

A Case Report on Necrotizing Fasciitis Due to Multidrug-Resistant *Pseudomonas aeruginosa* in an Elderly Patient from South India: Highlighting Economic Burden and Treatment Inaccessibility

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ABSTRACT

The report emphasizes on the case of necrotizing fasciitis with multi-drug-resistant *Pseudomonas aeruginosa*. A 70-year-old male admitted with lower limb swelling and pus discharge was later diagnosed with necrotizing fasciitis. The patient developed multiple comorbidities on subsequent days, limiting treatment options due to antimicrobial resistance, financial constraints and poor nutritional intake. This case underscores the emerging threat of MDR gram-negative pathogens in severe soft tissue infections, increased hospital stays, prolonged ICU admissions, and treatment inaccessibility for patients in low- and middle-income countries; and the need for antimicrobial stewardship.

Keywords: Antimicrobial drug resistance, Case report, Cost of illness, LRINEC score, Necrotizing fasciitis.

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INTRODUCTION

Necrotizing fasciitis is a nosocomial soft tissue infection that is either monomicrobial or polymicrobial in origin (Halbhavi *et al.*, 2018). According to studies, Group A *Streptococci*, *Staphylococcus aureus*, *Klebsiella* spp., *Acinetobacter* spp., and *Pseudomonas aeruginosa* are becoming prevalent in Indian settings (Tan *et al.*, 2025; Sinha *et al.*, 2022). These organisms are known to show very little susceptibility to antibiotics, including ampicillin, amoxicillin-clavulanate, and ciprofloxacin (Sinha *et al.*, 2022). Early diagnosis of necrotizing fasciitis remains challenging, as nonspecific clinical features frequently misdiagnose the condition as cellulitis in its initial stages.

Factors like delayed empirical therapy, inadequate antimicrobial coverage, nutritional deficiencies, and limited access to prompt supportive care impact patient outcomes. Additionally, in the case of lower socioeconomic backgrounds, it adds direct and

indirect costs such as high out-of-pocket expenditure, additional medical costs, caregiver burden, and other non-pharmacological treatments that impose a high financial burden (Kadam *et al.*, 2024). Both rural and urban households see a sharp decline in employment due to patient illness and related OOPEx, which forces families to sell assets and cut back on spending on necessities (Thomas *et al.*, 2025). The case underlines the significance of timely clinical management, antimicrobial stewardship, and improved understanding of the economic burden of AMR, especially in rural populations. Antimicrobial infections extend beyond the health of an individual, affecting household economics, the workforce, and caregivers.

CASE PRESENTATION

A 70-year-old male patient was admitted to the Department of General Surgery, exhibiting acute pain, swelling of the left leg, fever, and localized inflammatory signs on the affected limb, initially indicative of cellulitis. Within a few days of being admitted, the wound on the left foot started to ooze a foul-smelling, toxic fluid that was green in color along the side. After that, the skin began to die and bleed, and the wound was about 10 × 3 cm. The presence of green discoloration (pyocyanin pigment) indicated a possible *Pseudomonas aeruginosa* infection.



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CLINICAL FINDINGS

Upon admission, the patient underwent a thorough laboratory assessment, encompassing hematological parameters, glycemic evaluation (HbA_{1c}), lipid profile analysis, Electrocardiogram (ECG), liver and renal function tests, urinalysis, and thyroid function assessment, as detailed in the Table 1.

Diagnostic assessment

Abnormal lab investigations, like increasing serum creatinine, blood glucose, and total leukocyte count, increased suspicion for infection. The infection rapidly progressed with visible skin changes and discoloration along with swelling, fever, and erythema. Pus culture was taken after purulent discharge and green-colored discoloration from the infection site, and it confirmed *Pseudomonas aeruginosa*. Although the LRINEC score was taken as mentioned in Table 2, it was not considered to be the primary tool for diagnosis.

Therapeutic interventions

Initial empirical antimicrobial therapy was started with intravenous cefaperazone-sulbactam (1.5 g every 12 hr) and metronidazole (500 mg every 8 hr). The patient was diagnosed with type 2 diabetes mellitus (FBS 145 mg/dL, PRBS 139 mg/dL, RBS 197 mg/dL, HbA_{1c} 7.4%) after admission and started on drugs.

Subsequent management included taurine and acetylcysteine (500/150 mg twice daily), sodium bicarbonate (500 mg twice daily), linagliptin (5 mg once daily), and aspirin (75 mg once daily), atorvastatin (10 mg), and clopidogrel (75 mg) as a combination drug. Prompt surgical intervention in the form of fasciotomy and surgical drainage was undertaken and proved crucial in achieving early source control, even when diagnostic certainty is evolving. Due to disease progression, antimicrobial therapy was revised to clindamycin (300 mg), linezolid (600 mg), and intravenous metronidazole (500 mg).

Initially, the patient had proper glycemic control, but because of poor baseline nutrition and a calorie deficit, intake of linagliptin led to recurrent episodes of hypoglycemia (80 mg/dL). The drug was withdrawn, and glycemic control was achieved with a 25.0% w/v dextrose injection by intravenous route. Considering wound enlargement to 25 x 7 cm on the lateral aspect of the lower limb in subsequent days, antimicrobial susceptibility was considered, and a second wound debridement was planned, following assessment of surgical fitness. Negative Pressure Wound Therapy (NPWT) was initiated for wound healing and to promote granulation.

A pulmonology consultation was obtained for complaints of repeated cough with sputum. Chest radiography and CT thorax revealed heterogenous opacities in the bilateral middle and lower lung zones. The Cartridge-Based Nucleic Acid Amplification Test

(CBNAAT) did not reveal any significant risk for tuberculosis. The patient was managed with oseltamivir (75 mg twice daily).

The clinical course was further complicated by reduced left ventricular ejection fraction (Table 3) (39%), hyperkalemia (serum potassium 5.6 mmol/L), anemia (hemoglobin 7.9 g/dL), increased serum creatinine level (2.7 mg/dL), and persistently poor protein intake. During hospitalization, the patient developed features suggestive of sepsis along with intermittent chest pain. Cardiology consultation was sought, and additional medications were initiated following source control. Following multidisciplinary consultation, calcium supplementation and sevelamer bicarbonate (400 mg once daily) were initiated. Low-dose bisoprolol fumarate (1.25 mg once daily) was started after achieving source control, with careful avoidance of fluid overload and nephrotoxic medications.

Antimicrobial susceptibility testing revealed sensitivity only to colistin and mild sensitivity to piperacillin-tazobactam. Escalation to intravenous piperacillin-tazobactam (4.5 g every 8 hr) was advised; however, after 5 days of adherence, the patient declined treatment due to financial constraints. The wound size

Table 1: Abnormal lab parameters in initial days of admission.

Parameters	Abnormal Values
Haemoglobin	9.3 gm/dL
HCT	24.5%
Total WBC count	16390 cells/cumm
Platelet count	1121000 cells/cumm
Calcium	7.4 mmol/L
Sodium	134 mmol/L
Potassium	4.2 mmol/L
Troponin I	0.091 ng/dL
TSH	1.920 uIU/mL
Albumin	3.2 gm/dL
Cholesterol- Total	270 mg/dL
Triglyceride - TGL	220 mg/dL
Non-HDL cholesterol	237 mg/dL
HDL ratio	8.2
VLDL	44 mg/dL
HbA _{1c}	7.4%

Table 2: LRINEC Score.

Parameters	Value	Score
C-reactive protein	23 mg/L	0
Haemoglobin	7.9 g/dL	2
Total leukocyte count	16.39 cells/mm ³	1
Serum sodium	133 mmol/L	2
Serum creatinine	2.3 mg/dL	2
Blood glucose level	193 mg/dL	1



A

B

Figure 1: A and B: Illustrates the necrotized portion of the lower limb and foot.**Table 3: Clinical and economic impact associated with various parameters involved in the study.**

Sl. No.	Parameter	Observed Practice	Clinical And Economic Impact
1	Risk factor	Newly diagnosed DM	Impaired immunity and healing
2	Microbiology	Conventional culture and delayed AST	Prolonged empirical antibiotics
3	Empirical antibiotics	Broad spectrum use continued	Increased cost and AMR risk
4	Surgical intervention	Fasciotomy performed	Positive outcome for source control
5	Glycaemic management	Hypoglycaemia with Linagliptin	Drug withdrawal
6	Nutritional support	Low protein intake and delayed iron	Delayed recovery
7	Stewardship review	Limited due to delayed reports	Delayed escalation
8	Definitive therapy	Piperacillin- tazobactam declined	Incomplete optimal therapy
9	Supportive care	Refused due to cost	Persistent anaemia

increased to 29×10 cm, reflecting ongoing disease severity. The patient resumed antibiotics after necessitating their need to avoid severe progression and future complications.

Subsequently, combination therapy was de-escalated to individual agents, including aspirin (75 mg) and atorvastatin (20 mg). Recommended supportive interventions after a significant low hemoglobin count (7.9 mg/dL), such as packed red blood cell transfusions and intravenous iron sucrose for anemia, were declined; as a result, syrup ferrous fumarate was suggested as a replacement. Given the need for adequate nutritional rehabilitation and glycemic optimization before split skin grafting, the patient was discharged with advice for readmission after stabilization.

Follow-up and Outcomes

No follow-up information was available as the patient did not return after discharge (Figures 1 and 2).

CASE DISCUSSION

The primary diagnosis in this instance is necrotizing fasciitis; however, the symptoms were first misdiagnosed as cellulitis. When it comes to multidrug resistance, *Pseudomonas aeruginosa* inherent resistance makes therapeutic management more difficult. There are now more recent medications such as ceftolazone-tazobactam, ceftazidime-avibactam, and cefiderocol (Kunz *et al.*, 2022). However, the limited availability and affordability of these drugs remain limited in many low- and middle-income countries. Although initial empirical treatment provided adequate gram-positive coverage and toxin suppression,

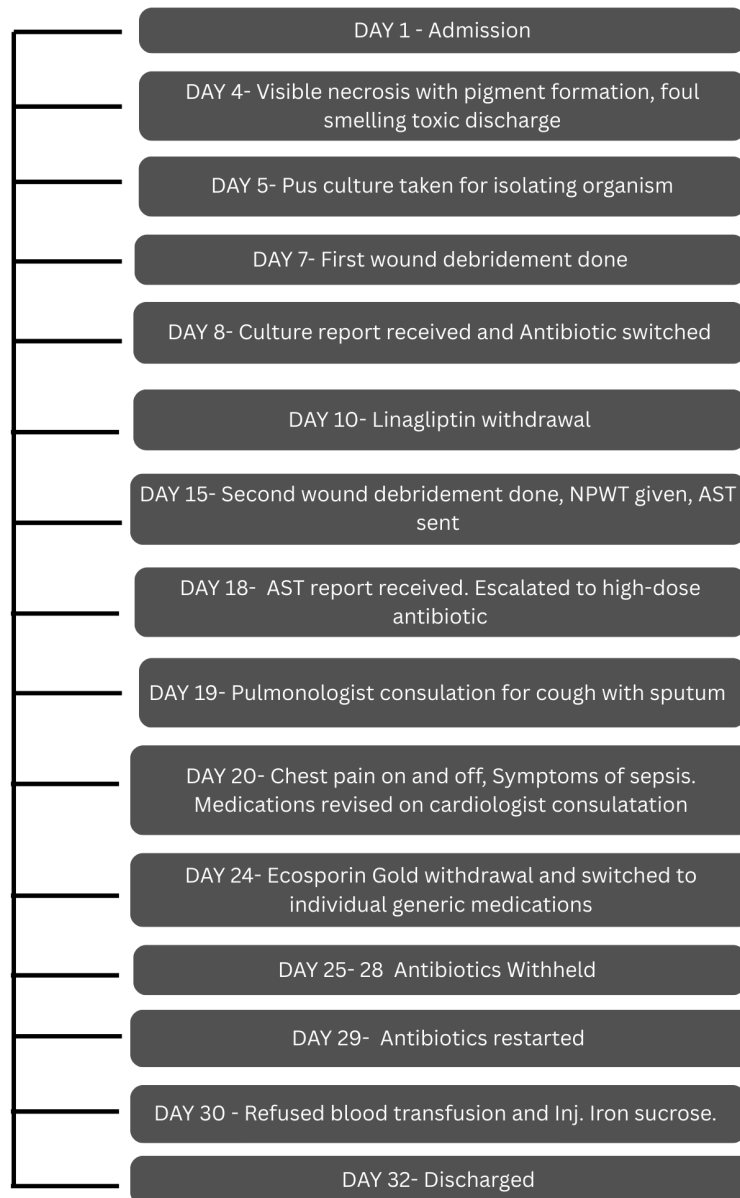


Figure 2: Disease progression timeline and clinical choices made while the patient was in the hospital.

it lacked sufficient gram-negative coverage, necessitating subsequent escalation based on microbiological findings.

Laboratory risk indicators for NF are often used for early diagnosis and are especially considered in the case of identifying high-risk patients (Siba *et al.*, 2023; Rathore *et al.*, 2023). However, evidence suggests that the LRINEC score may not accurately differentiate NF from cellulitis, particularly in diabetic and non-diabetic patients. Importantly, a low LRINEC score does not exclude NF, reinforcing continuous vigilance and reassessment (Rao *et al.*, 2024). A low LRINEC score does not rule out necrotizing fasciitis, highlighting the necessity for ongoing clinical vigilance and reevaluation (Oruc *et al.*, 2022; García-Tarriño *et al.*, 2021). Antimicrobial Susceptibility Testing (AST) showed that the bacteria were resistant to most antibiotics. They were only mildly

Table 4: Updated BG Prasad scale 2025 (Anand *et al.*, 2025).

Class	Updated income (INR) 2025
I (Upper)	≥ 9414
II (Upper middle)	4707-9413
III (Middle)	2824-4707
IV (Lower middle)	1412-2823
V (Lower)	<1412

sensitive to piperacillin-tazobactam and sensitive to polymyxin. The doctor suggested that the patient take piperacillin-tazobactam (4.5 g three times a day), but the patient couldn't afford it. The patient's financial situation had a big impact on which drugs were chosen during treatment.

Table 5: Direct and indirect costs resulting in economic burden.

Cost Component	Estimated Burden	Relevance to Case
Direct Medical Cost		
Hospital admission	Moderate	Prolonged stay of cost
Surgical procedures	High	Multiple interventions needed
Operating room charges	High	Emergency procedure
Empirical antibiotics	High	Prolonged empirical therapy
Definitive antibiotics	High	Prolonged empirical therapy
Supportive medications cardiovascular medications	Low -moderate	Continuous requirement
Cardiovascular medications	Moderate	Reduced ejection fraction and to prevent future complication Hypoglycaemia
Diabetic medications	Low	Adjusted due to Hypoglycaemia
Laboratory tests	Moderate	Repeated monitoring
Microbiology tests	Moderate	Delayed reporting
Imaging	Low - moderate	Delayed reporting
Bloods products	High	Refused due to cost
Wound care	Moderate- high	Daily requirement
Direct Non- Medical Cost		
Travel	Moderate	Financial strain
Food	Low	Lacked essential nutrient
Accommodation	Low - moderate	Prolonged stay
Wound care after discharge	Moderate	Risk of non-adherence
Indirect Cost		
Loss of wages (patient)	Agricultural irrigation work	High
Loss of wages (Caregiver)	Family member attendance	Moderate
Future income loss	Reduced mobility/ weakness	Moderate loss

Nutritional assessment revealed severe protein-energy deficiency, and he was impacted by stress and anxiety over his health secondary to affordability. In rural India, nutritious diets remain largely unaffordable relative to daily wages, contributing to persistent undernutrition and health risks (Raghunathan *et al.*, 2020). Poor nutritional status adversely affected wound healing and immune recovery, increasing subsequent ICU stays.

Beyond clinical complexity, this case highlights the substantial economic burden associated with NF. The patient was a daily wage labour in agricultural land, with irregular earnings and no health insurance coverage. The patient sought the medical school hospital because of the treatment affordability, specialized patient care, and lower travel costs compared to private tertiary facilities. Due to seasonal unpredictability, income was inconsistent, averaging less than INR 9,000 per month, assuming 25 working days. During hospitalization, the spouse's involvement as a caretaker resulted in further wage losses.

According to the most recent BG Prasad scale (Aslam *et al.*, 2018), although the household represented an upper-middle socioeconomic class (Table 4), the family showed poor financial resilience, as seen by treatment refusal due to out-of-pocket expenses, demonstrating effective economic vulnerability.

In rural healthcare settings, inconsistent antimicrobial stewardship programs and reliance on conventional antimicrobial susceptibility testing delay optimized therapy, prolonging hospital stays and escalating direct and indirect costs (Table 5). AMR infections impose a high treatment burden and medical expenses and force debts for hospital stays (Anand *et al.*, 2025). As a daily wage rural worker, the patient experienced complete income loss during illness, along with the caregiver's wage loss. Prolonged functional impairment and delayed recovery due to AMR infection contribute to Disability-Adjusted Life Years (DALYs). Wage loss represents an illness-related economic burden in India (Shrinivas *et al.*, 2023), reducing workforce participation and workdays and increasing Out-of-Pocket Expenditure (OOPE) for patients and family members (Satrughan *et al.*, 2023). Significant male income loss imposes a greater household economic burden, whereas women are disproportionately affected due to informal caregiving roles and job discontinuation.

Insurance coverage improves access to care but doesn't necessarily ensure financial risk protection in the absence of comprehensive coverage and effective implementation (Thomas *et al.*, 2024). The cumulative effect of direct medical costs, along with indirect and non-medical expenses, affected treatment adherence over the course of a prolonged hospital stay.

CONCLUSION

This case illustrates the unequal economic burden experienced by the rural population in managing severe infections, where elevated antibiotic costs, insufficient financial protection, and

reliance on daily wages markedly affect treatment accessibility and compliance. The absence of health insurance amplifies this burden, often leading to delayed care, treatment discontinuation, and loss to follow-up. For a daily wage worker, income loss affects caregivers, household financial security, and future healthcare and non-healthcare expenditures. This case underscores the urgent need for strengthened antimicrobial stewardship, faster diagnostic stewardship, improved financial risk protection, and context-specific policies to reduce both clinical and economic consequences of severe infections in the rural population.

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ABBREVIATIONS

AMR: Antimicrobial Resistance; **AST:** Aspartate Aminotransferase; **CB-NAAT:** Cartridge-Based Nucleic Acid Amplification Test; **CT:** Computed Tomography; **DALY:** Disability-Adjusted Life Year; **ECG:** Electrocardiogram; **FBS:** Fasting Blood Sugar; **HbA_{1c}:** Glycated Hemoglobin; **HDL:** High-Density Lipoprotein; **HCT:** Hematocrit; **ICU:** Intensive Care Unit; **INR:** International Normalized Ratio; **LRINEC:** Laboratory Risk Indicator for Necrotizing Fasciitis; **NDL:** Non-High-Density Lipoprotein; **NF:** Necrotizing Fasciitis; **NPWT:** Negative Pressure Wound Therapy; **OOPE:** Out-of-Pocket Expenditure; **pRBC:** Packed Red Blood Cells; **PRBS:** Postprandial Blood Sugar; **RBS:** Random Blood Sugar; **TSH:** Thyroid-Stimulating Hormone; **VLDL:** Very Low-Density Lipoprotein; **WHO:** World Health Organization.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

INFORMED CONSENT

- Verbal informed consent was obtained from the patient.
- Approval obtained from the institution/ hospital.

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