
WHO Watch Group antibiotics			
Fosfomycin	01 (100%)	00	01
Cefixime	84 (65.62%)	44 (34.38%)	128
Cefuroxime	23 (19.17%)	97 (80.83%)	120
Ceftriaxone	99 (77.34%)	29 (22.66%)	128
Cefoperazone	00	03 (100%)	03
Ceftazidime	50 (67.57%)	24 (32.43%)	74
Cefepime	42 (87.5%)	06 (12.5%)	48
Cefotaxime	86 (80.37%)	21(19.63%)	107
Imipenem	112 (100%)	00	112
Meropenem	127 (100%)	00	127
Piperacillin-tazobactam	14 (73.68%)	05 (26.32%)	19
Netilmicin	111 (100%)	00	111
Ciprofloxacin	51 (40.8%)	74 (59.2%)	125
Levofloxacin	38 (35.19%)	70 (64.81%)	108
Pefloxacin	04 (100%)	00	04
WHO Reserve Group antibiotics			
Aztreonam	03 (33.33%)	06 (66.67%)	9
Colistin	90 (95.74%)	04 (4.26%)	94
Linezolid	01 (100%)	00	01
Tigecycline	55 (98.21%)	01 (1.79%)	56
Unclassified			
Nalidixic acid	00	99 (100%)	99

WHO: World Health Organization

Completely Effective Antibiotics (100% Sensitivity): Imipenem (100% S), Meropenem (100% S), Netilmicin (100% S), Amikacin (100% S) were completely sensitive against gram negative uropathogens. (Table II)

Highly Effective Antibiotics (80-99% Sensitivity): Tigecycline (98.21%), Gentamicin (97.64% S), Colistin (95.74% S), Cefepime (87.5% S), Nitrofurantoin (82.81% S), Cefotaxime (80.37% S) showed the high sensitivity rates, indicating their strong efficacy against Gram-negative uropathogens. (Table II)

Moderately Effective Antibiotics (50–79% Sensitivity): Ceftriaxone (77.34% S), Piperacillin-tazobactam (73.68% S), Ceftazidime (67.57% S), and Cefixime (65.63% S) displayed moderate efficacy, suggesting their potential use depending on the clinical condition. (Table II)

Poorly Effective Antibiotics (1-50% Sensitivity): Ciprofloxacin (40.8%), Levofloxacin (35.19%), Aztreonam (33.33% S), Cefuroxime (19.17%), Ampicillin (16.66% S), Doxycycline (14.15% S), Amoxyclav (12.30%), Cotrimoxazole (7.2%), and Cephradine (1.56%) exhibited poor efficacy, indicating their limited therapeutic use. (Table II)

Complete Resistant antibiotics (0% Sensitivity): Nalidixic acid, Tetracycline and Cefoperazone showed complete resistance (100% R) against Gram negative uropathogens. (Table II)

Unconfirmed: Due to very low (<5) cases, sensitivity of Fosfomycin, Cefalotin, Linezolid and Pefloxacin could not be confirmed. (Table II)

Completely Resistant Antibiotics (100% Resistance): Penicillin (100% R), Cefoperazone (100% R), Cephradine (100% R), Azithromycin (100% R), Clindamycin (100% R), and Nalidixic acid (100% R) were completely resistant against gram positive organisms. (Table III)

Highly Resistant Antibiotics (80-99% Resistance): Cefixime (85.71% R), Cefuroxime (85.71% R), and Levofloxacin (80% R) showed high resistance, indicating limited therapeutic use. (Table III)

Moderately resistant Antibiotics (50–79% Resistance): Cotrimoxazole (75% R), Ceftriaxone (71.43% R), Cefotaxime (66.67% R), Ceftazidime (66.67% R) Ciprofloxacin (62.5% R) displayed moderate resistance, suggesting their potential use depending on the clinical condition. (Table III)

Table III: Antibiotic sensitivity and resistance pattern of isolated gram-positive uropathogens (n=09)

	Sensitive (S) n (%)	Resistant (R) n (%)	Total n
WHO Access Group antibiotics			
Ampicillin	04 (57.14%)	03 (42.86%)	07
Penicillin	00	04 (100%)	04
Amoxyclav	06 (85.71%)	01 (14.29%)	07
Cephradine	00	03 (100%)	03
Nitrofurantoin	06 (100%)	00	06
Amikacin	04 (100%)	00	04
Gentamicin	07 (100%)	00	07
Clindamycin	00	04 (100%)	04
Doxycycline	05 (71.43%)	02 (28.57%)	07
Cotrimoxazole	02 (25%)	06 (75%)	08
WHO Watch Group antibiotics			
Vancomycin	07 (100%)	00	07
Cefixime	01	06 (85.71%)	07
Cefuroxime	01	06 (85.71%)	07
Ceftriaxone	02 (28.57%)	05 (71.43%)	07
Cefoperazone	00	01 (100%)	01
Ceftazidime	02 (33.33%)	04 (66.67%)	06
Cefepime	02 (100%)	00	02
Cefotaxime	02 (33.33%)	04 (66.67%)	06
Imipenem	02 (100%)	00	02
Meropenem	03 (100%)	00	03
Teicoplanin	01 (100%)	00	01
Netilmicin	03 (100%)	00	03
Azithromycin	00	03 (100%)	03
Ciprofloxacin	03 (37.5%)	05 (62.5%)	08
Levofloxacin	01 (20%)	04 (80%)	05
Rifampicin	01 (100%)	00	01
WHO Reserve Group antibiotics			
Linezolid	07 (100%)	00	07
Daptomycin	01 (100%)	00	01
Tigecycline	03 (100%)	00	03
Unclassified			
Nalidixic acid	00	02 (100%)	02

WHO: World Health Organization

Poorly resistant Antibiotics (1-50% Resistance): Ampicillin (42.86% R), Doxycycline (28.57% R), and Amoxiclav (14.29% R), exhibited poor resistance, indicating their strong efficacy. (Table III)

No Resistance (0% Resistance): Linezolid, Vancomycin, Gentamicin, Nitrofurantoin, Amikacin, Meropenem, Imipenem, and Netilmicin had no resistant cases, suggesting strong efficacy but requiring further confirmation. (Table III)

Discussion

UTI still remains one of the leading causes of illness and mortality in developing countries such as Bangladesh. This could be due to a lack of proper research, incorrect diagnostic process, misuse of chemotherapeutic medicines etc.[27] The purpose of this study was to find out the bacteriological profile and their antibiotic susceptibility pattern in patients with UTI according to the WHO AWaRe classification in a diagnostic center in Narayanganj district of Bangladesh.

In the present study, 48.75% (137/281) had positive bacterial growth. This growth rate is almost similar to previous study conducted by Semwal et al., 2017 in Uttarakhand, India where it was 49.11%.28 But, unlike the present study, many other studies that are done in Dhaka (40.14%) and Mumbai (33.54%), lower growth rates were observed.[27,28] Some authors also reported the positive culture rate to be 55.08% and 71% in Dhaka city.[9,24] One reason for this higher growth rate of uropathogens in Dhaka city[9] and in the present study in Narayanganj district may be due to patients with poor personal hygiene and sanitation facilities coming from rural catchment areas. Another reason may be due to larger sample size (3200/4500).[24]

The results showed a higher growth positivity rate in females (69.60%) compared to males (25.56%), that indicate a sex-based difference in UTI prevalence, which is similar to previous findings.[27,30,32,33] Females are more prone to UTI as compared to males due to the short urethra, easy exposure of the tract with fecal matter, absence of prostatic secretion, pregnancy, obstruction and sexual activity.[34,35]

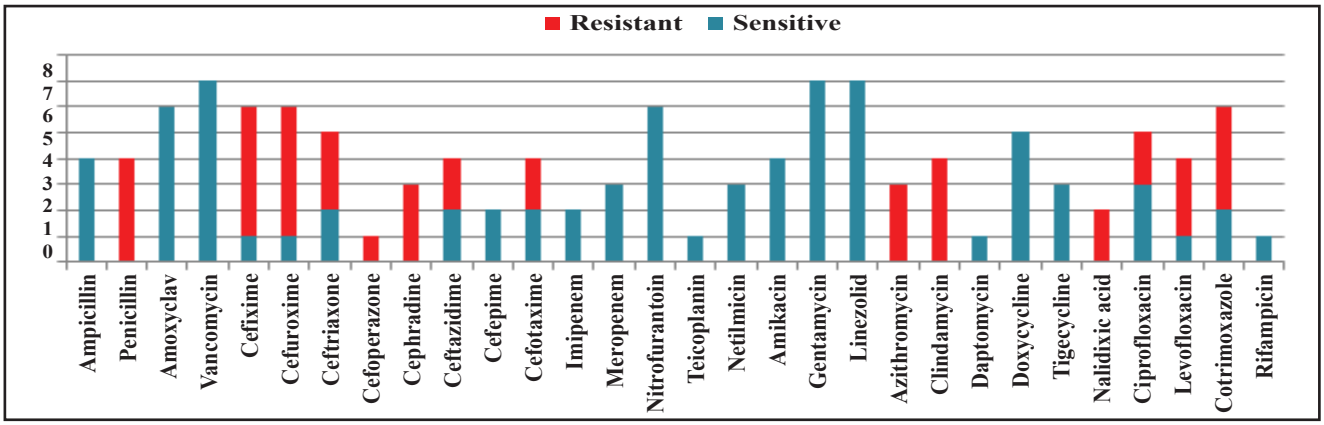

Figure 3: Antibiotic sensitivity and resistance profiles of isolated gram-positive uropathogens (n=09)

In the present study, Gram-negative bacteria, particularly E. coli, were the most common isolates (78.8%). It was similar to the findings of other studies done by Zannat et al (77.14%) and Sharmin et al. (74.1%).[31,36] E. coli is the leading cause of urinary tract infections (UTIs) because it naturally is present in the human gut, making it readily transferable to the urethral opening, especially in women due to the close proximity between the anus and urethra, and certain strains of E. coli have specific virulence factors that allow them to attach to the bladder lining and cause infection within the urinary tract.[37] The increased incidence of Klebsiella (12.4%) and Pseudomonas (2.2%), is also consistent with earlier observations.[24]

Gram-positive bacteria are less prevalent among community-acquired UTIs.[38] In this study, Gram-positive organisms, Staphylococcus aureus (3.6%) and Enterococci (2.9%) being the most frequently isolated species, comparable to earlier research.[1]

The antibiotic resistance patterns revealed in this study are alarming because they reflect the larger worldwide trend of growing resistance in UTI bacteria.[39] The Gram-negative bacteria were highly resistant to WHO Access group antibiotics like Tetracycline, Cephradine, Cotrimoxazole, Amoxyclav, Doxycycline & Ampicillin but, showed highest susceptibility to Amikacin, Gentamicin & Nitrofurantoin (Table II). These antibiotics are first-or second-choice for the treatments of the most common bacterial infections. They have lower possibility of developing resistance.[40] But, increasing resistance to them in this study is a direct reflection of overuse and misuse of these antibiotics.[41]

The Gram-negative bacteria were highly resistant to two of the commonly used WHO Watch group antibiotics (Cefuroxime & Cefoperazone) but, showed reliable susceptibility for rest of the antibiotics (Imipenem, Meropenem, Pefloxacin, Cefepime & Cefotaxime) (Table II). They have higher resistance potential and their use should be restricted.[40]

The Gram-negative bacteria were moderately resistant to WHO Reserve group antibiotics also like Aztreonam while showed highest susceptibility to Tigecycline & Colistin (Table II). These are reserved for severe & complex infections caused by multidrug-resistant uropathogens and should only be used when all other antibiotics have failed.[40]

Isolated gram-positive bacteria also were highly resistant to Penicillin, Cefoperazone, Cephradine, Azithromycin, Clindamycin, & Nalidixic acid (Table III). Gram-positive bacteria showed excellent susceptibility to Linezolid, Vancomycin, Nitrofurantoin, Amikacin, Meropenem, Imipenem, and Amoxiclav (Table III).

Both Gram-positive and Gram-negative uropathogens showed high rates of resistance, which is consistent with earlier research concerning the rising incidence of multidrug-resistant infections.[27-36,39,43] The findings of this study emphasize the need for regular and regional surveillance of antimicrobial resistance patterns. The significant resistance rates revealed in this study indicate the need of giving specific antibiotics based on culture and sensitivity testing rather than relying entirely on empirical therapy.[29]

According to International guidelines, Nitrofurantoin, Cotrimoxazole, and β-lactam, Fluoroquinolones antibiotics are recommended as first-line and second-line therapy, respectively, for the treatment of UTI.[42] Though, Nitrofurantoin showed excellent efficacy but, Cotrimoxazole, some of the β-lactams and Fluoroquinolones showed considerable resistance in the present study, which supports the earlier findings of increasing resistance in UTI.[32,36,43]That's why, their present recommended use in guidelines as a first- and second-line treatment for UTI, may need to be reconsidered. WHO Reserve group antibiotics showed excellent susceptibility against uropathogens in this study. Widespread use of these reserve antibiotics should be strictly controlled to ensure their rational use only for treating MDR-UTIs.[41,44]

UTIs pose a serious burden for the National Health Service.[45] The findings point to the need of instituting antimicrobial stewardship programs, especially in healthcare centers, to ensure judicious use of antibiotics and slow down the spread of resistance.[46] Besides, these results highlight the need for public health initiatives such as creating awareness on WASH (Water, Sanitation & Hygiene) and hydration to prevent UTIs.[47]

There are some limitations in this study. For example, standard ATCC strains were not used for antimicrobial susceptibility testing quality control. Also, demographic data (residence, socioeconomic status, literacy etc.) and clinical information (community acquired/ nosocomial, complicated/ uncomplicated) of patients could not be collected. Besides, level of awareness of the patients about health, hygiene & hydration could not be known.

Conclusion

This study provides important insights into the prevalence, microbiological etiology, and antibiotic resistance patterns of urinary tract infections (UTIs). Increasing resistance of uropathogens to first line therapy (e.g. Cotrimoxazole), and second line therapy (e.g. some of the β-lactams, fluoroquinolones) of UTI has been a significant concern for us. So, in addition to Nitrofurantoin; Amikacin & Gentamicin from the WHO Access group and Cefepime, Cefotaxime, Ceftriaxone & Pefloxacin from the WHO Watch group, may be prioritized for the treatment of UTI due to their excellent efficacy. Also, antibiotics from the WHO Watch group and Reserve group should be used for UTI treatment, but only with caution and rationale. As the antibiotic susceptibility pattern of uropathogens differs according to time and geographical locations, continued surveillance of antibiotic resistance should be done to ensure the selection of the best empiric treatment for UTI.

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Original article

Correlation and Diagnostic Value of Lipid Profile Indicators for Evaluating Health Risks Related to Shorter Breastfeeding Periods

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Abstract

Background: Breastfeeding duration influences maternal metabolic recovery, yet practical markers for identifying shorter breastfeeding patterns remain limited. ***Objectives:*** To examine associations between breastfeeding duration and maternal metabolic indicators and to evaluate lipid ratios as markers associated with breastfeeding ≤6 months. ***Methodology:*** A cross-sectional analytical study was conducted in the Department of Physiology, Ad-din Momin Medical College, South Keraniganj, Dhaka, Bangladesh, from January 2025 to December 2025. A total of 196 postpartum women aged 20–39 years were enrolled and divided equally into two groups according to breastfeeding duration: ≤6 months (n=98) and >6 months (n=98) from Jan 2025 to Dec 2025 Anthropometry, blood pressure, fasting glucose, lipid levels, and lipid ratios were assessed using standard methods. Statistical analyses were performed using SPSS version 26.0, including group comparisons, Spearman correlation, ROC curve analysis, and logistic regression. ***Results:*** Shorter-duration mothers were older (27 vs 25 years) and had higher BMI (24.46 vs 22.24 kg/m²) and BP. They showed worse metabolic values: fasting glucose (106.2 vs 91.8 mg/dL), triglycerides (142.5 vs 92.0 mg/dL), and LDL-C (106.5 vs 95.5 mg/dL). Breastfeeding duration correlated negatively with glucose, TG, LDL-C, and lipid ratios. TG/HDL showed the best discrimination (AUC 0.728) and was the only independent predictor (OR 6.17, p=0.001). ***Conclusion:*** TG/HDL may serve as a practical metabolic marker associated with shorter breastfeeding duration.

Keywords: Breastfeeding duration; Lipid profile; TG/HDL ratio; maternal metabolic health; postpartum women; metabolic risk.

Introduction:

Breastfeeding is essential for maternal and infant health, with initiation rates in Bangladesh approaching universality.[1] Longer breastfeeding duration is consistently associated with reduced risks of obesity, dyslipidemia and cardiovascular disease, while shorter breastfeeding periods increase susceptibility to metabolic complications.[2-4] Exclusive breastfeeding for six months, continued with complementary feeding up to two years, supports optimal infant development and may prevent up to 19% of

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under-five deaths.5 These long-term benefits stem from nutritional programming, as bioactive components of breast milk, including LCPUFAs, leptin and adiponectin, influence lipid metabolism and metabolic regulation in both infants and mothers.[6,7] Breastfed infants may develop more efficient cholesterol-processing pathways, while lactation promotes maternal metabolic resetting through enhanced insulin sensitivity and mobilization of fat stores.[8,9] Disturbances in lipid profiles, including elevated LDL-C, triglycerides and reduced HDL-C, are evident among individuals breastfed for shorter durations, particularly in high-risk Bangladeshi populations.[1,2] Given their predictive value, lipid indicators and atherogenic indices offer practical tools for identifying metabolic risks associated with insufficient breastfeeding. This study examines these associations to inform early detection and targeted public health strategies.

The study aims to evaluate the relationship between breastfeeding duration and maternal metabolic health while identifying specific lipid markers that offer diagnostic value for shorter breastfeeding patterns. To achieve this, the research evaluates biochemical and lipid profile indicators in relation to breastfeeding duration and determines the correlation between these metabolic markers and the length of lactation. Additionally, the study assesses the diagnostic performance of various lipid ratios to determine their effectiveness in identifying shorter breastfeeding durations.

Materials and methods

This cross-sectional analytical study was conducted among postpartum women aged 20–39 years at the Department of Physiology, Ad-din Momin Medical College, South Keraniganj, Dhaka, Bangladesh, during the study period from January 2025 to December 2025. Ethical approval was obtained from the Ethical Review Committee of Ad-din Momin Medical College, South Keraniganj, Dhaka, Bangladesh. Informed written consent was obtained from each participant before data collection. Confidentiality of all participants was maintained throughout the study. Participants were enrolled after completing breastfeeding and categorized into two groups based on duration: Group A (≤6 months) and Group B (>6 months). Women with known metabolic disorders, chronic illness, current pregnancy or ongoing lactation, use of lipid-altering medications, or incomplete clinical data were excluded. Anthropometric measurements including height, weight, waist circumference, and blood pressure were obtained using standardized procedures. Fasting venous blood samples were collected to measure fasting blood glucose, total cholesterol, triglycerides, HDL-cholesterol, and LDL-cholesterol using enzymatic methods. Atherogenic lipid ratios (TC/HDL, LDL/HDL, and TG/HDL) were subsequently calculated. Metabolic measurements were obtained within a defined postpartum period following cessation of breastfeeding to minimize long-term metabolic variability. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). As several variables were non-normally distributed, continuous variables were compared using the Mann–Whitney U test and categorical variables using the Chi-square test. Associations between breastfeeding duration and metabolic indicators were assessed using Spearman's rank correlation coefficients. Receiver Operating Characteristic (ROC) curve analysis was applied to evaluate the discriminative performance of lipid ratios, with area under the curve (AUC), optimal cut-off values determined by the Youden Index, and corresponding sensitivity and specificity calculated. Univariate and multivariable logistic regression analyses were conducted to identify independent associations between lipid ratios and shorter breastfeeding duration, adjusting for potential confounders including maternal age and BMI. Results were expressed as adjusted odds ratios (ORs) with 95% confidence intervals. A p-value <0.05 was considered statistically significant.

Result:

Table 1 & Fig A showed that mothers in Group A (≤6 months breastfeeding) were older (median age 27 vs 25 years) and had higher BMI (24.46 vs 22.24 kg/m²), systolic blood pressure (120 vs 100 mmHg), and diastolic blood pressure (80 vs 70 mmHg) compared to those in Group B (>6 months breastfeeding). The differences in age, BMI, systolic, and diastolic blood pressure were statistically significant ($p < 0.05$). However, waist circumference did not differ significantly between the groups ($p = 0.082$). diagnosis (Table 6). Correlation of colposcopy and histopathological examination. All women with CIN on colposcopy (100%) had CIN on histopathology, while 38.1% with CIN on colposcopy had cervicitis on histopathology (Table 7).

Table 2 showed that mothers in Group A (≤6 months breast-feeding) had significantly higher levels of fasting blood sugar (106.2 vs 91.8 mg/dL), total cholesterol (189.0 vs 172.0 mg/dL), triglycerides (142.5 vs 92.0 mg/dL), and LDL cholesterol (106.5 vs 95.5 mg/dL) compared to those in Group B (>6 months breastfeeding), with p-values all less than 0.01. The lipid ratios (TC/HDL, LDL/HDL, and TG/HDL) were also higher in Group A, with the TG/HDL ratio showing the most significant difference (2.76 vs 1.73, $p = 0.001$). HDL levels did not differ significantly between the groups ($p = 0.637$).

Table 1: Baseline characteristics of the study population

Variables	Group A (n=98)	Group B (n=98)	p-value
	f (%) Median (Range)	f (%) Median (Range)	
Age (in years)			
20-24	33 (33.7)	48 (49.0)	**0.037**
25-29	35 (35.7)	28 (28.6)	
30-34	26 (26.5)	14 (14.3)	
35-39	4 (4.1)	8 (8.2)	
Median (Range)	27 (20-36)	25 (20-39)	**0.022**
Physical parameters			
WC (cm)	83 (63-99)	79 (64-102)	0.082
BMI (kg/m^2)	24.46 (15.40-31.47)	22.24 (16.01-43.67)	**0.011**
SBP (mmHg)	120 (100-140)	100 (85-140)	**0.001**
DBP (mmHg)	80 (60-90)	70 (60-100)	**0.001**

Group A = Short breastfeeding ≤ 6 months; Group B = Longer breastfeeding > 6 months.
Chi-square test was used for categorical variables, and the Mann–Whitney U test was used for non-normally distributed continuous variables. A p-value < 0.05 was considered statistically significant.

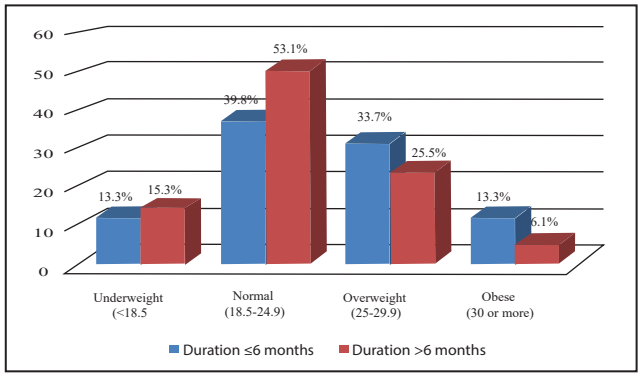

Fig A: Distribution of the participants according to BMI

Table 3 showed significant negative correlations between breastfeeding duration and BMI, fasting blood glucose, total cholesterol, triglycerides, LDL, and lipid ratios (TC/HDL, LDL/HDL, TG/HDL), indicating that longer breastfeeding was associated with better metabolic health. The strongest correlations were observed with fasting blood glucose (rs = -0.401) and triglycerides (rs = -0.264). These findings were further supported by Figure B, which illustrated that as breastfeeding duration increased, all three lipid ratios—TC/HDL, LDL/HDL and TG/HDL showed a decreasing trend.

Table 2: Biochemical parameters of the study population

Biochemical parameters	Group A (n=98)	Group B (n=98)	p-value
	Median (Range)	Median (Range)	
FBS (mg/dl)	106.20 (77.40-360.0)	91.80 (70.20-118.80)	**<0.001**
TC (mg/dl)	189.0 (120.0-293.0)	172.0 (77.0-293.0)	**0.001**
TG (mg/dl)	142.50 (65.0-293.0)	92.0 (38.0-368.0)	**<0.001**
LDL (mg/dl)	106.50 (61.0-177.0)	95.50 (30.0-169.0)	**0.009**
HDL (mg/dl)	50.0 (25.0-79.0)	50.50 (38.0-78.0)	**0.637**
TC/HDL ratio	3.75 (1.94-8.89)	3.43 (1.07-5.81)	**0.008**
LDL/HDL ratio	2.05 (0.98-5.28)	1.81 (0.65-3.39)	**0.017**
TG/HDL ratio	2.76 (1.05-7.74)	1.73 (0.60-7.48)	**0.001**

Group A = Short breastfeeding ≤ 6 months; Group B = Longer breastfeeding > 6 months.
Chi-square test was used for categorical variables, and the Mann–Whitney U test was used for non-normally distributed continuous variables. A p-value < 0.05 was considered statistically significant.

Table 3: Spearman correlation of breastfeeding duration with biochemical and lipid profile indicators

Variables	Spearman correlation coefficient (Duration of breast feeding in months)	
	r_s	p-value
BMI (kg/m^2)	-0.271	**<0.001**
FBS (mg/dl)	-0.401	**<0.001**
TC (mg/dl)	-0.275	**<0.001**
TG (mg/dl)	-0.264	**<0.001**
LDL (mg/dl)	-0.260	**<0.001**
HDL (mg/dl)	0.071	**0.320**
TC/HDL ratio	-0.232	**0.001**
LDL/HDL ratio	-0.247	**<0.001**
TG/HDL ratio	-0.287	**<0.001**

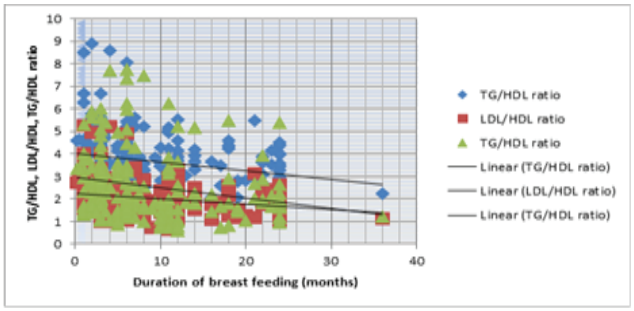

Figure B: Correlation between breastfeeding duration and lipid ratios (TC/HDL, LDL/HDL and TG/HDL)

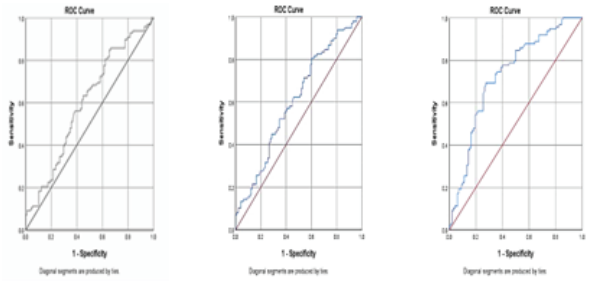

Fig C–E: ROC curves of lipid ratios (C: TC/HDL, D: LDL/HDL, E: TG/HDL)

ROC curve analysis (Fig C–E and Table 4) demonstrated that the TG/HDL ratio had the strongest diagnostic performance for identifying mothers who breastfed ≤6 months, with the highest AUC and a balanced sensitivity and specificity profile. In contrast, TC/HDL and LDL/HDL showed weaker discriminatory ability.

Table 4: Diagnostic performance of lipid ratios for predicting short breastfeeding duration

Lipid Ratio	AUC (95% CI)	p-value	Best Cut-off (Youden)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
TC/HDL	0.609 (0.530–0.688)	0.008	≥ 3.0421	80.6	39.8	57.25	67.24	60.20
LDL/HDL	0.598 (0.519–0.678)	0.017	≥ 1.5465	85.7	33.7	56.38	70.21	59.69
TG/HDL	0.728 (0.657–0.799)	<0.001	≥ 2.224	69.4	72.4	71.58	70.30	70.92

Table 5 showed that all lipid ratios were significantly associated with short breastfeeding duration in univariate analysis, with TG/HDL demonstrating the strongest effect. However, in the multivariate model, only TG/HDL remained a significant independent predictor, while TC/HDL and LDL/HDL lost significance. This indicates that the TG/HDL ratio is the most robust marker linked to shorter breastfeeding duration.

Table 5: Univariate and Multivariate logistic regression analysis of lipid ratios associated with short breastfeeding duration

Lipid ratios	Univariate Logistic Regression		Multivariate Logistic Regression	
	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
TC/HDL	2.74 (1.44-5.23)	**0.0021**	0.61 (0.21-1.72)	0.355
LDL/HDL	3.04 (1.50-6.15)	**0.0019**	1.87 (0.69-5.09)	0.218
TG/HDL	5.96 (3.21-11.04)	**<0.0001**	6.17 (2.90-13.11)	**0.001**

Discussion

In this study, mothers who breastfed for ≤6 months were older than those who breastfed for longer durations (median age 27 vs 25 years, p = 0.022), with a lower proportion in the youngest age group (20–24 years: 33.7% vs 49.0%). Comparable age trends appear in Choi et al., where Korean parous women showed incremental age differences across breastfeeding durations (≤5 mo: 39.78, 6–11 mo: 39.45, 12–23 mo: 39.44, ≥24 mo: 40.50 years, p = 0.001)8. Other studies provided older or broader age ranges; Project Viva modeled outcomes for women aged 35–40, 10, Villegas et al. reported a mean cohort age of 52.1±9.1, and the WHI included women aged 50–79 years11 while Hayosh et al. examined younger adults (mean 29.9, 28.8, 27.0 years across groups).12 These differences largely reflect methodological variation in timing of assessment, as most comparison studies evaluated women years or decades after breastfeeding rather than in the immediate postpartum period.

BMI showed a consistent pattern with breastfeeding duration. Mothers who breastfed for ≤6 months had higher BMI compared to those with longer breastfeeding duration (median 24.46 vs 22.24 kg/m², p = 0.011). Choi et al. reported modest BMI variation by breastfeeding length (≤5 months: 22.85, 6–11 months: 22.55, 12–23 months: 23.03, ≥ 24 months: 23.43 kg/m², p<0.001).8 Stuebe et al. found lower BMI three years postpartum among women exclusively breastfeeding >6 months (25.2) versus never-exclusive (27.0 kg/m², p = 0.05).10 Hayosh et al. observed uniformly lean BMIs across their young adult groups (21.1, 22.5, 22.2 kg/m²).12 Together, these patterns

consistently show that women who sustain longer breastfeeding tend to exhibit more favorable BMI profiles across populations and study designs. These disparities arise because our study captured active postpartum metabolic effects, whereas others assessed women long after lactation, when BMI reflects accumulated lifestyle and aging influences rather than breastfeeding behavior.

Blood pressure findings in this study further support the metabolic benefits of longer breastfeeding. Mothers who breastfed for more than six months had lower systolic and diastolic blood pressure compared to those who breastfed for ≤6 months (median SBP: 100 vs 120 mmHg; DBP: 70 vs 80 mmHg; $p < 0.05$). Choi et al. reported a similar directional pattern, observing gradual reductions in SBP across breastfeeding categories (110.49 → 108.55 mmHg, $p<0.001$) and modest DBP variation (71.7–73.2 mmHg, $p<0.001$).8

Biochemically, shorter-duration mothers demonstrated less favorable metabolic profiles. Median fasting blood glucose (106.2 vs 91.8 mg/dL), triglycerides (142.5 vs 92.0 mg/dL), total cholesterol (189.0 vs 172.0 mg/dL), and LDL cholesterol (106.5 vs 95.5 mg/dL) were all higher among mothers who breastfed for ≤6 months. In contrast, HDL levels did not differ significantly between the groups. Choi et al., however, showed fasting glucose nearly unchanged across breastfeeding durations (92–93 mg/dL, $p=0.375$),8 while Shub et al. (early postpartum) found exclusive breastfeeding associated with lower fasting glucose (4.60 vs 4.90 mmol/L, $p<0.0001$).9 These differences largely reflect timing, as our measurements captured the immediate postpartum metabolic shift when lactation most strongly influences glucose and lipid regulation, whereas Choi's national dataset reflects later, stabilized metabolic states.

Correlation analysis revealed significant negative associations between breastfeeding duration and BMI, fasting glucose, total cholesterol, triglycerides, LDL cholesterol, and lipid ratios, indicating that longer breastfeeding duration is associated with improved metabolic profiles (<0.001). HDL cholesterol showed no significant correlation, consistent with its relatively stable behavior in the postpartum period. A similar pattern was seen in the Shanghai Women's Health Study, although their correlation was far weaker (BMI $r = 0.22$),11 likely because measurements occurred decades after childbirth rather than during active postpartum metabolic adaptation.

Regression analysis further reinforced these findings. Although all lipid ratios (TC/HDL, LDL/HDL, and TG/HDL) were significantly associated with shorter breastfeeding duration in univariate models, only the TG/HDL ratio remained an independent predictor after adjustment (OR 6.17, $p = 0.001$). This highlights the robustness of TG/HDL as a marker of metabolic risk in relation to breastfeeding duration. Choi et al.'s adjusted regression likewise demonstrated protective metabolic effects of longer breastfeeding, reporting reduced odds for elevated blood pressure (OR 0.67–0.68), elevated glucose (OR 0.62–0.78), elevated triglycerides (OR 0.76), and metabolic syndrome (OR 0.70–0.73).8 Shub et al. also observed favorable lipid shifts with exclusive breastfeeding, with adjusted differences for TG (–0.24 mmol/L), LDL (–0.02 mmol/L), and HDL (+0.098 mmol/L), though smaller in magnitude due to their earlier postpartum window.9 Collectively, these comparisons show that stronger associations in our study likely reflect real-time postpartum metabolic responses, whereas population-based or later postpartum studies capture more attenuated long-term effects.

This study has several limitations. First, its cross-sectional design precludes causal inference between breastfeeding duration and metabolic parameters. Second, potential residual confounding from lifestyle factors such as diet and physical activity could not be fully excluded. Third, metabolic measurements were taken after completion of breastfeeding and may not fully capture long-term metabolic adaptation. Finally, the findings may not be generalizable beyond similar Bangladeshi populations.

Conclusion

Overall, the study's findings consistently indicate that longer breastfeeding duration is associated with more favourable maternal anthropometric, biochemical, and lipid profiles. These results highlight the importance of supporting breastfeeding beyond six months, not only for infant health but also for maternal metabolic well-being. Healthcare providers should consider incorporating TG/HDL ratio into postpartum metabolic risk assessments, particularly for mothers who breastfed for six months or less.

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Duality of Interest

The authors declare that there is no conflict of interest and no financial or personal relationships that could have influenced the work reported in this manuscript.

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Original article

Antibiotic Susceptibility Pattern of Major Uropathogens in a Private Medical College Hospital in Khulna, Bangladesh

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Abstract

Background: Urinary tract infections (UTIs) lie among the most prevalent bacterial infections worldwide, fueling extensive antibiotic use in both community and hospital settings. The increasing pattern of antimicrobial resistance (AMR) in uropathogens has critically diminished the effectiveness of empirical therapy, particularly in low and middle-income countries such as Bangladesh. ***Objectives:*** The study was conducted to investigate antibiotic susceptibility pattern of major uropathogens in a private medical college hospital. ***Methodology:*** This prospective cross-sectional study was conducted between March and November 2025 at the Department of Microbiology, Gazi Medical College Hospital, Khulna, Bangladesh. A total of 228 midstream urine specimens from patients with suspected UTIs underwent standard microbiological processing. Isolates were identified using conventional culture and biochemical methods, with antimicrobial susceptibility determined by the Kirby–Bauer disk diffusion technique on Mueller-Hinton agar, interpreted per CLSI 2023 guidelines. ***Results:*** Significant bacterial growth was observed in 143 samples (62.7%). Gram-negative organisms predominated, led by Escherichia coli (30.7%) and Klebsiella spp. (13.6%), while Gram-positives included Enterococcus spp. (7.02%) and Staphylococcus aureus (5.26%). Gram-negative isolates exhibited alarming resistance to second- and third-generation cephalosporins (e.g., cefuroxime, ceftriaxone), amoxicillin-clavulanate, and trimethoprim-sulfamethoxazole. Amikacin retained strong activity against E. coli (89.7% susceptible), and colistin showed near-complete efficacy (94–100%) against both major Gram-negatives. Meropenem susceptibility was relatively preserved, yet emerging resistance reached 16% in E. coli and 32% in Klebsiella. Among S. aureus, 33.3% displayed cefoxitin resistance, suggesting probable MRSA; linezolid and vancomycin remained highly effective. ***Conclusion:*** This study reveals a considerable burden of multidrug-resistant uropathogens in Khulna, characterized by widespread resistance to widely used beta-lactams and cephalosporins. These findings indicate an urgent need for sustained local AMR surveillance, evidence-based empirical prescribing, and boosting antimicrobial stewardship to protect therapeutic options amid escalating resistance threats.

Keywords: UTI, Uropathogen, Antibiotic, Susceptibility, Resistance.

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Introduction:

Urinary tract infections (UTIs) are the most common bacterial infections affecting all age groups and sexes, with a high incidence in women due to certain physiological and anatomical factors. UTIs occur worldwide in both community and hospital settings, with approximately 150 million new cases each year.[1,2] UTIs impose a remarkable burden on global healthcare with increased morbidity, high antibiotic consumption, significantly elevated healthcare costs, and serve as a leading cause of both out- and inpatient antibiotic prescriptions throughout the world.[3,4] UTIs are principally caused by Gram-negative bacteria, mainly Escherichia coli, which contributes 70–90% of community-acquired infections, followed by Klebsiella pneumoniae, Proteus spp., and Pseudomonas aeruginosa. Gram-positive organisms like Enterococcus and Staphylococcus spp. are also responsible in particular patient populations.[5–7]

Rapid diagnosis and initiation of proper antibiotic therapy are key to preventing complications such as pyelonephritis, renal scarring, septicemia, and recurrent infections.[6] However, the outcome of empirical treatment has been highly compromised by the prompt emergence of antimicrobial resistance (AMR) among uropathogens.[8–10] Resistance to commonly used antibiotics—including fluoroquinolones, trimethoprim-sulfamethoxazole, and third-generation cephalosporins—have risen over the past few decades, leading to higher rates of treatment failure and increased healthcare expenditure.[11–13] Multidrug-resistant (MDR) and extended-spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae have more limited treatment options, leading to the use of carbapenems or other reserve antimicrobial options.[14,15] The scenario of antimicrobial resistance (AMR) is very alarming in many low- and middle-income Southeast Asian countries, including Bangladesh, where unrestricted access to antimicrobials, overprescribing of empirical therapies, self-medication, and insufficient laboratory facilities contribute to the accelerated increase of resistance rates.[16,17] Studies from different tertiary care hospitals across Bangladesh have documented significant resistance rates among urinary pathogens. Several studies reported alarmingly high resistance of E. coli and K. pneumoniae to ciprofloxacin, ceftriaxone, amoxicillin-clavulanate, and cotrimoxazole.[18–21] Detection of ESBL-producing strains and multidrug resistance (MDR) organisms has been increasingly observed in both inpatient and outpatient settings.[20,22] Moreover, AMR patterns vary considerably between countries, different geographic locations, and institutions, highlighting the necessity for local surveillance data to construct a hospital-specific antibiogram to guide empirical therapy.[21,23]

Divisional town-Khulna, situated in the southern corner of Bangladesh, has a diverse population with various healthcare needs. However, very scanty data are available for this region on the antibiotic susceptibility patterns of bacterial uropathogens. Understanding local susceptibility patterns is essential for prescribing empirical therapy, reducing therapeutic failures, and restricting the spread of resistant strains. Thus, this study was conducted to fill the existing information gap by investigating the prevalence and AMR pattern of uropathogens isolated from patients having UTIs in a privately funded medical college hospital in Khulna. The findings are expected to contribute to evidence-based therapeutic guidelines, support antimicrobial stewardship, and strengthen infection control strategies to reduce the burden of AMR.

Materials and methods

This was a prospective cross-sectional study conducted at the Department of Microbiology and Clinical Microbiology Laboratory of Gazi Medical College Hospital, Khulna, during the period of March 2025 to November 2025. Clinically suspected 265 UTI cases irrespective of age and sex, referred from outpatient and different inpatient departments of the hospital with a requisition for urine culture and sensitivity test, were included in the study.

Clean-catch midstream urine samples (MSU) (4-5 ml) were collected in a sterile disposable leakproof container from all the enrolled suspected UTI cases and transported immediately to the laboratory. Urine culture was done by semi-quantitative method on MacConkey agar, Nutrient agar, and Chromogenic agar media by using calibrated loops and incubated aerobically for 24 hours at 37°C.[24,25] Routine microscopic examination of all urine samples was done for counting pus cells. If no colony appeared after 24 hours of incubation, those culture plates were further incubated for 48 hours. Bacterial isolates were identified and confirmed by using standard microbiological and biochemical tests like Gram staining, examining colony morphology on culture media, motility, indole urease test, citrate utilization test, observing biochemical changes in TSI media, catalase, coagulase, and oxidase test.[25]

Antimicrobial susceptibility testing was performed on Mueller-Hinton agar using the disk diffusion Kirby-Bauer technique according to Clinical and Laboratory Standards Institute (CLSI) guidelines. Antibiotics were interpreted as sensitive or resistant on the basis of the zone of inhibition of bacterial growth. Interpretation of zone diameters was performed according to CLSI 2023 guidelines (M100-S33). Resistance to the cefoxitin disk (30 µg) was interpreted as indicative of methicillin-resistant Staphylococcus aureus (MRSA), with a zone diameter of ≤21 mm classified as resistant. Due to variation in antibiotic disc availability and organism-specific testing protocols, not all isolates were tested against every antimicrobial agent.

Ethical approval was obtained from the Institutional Review Board of Gazi Medical College. Written informed consent was obtained from all participants.

Due to disc availability, not every isolate was tested against every antibiotic, which could cause variation in the interpretation of susceptibility. Finally, the lack of molecular information on resistance mechanisms limited our comprehension of the genetic underpinnings of observed patterns.

Result:

A total of 228 urine samples were analyzed for culture and sensitivity during the study period, of which 143 (62.7%) had positive culture results. Among the gram-negative bacilli, the predominant isolate was the Escherichia coli (n=70, 30.7%), followed by Klebsiella spp. (n=31, 13.6%). Among the gram-positive bacteria, the most frequently identified organism was Enterococci (n=16, 7.02%) and Staphylococcus aureus (n=12,5.26%) (Fig 1).

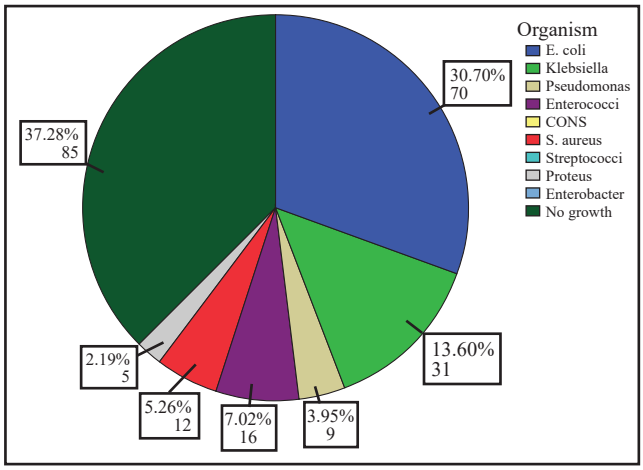

Fig 1: Distribution of Uropathogens Isolated in the Study

Susceptibility testing was successful for all but two E. coli isolates and one S. aureus isolate. These three isolates were excluded from AST analysis because they did not yield sufficient growth for reliable testing on Mueller-Hinton agar.

Table 1 shows the susceptibility patterns of Gram-negative organisms (E. coli, Klebsiella). A total of 68 (68.7%) Escherichia coli (excluding 2 isolates that couldn't produce reliable growth on Mueller-Hinton agar) and 31 (31.3%) Klebsiella spp isolates were analyzed. The antimicrobial susceptibility pattern showed high resistance to third-generation cephalosporins in both organisms. Among E. coli isolates, resistance was highest to cefuroxime (91.2%), co-amoxiclav (86.8%), ceftriaxone (80.9%), and co-trimoxazole (88.2%). Klebsiella spp. also demonstrated high resistance to co-amoxiclav (96.8%), ceftazidime (90.3%), cefuroxime (87.1%), and doxycycline (83.9%).

Aminoglycosides showed comparatively better sensitivity among E. coli, particularly amikacin (89.7%) and gentamicin (73.5%), whereas Klebsiella spp. showed moderate sensitivity to amikacin (54.8%) but high resistance to gentamicin (74.2%). Carbapenem (meropenem) retained good activity against E. coli (83.8% sensitivity) and Klebsiella spp. (67.7% sensitivity). Although emerging resistance was noted (16.2% and 32.3%, respectively).

Fluoroquinolones (ciprofloxacin and levofloxacin) demonstrated moderate sensitivity in both organisms (approximately 58%). Piperacillin-tazobactam showed good activity against Klebsiella spp. (83.9%) and moderate activity against E. coli (60.3%). Colistin remained highly effective, with 94.1% sensitivity in E. coli and 100% sensitivity in Klebsiella spp. Overall, multidrug resistance was prominently observed among both isolates, particularly against commonly used cephalosporins and beta-lactam antibiotics.

Table 2 shows the susceptibility patterns of Gram-positive bacteria (S. aureus, Enterococcus). A total of 28 Gram-positive isolates were obtained in primary culture. However, antimicrobial susceptibility testing was performed on 27 isolates, as one isolate failed to produce reliable growth on Mueller-Hinton agar. Among the tested isolates, 12 (44.4%) were Staphylococcus aureus and 15 (55.6%) were Enterococci. The antimicrobial susceptibility pattern demonstrated considerable resistance to beta-lactam antibiotics among both organisms. High resistance to ceftriaxone was observed in Enterococci (93.3%) and S. aureus (83.3%). Similarly, resistance to cefepime was high in both Enterococci (73.3%) and S. aureus (75.0%).

Clindamycin showed moderate sensitivity in S. aureus (33.3%) but no sensitivity in Enterococci. Cloxacillin resistance was notable in S. aureus (58.3%), while Enterococci demonstrated complete resistance among tested isolates. Cefoxitin resistance in S. aureus (33.3%) indicates the presence of methicillin-resistant strains (MRSA).

With linezolid sensitivity of 91.7% in S. aureus and 80.0% in Enterococci, and vancomycin sensitivity of 66.7% and 53.3%, respectively, both drugs maintained strong action against both species. Amikacin showed good action against Enterococci (73.3%) and S. aureus (83.3% sensitivity). Overall, there was clear evidence of multidrug resistance, especially to beta-lactam and cephalosporin drugs.

Table 1: Antibiotic Sensitivity and Resistance Patterns of E. coli and Klebsiella spp.

Antibiotic	E. coli Sensitive n (%)	E. coli Resistant n (%)	E. coli Total Tested(n)	Klebsiella Sensitive n (%)	Klebsiella Resistant n (%)	Klebsiella Total Tested (n)
Cefuroxime	6 (8.8%)	62 (91.2%)	**68**	4 (12.9%)	27 (87.1%)	**31**
Ceftazidime	18 (26.5%)	50 (73.5%)	**68**	3 (9.7%)	28 (90.3%)	**31**
Ceftriaxone	13 (19.1%)	55 (80.9%)	**68**	4 (12.9%)	17 (54.8%)	**21**
Cefepime	35 (51.5%)	33 (48.5%)	**68**	15 (48.4%)	16 (51.6%)	**31**
Amikacin	61 (89.7%)	6 (8.8%)	**67**	17 (54.8%)	14 (45.2%)	**31**
Gentamicin	50 (73.5%)	18 (26.5%)	**68**	8 (25.8%)	23 (74.2%)	**31**
Co-amoxiclav	1 (1.5%)	59 (86.8%)	**60**	0 (0.0%)	30 (96.8%)	**30**
Ciprofloxacin	40 (58.8%)	28 (41.2%)	**68**	18 (58.1%)	13 (41.9%)	**31**
Levofloxacin	40 (58.8%)	28 (41.2%)	**68**	18 (58.1%)	13 (41.9%)	**31**
Azithromycin	4 (5.9%)	31 (45.6%)	**35**	0 (0.0%)	10 (32.3%)	**10**
Colistin	64 (94.1%)	4 (5.9%)	**68**	31 (100%)	0	**31**
Co- trimoxazole	6 (8.8%)	60 (88.2%)	**66**	4 (12.9%)	25 (80.6%)	**29**
Tigecycline	32 (47.1%)	18 (26.5%)	**50**	9 (29.0%)	9 (29.0%)	**18**
Doxycycline	18 (26.5%)	48 (70.6%)	**66**	3 (9.7%)	26 (83.9%)	**29**
Meropenem	57 (83.8%)	11 (16.2%)	**68**	21 (67.7%)	10 (32.3%)	**31**
Nitrofurantoin	34 (50.0%)	18 (26.5%)	**52**	11 (35.5%)	16 (51.6%)	**27**
Piperacillin-Tazobactam	41 (60.3%)	10 (14.7%)	**51**	26 (83.9%)	4 (12.9%)	**30**

Note: The total number of isolates tested varied by antibiotic due to the availability of discs and clinical relevance. Sensitivity and resistance percentages were calculated using the number of isolates tested for each antibiotic as the denominator. Isolates not subjected to testing were excluded from analysis.

Table 2: Antibiotic Sensitivity and Resistance Patterns of S. aureus and Enterococci

Antibiotic	S. aureus Sensitive n (%)	S. aureus Resistant n (%)	S. aureus Total Tested(n)	Enterococci Sensitive n (%)	Enterococci Resistant n (%)	Enterococci Total Tested (n)
Clindamycin	4 (33.3%)	4 (33.3%)	**8**	0 (0.0%)	2 (13.3%)	**2**
Linezolid	11 (91.7%)	1 (8.3%)	**12**	13 (86.7%)	2 (13.3%)	**15**
Cloxacillin	2 (16.7%)	7 (58.3%)	**9**	0 (0.0%)	5 (33.3%)	**5**
Cefoxitin	5 (41.7%)	4 (33.3%)	**9**	1 (6.7%)	7 (46.7%)	**8**
Vancomycin	8 (66.7%)	—	**8**	8 (53.3%)	—	**8**
Amikacin	10 (83.3%)	2 (16.7%)	**12**	11 (73.3%)	4 (26.7%)	**15**
Cefepime	3 (25.0%)	9 (75.0%)	**12**	4 (26.7%)	11 (73.3%)	**15**
Ceftriaxone	2 (16.7%)	10(83.3%)	**12**	0 (0.0%)	14 (93.3%)	**14**
Cefuroxime	3 (25.0%)	9 (75.0%)	**12**	3 (20.0%)	12 (80.0%)	**15**

Note: Percentages calculated within the organism. Isolates marked as 'Not tested' were excluded from calculation. The total number of isolates tested varied by antibiotic due to the availability of discs and clinical relevance. Sensitivity and resistance percentages were calculated using the number of isolates tested for each antibiotic as the denominator. Isolates not subjected to testing were excluded from analysis.

Discussion

Urinary tract infections (UTIs) continue to be among the most prevalent bacterial infections globally, affecting individuals of all ages. The pattern of antimicrobial resistance (AMR) varies significantly across regions, healthcare settings, and patient populations. In a tertiary care hospital in Khulna, Bangladesh, the current study investigated the association between isolated bacterial infections and their antibiotic susceptibility profiles, highlighting significant regional resistance developments.
In this study, Gram-negative bacilli were the predominant uropathogens, with E. coli (67.6%) and Klebsiella spp. (8.23%) together accounting for 75.83%. A total of 143 positive cultures were identified among 228 urine samples. These results are consistent with regional trends where UTIs are dominated by E. coli and Klebsiella, which frequently account for over 70% of isolates in Bangladeshi hospitals.[26] Our data contradict a report by Haque et al., which revealed E. coli as the most frequent uropathogen at 59.3%.[27] Gram-positive bacteria, such as S. aureus (12.49%), were less common but notable, consistent with reports from Dhaka centers showing S. aureus and Enterococcus in 13.7% and 11.29% of cases, respectively.[28],[29]

The culture positivity rate of 62.7% in this study is relatively high, likely reflecting the inclusion of hospitalized and complex cases. Similar inpatient studies report positivity rates ranging from 50% to 70%, often associated with factors such as indwelling urinary catheters, prior antibiotic therapy, and the presence of extended-spectrum beta-lactamase (ESBL)-producing organisms.[30] National AMR surveillance data also support these findings, showing that in hospital-based samples, positive culture rates were two to three times higher than in outpatient samples, largely due to the predominance of resistant strains in inpatient settings.[31]

A notable observation in this study is the high resistance to second- and third-generation cephalosporins; E. coli showed 91.2% resistance to cefuroxime and 80.9% to ceftriaxone, while Klebsiella spp. reached 96.8% resistance to co-amoxiclav. While colistin performed exceptionally well (94.1–100% sensitive), amikacin and other aminoglycosides emerged as superior alternatives (89.7% sensitive for E. coli, 54.8% sensitive for Klebsiella); meropenem maintained moderate activity despite a 16–32% resistance rate. Such exceptionally high cephalosporin resistance is alarming but not unexpected; the overuse of broad-spectrum cephalosporins, facilitated by their easy availability in community and hospital settings, is well documented in South Asia.[32] The extensive empirical use of cephalosporins and fluoroquinolones in Bangladeshi outpatient and inpatient settings may potentially contribute to these high resistance rates. These patterns are consistent with findings from Bangladesh, where cephalosporin resistance in Klebsiella and E. coli frequently exceeds 70–90%, indicating widespread multidrug-resistant (MDR) strains and ESBL production.[33],[34],[35] Meropenem, a carbapenem, [L1] showed comparatively higher susceptibility among Gram-negative isolates in our cohort, with 83.8% sensitivity in E. coli and 67.7% in Klebsiella spp.[36] The relatively lower meropenem susceptibility in Klebsiella spp. compared to E. coli is consistent with increasing reports of carbapenem-resistant Klebsiella in South Asia.[37] However, the finding that a significant minority of isolates were resistant to meropenem is concerning and may indicate emerging carbapenem resistance, warranting further molecular investigation.

Among 27 Gram-positive isolates, S. aureus and Enterococcus showed high beta-lactam resistance, including 83.3% ceftriaxone resistance in S. aureus and 93.3% in Enterococcus. The detection of cefoxitin resistance in 33.3% of Staphylococcus aureus isolates suggests the presence of methicillin-resistant Staphylococcus aureus (MRSA) in our study population. Cefoxitin disk diffusion is recommended by the CLSI as a reliable phenotypic surrogate marker for methicillin resistance in S. aureus. Although molecular confirmation of the mecA or mecC gene was not performed in this study, phenotypic resistance to cefoxitin strongly indicates probable MRSA strains. The observed MRSA rate is comparable to previous hospital-based studies in Bangladesh, where MRSA prevalence has ranged between 25% and 45% among clinical isolates. These findings indicate that MRSA is not limited to bloodstream or wound infections but may also contribute to urinary tract infections in hospitalized patients.[38],[39] The presence of probable MRSA has significant therapeutic implications, as beta-lactam antibiotics, including penicillins and most cephalosporins, become ineffective against these strains. In our study, high resistance to ceftriaxone (83.3%) and cefepime (75.0%) among S. aureus isolates further supports this concern.

Although vancomycin exhibited moderate action and linezolid showed high susceptibility in this trial, dependency on these backup medicines raises treatment costs and may accelerate the development of resistance. Linezolid (80.0–91.7% sensitive) was reliable, and amikacin susceptibility was 73.0–83.0%, which is consistent with a similar study in Dhaka.[28] Vancomycin showed 53.0–67.0% susceptibility; however, since it was not tested against the remaining isolates, the absolute resistance rate could not be confirmed, though the lack of observed resistance suggests high susceptibility.[29] These findings indicate that glycopeptides serve as crucial resources against rising MDR. Aligning with South Asian trends, the resistance rate of cephalosporins in this study exceeded 70%.[40]

In this investigation, multidrug resistance—especially to

cephalosporins and beta-lactam agents—emerged as a predominant trend. This makes empirical treatment options in this tertiary care context considerably more difficult. This observation demands national calls for strengthened antimicrobial stewardship programs.[26],[35] The development of carbapenem resistance (16–32%) is concerning and jeopardizes the effectiveness of last-line treatments, even though amikacin, colistin, linezolid, and vancomycin remain useful therapeutic choices. This growing resistance issue is further exacerbated by community-level factors, such as the over-the-counter availability of antibiotics and improper prescription practices.[28]

Overall, the findings underscore the urgent need for consistent local surveillance, regular revision of empirical treatment guidelines, and effective implementation of antibiotic stewardship policies. Strengthening infection prevention measures and regulating antibiotic use at both the hospital and community levels are critical to mitigating the growing AMR burden in tertiary hospitals across Bangladesh.[41]

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Review article

The Role of the Central Sterile Supply Department (CSSD) in Tertiary Care Hospitals: A Literature Review

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Abstract

Hospital-acquired infections (HAIs) represent one of the most persistent and consequential challenges in modern healthcare systems, significantly impacting patient morbidity, mortality, and the economic burden on healthcare institutions. In tertiary care hospitals, where complex surgical procedures and high patient turnover are routine, prevention of HAIs is paramount to ensuring patient safety and operational efficiency. The Central Sterile Supply Department (CSSD) stands as the pivotal unit responsible for ensuring the sterility and safety of medical instruments, functioning as the backbone of infection prevention and control (IPC). This literature review synthesizes current empirical and theoretical evidence to explore the multifaceted role of the CSSD in tertiary hospitals. It examines structural requirements essential for effective operations including zoning, physical infrastructure, and equipment alongside detailed workflow processes ranging from decontamination to distribution. The review further analyzes critical quality control mechanisms, encompassing physical, chemical, and biological monitoring indicators, and evaluates modern management strategies such as the FOCUS-PDCA model, Key Point Control theory, and digital traceability systems. Human resource challenges, including knowledge gaps among support staff, occupational safety hazards, and causal pathways to adverse events, are assessed through the lens of recent empirical studies. The collective evidence underscores that an effective CSSD is not merely a logistical support unit but a clinical safety hub requiring continuous staff education, data-driven management, and a zero-defect culture to mitigate infection risks and enhance patient outcomes.

Keywords: Central Sterile Supply Department, hospital-acquired infections, sterilization, infection prevention and control, tertiary care, quality management, occupational safety.

Introduction

1.1 The Global Burden of Healthcare-Associated Infections

Healthcare-associated infections (HAIs), also referred to as nosocomial or hospital infections, constitute a pervasive global public health crisis. The World Health Organization (WHO) defines an HAI as any infection occurring in a patient during the process of care in a hospital or other healthcare facility that was neither present nor incubating at the time of admission.[1,2,3] The scope of the problem is staggering: WHO estimates that hundreds of millions of patients are affected by HAIs annually, with the burden disproportionately concentrated in low- and middle-income countries (LMICs), though the challenge remains formidable across all healthcare systems globally.[3,4]

The most common HAI categories include surgical site infections (SSIs), catheter-associated urinary tract infections (CAUTIs), central line-associated bloodstream

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infections (CLABSIs), and ventilator-associated pneumonia (VAP).[5] SSIs remain the most common type of HAI in resource-limited settings and are directly influenced by the microbial burden on surgical instruments, making instrument reprocessing a primary prevention target.[3,4]

The clinical implications of HAIs extend far beyond immediate physiological insult. They serve as a primary driver of antimicrobial resistance (AMR), as the treatment of multi-drug-resistant (MDR) organisms necessitates the use of last-resort antibiotics, thereby accelerating evolutionary pressure for further resistance creating a vicious cycle of increasingly difficult to treat pathogens.[6] In tertiary care settings, patients are frequently immunocompromised due to underlying conditions such as malignancy, solid organ transplantation, or advanced diabetes mellitus. For these vulnerable populations, a HAI is not merely a complication but often a life-threatening event.

The economic calculus of HAIs is equally sobering. These infections contribute to prolonged hospital stays, unplanned admissions to intensive care units (ICUs), additional surgical interventions, and extended antimicrobial therapy courses.[6] In the United States alone, the annual attributable cost of HAIs is estimated to run into the billions of dollars a figure that escalates exponentially when global impact is considered. For healthcare institutions operating within value-based care frameworks, elevated HAI rates carry additional consequences: financial penalties, reputational damage, and erosion of public trust.[7]

1.2 Definition and Evolution of the CSSD

The historical development of the CSSD mirrors the broader evolution of infection control science. In the pre-antibiotic era and early modern surgical period, instrument reprocessing was a decentralized activity conducted within individual wards, operating rooms, and outpatient clinics. This fragmented approach yielded significant inconsistencies: cleaning procedures varied widely, sterilization parameters were rarely validated, and the expertise of personnel responsible for these tasks was uneven.[8] This 'cottage industry' approach created systemic blind spots that facilitated pathogen transmission and contributed to the high infection rates characteristic of early twentieth century hospitals.

The modern CSSD emerged as a centralized institutional response to these inconsistencies.[4,6] Consolidating instrument reprocessing into a specialized department enabled the standardization of evidence-based procedures, the implementation of rigorous quality control systems, and the development of specialized expertise. As a result, the conceptual definition of the CSSD evolved from a simple 'supply room' to that of an advanced quasi-manufacturing facility whose product is sterility. [9] Today, the CSSD is recognized as the 'heart of hospital hygiene,' managing the complete lifecycle of reusable instruments: receipt, decontamination, cleaning, inspection, assembly, packaging, sterilization, storage, and distribution.[6]

This evolution has been accompanied by increasing technological complexity. Whereas early departments processed simple steel instruments and linen drapes, the contemporary CSSD must handle powered surgical instruments, flexible endoscopes, robotic surgical components, and implantable devices each category presenting distinct and often demanding reprocessing requirements.[3,6]

1.3 The Role of the CSSD in Tertiary Care Hospitals

Within the ecosystem of a tertiary care hospital, the CSSD occupies a role that is simultaneously logistical and profoundly clinical. Tertiary hospitals function as referral centers for complex and severe pathologies, necessitating a diverse array of specialized surgical interventions performed at high volume. Consequently, the quantity and complexity of instruments processed daily in a tertiary CSSD far exceed those managed in primary or secondary care facilities.[10,11]

Operationally, the CSSD functions as the 'engine room' supporting the hospital's surgical schedule. Any failure or delay in CSSD output produces immediate cascading consequences: surgical cases are postponed or cancelled, operating theatre turnover slows, and patient length of stay increases. Conversely, a highly efficient and reliable CSSD enables rapid instrument turnaround, directly supporting the institution's financial sustainability and operational performance.[10,12]

Clinically, the CSSD serves as the primary intervention point for breaking the chain of infection. By ensuring that all instruments delivered to the surgical field are free of viable microorganisms, the CSSD interrupts the transmission route between patients. In this regard, the CSSD functions as the first line of defense against SSIs Public Health Ontario, 2013.[6] A single lapse in the sterilization process whether attributable to inadequate cleaning, improper packaging, or equipment malfunction can precipitate an outbreak affecting multiple patients. [10] Furthermore, in an era of heightened patient awareness, national accreditation requirements, and regulatory scrutiny (e.g., Joint Commission International; ISO standards), the CSSD is recognized as a key indicator of institutional quality and a cornerstone of clinical governance.

1.4 Theoretical Frameworks: Spaulding Classification and Sterility Assurance

CSSD operations are governed by established theoretical frameworks that guide decision-making regarding the appropriate intensity of reprocessing for different categories of medical devices. The Spaulding Classification System, developed by Dr. Earle H. Spaulding in 1939, remains the international gold standard for this purpose. The system stratifies devices into three risk categories

based on the nature of patient contact: (1) Critical items, which penetrate sterile tissues or the vascular system (e.g., surgical instruments, implants) and must be sterilized; (2) Semi-critical items, which contact mucous membranes or non-intact skin (e.g., flexible endoscopes) and require at minimum high-level disinfection (HLD), with sterilization preferred where the device is heat-tolerant; and (3) Non-critical items, which contact intact skin only (e.g., blood pressure cuffs) and require low-level disinfection.[13]

The quantitative goal of sterilization is expressed through the Sterility Assurance Level (SAL). The internationally accepted standard for sterile medical devices is an SAL of 10^{-6}, signifying a theoretical probability of no greater than one in one million that a single viable microorganism is present on a processed item. This stringent standard necessitates rigorously validated sterilization processes and robust, multi-layered monitoring systems.[6]

2. Organizational Structure and Physical Infrastructure

The effectiveness of a CSSD is heavily predicated on its physical design. A well-planned layout not only facilitates efficient workflow but also acts as a physical barrier against cross-contamination the inadvertent transfer of microorganisms from contaminated to clean areas.[9]

2.1 Zoning and the Principle of Unidirectional Workflow

The cardinal design principle of CSSD architecture is the enforcement of a strict unidirectional workflow. Instruments must progress continuously and irreversibly through a defined sequence of zones from contaminated to clean to sterile with no crossover or backflow permitted between zones.[9,10] This principle is operationalized through the physical separation of three functionally distinct areas.

The Decontamination Zone (Red Zone) serves as the entry point for the reprocessing cycle, typically occupying 30–35% of the total CSSD floor space. It is maintained under negative air pressure relative to adjacent areas to contain airborne pathogens. Infrastructure includes deep wash sinks, ultrasonic cleaning units, and automated washer-disinfectors. All personnel working in this zone are required to wear full personal protective equipment (PPE), including gowns, gloves, eye protection, and respiratory protection where indicated.[10,14]

The Clean Zone (Blue Zone) is a restricted-access area maintained under positive air pressure. Activities conducted in this zone include instrument inspection, assembly into surgical sets according to standardized count sheets, and packaging. The design prioritizes high-intensity lighting (typically exceeding 500 lux) and ergonomic workstation configuration to facilitate the reliable detection of microscopic debris and instrument defects.[10,11]

The Sterile Storage and Dispatch Zone (Green Zone) represents the terminal stage of the reprocessing cycle. It is maintained under positive pressure with strictly controlled environmental parameters, including temperature below 24°C and relative humidity below 70%, to prevent condensation and maintain packaging integrity. Storage adheres to the First-In, First-Out (FIFO) principle, with items kept off the floor and away from external walls.[10,11]

2.2 Infrastructure Specifications

Beyond macroscopic zoning, the microenvironmental conditions within each zone are critical determinants of CSSD performance. Heating, ventilation, and air conditioning (HVAC) systems must provide a minimum of 6 to 10 air changes per hour (ACH) in the decontamination area, with high-efficiency particulate air (HEPA) filtration in clean zones. Lighting in inspection areas must meet or exceed 500 lux to enable reliable visual quality control. Water quality is a further critical variable: final rinse water should be purified (deionized or osmosis-treated) to prevent mineral deposits on instrument surfaces deposits that can shield residual microorganisms from the penetrating action of sterilizing agents.[6]

2.3 Equipment Inventory

A tertiary-level CSSD is technology-intensive. Steam sterilizers (autoclaves) constitute the primary workhorse for heat-stable devices, utilizing moist heat to achieve microbial kill. For heat-sensitive devices such as flexible endoscopes and robotic surgical components, low-temperature sterilization modalities are essential; these include Hydrogen Peroxide Gas Plasma and Ethylene Oxide (ETO) systems. [10,11] Automated Washer-Disinfectors (WDs) standardize and document the mechanical cleaning process, reducing operator-dependent variability. Increasingly, digital instrument tracking systems utilizing barcode or radio-frequency identification (RFID) technology are being integrated into CSSD operations, enabling real-time traceability of every instrument set from processing through patient use.[14]

3. Theoretical Frameworks of Sterilization Science

Sterilization science operates according to first-order kinetic principles: the number of viable microorganisms on a device decreases exponentially as a function of time of exposure to the sterilizing agent. A fundamental tenet of this framework is the primacy of cleaning as a prerequisite to sterilization. Organic soil including blood, proteins, and tissue fragments acts as a physical shield, preventing the sterilizing agent from achieving direct contact with microbial cells. Therefore, sterilization cannot be reliably achieved on an instrument that has not first been thoroughly cleaned.[6]

Packaging constitutes the second critical element: the sterile barrier system (SBS) maintains the sterility of processed instruments from the point of sterilization to the point of use. Contemporary best practice is guided by the principle of Event-Related Sterility (ERS), which holds that sterility is compromised by events physical damage,

moisture exposure, package compromise rather than by the mere passage of time. This represents a significant departure from older time-based expiry models and has important practical implications for CSSD storage and distribution protocols.[6]

4. Workflow Management and Operational Processes

The operational core of the CSSD constitutes a linear, quasi-manufacturing process in which the tolerance for error approximates zero. Each stage of the workflow represents a critical control point.[14]

4.1 Receipt and Transport

Contaminated instruments are collected from point-of-use locations operating theatres, wards, and procedural areas and transported to the CSSD in sealed, impermeable carts. This containment strategy prevents aerosolization of pathogens during transit. Upon receipt in the decontamination zone, items are logged into the quality traceability system, establishing the chain of custody. Pre-soaking of instruments at the point of use, using enzymatic solutions, is a recommended practice to prevent organic matter from desiccating and adhering to instrument surfaces, which would significantly complicate subsequent cleaning.[14]

4.2 Decontamination

Decontamination encompasses sorting, disassembly of multi-component instruments, and cleaning by manual or automated means. Manual cleaning, using brushes and enzymatic detergents, is indispensable for delicate, articulated, or lumen-bearing instruments that cannot withstand automated processes; however, it represents the highest-risk activity in terms of staff exposure to sharps and biological fluids. Automated cleaning via washer-disinfectors offers superior reproducibility and documentation capabilities. Ultrasonic cleaning units deploy acoustic cavitation the formation and implosive collapse of micro-bubbles to dislodge debris from recesses, hinges, and serrations inaccessible to manual brushing.[10,11]

4.3 Inspection, Assembly, and Packaging

In the clean zone, instruments undergo systematic visual and functional inspection. Magnification loupes and intense illumination are employed to identify residual soil, damage, or functional deficits.[15] Approved instruments are assembled into sets according to standardized count sheets, which serve both as assembly guides and as documentation tools. Packaging employs materials such as nonwoven polypropylene wraps and paper-plastic pouches that simultaneously permit sterilant penetration and provide a protective microbial barrier. Double-wrapping of instrument trays is standard practice. Errors at this stage, including missing instruments, count discrepancies, or seal integrity failures, represent a significant source of adverse events in the perioperative environment.[16]

4.4 Sterilization

Steam sterilization employs saturated moist heat at defined temperatures (typically 121°C or 134°C) and pressures to denature proteins and destroy all microbial life. Pre-vacuum cycles, which actively evacuate air from the chamber prior to steam admission, are preferred for porous loads and complex instruments to ensure uniform steam penetration. For heat-sensitive or moisture-sensitive devices, low-temperature alternatives are employed: Hydrogen Peroxide Gas Plasma sterilization offers rapid cycle times and no toxic residues, while ETO sterilization though highly efficacious requires prolonged aeration cycles to eliminate toxic residues from processed items.[6]

4.5 Storage and Distribution

Following sterilization, instrument sets must be cooled on open, ventilated racks prior to packaging and storage; premature packaging of warm packs can generate internal condensation, which compromises packaging integrity through a phenomenon known as 'moisture wicking' and can support microbial growth. A final visual integrity check is performed on all packs before distribution to ensure that packaging remains intact, seals are unbroken, and chemical indicators have changed appropriately.[9]

5. Quality Control and Assurance Mechanisms

Quality assurance in the CSSD is achieved through a hierarchical, multi-layered monitoring system encompassing physical, chemical, and biological indicators, each operating at a different level of process validation.[17]

Physical monitoring involves the continuous recording of critical process parameters time, temperature, pressure, and steam quality by machine-integrated gauges, sensors, and printout records. These provide real time documentation of every sterilization cycle.[18]

Chemical indicators (CIs) utilize dye-migration or color-change chemistry to provide a visual signal that a specific process variable has been achieved. Type 1 CIs (process indicators, such as autoclave tape) confirm only that the item was exposed to the sterilization process. Type 5 integrating indicators, which respond to all critical parameters (time, temperature, and saturated steam), provide substantially greater assurance and are recommended for use inside every instrument pack.[19]

Biological indicators (BIs) constitute the gold standard for sterilization process validation. They contain a standardized population of highly resistant bacterial spores typically Geobacillus stearothermophilus for steam sterilization and directly test the lethality of the sterilization process itself. BIs are cultured post-sterilization; failure of all spores to be inactivated indicates a process failure. Pre-vacuum sterilizers are additionally subjected to the Bowie-Dick test daily to evaluate the efficacy of air removal, a critical prerequisite for uniform steam penetration.[20]

Modern CSSD quality management increasingly incorporates Key Point Control (KPC) theory as a proactive risk identification framework. KPC involves systematic monitoring of Structure indicators (e.g., equipment qualification, staff competency), Process indicators (e.g.,

cycle parameter compliance, packaging defect rates), and Outcome indicators (e.g., sterility test failure rates, adverse event incidence) to identify system weaknesses before they manifest as patient harm events.[14,16]

6. Modern Management Strategies

6.1 The FOCUS-PDCA Model

The FOCUS-PDCA model represents a structured, cyclical quality improvement methodology particularly well-suited to the CSSD environment. The acronym encapsulates a sequential problem-solving process: Find an opportunity for improvement; Organize a team with knowledge of the process; Clarify the current state of knowledge through data collection; Understand the sources of process variation; and Select an improvement strategy for testing. This preparatory phase feeds into the Plan-Do-Check-Act (PDCA) cycle: planning the intervention, implementing it on a test basis, evaluating outcomes against pre-defined metrics, and acting to standardize successful changes or iterate based on learning. Studies have demonstrated the model's efficacy in significantly reducing specific CSSD error categories, including packaging defects and instrument set assembly errors.[14]

6.2 Digital Traceability Systems

Quality Traceability Systems (QTS) represent a paradigmatic shift in CSSD management from reactive incident response to proactive, data-driven quality governance. By linking every instrument set via barcode or RFID to specific processing parameters, the responsible operator, and the patient in whom the instruments were ultimately used, the QTS creates a comprehensive, auditable chain of custody. In the event of a verified sterilization failure, the system enables rapid, targeted recall of affected instrument sets and the identification of all potentially exposed patients, significantly reducing the scope and impact of a potential outbreak.[14,16] Beyond recall functionality, aggregate QTS data supports trend analysis, benchmarking, and evidence-based resource allocation decisions.

7 Human Resource Management: The Cognitive Engine of Sterility

While physical infrastructure provides operational capacity, the knowledge, skills, and attitudes of CSSD personnel ultimately determine the quality of outcomes. CSSD teams are typically composed of a heterogeneous workforce, including registered nurses (RNs) who may serve in supervisory or quality oversight roles, trained technicians responsible for core reprocessing tasks, and support staff who perform ancillary functions including the manual decontamination of instruments.[21]

Multiple empirical studies have identified a significant and clinically important knowledge deficit, particularly among support-level staff who paradoxically perform the highest-risk manual tasks in the decontamination area.[16,22,23] Al-Balawi and Al-Mutairi (2025) documented these gaps in a cross-sectional study of CSSD staff in Ministry of Defense hospitals in Saudi Arabia, noting that while general attitudes toward infection prevention were positive, significant gaps existed in the technical understanding of sterilization parameters and quality monitoring.[24] A consistent finding across studies is a 'moderate positive correlation' between theoretical knowledge and safe clinical practice, underscoring that knowledge is a necessary though not always sufficient antecedent to safe behavior.[22]

Barriers to optimal performance extend beyond individual knowledge deficits. Time pressure arising from high-volume surgical schedules, resource constraints in lower-income settings, inadequate access to in-service education, and a historically reactive rather than proactive institutional culture collectively impede performance.[23,24] The evidence consistently advocates for competency-based education programs that bridge the gap between theoretical understanding of why specific procedures are required and the practical technical proficiency in executing them.

8. Adverse Events and Risk Management

Adverse events originating in the CSSD are predominantly latent errors failures that are not immediately apparent at the point of occurrence but manifest as patient harm during subsequent clinical use. Retrospective analysis by Chen et al. (2023) in a single-center study identified the Inspection/Assembly/Packaging stage and the Cleaning/Decontamination stage as the two principal 'hotspots' for error occurrence.[15] Common event types include incomplete cleaning of lumened instruments, incorrect instrument count in assembled sets, packaging seal failures, and errors in labeling or load documentation.

Contributing causal factors identified in the literature include the increasing complexity of modern surgical instruments, which possess multiple articulations, narrow lumens, and heat-sensitive components; the time pressures imposed by demanding surgical schedules; high staff turnover and inadequate training of new personnel; and the absence of a robust incident reporting culture.[14,16] Demonstrated that root cause analysis of seal defects in paper-plastic packaging pouches identified modifiable factors including incorrect machine settings, inadequate staff training, and substandard packaging material quality that were amenable to targeted quality improvement interventions.[14]

Effective risk mitigation in the CSSD requires a fundamental cultural transition: from a 'blame culture, in which individual error attribution discourages reporting, to a 'safety culture,' in which transparent reporting of near-misses and adverse events is encouraged, systematically analyzed, and used to drive system-level improvements.[15,16]

9. Occupational Safety: Protecting the CSSD Workforce

The CSSD environment presents a constellation of occupational hazards that necessitate systematic risk

assessment, mitigation strategies, and ongoing staff education. Failure to adequately address these hazards results in preventable harm to the very workforce responsible for patient protection.[12]

9.1 Biological Hazards

The decontamination zone poses the highest risk of occupational exposure to blood-borne pathogens, including Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and Human Immunodeficiency Virus (HIV). Sharps injuries (SIs) during manual instrument cleaning represent the primary exposure mechanism. Gao et al. (2017) conducted a large-scale survey of sharps injuries among hospital-based healthcare workers in China, identifying CSSD staff as a high-risk group.[15] Prevention strategies with demonstrated efficacy include the routine use of puncture-resistant gloves during manual cleaning, implementation of no-touch instrument handling techniques, standardized instrument disassembly procedures that minimize direct contact with sharp surfaces, and comprehensive vaccination programs targeting HBV.[25,26]

9.2 Chemical Hazards

CSSD staff are routinely exposed to potent chemical agents employed in the reprocessing workflow, including proteolytic enzymatic detergents, high-level disinfectants (e.g., glutaraldehyde), and chemical sterilants (e.g., ETO, hydrogen peroxide). ETO, in particular, is a known carcinogen and reproductive toxin. Mandatory controls include engineering controls (dedicated ventilated storage and dispensing areas, ETO-specific exhaust systems), administrative controls (adherence to Material Safety Data Sheets [MSDS] for all chemical agents, spill response protocols), and PPE (chemical-resistant gloves, aprons, and appropriate respiratory protection).[27]

9.3 Physical and Ergonomic Hazards

The physical demands of CSSD work including repetitive upper limb movements during manual cleaning and packaging, heavy lifting of instrument trays and sterilization carts, and prolonged periods of static standing confer significant risk for musculoskeletal disorders (MSDs).[28] Ergonomic interventions with established preventive value include height-adjustable workbenches to accommodate varying staff statures, anti-fatigue flooring or mats in standing work areas, mechanized transport aids for heavy loads, and structured job rotation programs that prevent sustained exposure to any single ergonomic risk factor.[27]

9.4 Thermal Hazards

The retrieval and handling of instrument sets immediately following high-temperature steam sterilization cycles presents a burn risk. Standard precautionary measures include enforced cooling periods before packs are handled with bare hands, the mandatory use of heat-resistant handling gloves, and audible/visual autoclave cycle completion indicators to prevent premature pack retrieval.[7]

10. Discussion

The evidence synthesized in this review collectively establishes the CSSD as an irreplaceable pillar of clinical safety infrastructure in the tertiary care hospital. The scope of its impact from preventing SSIs and reducing AMR to enabling complex surgical throughput far transcends its traditional characterization as a support service. Several overarching themes warrant further discussion.

First, the evidence consistently demonstrates that physical infrastructure design is a foundational determinant of CSSD safety. The principle of unidirectional workflow, enforced through architectural zoning and differential air pressure regimes, is not a bureaucratic convention but a scientifically validated infection control measure. Investments in CSSD design should therefore be recognized as patient safety investments, not merely capital expenditure.[29]

Second, the integration of digital technologies particularly Quality Traceability Systems and automated washer-disinfectors with electronic process documentation represents a critical modernization imperative. These technologies shift the operational paradigm from qualitative, human-dependent assurance to quantitative, data-driven accountability, with direct implications for the speed and precision of outbreak investigation and response.[30]

Third, the human factor emerges repeatedly across the literature as both the greatest vulnerability and the greatest opportunity within the CSSD system. Knowledge deficits, particularly among frontline support staff, exist across diverse healthcare contexts and represent a modifiable risk factor amenable to targeted educational intervention. The consistently observed positive correlation between knowledge and safe practice provides the empirical rationale for investment in competency-based, simulation-enhanced CSSD education programs.

Finally, the occupational safety literature highlights an ethical imperative: the same principles of harm prevention that motivate CSSD work toward patient protection must be applied with equal rigor to the protection of CSSD staff themselves. Sharps injury prevention, chemical exposure controls, and ergonomic risk management are not peripheral concerns but integral components of a comprehensive CSSD safety culture.[22]

11. Conclusion

From its origins as a simple instrument supply room, the Central Sterile Supply Department has evolved into a sophisticated, technology-enabled clinical safety hub. In the tertiary care hospital, the CSSD functions as the crucial junction between surgical capability and patient safety, fulfilling a preventive role of profound clinical consequence: every sterile instrument delivered to the surgical field represents a barrier against potentially life-threatening infection.

Achieving the zero-defect standard required by modern patient safety expectations demands a comprehensive, systems-level approach that integrates evidence-based physical infrastructure, validated and consistently applied workflow processes, multi-layered quality monitoring, data-driven management, and most critically a skilled, informed, and empowered workforce operating within a pervasive culture of safety. The CSSD cannot function as a peripheral concern of hospital administration; it must be recognized and resourced as a strategic clinical priority.

As healthcare continues to advance toward increasing surgical complexity, greater volumes of heat-sensitive and robotic instruments, and expanding standards of infection prevention accountability, the demands placed upon the CSSD will continue to intensify. The evidence reviewed here provides a robust foundation for future policy development, resource allocation decisions, and research priorities aimed at ensuring that the CSSD remains what it must be: the silent, vigilant guardian between the instruments of healing and the patients they serve.

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Case report

Early-Onset of Subacute Sclerosing Panencephalitis in a 3-Year-Old Girl Following Measles Infection: A Case Report

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Abstract

Subacute sclerosing panencephalitis (SSPE) is a rare, invariably fatal neurodegenerative disorder caused by persistent central nervous system infection with mutant measles virus. Early-onset SSPE in toddlers poses significant diagnostic challenges owing to low clinical suspicion and frequently absent documented measles history. A 3-year-old girl presented with a 15-day history of abnormal behavior, myoclonic jerks, progressive gait disturbance, and excessive somnolence. She had not received the measles-rubella vaccine, as her mother reported a presumed, laboratory-unconfirmed measles illness at two months of age. Empirical treatment with intravenous immunoglobulin and high-dose methylprednisolone for suspected autoimmune encephalitis yielded no improvement. Cerebrospinal fluid analysis revealed markedly elevated measles-specific IgG antibodies, and electroencephalography demonstrated high-amplitude quasi-periodic slow-wave complexes time-locked with myoclonic jerks. Diagnosis of SSPE was established using Dyken's modified criteria, and the patient was commenced on isoprinosine and lamivudine, though her condition continued to deteriorate. This case illustrates the diagnostic primacy of CSF anti-measles serology and EEG in early-onset SSPE, the frequent initial misdiagnosis as autoimmune encephalitis, and the heightened SSPE risk associated with primary measles infection in infancy due to relative immune immaturity and shortened incubation intervals. Withholding measles vaccination based on unconfirmed natural infection contributed to a preventable outcome, reinforcing the critical importance of documented immunization irrespective of clinical history.

Key word: SSPE, measles, early-onset, myoclonus, vaccination

Introduction

Subacute sclerosing panencephalitis (SSPE) is a rare, progressive, and invariably fatal neurodegenerative disorder caused by persistent central nervous system infection with a mutant measles virus (MeV).[1] It is classified as a delayed complication of primary measles, typically presenting months to years after the initial infection. Four overlapping stages characterize the clinical course: an early phase of subtle behavioral and cognitive change; a second phase of myoclonic jerks, seizures, and progressive motor deterioration; a third phase of extrapyramidal and pyramidal involvement with increasing disorientation; and a terminal vegetative state.[2,3]

The incubation interval between measles infection and SSPE onset is variable, typically ranging from 6 to 8 years, though shorter intervals—including early-onset disease in young children are increasingly reported, particularly in regions with ongoing measles transmission or incomplete vaccine coverage.[4] Importantly, SSPE risk is attributable to wild-type measles virus; epidemiological evidence consistently demonstrates that immunization reduces SSPE incidence by preventing primary measles infection.[5,6]

Diagnosis is established using Dyken's modified criteria,

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which require the presence of at least two major and one minor criterion. Major criteria comprise progressive subacute neurological deterioration—characteristically including myoclonus—and elevated anti-measles antibody titers in serum and/or CSF. Minor criteria include periodic stereotyped high-voltage EEG complexes, elevated CSF gamma globulin or oligoclonal banding, histopathological evidence on brain biopsy, and molecular detection of measles virus.[7]

The non-specific early symptoms of SSPE frequently lead to diagnostic delay, with initial misdiagnosis as autoimmune encephalitis, metabolic disorders, or other progressive myoclonic epilepsies.[3,4] Early-onset cases, particularly in toddlers, pose an additional diagnostic challenge owing to a low index of suspicion and the frequent absence of a clearly documented antecedent measles infection. We report a 3-year-old girl diagnosed with SSPE following an atypical measles illness in infancy, to raise clinical awareness of early-onset SSPE and highlight the diagnostic value of CSF measles serology and EEG.

Case Presentation

In October 2023, A 3-year-old girl presented with abnormal behavior and jerk movements persisting for 15 days, followed by progressive neurological symptoms. These included difficulty walking, inability to sit without support, and worsening imbalance. Excessive somnolence had developed over the preceding 10 days. There was no preceding history of head trauma, suspected toxin ingestion, or known structural renal disease. The child was developmentally normal before this presentation (milestones, speech, motor). Considering the possibility of autoimmune encephalitis, the child had received one 10 g dose of immunoglobulin and 3 high doses of methylprednisolone between October 2023 and November 2021. However, the child's condition was not significantly improved.

The child's mother reported that the child had received all age-appropriate EPI vaccines except the measles-rubella (MR) vaccine. She stated that the child had previously experienced a febrile illness clinically suggestive of measles at her 2 months of age, and therefore, the MR vaccine was not administered thereafter. However, no laboratory confirmation was obtained at that time. The absence of a prominent cutaneous rash raises the possibility that the illness may have represented an atypical or subclinical measles infection.

On examination, she was drowsy, with a Glasgow Coma Scale score of 9/15. Myoclonic jerks were present in both the upper and lower limbs, accompanied by atonia and tremor. No meningeal signs were elicited. Higher mental functions were impaired, as evidenced by nonspecific behavioral disturbances and increased restlessness. Cranial nerve examination was unremarkable. Deep tendon reflexes were brisk, and bilateral extensor plantar responses were present. Frequent myoclonic drops were also noted.

Brain magnetic resonance imaging revealed small hyperintensities in the bilateral periventricular regions, with mild enlargement of the lateral ventricles, subtle hyperintensity in the putamen, and subcortical involvement. The CSF analysis revealed elevated levels of total IgG (9.4 g/L) and positive measles IgG antibodies (5.58 g/L), indicative of SSPE (Table 1). Other CSF parameters, such as cell count, neutrophil/lymphocyte ratio, protein, glucose, adenosine deaminase, and lactate levels, were within normal ranges. The virology panel results were negative.

Table 1: Study of CSF panel

Parameter	Result (g/L)	Normal range (g/L)
Serum total IgG	1,567	700 –1,600
CSF total IgG	9.4	0–3.4
CSF measles IgG antibodies (+ve)	5.58	<1.5
Measles virus IgG (+ve)	>300	<300

CSF = cerebrospinal fluid; IgG = immunoglobulin G

Additional investigations did not reveal any abnormalities (Table 2).

Table 2: Study of Blood investigations.

Parameter	Value
Hemoglobin	10.5 g/dL
TLC	11,100/µL
Ca^{2+}	9.3 mg/dL
CRP	5.12 mg/dL
Dengue	Negative
COVID -19 IgG	Negative
Platelets	3.22 lacs/mu L
N/L	52/35
PCV	41.8%
Na	139 mEq/L
K	3.55 mEq/L
Cl	95 mEq/L
Blood culture	No microbial growth

TLC = total leucocyte count; CRP = C-reactive protein; IgG = immunoglobulin G; N/L = neutrophil/lymphocyte; PCV = packed cell volume

Electroencephalography demonstrated High-amplitude quasiperiodic slow wave complexes time-locked with myoclonic jerks, a characteristic EEG pattern consistent with SSPE and fulfilling a minor criterion of Dyken's modified criteria.[7]

The differential diagnosis included autoimmune encephalitis (including anti-NMDAR and other antibody-mediated encephalitides), acute viral or bacterial encephalitis, progressive myoclonic epilepsies, and inherited metabolic or mitochondrial encephalopathies. However, the subacute and progressively deteriorating clinical course, the combination of cognitive decline with myoclonus and seizures, and the positive CSF anti-measles antibody result, together with the supportive EEG findings, were collectively consistent with SSPE using Dyken's modified criteria.[3,8] The absence of CSF pleocytosis and the lack of response to empirical antiviral or immunosuppressive therapy for alternative diagnoses further supported this conclusion.

The patient was managed with supportive care, nutritional support, and physiotherapy. Disease-modifying therapy with Isoprinosine, Lamivudin and/or intrathecal interferon-alpha was initiated for partial improvement in symptoms or to slow down disease progression. In keeping with current evidence that no definitive curative treatment exists for SSPE and that pharmacological interventions offer, at best, variable stabilisation.[4,9]

Despite optimal supportive management, the patient's condition continued to deteriorate. The family received counselling regarding the poor prognosis, the progressive nature of the disease, and the goals of long-term supportive care.

Discussion

SSPE is a rare, fatal neurodegenerative disorder caused by persistent mutated measles virus infection, progressing through personality changes, seizures, intellectual decline, and coma, predominantly affecting unvaccinated children in developing countries years after primary measles exposure.[8] The present case of a 3-year-old girl with a probable antecedent atypical measles illness at the age of 2 months, who developed progressive myoclonus, cognitive decline, and motor deterioration after 3 years.

The risk of developing SSPE is markedly higher when primary measles infection occurs at a young age, rising to approximately 18 per 100,000 measles cases in children under five years old.[4] This elevated risk is attributable to the relative immaturity of the infant's immune system, which is thought to favor viral persistence in neural tissue and hasten the development of disease.[10] In a systematic review of SSPE cases in children aged three years or younger, most patients had not received measles vaccination, and measles infection frequently preceded SSPE by as little as one to five years, with a reported prognosis that was dismal in this age group, with the majority progressing rapidly to a severe neurological outcome.[10]

According to a Chinese study, the measles antibodies in the vast majority of mothers in China are induced by vaccination rather than by the natural infection. Therefore, it is speculated that infants may acquire fewer antibodies from their mothers, resulting in the reduced duration of protection against measles and leading to the onset of measles before the age of receiving the vaccine. [11]

If the mother had neither natural measles infection nor measles vaccination, she would not be expected to pass protective measles-specific IgG to her infant. Since maternal antibodies are transferred through the placenta, a mother without measles immunity would provide little or no passive protection. As a result, the infant could become susceptible to measles in early life.

The decision to withhold the measles-rubella vaccine on the basis of a presumed prior natural infection, without serological confirmation, left the child unprotected against a pathogen whose neurotropic consequences can be catastrophic. Epidemiological evidence consistently demonstrates that SSPE incidence has an inverse relationship with measles vaccination coverage, and vaccination prevents SSPE by preventing the primary measles infection that underlies it.[4] This case therefore exemplifies a preventable tragedy arising from an unverified assumption of natural immunity.

The presenting features—progressive behavioral change, myoclonic jerks of the upper and lower limbs, atonia, tremor, increasing somnolence, and evolving motor deficits—are consistent with the overlapping clinical stages described in SSPE.[12] The initial consideration of autoimmune encephalitis, for which the child received immunoglobulin and high-dose methylprednisolone without meaningful improvement, is common in clinical practice. Differential diagnoses for SSPE include epileptic encephalopathies such as Dravet syndrome and Lennox-Gastaut syndrome, autoimmune encephalitides (including anti-NMDA receptor and other antibody-mediated conditions), progressive myoclonic epilepsies, and inherited metabolic or mitochondrial encephalopathies.[13] In this patient, the subacute and relentlessly progressive clinical course, the combination of cognitive regression with prominent myoclonus, the absence of CSF pleocytosis, and the lack of response to immunosuppressive or empirical antiviral therapy for alternative diagnoses collectively argued against these entities. Ultimately, the combination of a compatible clinical history with measles exposure and the serological findings secured the diagnosis.

The diagnostic work-up in this case illustrates the central role of CSF anti-measles antibody testing and EEG in confirming SSPE. Among tested paired samples, CSF measles-specific IgG levels at a threshold of 0.5 IU/mL or greater, together with a CSF-to-serum ratio of at least 0.05,

effectively distinguished SSPE from non-SSPE encephalitis.[13]

The EEG demonstrated high-amplitude quasi-periodic slow-wave complexes, time-locked with the observed myoclonic jerks—characteristically described in SSPE. These EEG periodic complexes are identified in approximately 65% to 83% of SSPE cases, and their presence in the appropriate clinical context constitutes a minor criterion under Dyken's modified diagnostic criteria.[4,14]

The diagnosis in this patient was established by fulfilling two major criteria and one minor criterion as specified by Dyken's modified diagnostic framework.[7] The major criteria met were: a progressive subacute neurological deterioration characterized by myoclonus, and markedly elevated serum and CSF anti-measles antibody titers. The minor criterion was the characteristic quasi-periodic EEG pattern. Compared to other techniques, measles antibody detection in CSF using ELISA has demonstrated superior diagnostic performance in SSPE, and its role in establishing the diagnosis in this young child, where clinical suspicion may otherwise be delayed, cannot be overstated.

No curative therapy currently exists for SSPE. Treatment is directed at disease modification, symptom control, and palliative support. Oral isoprinosine stabilizes or improves symptoms in approximately 30% of patients, while intrathecal interferon-alpha is used with variable results.[15]

A randomized study comparing oral isoprinosine alone with combined oral isoprinosine and intraventricular interferon-alpha found no significant difference in survival or neurological disability between the groups, though treatment was superior to no treatment, with satisfactory outcomes observed in approximately 34-35% of patients.[16] SSPE is almost always lethal, typically within one to three years of onset, with approximately 60% of patients surviving less than two years.[17]

A recent surge in SSPE cases in developed countries has been attributed to reduced vaccination coverage, aggravated by misinformation and a decline in immunization following the COVID-19 pandemic.[18]

Conclusion

SSPE is preventable by vaccinating children against measles before they become infected; the strains of measles virus contained in measles vaccines do not cause SSPE. The present case, in which the MR vaccine was withheld based on a presumed and unconfirmed measles illness, illustrates the critical need for clinicians and public health authorities to reinforce the importance of documented immunization, irrespective of clinical history.

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Manuscript Submission Guidelines

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The journal accepts original articles, review articles, case reports, and editorials. Original articles must be written by the researchers themselves. Review articles should be written by experienced authors with prior publications in the relevant field. Case reports and editorials are also considered based on relevance and quality.

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The manuscript should begin with the title, followed by a numbered list of authors including their full names, designations, and institutional affiliations. Below this, a separate section must include the corresponding author's name, full address, phone number, and email address for communication.

Formatting Requirements

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Standard abbreviations may be used, but should be avoided in the title and abstract. The full form of an abbreviation must be provided at its first mention. Statistical methods should be clearly described in the Materials and Methods section with appropriate references. Tables and figures must be numbered, simple, and placed separately from the main text. References must follow Vancouver style and be cited in the text as superscript numbers (just after full stop or comma) in order of appearance.

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Original Articles:

The abstract should be a single paragraph of up to 300 words structured under Background, Objectives, Methodology, Results, and Conclusion, followed by 3 to 8 keywords. The main text should not exceed 4000 words and must include Introduction, Materials and Methods, Results, Discussion, Conclusion, and References. Up to 6 tables/figures and 60 references are allowed.

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