RESEARCH PAPER

# HOSPITAL-BASED BURDEN OF CARDIOVASCULAR DISEASES IN AN URBAN TERTIARY CARE CENTER IN GUJARAT: A RETROSPECTIVE STUDY

**Khyati Mewada[1*], Rejoice Ravi[1], Golak B. Patra[1]**
[1] Faculty of medicine, Parul University, Vadodara, Gujarat, India
khyati.physio87@gmail.com

**Abstract**
**Background:** Cardiovascular diseases represent a growing public health burden in India; data on admission patterns and determinants of length of stay at tertiary cardiovascular units in urban Gujarat remain scarce. This study aimed to characterize inpatient admission patterns and identify independent determinants of LOS among cardiology and cardiac surgery patients at a tertiary care centre.
**Materials and Methods:** A retrospective observational study was conducted at a tertiary care hospital in Gujarat, using Electronic Health Records. Total of 4,617 individual records were collected during study period from February 2024 to April 2026. LOS was compared across groups using Wilcoxon rank-sum and Kruskal–Wallis tests. Multivariable linear regression identified independent predictors of LOS.
**Results:** A total of 4,617 patients were admitted. Admissions fluctuated seasonally, peaking in April (12.3%) and reaching their lowest in January (3.6%). Monday recorded the highest daily admission frequency (19.2%). Cash and credit/ Insurance payments were nearly equally distributed (49.4% vs. 50.6%). Credit/ Insurance patients had a significantly higher mean LOS than cash patients (2.72 vs. 2.06 days; $p < 0.001$). On multivariable regression, age ($\beta = 0.018$; $p < 0.001$) and credit/ Insurance payment status ($\beta = 0.657$; $p < 0.001$) were independent determinants of longer LOS.
**Conclusions:** Age and credit or insurance payment status are key predictors of longer hospital stays among cardiovascular patients at a tertiary care centre. These insights emphasize the role of demographic and financial factors in hospitalization patterns, influencing bed management and discharge planning.
**Keywords:** Cardiovascular diseases, hospital admissions, length of stay, payment type, tertiary care
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## Introduction

Non- communicable diseases (NCDs) have become a leading public health challenge of the 21st century, consisting of cardiovascular diseases (CVDs), diabetes mellitus, cancer, chronic respiratory diseases, and stroke. In 2019, NCDs accounted for 71% of the 55 million deaths globally. In India alone, over 5.8 million individuals succumb to NCDs annually, with one in four Indians at risk of dying from an NCD before reaching the age of 70 [1]. This disease progression has led to a steep and sustained increase in the healthcare demand, especially at the tertiary care facilities, which serve as the primary destination for complex diseases [2]. This significant regional variation in healthcare utilization across India, influenced by disparities in infrastructure, access, and socioeconomic factors, highlights the need for region-specific health planning and interventions [3].

Among the NCDs, CVDs are the fastest growing chronic illness in India. The annual CVD-related deaths have increased from 2.26 million in 1990 to approximately 4.77 million in 2020, indicating a 34% rise in CVD mortality between 1990 and 2016 [1]. Mean outpatient visits in India increased from 2.2 to 6.2 per year and the percentage reporting an overnight hospital stay rose from 9% to 29% as the number of NCDs per individual increased from zero to two or more, directly reflecting the growing healthcare utilization burden of cardiovascular and other chronic diseases [4]. Contemporary data on evolving admission patterns at tertiary cardiovascular centres remain limited despite the critical role these units play in managing high-acuity cardiovascular conditions [5]. This gap highlights the necessity of conducting methodical, institution-level assessments of hospital use patterns.

In the Indian healthcare system, tertiary care centres play an important role by absorbing the complex and advanced CVDs that cannot be managed at the primary or secondary levels [2]. Hospital admission patterns provide insights into the healthcare utilization, disease burden trends in morbidity and mortality, thereby allowing for proper planning and prevention[6]. With the growing burden of CVD, India's tertiary healthcare infrastructure faces significant challenges, including inadequate facilities, workforce shortages, and poorly coordinated service delivery across public and private sectors [2].
Despite the growing CVD burden in urban Gujarat, a rapidly urbanising setting where lifestyle-related

risk factors are intensifying alongside demographic transition, the systematic analyses of temporal trends in hospital admissions for CVD at tertiary centres remain scarce. The present retrospective study was therefore undertaken at a tertiary care centre in urban Gujarat with the objective of analysing patterns in hospital admissions, patient characteristics, and determinants of length of stay (LOS) related to CVD from February 2024 to April 2026, to generate actionable evidence for health service planning and hospital management in the region.

**Materials and Methods**

**Study Design and Setting**

This was a retrospective observational study conducted at a tertiary care hospital in Gujarat, India. The study included inpatient admissions to the Cardiology and Cardiac Surgery departments, as well as in other departments between February 2024 and April 2026.

**Data Source and Data Collection**

Data were extracted retrospectively from the hospital's Electronic Health Record (EHR) system. Variables retrieved for each admission included: admission date, admission month, admission weekday, patient age, gender, bed category, treating department, payment type, city of residence, and length of stay (LOS).

**Study Population**

All inpatients admitted to the Cardiology, Cardiac Surgery and other departments during the study period were considered for inclusion. Records were included if they contained complete data for all variables of interest. Records were excluded if key variables were missing or inconsistent (such as admission date, length of stay (LOS), age, or department); if the admission was a duplication; or if it was incorrectly recorded as the cardiology unit. After applying these criteria, a final sample of 4,617 admissions was derived.

**Variable Definitions**

Length of stay was determined as the number of calendar days between admission and discharge. Same day admissions and discharges were counted as zero days. Patients were classified by age into four categories: pediatric (<18 years), 18–40 years, 41–60 years and older adult (>60 years). Payment type was divided into two groups; Cash, which meant that payments were to be made by the patient or family members at the time of admission, and Credit/ Insurance, which included all admissions funded by health insurance, corporate credit or government-sponsored schemes.

**Statistical Analysis**

All statistical analyzes were performed using R studio, Version 2026.01.1 Build 403. Categorical variables were summarized as frequencies and percentages. Continuous variables were described using mean, median, and interquartile range (IQR). Normality of the LOS distribution was assessed using the Shapiro–Wilk test, which indicated significant departure from normality ($p < 0.001$); hence, non-parametric tests were used for group comparisons.

The Wilcoxon rank-sum test was used to compare LOS distributions specifically for gender and payment type. The Kruskal–Walli's test was applied for comparisons across three or more groups, namely age group and bed category. Pearson's Chi-square test was used to evaluate differences in categorical characteristics between cash-paying and credit/ Insurance-based patients.

A multivariable linear regression model was built to determine factors independent of other variables related to LOS. Age, gender, bed category, department and payment type were used as covariates in the model. They are presented as β coefficients and their 95% confidence intervals (CI) and p values. Throughout, $p < 0.05$ was considered statistically significant.

**Ethical Considerations**

As this was a retrospective analysis of routinely collected administrative data, Ethics approval was not necessary. All data were analyzed in anonymized form, and no personal identifiers were retained at any stage of the analysis. Patient confidentiality was maintained in accordance with institutional guidelines and applicable data protection regulations.

**Results**

**Baseline characteristics**

Out of the 4,617 cardiology and cardiac surgery inpatients admitted, 3,084 (66.79%) were male and 1,533 (33.20%) were female. The majority of patients were aged >60 years (n = 2,664; 57.69%). Cash and credit/ insurance payment types were nearly equally distributed, accounting for 49.40% and 50.59% of admissions, respectively. Cardiology accounted for 97.7% of admissions (n = 4,509), with Cardiac Surgery contributing 2.1% (n = 95). Baseline demographic and clinical characteristics are presented in **Table 1**.

**Table 1:** Demographic and clinical characteristics of cardiology/cardiac surgery inpatients (N= 4,617)

| Characteristic | n (%) |
|---|---|
| **Gender** | |
| Male | 3,084 (66.8) |
| Female | 1,533 (33.2) |
| **Age group** | |
| Paediatric (<18 years) | 17 (0.4) |
| 18–40 years | 302 (6.5) |
| 41–60 years | 1,634 (35.4) |
| >60 years | 2,664 (57.7) |
| **Payment type** | |
| Cash | 2,281 (49.4) |
| Credit/Insurance | 2,336 (50.6) |
| **Department** | |
| Cardiology | 4,509 (97.7) |
| Cardiac Surgery | 95 (2.1) |
| Others | 13 (0.3) |

*n = number of patients; % = percentage of total sample (N = 4,617).*

**Temporal distribution of admissions**

Monthly admissions were ranged from 167 in January (3.6%) to 566 in April (12.3%), with March and April having 11.3% and 12.3%, respectively (**Table 2**). By the day of the week, Monday recorded the admission frequency of (n = 887; 19.2%), Friday of (n = 771; 16.7%) and Tuesday of (n = 696; 15.1%).

**Bed category and payment type distribution**

A.C. General Ward accounted for 40.7% of admissions (n = 1,877), followed by A.C. Semi Special (16.7%; n = 769) and ICCU (14.2%; n = 655) (**Table 2**). High-dependency units, MICU (5.6%; n = 257), ITU (0.3%; n = 13), and SICU (0.02%; n = 1) together accounted for fewer than 6% of admissions. Day Care/Triage represented 1.1% of admissions (n = 49).

**Table 2:** Temporal distribution of admissions according to month and day of the week, bed category and payment type (N = 4,617)

| Variable | n (%) | Variable | n (%) |
|---|---|---|---|
| **Month** | | **Days of week** | |
| January | 167 (3.6) | Monday | 887 (19.2) |
| February | 427 (9.3) | Tuesday | 696 (15.1) |
| March | 521 (11.3) | Wednesday | 642 (13.9) |
| April | 566 (12.3) | Thursday | 664 (14.4) |
| May | 402 (8.7) | Friday | 771 (16.7) |
| June | 236 (5.1) | Saturday | 646 (14.0) |
| July | 427 (9.3) | Sunday | 311 (6.7) |
| August | 363 (7.9) | **Bed category** | |
| September | 386 (8.4) | A.C. General Ward | 1877 (40.7) |
| October | 368 (8.0) | A.C. Semi Special | 769 (16.7) |
| November | 363 (7.9) | ICCU | 655 (14.2) |
| December | 391 (8.5) | A.C. Special | 451 (9.8) |
| **Payment type** | | MICU | 257 (5.6) |

| | | | |
|---|---|---|---|
| Cash | 2281 (49.4) | Standard | 224 (4.9) |
| Credit/Insurance | 2336 (50.6) | Deluxe | 206 (4.5) |
| | | Executive Twin | 71 (1.5) |
| | | Day Care/Triage | 49 (1.1) |
| | | Premium | 44 (1.0) |
| | | ITU | 13 (0.3) |
| | | SICU | 1 (0.02) |

*n = number of admissions; % = percentage of total sample (N = 4,617). A.C. = Air Conditioned.*

**Length of Stay (LOS) analysis**

LOS differed significantly by payment type (Wilcoxon rank-sum test, P < 0.001). Credit/ Insurance patients had a mean LOS of 2.72 days compared with 2.06 days among cash patients, with identical medians of 2 days (IQR 1–3) in both groups (**Table 3**). LOS between male and female patients was 2.41 vs. 2.37 days (P = 0.069). **Figure 1** illustrates the distribution of LOS according to payment type. Although the median LOS was identical in both groups (2 days), patients covered by credit/insurance demonstrated a wider distribution and a greater number of prolonged hospitals stays than cash-paying patients (Wilcoxon rank-sum test, < 0.001).

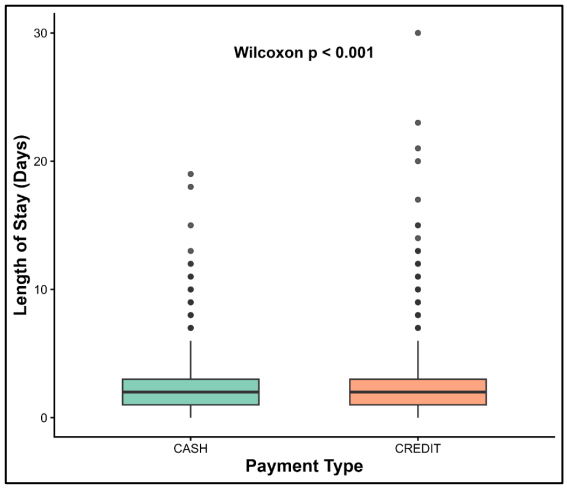



**Figure 1: Distribution of length of stay (LOS) by payment type.**

*Box plots show the median (horizontal line), interquartile range (box), and 1.5 × IQR whiskers. Individual points beyond the whiskers represent outlier admissions. Credit/Insurance patients had significantly longer LOS than cash-paying patients (Wilcoxon rank-sum test, P < 0.001).*Significant variation in LOS was observed across age groups (Kruskal-Walli's test, P < 0.001). Patients aged >60 years had the mean LOS of 2.54 days (median 2, IQR 1–3), whereas pediatric patients had 1.76 days (median 1, IQR 1–2). The 41–60-year group had a mean LOS of 2.24 days and the 18–40-year group 1.90 days (**Table 3**).

**Table 3:** LOS according to patient characteristics (N = 4,617)

| **Variable** | **Mean LOS (days)** | **Median (IQR)** | **p-value** |
|---|---|---|---|
| **Payment type** | | | <0.001 |
| Cash | 2.06 | 2 (1–3) | |
| Credit/ Insurance | 2.72 | 2 (1–3) | |
| **Gender** | | | 0.069 |
| Female | 2.37 | — | |
| Male | 2.41 | — | |
| **Age group** | | | <0.001 |
| 18–40 years | 1.90 | 1 (1–2) | |
| 41–60 years | 2.24 | 2 (1–3) | |

| | | | |
|---|---|---|---|
| >60 years | 2.54 | 2 (1–3) | |
| Pediatric | 1.76 | 1 (1–2) | |
| **Bed category** | | | <0.001 |
| A.C. General Ward | 2.32 | 2 (1–3) | |
| A.C. Semi Special | 2.89 | 2 (1–3) | |
| A.C. Special | 2.99 | 2 (2–4) | |
| Day Care/Triage | 1.39 | 1 (1–1) | |
| Deluxe | 3.00 | 2 (2–4) | |
| Executive Twin | 3.48 | 3 (2–4) | |
| ICCU | 1.62 | 1 (1–2) | |
| ITU | 3.38 | 2 (1–6) | |
| MICU | 1.44 | 1 (1–1) | |
| Premium | 2.93 | 2.5 (1–4) | |
| SICU | 6.00 | 6 (6–6) | |
| Standard | 2.59 | 3 (1–3) | |

*LOS = length of stay; IQR = interquartile range (25th–75th percentile). Wilcoxon rank-sum test was used for binary-group comparisons (payment type, gender); Kruskal–Walli's test was used for comparisons across three or more groups (age group, bed category).*

LOS also varied significantly across bed categories (Kruskal-Walli's test, P < 0.001). SICU recorded the mean LOS of 6.00 days (median 6, IQR 6–6), Executive Twin had the LOS of 3.48 days (median 3, IQR 2–4) and ITU of 3.38 days (median 2, IQR 1–6). Day Care/Triage had the mean LOS of 1.39 days (median 1, IQR 1–1) (**Figure 2**).

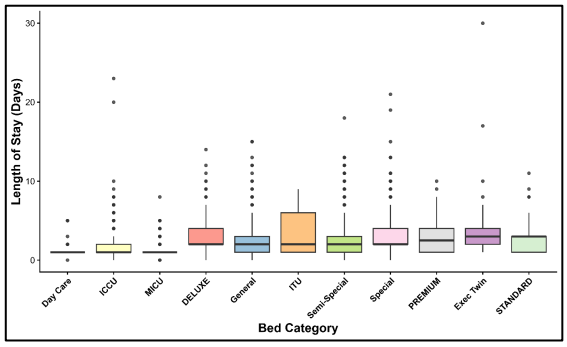



**Figure 2: Distribution of LOS by bed category**

*Distribution of length of stay (days) by bed category. Box plots show median (horizontal line), interquartile range (box), and 1.5× IQR whiskers; individual points beyond the whiskers represent outlier admissions. SICU is excluded owing to its minimal sample size (n = 1).*

**Comparison of cash and credit/insurance-based patients**

Gender, age group, and bed category distribution differed significantly between cash and credit/ Insurance patients (all P ≤ 0.020) (**Table 4**). Among cash patients, 60.5% were aged >60 years compared with 55.0% among credit/ Insurance patients, while the 41–60-year group was more represented among credit/ Insurance patients (39.0% vs. 31.7%; P < 0.001). ICCU utilization was 19.7% in cash patients versus 8.8% in credit/insurance patients; MICU analyze was 2.5% versus 8.5%, and A.C. Semi Special 14.3% versus 18.9% (P < 0.001). Males accounted for 65.2% of cash patients and 68.4% of credit/insurance patients (P = 0.020).

**Table 4:** Comparison of admission characteristics between cash and credit/insurance-based patients

| **Variable** | **Cash n (%)** | **Credit/ Insurance n (%)** | **p-value** |
|---|---|---|---|
| **Gender** | | | 0.020 |
| Female | 795 (34.8) | 738 (31.6) | |
| Male | 1486 (65.2) | 1598 (68.4) | |
| **Age Group** | | | <0.001 |
| >60 years | 1379 (60.5) | 1285 (55.0) | |

| | | | |
|---|---|---|---|
| 41–60 years | 724 (31.7) | 910 (39.0) | |
| 18–40 years | 167 (7.3) | 135 (5.8) | |
| Pediatric | 11 (0.5) | 6 (0.3) | |
| **Bed Category** | | | <0.001 |
| A.C. General Ward | 1011 (46.4) | 866 (37.0) | |
| A.C. Semi Special | 327 (14.3) | 442 (18.9) | |
| A.C. Special | 187 (8.9) | 264 (11.3) | |
| Day Care/Triage | 6 (0.2) | 43 (1.8) | |
| Deluxe | 95 (4.1) | 111 (4.7) | |
| Executive Twin | 32 (1.4) | 39 (1.6) | |
| ICCU | 450 (19.7) | 205 (8.7) | |
| ITU | 6 (0.2) | 7 (0.2) | |
| MICU | 58 (2.5) | 199 (8.5) | |
| Premium | 23 (1.0) | 21 (0.8) | |
| SICU | 1 (0.0) | 0 | |
| Standard | 85 (3.7) | 139 (5.8) | |

*n (%) = number and percentage within payment-type group. P-values derived from Pearson's Chi-square test for categorical comparisons between cash-paying and credit/insurance-based patients.*

**Factors associated with length of stay**

In multivariable linear regression, credit/ insurance payment (β = 0.657; 95% CI 0.549–0.765; P < 0.001), age (β = 0.018 per year; 95% CI 0.014–0.022; P < 0.001), Executive Twin (β = 0.973; 95% CI 0.542–1.404; P < 0.001), ITU (β = 0.988; 95% CI −0.002 to 1.977; P = 0.050), and SICU (β = 3.606; 95% CI 0.048–7.164; P = 0.047) were significantly associated with LOS. Day Care/Triage (β = −1.230; 95% CI −1.747 to −0.713; P < 0.001) and MICU (β = −1.079; 95% CI −1.318 to −0.840; P < 0.001) showed negative β coefficients. Male gender (β = 0.015; 95% CI −0.097 to 0.126; P = 0.796) was not statistically significant. (**Table 5**)

**Table 5:** Multivariable linear regression analysis of factors associated with length of stay

| Variable | β Coefficient | 95% CI | p-value |
|---|---|---|---|
| Age (years) | 0.018 | 0.014 to 0.022 | <0.001 |
| Male gender | 0.015 | −0.097 to 0.126 | 0.796 |
| Credit/ Insurance payment | 0.657 | 0.549 to 0.765 | <0.001 |
| A.C. Semi Special | 0.451 | 0.298 to 0.604 | <0.001 |
| A.C. Special | 0.491 | 0.303 to 0.679 | <0.001 |
| Day Care/Triage | −1.230 | −1.747 to −0.713 | <0.001 |
| Deluxe | 0.516 | 0.254 to 0.779 | <0.001 |
| Executive Twin | 0.973 | 0.542 to 1.404 | <0.001 |
| ICCU | −0.694 | −0.857 to −0.531 | <0.001 |
| ITU | 0.988 | −0.002 to 1.977 | 0.050 |

| | | | |
|---|---|---|---|
| MICU | −1.079 | −1.318 to −0.840 | <0.001 |
| Premium | 0.460 | −0.083 to 1.003 | 0.097 |
| SICU | 3.606 | 0.048 to 7.164 | 0.047 |
| Standard | 0.159 | −0.093 to 0.410 | 0.217 |

*β = unstandardized regression coefficient; CI = confidence interval. Reference categories: Female gender, Cash payment, A.C. General Ward. Model fit: $R^2 = 0.114$; Adjusted $R^2 = 0.111$; $F = 42.28$; $P < 0.001$.*

**Discussion**

This retrospective study characterized hospital admission patterns and determinants of length of stay (LOS) among cardiology and cardiac surgery inpatients at a tertiary care center in urban Gujarat between 2024 and 2026. Cash and credit/insurance-based payments were nearly equally distributed. Credit/Insurance admissions marginally exceeded cash payments. Most admissions involved patients over the age of 60. This observation supports Jan B, et al. findings, which state that increased age leads to decreased cardiovascular function and a higher likelihood of developing cardiovascular disease [7]. In gender analysis, male patients outnumbered the female patients. This finding is consistent with Hamatani Y et al., who found that males have the highest mortality due to IHD, with tobacco use identified as a marker for the disease burden [8].

**Admission patterns**

The temporal admission patterns revealed admission peaking in April followed by March and February (**Supplementary Figure 1)**. These results are consistent with the findings of Gallerani M, et al., which highlights that lower temperatures are linked to a decrease in blood pressure, whereas an increased temperature is associated with HF decompensation and increased hospitalization rates [9]. The highest frequency of admissions in the present study was observed on Mondays, whereas Sundays recorded the lowest admissions. Similar patterns were reported by Heslin S, et al. who found that hospital admissions peaked early in the week and steadily declined toward Friday, reflecting predictable weekly variations in healthcare utilization [10]. The majority of admissions were concentrated in AC general and semi-special ward categories, reflecting the typical utilization pattern of a tertiary care center that serves a broad socioeconomic spectrum. A smaller proportion occupied premium or deluxe categories.

**Length of Stay**

The overall LOS differed between cash and credit/ Insurance patients, with credit/ Insurance patients demonstrating a higher mean LOS than cash-paying patients. This finding is consistent with the observations of Gupta R, et al., who reported differences in healthcare utilization and treatment patterns between insured and uninsured cardiovascular patients, suggesting that insurance coverage can influence the delivery of inpatient care [11]. Additionally, administrative processes associated with insurance claims, including pre-authorization requirements, documentation reviews, and reimbursement procedures, may contribute to prolonged hospitalization. Similar findings have been reported internationally; Vavalle J, et al. identified insurance type as an independent predictor of LOS among NSTEMI patients, with Medicare and Medicaid beneficiaries exhibiting significantly greater odds of prolonged hospitalization than privately insured individuals [12]. Collectively, these findings suggest that payment and insurance structures may influence hospital utilization and discharge patterns independently of clinical complexity.

Older patients demonstrated longer lengths of stay (LOS) across the analysis, consistent with the findings of Corra U, et al., who reported that older adults require more prolonged hospitalization than younger patients [13]. This may be attributed to the higher burden of comorbidities, particularly cardiovascular conditions, among older individuals.

**Multivariable Regression Findings**

Gender and bed category remained independent of age and credit/ Insurance payment status after they were adjusted for. The observed age-related incremental effect of age is in accord with the known relationship between older age and higher utilization of health services. This is consistent with the results of Bender U, et al. who found that older age was one of the strongest independent predictors of LOS, regardless of the sex of the patient, and indicates that the effect of age on hospitalization duration is strong and independent of other clinical differences or burdens in the patients [14]. An independent contribution of credit/Insurance payment status indicates that payer type is a measure of clinical intensity that is not entirely accounted for by the available covariates. Gender was not independently associated with LOS in the adjusted model, similar to the results found by A Saad, et al., who found that sex was not an independent predictor of LOS after multivariable adjustment [15]. This suggests that the unadjusted sex difference in LOS is attributable to the sex variations in age distribution and allocation of the beds into categories, not to direct sex associations with the length of stay.

**Strengths and Limitations**

This study has several strengths. The large sample size from a tertiary care centre provides adequate statistical power and reflects real-world practice patterns in urban Gujarat. The simultaneous evaluation of multiple demographic, temporal, and operational admission characteristics enabled a comprehensive assessment of LOS determinants. Furthermore, the use of non-parametric statistical tests and multivariable regression was methodologically appropriate for analyzing LOS data and identifying independent predictors.

Several limitations should be acknowledged. The single-center retrospective design limits causal inference and generalizability to other healthcare settings. A major limitation is the absence of diagnosis-specific and comorbidity data, which are important determinants of LOS in cardiology and may explain the modest variance accounted for by the model. The very small number of SICU admissions also limits interpretation for this category. Finally, the findings may not be directly applicable to private hospitals, secondary care facilities, or centers in other regions of India.

**Conclusion**

This study provides a systematic characterization of cardiovascular inpatient admission patterns and determinants of LOS at a tertiary care centre in urban Gujarat. The predominance of older male patients, the near-equal distribution of cash and credit/ Insurance admissions, and the spring concentration of admissions collectively reflect the demographic and healthcare utilization profile of a high-volume tertiary cardiovascular unit. Age and credit/Insurance payment status were identified as the principal independent determinants of longer LOS, while gender did not emerge as an independent predictor after adjustment. These findings highlight the influence of demographic and healthcare financing factors on hospitalization patterns and resource utilization. Understanding these determinants may support more effective bed management, discharge planning, and resource allocation in tertiary cardiac care settings. Further multicentre studies incorporating diagnosis-specific and comorbidity data are warranted to better explain variations in LOS and enhance the generalizability of these findings.

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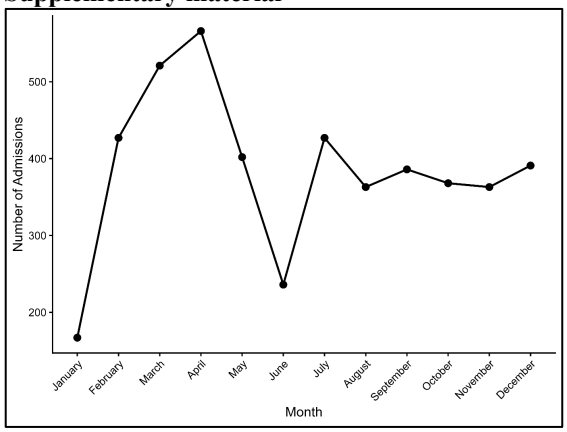
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**Supplementary material**




**Supplementary Figure 1: Monthly distribution of cardiovascular admissions during the study period.**

*The line graph shows the total number of hospital admissions by month. Admissions peaked in April, followed by March, while the lowest number of admissions was recorded in January. A decline was observed from May to June, followed by a rise in July, with relatively stable admission volumes from August through December.*