

Analysis of Risk Factors, Clinical Profile, and Management Outcomes associated with Lower Limb Cellulitis in Central India

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Abstract

Background: Cellulitis of the lower limb is among the leading causes of surgical admissions worldwide. Nearly 14 million cases are reported annually in the United States alone and billions spent on treatment. In India, reliable data is scarce. However, hospital wards frequently see it often in patients with diabetes, poor hygiene or simple habits like barefoot walking. The disease looks straightforward in textbooks, but in practice, it is unpredictable. Some cases resolve with oral antibiotics, others spiral into abscesses, necrotising fasciitis, or sepsis. **Material and Methods:** This prospective observational study was conducted at RIMS, Raipur, between April 2024 and October 2025. A total of 86 patients aged 18–90 years with Grade II–IV cellulitis according to the CREST classification were included. Detailed clinical data, risk factors, and outcomes were recorded. Investigations included CBC, HbA1c, wound cultures, Doppler studies, and plain radiographs. Patients were managed with either antibiotics and supportive care or surgery (incision & drainage, debridement, fasciotomy, or skin grafting) as indicated. **Results:** Men accounted for nearly two-thirds of the study population, and most were in their fifth decade of life. Diabetes mellitus was the leading risk factor (38%), followed by barefoot walking (34%) and trauma (29%). More than half (52%) presented with Grade II cellulitis, while 18% had severe Grade IV disease. Conservative management was successful in 70% of cases, but 30% required surgical procedures. The complications included abscess (15%), osteomyelitis (7%), and sepsis (5%). Almost all patients (90 percent) recovered, but three were permanently turned off, and two succumbed despite intensive care. **Conclusion:** Central India Lower limb cellulitis is an indicator of biological determinants of health, combined with social determinants. Prevention through controlling diabetes, enhancing hygiene, and reducing barefoot walking within at-risk groups will only be effective with early-stage diagnosis; some lives can be saved through rational antibiotics. This paper demonstrates that cellulitis is not only an infection but also a reflection of gaps in community health and the acute lack of awareness.

Keywords: Cellulitis, Lower limb infection, Diabetes mellitus, Risk factors, CREST classification, Surgical management, Central India.

Received: 01 January 2026

Revised: 20 January 2026

Accepted: 06 February 2026

Published: 24 February 2026

INTRODUCTION

Cellulitis is one of those common infections that continue to baffle clinicians with its unpredictable course. It may appear to be a simple skin redness, but it may evolve into a deep-seated infection. It can be a threat to both limb and life the next. It is among the leading causes of hospital admissions under general surgery worldwide.^[1] The still true magnitude of its nature is often underestimated. It affects millions each year around the world, particularly adults with chronic illnesses or those living in unhygienic conditions.^[2] The United States alone records nearly 14 million cases annually, spending billions on treatment and hospitalization.^[3] It is an economic burden that quietly keeps rising every year.

India is a country with a huge population diversity and social disparities. It lacks comprehensive epidemiological data on cellulitis.^[4] There is data somewhere buried within hospital records, but not systematically studied. But it is common knowledge among surgeons working in a tertiary hospital that cellulitis presents to the ward almost daily. Patients often come from rural areas, barefoot, sometimes diabetic, sometimes malnourished, and often too late to get

help. The problem is not merely microbial, but it is social, behavioral, and infrastructural.^[5] Specifically, lower limb cellulitis deserves focused attention. The legs are the most frequent place of infection occurrence. Legs are mostly exposed to minor traumas or insect bites or to environmental contamination.^[6] People with diabetes and elderly patients also suffer more from poor circulation, which leads to delayed healing. They can culminate in abscesses, necrotising fasciitis, or even sepsis if such infections progress unchecked. It is highly important to study region-specific patterns. It is important to analyse everyday habits, poverty and lack of awareness shape disease outcomes in realworld clinical practice.^[7]

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DOI:
10.21276/amit.2026.v13.i1.376

How to cite this article: Panthi R, Nanda R, Churendra Y, Chandrasen MS. Analysis of Risk Factors, Clinical Profile, and Management Outcomes associated with Lower Limb Cellulitis in Central India. *Acta Med Int.* 2026;13(1):486-491.

It has a high potential for research in the field of cellulitis in Central India because it has an eclectic mix of urban and rural inhabitants, different occupational exposures, and inadequate access to specialized healthcare. It is not uncommon to have walking around barefoot and unregulated diabetes, which provides an environment favourable to frequent cases of cellulitis. In addition to bacterial invasion, social behavior and biological susceptibility are also important factors. Regardless of the improvement in antibiotics, the recurrence of cellulitis is still high. The local risk factor has not been studied in many studies; microbiological patterns and treatment outcomes are not investigated in this area, resulting in knowledge gaps and inconsistent management controls. The current study aims to monitor and evaluate real-life situations to establish the risk factors, clinical presentation, and management of lower limb cellulitis in Central India. It aims to fill the gap between theory and practice at the bedside, guiding prevention and encouraging more rational, context-specific management.

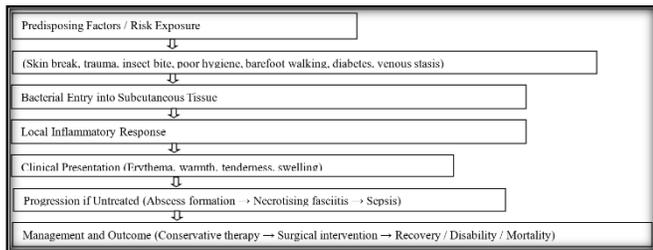


Figure 1: A flow diagram illustrating the natural course of cellulitis

Review of Literature

It might seem that the bacterium cellulite is a skin infection that could be cured with the help of such a medication, yet the international statistics demonstrate otherwise. Its risk factors, as well as its behavior and outcomes, have been studied extensively in the past decades.^[2] Research shows that the predominant causative organisms in the world are *Streptococcus pyogenes* and *Staphylococcus aureus*. On Group A *Streptococcus*, Stevens and Bisno (2014) also documented it to be the most prevalent in non-purulent cellulitis, with *S. aureus* (and especially MRSA strains) being predominant in purulent types of cellulitis.^[1,8] These findings, however, are regionally different, although, mixed gram-negative infections have been reported in the tropical climates.

According to a study by Cannon et al. (2018), cellulitis of the lower limbs accounted for almost 3% of total hospitalizations in the UK due to skin infections; diabetes and obesity were the primary risk factors. Conversely, Okoromah et al. (2019) of sub-Saharan Africa also highlighted the importance of environmental and behavioral characteristics and cited trauma and poor hygiene as the main causes.^[9] These heterogeneities point out that the conditions of local living use different conditions to alter the pattern of infections.

Research conducted in India is limited and largely hospital-based, with small sample sizes. The themes are common

ones, such as diabetes, walking barefoot, and unattended minor wounds. Gupta et al. (2020) have noted that close to 40 percent of patients with cellulitis were diabetic, and more than one-third wore bare shoes, which is an ethnically based practice that predisposes skin to vulnerability. According to Bhattacharya et al (2022),^[7] cellulitis was identified as a disease of neglect, with recurrence driven by low health literacy, poor hygiene, and poor diabetes management.

Although there are also valuable contributions, there is no region-specific information in Central India.^[10] The vast majority of the research is of northern or urban origin and might not represent semi-urban or rural populations of Chhattisgarh and surrounding regions. Literature relating the CREST classification to other outcomes (surgery, recovery time, or mortality) is also limited.

This investigation aims to fill this gap by providing contextual evidence on Central India. It seeks to determine the interplay among lifestyle, infection, and management outcomes by bridging the gap between social determinants and clinical realities.

MATERIALS AND METHODS

The present observational study was a prospective study conducted in the department of general surgery at Raipur Institute of Medical Sciences (RIMS), Raipur, Chhattisgarh. It focused on documenting clinical patterns of cellulitis in practice, rather than testing interventions.

Study Design: It was decided to use a prospective observational design because cellulitis manifests differently in different people. All patients were tracked from admission to discharge, and the results were documented systematically.

Study Setting and Duration: The research was conducted in RIMS, a teaching hospital that provides tertiary care and serves the rural and urban populations in Central India. The period between 18 months (April 2024 to October 2025) was taken because it would capture seasonal and behavioral changes.

Population and Sample Size of the study: The study included 86 patients diagnosed with Grade II to IV lower limb cellulitis according to the CREST classification. Cases presented during the study period, consecutively and eligible, were enrolled to create a representation of the actual case distribution in the hospital.

Inclusion Criteria

- Patients aged 18 years and above
- Patients diagnosed with Grade II–IV cellulitis of the lower limb
- Patients who are willing to provide informed consent and undergo the necessary investigations and follow-up

Exclusion Criteria

- Patients with Grade I cellulitis (mild, treated as outpatient)
- Patients with immunocompromised states (HIV, long-term steroids, chemotherapy)
- Cases with chronic venous ulcers, gangrene, or osteomyelitis prior to admission
- Patients unwilling or unable to provide consent

Each time a patient was hospitalized, an elaborate clinical history was obtained. Emphasis was put on the period of illness, a history of trauma, walking barefoot, being bitten by an insect,

diabetes, or other comorbidities. An exhaustive physical examination was performed to determine the scope of infection. Alsolocal temperature, tenderness and grading based on CREST criteria were recorded. All the findings were noted using a predesigned proforma. The data was collected accurately. It occurred numerous times during the discussions, albeit with some interruptions, during which patients were asked more about their lifestyle and habits than only their symptoms. It was a lesson to remember that a disease rooted in daily living is usually due to daily living.

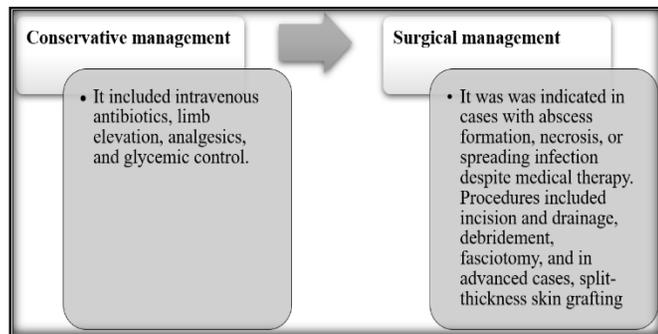
Investigations Performed

Each patient had a baseline and disease-specific tests, which included:

- Complete Blood Count (CBC)
- Blood Sugar and HbA1c levels
- Wound culture and sensitivity (where pus or discharge was present)
- Doppler ultrasonography to rule out venous insufficiency or deep vein thrombosis
- Plain X-ray of the affected limb (where clinically indicated to rule out gas formation or bone involvement)

Management Protocol

Management was individualized based on severity.



Patients were reviewed daily, and clinical improvement was documented with precision. Postoperative outcomes were also recorded until discharge in cases that required surgery. Recurrence or long-term disability was noted where possible.

Statistical Analysis: Data entry was performed in Microsoft Excel, and the data were analyzed using SPSS version 26. Descriptive statistics, such as means, standard deviations, and percentages, were used for quantitative variables. Categorical variables were compared using the Chi-square test or Fisher’s exact test where applicable. A p-value <0.05 was considered statistically significant.

Statistical analysis was carried out on the numbers to identify patterns of who gets better, who doesn’t, and what makes the difference.

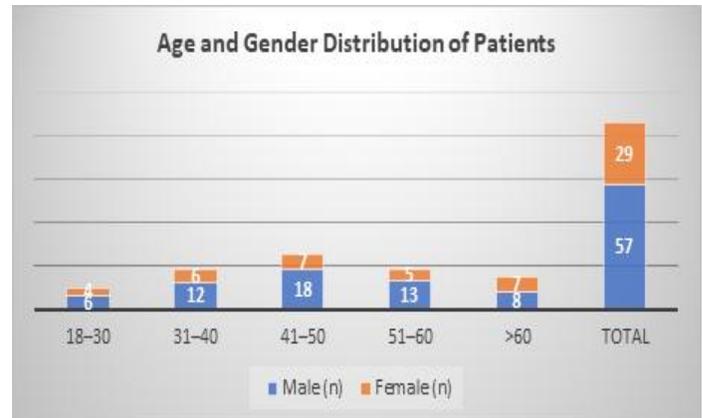


Chart1: Age and gender distribution of study participants

The mean age analysed was approximately 49.8 ± 13.7 years. Older adults dominated the findings, but a good number of younger adults, who were below 40 years, also presented many of them with trauma or a barefoot walking history. Nearly 11.6% were below 30 Years of age.

Risk Factors: Risk factor analysis indicated that diabetes mellitus was the most frequent association. It was seen in 33 patients, accounting to 38% of the total population. Barefoot walking was the next most frequent association, observed in 29 patients, accounting for 34%. Trauma accounted for 25 patients, representing 29% of the total population. A smaller proportion reported insect bites, poor hygiene, or other chronic venous insufficiency.

Table 1: Variables and Their Operational Definitions

Variable	Definition / Measurement	Type
Age	Patient’s age in completed years at admission	Continuous
Gender	Male / Female	Categorical
Risk Factors	Diabetes mellitus, trauma, barefoot walking, poor hygiene, etc.	Categorical
Severity Grade (CREST)	Grade II: Moderate infection. Grade III: Severe with systemic symptoms. Grade IV: Extensive/local necrosis	Ordinal
Type of Management	Conservative vs Surgical	Categorical
Complications	Abscess, necrosis, osteomyelitis, sepsis	Categorical
Outcome	Recovered, residual disability, death	Categorical

RESULTS

The findings of this prospective study are presented below. Each part is arranged to systematically represent the patient profile, disease characteristics, management, and outcomes.

A) Demographic Profile

A total of 86 patients with lower limb cellulitis were considered for this study. The age range varied widely from 18 to 90 years. It reflected that cellulitis is common among

all age groups. It was found that the majority were in their fifties or sixties, accounting for nearly half of all cases. Findings showed a clear male predominance. Men comprised roughly two-thirds of the study population. At the same time, women accounted for one-third of the population. This could be partly due to greater outdoor exposure, occupational hazards, or perhaps delayed care-seeking behavior among males who often underestimate minor wounds.

Table 2: Age and Gender Distribution of Patients (n = 86)

Age Group (Years)	Male (n)	Female (n)	Total (n)	Percentage (%)
18-30	6	4	10	11.6
31-40	12	6	18	20.9
41-50	18	7	25	29.0
51-60	13	5	18	20.9
>60	8	7	15	17.4
Total	57	29	86	100

Table 3: Frequency of Risk Factors in Lower Limb Cellulitis

Risk Factor	Number (n)	Percentage (%)
Diabetes Mellitus	33	38.4
Barefoot Walking	29	33.7
Trauma	25	29.1
Poor Hygiene	14	16.3
Insect Bite	9	10.5
Chronic Venous Disease	6	7.0

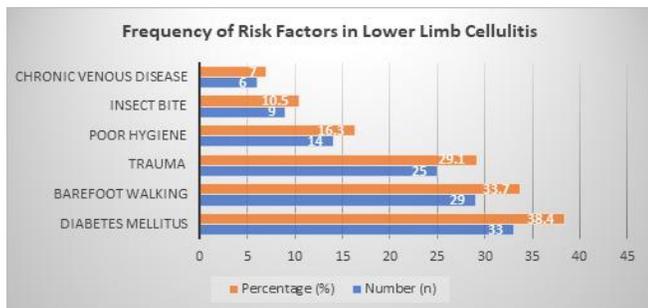


Chart 2: Frequency of Risk Factors in Lower Limb Cellulitis

This pattern indicates a mix of lifestyle and medical vulnerabilities. It shows that diabetes weakens the immune barrier and barefoot walking with minor injuries provides direct routes for bacterial entry, a combination too common

in semi-urban Central India.

Clinical Profile: Analysis based on the CREST classification found that more than half of the patients (nearly 52%) presented with Grade II cellulitis. This suggested a moderate infection manageable by medical therapy. Grade III disease was seen in 30% of cases, while Grade IV, the severe, often limb-threatening form, was found in 18% of the population.

The right lower limb was affected slightly more often (56%) than the left (44%) in the population. Bilateral involvement was rare. Some patients reported recurrent infections in the same limb. This could be due to persistent microangiopathy in people with diabetes or even because of inadequate footwear protection.

Table 4: Distribution of Patients According to CREST Grade

CREST Grade	Description	Number (n)	Percentage (%)
Grade II	Moderate infection without systemic toxicity	45	52.3
Grade III	Severe infection with systemic features	26	30.2
Grade IV	Extensive infection with necrosis or deep tissue involvement	15	17.5
Total	—	86	100

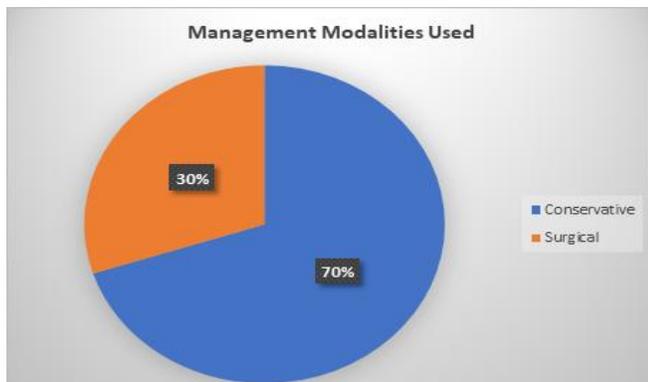


Chart 3: Management Modalities Used

Management Modalities: Out of the total 86 patients 60 patients which account to 70% were managed conservatively. Nearly 26 patients which are 30% of the population required surgical intervention. Conservative

therapy included intravenous antibiotics, glycemic control, and local wound care. Surgical procedures ranged from incision and drainage to fasciotomy and debridement. Skin grafting was done in a few advanced cases.

Patients undergoing surgery tended to belong to Grade III or IV categories, though a few Grade II patients with abscess formation also needed minor operative procedures.

This distribution emphasises that timely antibiotic therapy can prevent many patients from requiring surgery. But once necrosis sets in, there is little room left for medicines to work.

Complications and Outcomes: Complications were recorded in 27 patients, accounting for 31% of the total population. Abscess formation was the most frequent complication, with 15%. It was followed by osteomyelitis with 7% and sepsis with 5%. A few patients developed residual deformity or restricted mobility due to fibrosis and contracture.

The majority of patients recovered completely with

appropriate therapy. The overall recovery rate was 90%. Mortality was recorded 2.3% with 2 patients despite

intensive care and broad-spectrum antibiotics.

Table 5: Complications and Treatment Outcomes

Complication / Outcome	Number (n)	Percentage (%)
Abscess Formation	13	15.1
Osteomyelitis	6	7.0
Sepsis	4	4.7
Residual Disability / Contracture	3	3.5
Complete Recovery	78	90.7
Mortality	2	2.3

In conclusion, in Central India, cellulitis is not a simple infection; it reflects health behavior. The weight is borne by middle-aged men, people with diabetes, and men who habitually walk barefoot. Prompt treatment and proper antibiotic response are very positive; once delayed or not treated at all, the disease progresses very quickly. It goes on to surgery, disability, and even death.

DISCUSSION

The study population had cellulitis of the lower limbs, with most participants being middle-aged males (66%). In this, the population had over half, i.e., 52%, with Grade II cellulitis as per the CREST classification. These results are closely aligned with those of Gupta et al. (2020), who reported 58% male predominance in their study and 49% Grade II in a North Indian cohort.^[7]

In a study conducted by Cannon et al. (2018, UK), 60% of the population was male, with a median age of 52 years. It reiterated the same demographic pattern. In our study, the divergence will be due to the fact that it is centered in Central India. Here, plain environmental and cultural causes, such as barefoot walking (34%), are present alongside metabolic disorders, such as diabetes (38%). This generates one of the apparent dual risk environments that are not easily observed in the region in non-documented records.^[8]

Comparison to previous studies improved our complication and recovery rates by almost 15% and osteomyelitis by nearly 7%, which comparatively were lower than the results obtained by Sharma et al. (2021).^[4] 19% and 9% cases in that study had abscess and osteomyelitis, respectively. Our study had a 90% recovery and 2.3% mortality in the cohort, which is comparable to the 88% recovery and 35% mortality in the cohort (esteems) reported in other countries (Stevens and Bisno, 2014; Okoromah et al., 2019).^[1,9] This implies that in the setup with resource constraints, appropriate diagnosis, rational use of antibiotics, and selective early surgery can produce results equal to those of a bigger setup. One of the strengths of our research is that we use CREST grading systematically to manage the study. It provided a repeatable design that has not been consistently used across numerous works in Indian studies.^[12]

The relation between socioeconomic and behavioral factors was evident throughout our research. Delayed presentation, poor foot hygiene, and lack of footwear contributed to advanced disease at admission. This often leads to the

“disease of neglect” concept proposed by Bhattacharya et al. (2022).^[5] Still, our low mortality and better complication profile indicate effective hospital protocols and attentive follow-up. The limitations of this study include its single-centre design. Limited moderate sample size and follow-up beyond discharge were lacunas of the research. Still, this study provides one of the few structured datasets from Central India that link risk factors to CREST grading and outcomes in cellulitis.^[10] The findings highlight that improving diabetic control, promoting footwear use, and ensuring early referral could substantially reduce morbidity in similar populations.^[13-15]

CONCLUSION

This study emphasised that lower limb cellulitis in Central India occurs as much through everyday behaviour as through medical risk factors. Of the total 86 patients studied, nearly 38% were with diabetes mellitus and 34% with barefoot walking habit, while 29% had trauma. These were the leading contributors to the infection. More than 52% of the patients with Grade II cellulitis responded well to conservative management. It resulted in an overall recovery of 90%. These implications corroborate the fact that early diagnosis, proper use of antibiotics, and surgery in time are important in preventing the severe complications and mortality caused by the disease, which is beyond clinical care. Easy preventive interventions, such as routine foot examination in diabetes, good glycemic control, community education on wearing shoes, and sensitizing people to early medical access, may significantly decrease the burden of the disease. Cellulitis, however, is common yet an indicator of broader problems of access, lifestyle, and hygiene. These social determinants need to be addressed in the same way as the infection itself.

Prevention and early intervention are therefore the best forms of treatment for cellulitis. With better awareness, improved primary care systems can save both limbs and lives, often before they ever reach the hospital. Community-based diabetic and hygiene programs also play a major role in it.

Recommendations

Several practical measures can help reduce the burden of lower limb cellulitis in Central India and similar settings. Based on the findings of this study, the following recommendations are offered. Every diabetic patient should be counselled on proper foot care. Early signs of infection detected can help control the infection. Guidance should be given to them on the importance of maintaining glycemic control. Routine foot examinations in outpatient clinics can detect minor injuries before they progress into cellulitis. Barefoot walking, which remains common in

many rural and semi-urban communities, must be addressed through awareness campaigns and affordable footwear programs. Hospitals, NGOs, and local health departments could collaborate to distribute low-cost protective footwear, especially to high-risk groups. There is a need for educational initiatives focused on personal hygiene and wound care. The hazards of self-treatment need to be addressed to reduce recurrence significantly. Using village health workers to spread this message could make prevention more culturally sustainable and increase its reach among these people. Primary health centers should be trained to identify cellulitis early.

Efficient resolution of such cases will be through the initiation of empirical therapy and prompt referral of the severe cases. Standardized scoring using CREST may be adopted at any grade level to ensure consistent evaluation and timely, appropriate scale-up of treatment.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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