

Elevated Length of Stay and Cost of Orthopedic Hospitalization are Associated with Urban Setting, Non-Trauma Diagnosis, and Medicare Enrollment

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Purpose: Disparities in orthopedic care delivery across hospital settings and payer types may significantly correlate with length of stay (LOS), cost burden, and care efficiency. This study quantifies the associations between geographic location, case acuity, insurance status and resource utilization in Michigan.

Methods: We conducted a retrospective cohort study using 2018–2020 discharge records from the Healthcare Cost and Utilization Project (HCUP) State Inpatient Database (SID) for Michigan. Orthopedic-related hospitalizations were identified and stratified by hospital location (urban vs rural), injury mechanism (trauma vs non-trauma), and primary payer (Medicare, Medicaid, private, other, uninsured). Outcomes included LOS, per-discharge cost, aggregate hospital-level expenditures, and population-adjusted discharge rates. Statistical comparisons were performed using two-sample t-tests and ANOVA. Independent associations were evaluated via mixed-effects regression models with hospital-level random intercepts.

Results: Among 334,756 orthopedic discharges, urban facilities recorded longer average LOS (4.57 vs 4.09 days; $P < 0.001$) and higher mean aggregate costs per hospital (\$8.70M vs \$1.74M; $P < 0.001$) than rural counterparts. Non-traumatic cases were associated with greater per-stay costs (\$19,645 vs \$16,630; $P < 0.001$). Uninsured patients experienced the longest LOS (4.70 days), followed by Medicare (4.35 days), Medicaid (3.89 days), private (3.72 days), and other (3.06 days; all $P < 0.001$). Medicare accounted for the largest hospital-level expenditure (\$3.28M mean; $P < 0.001$). Mixed-effects models confirmed urban setting, non-trauma diagnosis, and Medicare enrollment as independent factors associated with elevated LOS and cost ($P < 0.001$).

Conclusion: Orthopedic care patterns demonstrate distinct variations linked to structural, clinical, and financial factors. These findings highlight disparities that may inform future discussions on reimbursement policies and rural capacity planning.

Plain Language Summary:

Why did we do this study?

A broken bone or worn-out joint should not mean a longer hospital stay or a bigger bill just because of where you live or your insurance. Yet, these differences are real and they affect patients every day. We needed solid data to reveal exactly what is happening, so policymakers can make smart, evidence-based changes to improve fairness and cut waste. We use Michigan statewide data as a case study.

What did we do?

We examined 334,756 real hospital records for orthopedic care in Michigan from 2018 to 2020. We sorted them by: Location: city (urban) vs rural hospitals, Injury type: sudden (trauma) or long-term (non-trauma, like arthritis) and Insurance: Medicare, Medicaid, private, other, or none.

We tracked stay length, cost per patient, total spending per hospital, and admission rates.

What did we find?

City hospitals kept patients longer (4.6 vs 4.1 days) and spent five times more per hospital (\$8.7 million vs \$1.7 million). Non trauma cases cost more per stay than traumatic ones. Uninsured patients stayed longest (4.7 days); Medicare drove the biggest overall bills. Rural areas admitted more people per resident, likely due to fewer local clinics.

What does this mean?

Your address and insurance card can shape your orthopedic care. City hospitals manage tougher cases; rural ones stretch limited resources. With this data in hand, leaders can now fix insurance rules and strengthen rural clinics making healing faster, cheaper, and fairer for all Michiganders.

Keywords: orthopedic, urban-rural, hospital costs, length of stay, trauma status, reimbursement, resource allocation

Introduction

Orthopedic care poses a significant burden on the United States healthcare system, with billions in annual expenditures for treatment and associated lost productivity due to morbidity.^{1,2} While advancements in surgical approaches and rehabilitation have enhanced patient outcomes, the complexity of musculoskeletal injuries continues to pose a significant challenge for hospitals in various settings.³ Urban hospitals typically benefit from specialized resources, yet they may also experience higher patient volumes and more complex presentations.⁴ Conversely, rural hospitals often operate with infrastructure constraints and limited specialist availability, which can influence the timely and efficient delivery of orthopedic care.⁵ As the population continues to age and the demand for orthopedic services expands, understanding how hospital location, trauma status, and insurance coverage affect patient outcomes and resource allocation is critical.⁶

Prior research have established the independent risks associated with rural delivery, trauma acuity, and underinsurance,^{7–9} yet these factors are often examined in isolation. This study differentiates itself by performing a simultaneous, integrated evaluation of hospital location, trauma status, and payer type across a statewide cohort. The primary objective is to quantify the independent and interactive associations of this “triad” with length of stay, cost, and discharge volume, providing a data-driven foundation for targeted resource planning.

Material and Methods

Data Source

Data was obtained from the Healthcare Cost and Utilization Project (HCUP), a nationwide initiative sponsored by the Agency for Healthcare Research and Quality (AHRQ).¹⁰ The HCUP database is the largest publicly available all-payer inpatient care database in the United States. The dataset contains no patient-identifiable information. It provides standardized data elements on hospital utilization, inpatient charges, patient demographics, and clinical outcomes. HCUP data has been widely cited in peer-reviewed journals and serves as a foundation for studies on hospitalization patterns, patient safety, and cost variations across different healthcare settings.^{2,4,11,12} This study was determined not to involve human subjects research by the Michigan State University Institutional Review Board (MSU IRB; Study ID: STUDY202600107). The analysis involved a retrospective secondary analysis of a publicly available, de-identified administrative dataset from the Healthcare Cost and Utilization Project (HCUP). The dataset contains no direct or indirect identifiers, and investigators did not interact with individuals, intervene in care, or access identifiable private information. Therefore, the study does not meet the definition of human subjects research under 45 CFR 46.102(e), and IRB approval was not required.

Classification of Orthopedic-Related Diagnoses

Discharge data from Michigan hospitals for the most recently available three-year period (2018–2020) was used to study orthopedic-related hospitalizations in Michigan. This allowed for a more precise examination of regional variations in orthopedic care utilization, costs, and LOS. Specific ICD-10 codes used to define traumatic and non-traumatic orthopedic conditions, as well as the detailed county classifications for urban and rural designations, are outlined in the [Supplementary Appendix](#).

Orthopedic-related conditions were defined as diagnoses primarily affecting the musculoskeletal system, including fractures, joint disorders, soft tissue injuries, and spinal conditions. Cases were further classified into two major categories: traumatic orthopedic conditions and non-traumatic orthopedic conditions to evaluate potential differences in clinical outcomes and healthcare utilization patterns. Traumatic orthopedic conditions were defined as musculoskeletal injuries resulting from an acute external force or event. Non-traumatic orthopedic conditions were defined as

musculoskeletal disorders and degenerative conditions that develop over time or result from internal pathology rather than acute trauma. Since HCUP provides county-level hospital data, each hospital's location was classified as rural or urban based on the State of Michigan's official rural–urban classification.¹³

Insurance Classification

Payer classifications were obtained from HCUP and categorized into five general groups. Medicare includes both fee-for-service and managed care Medicare enrollees. Medicaid includes both fee-for-service and managed care Medicaid patients. Private insurance encompasses commercial carriers, Blue Cross plans, and private HMOs and PPOs. Other insurance includes Worker's Compensation, TRICARE/CHAMPUS, CHAMPVA, Title V, and other government programs. Uninsured status includes patients classified as self-pay or no charge.²

Outcome Measures

The primary outcome measures recorded included LOS, per-stay hospital costs, aggregate hospital costs, and discharge rates per 100,000 population. LOS is defined as the number of nights a patient remains hospitalized. For example, same-day admission and discharge is considered a LOS of zero. Aggregate costs represent the total hospital costs for all discharges within a category. Discharge rates per 100,000 population reflect the number of hospital discharges for a given condition per 100,000 individuals, indicating hospitalization prevalence in the population.

Statistical Analysis

Descriptive statistics were calculated for each outcome within each subgroup. Two-sample t-tests and one-way Analysis of Variance (ANOVA) were used to compare LOS, costs, and discharge rates across urban and rural hospitals, traumatic and non-traumatic conditions, and payer types.

To evaluate independence and interaction effects, we conducted Three-Way ANOVA models using valid hospital identifiers consistently across all analytic runs to account for clustering. This approach was chosen to simultaneously isolate the main effects of hospital location (Urban vs Rural), trauma status (Traumatic vs Non-Traumatic), and insurance type (Medicare, Medicaid, Private, Other), as well as their two-way and three-way interactions. Assumptions of normality and homogeneity of variance were assessed; while minor deviations were expected given the large sample size, the robust nature of the F-test with >330,000 cases supports the validity of the inference. Given the substantial statistical power inherent in such a large dataset, interpretation focused on the magnitude of mean differences and confidence intervals to ensure clinical relevance, rather than relying solely on p-values which may detect trivial differences. Post-hoc comparisons were performed using Tukey-adjusted pairwise comparisons to identify specific group differences. All analyses were performed using Stata Statistical Software (College Station, Texas).

Results

Among the 334,756 total orthopedic discharges, non-traumatic cases accounted for 62.8% (210,211), while traumatic cases made up 37.2% (124,545). Similarly, non-traumatic conditions represented the majority of total aggregate hospital costs, amounting to \$3.64 billion (63.2%), compared to \$2.11 billion (36.8%) for traumatic cases. Summary of Discharges, LOS, Discharge Rate per 100,000 population, and Costs by Trauma status and rural/urban status are highlighted in Descriptive statistics for hospital utilization and costs stratified by trauma status, rural versus urban location, and insurance type are presented in [Tables 1 and 2](#).

Urban vs Rural Analysis

The average LOS was lower in rural hospitals (4.09 days) compared to urban hospitals (4.57 days), with a statistically significant difference between the two groups ($t(980.63) = -4.4$, mean difference = 0.48, 95% CI [-0.69, -0.26], $p < 0.001$). Additionally, the rate of discharges per 100,000 population was substantially higher in rural areas (101.71) than in urban areas (49.71), with a significant difference observed ($t(1217.11) = 7.93$, mean difference = -52, 95% CI [39.13, 64.87], $p < 0.001$).

Table 1 Summary of Discharges, LOS, Discharge Rate per 100,000 Population, and Costs by Trauma Status and Rural/Urban Status

Traumatic	Setting	Metric	Discharges	Length of Stay (LOS)	Discharge Rate per 100,000 Population	Aggregate Costs (\$)	Avg Costs per Stay (\$)
No	Rural	Mean	140.85	3.73	147.50	2,556,104.40	19,598.28
No	Rural	Median	22.50	3.30	19.00	471,927.50	16,935.00
No	Rural	SD	235.64	2.30	197.59	3,988,582.60	10,808.61
No	Urban	Mean	569.10	4.60	56.23	9,676,344.40	19,587.61
No	Urban	Median	60.00	4.10	10.20	1,142,568.00	15,927.00
No	Urban	SD	1711.94	2.46	113.47	27,501,053.60	12,078.82
Yes	Rural	Mean	63.35	4.38	65.26	1,082,630.20	16,659.92
Yes	Rural	Median	45.00	4.30	57.30	700,897.00	16,402.00
Yes	Rural	SD	59.19	1.01	44.40	1,074,889.60	4425.98
Yes	Urban	Mean	439.88	4.54	41.36	7,444,939.80	16,509.63
Yes	Urban	Median	203.50	4.60	33.85	3,195,431.50	16,397.00
Yes	Urban	SD	726.59	0.99	33.20	12,467,533.00	3982.42

Table 2 Summary of Discharges, LOS, Discharge Rates, and Costs by Insurance

Insurance	Area	Metric	Discharges	Length of Stay (LOS)	Aggregate Costs (\$)	Avg Costs per Stay (\$)
Medicaid	Rural	Mean	24.13	2.91	463,355.4	18,811.007
Medicaid	Rural	Median	19.50	2.60	373,311.5	17,719.500
Medicaid	Rural	SD	13.26	1.45	303,043.3	5,474.228
Medicaid	Urban	Mean	92.03	4.42	1,611,254.5	18,482.729
Medicaid	Urban	Median	35.00	4.25	634,943.5	16,776.000
Medicaid	Urban	SD	193.59	2.02	3,324,318.4	10,214.378
Medicare	Rural	Mean	77.30	4.10	1,341,463.2	16,916.606
Medicare	Rural	Median	35.00	4.10	559,472.5	15,984.000
Medicare	Rural	SD	111.53	1.55	1,901,797.9	6,522.714
Medicare	Urban	Mean	355.51	4.69	5,860,438.1	17,184.442
Medicare	Urban	Median	83.00	4.50	1,304,992.0	15,221.000
Medicare	Urban	SD	862.46	1.92	13,839,883.5	9,373.289
Private	Rural	Mean	55.44	3.33	1,007,981.6	19,352.372
Private	Rural	Median	25.50	3.20	523,141.5	18,686.500
Private	Rural	SD	77.05	1.55	1,250,557.8	6,098.182
Private	Urban	Mean	197.47	4.06	3,505,593.5	19,762.529

(Continued)

Table 2 (Continued).

Insurance	Area	Metric	Discharges	Length of Stay (LOS)	Aggregate Costs (\$)	Avg Costs per Stay (\$)
Private	Urban	Median	52.00	3.90	988,523.0	18,567.000
Private	Urban	SD	506.47	1.81	8,141,208.7	9,516.509
Other	Rural	Mean	18.67	2.44	357,568.2	19,393.972
Other	Rural	Median	18.00	2.65	334,081.0	18,065.000
Other	Rural	SD	7.21	0.86	150,891.1	5,440.081
Other	Urban	Mean	37.59	3.26	687,567.8	18,087.937
Other	Urban	Median	23.00	3.00	440,313.0	16,862.000
Other	Urban	SD	38.92	1.42	748,186.8	5,226.557
Uninsured	Rural	Mean	*	*	*	*
Uninsured	Rural	Median	*	*	*	*
Uninsured	Rural	SD	*	*	*	*
Uninsured	Urban	Mean	47.06	4.70	720,899.0	14,692.725
Uninsured	Urban	Median	26.00	4.00	360,694.0	15,356.000
Uninsured	Urban	SD	47.59	2.51	793,816.6	4,111.248

Notes: * Statistic is not reported because the reporting cell draws from fewer than 2 hospitals or contains fewer than 11 discharges.

Abbreviations: AHRQ, Agency for Healthcare Research and Quality; ANOVA, Analysis of Variance; HCUP, Healthcare Cost and Utilization Project; HRRP, Hospital Readmissions Reduction Program; ICD, International Classification of Diseases; LOS, Length of Stay; SD, Standard Deviation.

Cost analysis showed that aggregate hospital expenditures were considerably lower in rural hospitals (\$1,735,716) compared to urban hospitals (\$8,697,579), with a statistically significant difference ($t(507.26) = -6.95$, mean difference = \$6,961,864, 95% CI [-\$8,929,910, -\$4,993,817], $p < 0.001$). However, when examining average hospital costs per stay, there was no significant difference between rural (\$17,962.28) and urban hospitals (\$18,237.51) ($t(941.8) = -0.53$, mean difference = \$275.23, 95% CI [-\$1,298.23, \$747.78], $p = 0.598$).

Trauma vs Non-Trauma Analysis

The average LOS was significantly higher for traumatic cases (4.45 days) compared to non-trauma cases (4.16 days) ($t(834.96) = -2.76$, mean difference = 0.29 days, 95% CI [-0.49, -0.08], $p = 0.0059$). The rate of discharges per 100,000 population was significantly higher for non-traumatic cases (102.9) than for traumatic cases (56.36) ($t(704.8) = 6.74$, mean difference = -46.54, 95% CI [32.98, 60.1], $p < 0.001$).

The aggregate hospital costs were significantly higher in urban hospitals (\$8,697,579) compared to rural hospitals (\$1,735,716) ($t(507.26) = -6.95$, mean difference = \$6,961,864, 95% CI [-\$8,929,910, -\$4,993,817], $p < 0.001$). The average hospital costs per stay were significantly greater for non-trauma cases (\$19,644.69) than for traumatic cases (\$16,630.05) ($t(794.37) = 6.19$, mean difference = -\$3,014.65, 95% CI [\$2,058.60, \$3,970.70], $p < 0.001$).

Trauma Status and Settlement Interactions

Estimated marginal means showed longer length of stay in urban compared with rural hospitals for both non traumatic admissions (4.60 vs 3.73 days) and trauma admissions (4.54 vs 4.38 days) (Figure 1A). Aggregate hospital costs were substantially higher in urban settings for non-traumatic (\$9.68M vs \$2.56M) and trauma admissions (\$7.44M vs \$1.08M) (Figure 1B). Whereas average cost per stay was similar between rural and urban hospitals within trauma strata

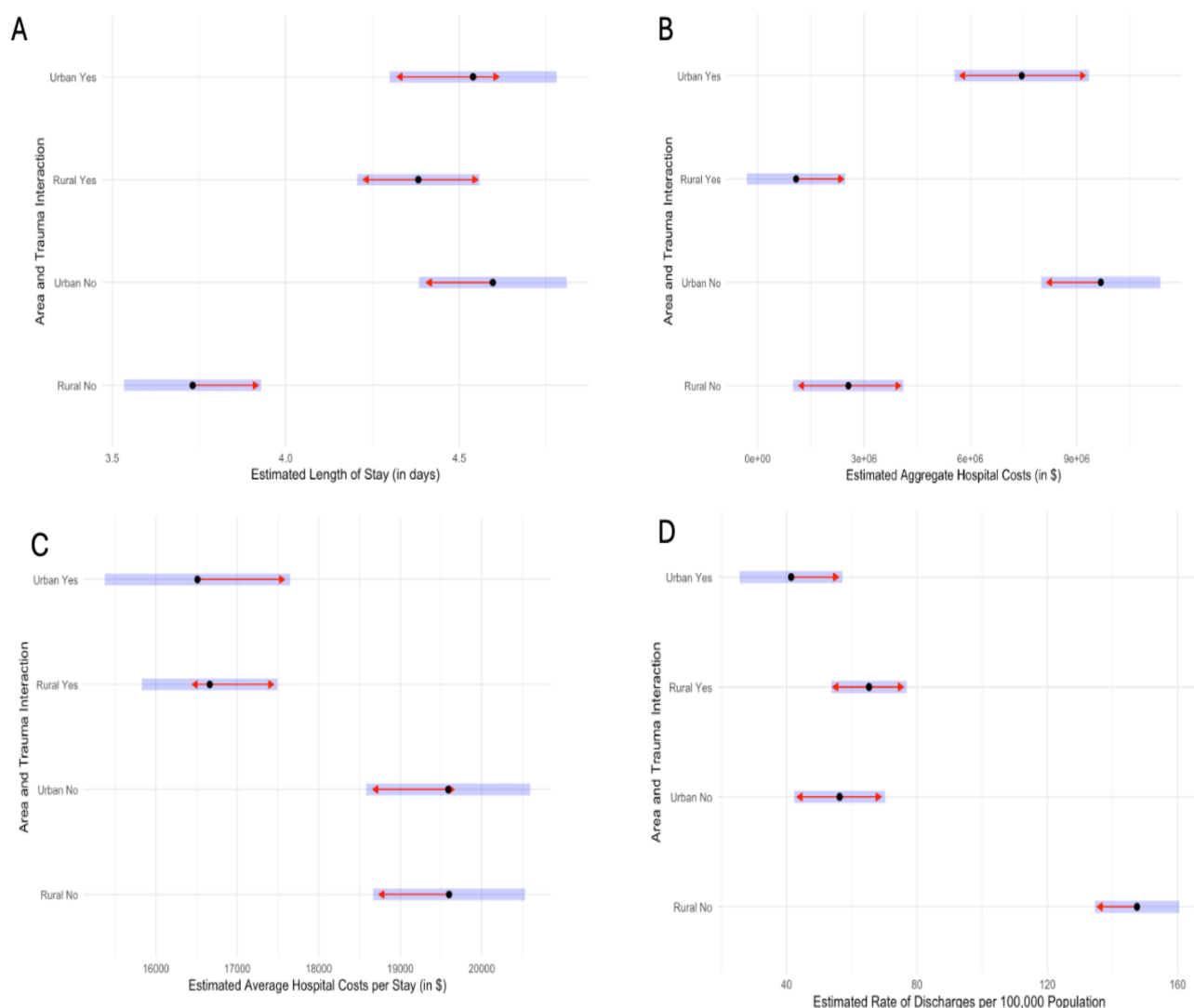


Figure 1 Estimated marginal means for LOS (days) (A), Aggregate Hospital Costs (\$) (B), Average Hospital Costs per Stay (\$) (C), and Rate of Discharges per 100,000 Population (D), stratified by hospital location (urban vs rural) and trauma status (Yes = Trauma, No = Non-Traumatic). Estimated marginal means represent statistically adjusted averages that isolate the interaction effects of location and trauma status after controlling for other variables.

(Figure 1C). Discharge rates per 100,000 population were higher in rural than urban areas in both non traumatic (147.50 vs 56.23) and trauma cohorts (65.26 vs 41.36) (Figure 1D).

Payer Analysis

Estimated marginal means varied substantially by insurance type (Figure 2). Length of stay was longest among uninsured (4.70 days) and Medicare patients (4.35 days), and shortest among patients categorized as “Other” insurance (3.06 days) and privately insured patients (3.72 days) (Figure 2A). The number of discharges was highest among Medicare beneficiaries (196.61), followed by privately insured patients (131.23), whereas uninsured and “Other” categories demonstrated wide confidence intervals reflecting lower procedural volume (Figure 2B). Aggregate hospital costs were greatest for Medicare (\$3.28M), followed by private insurance (\$2.34M) and Medicaid (\$1.21M), with substantially lower and less stable estimates in the uninsured and “Other” groups (Figure 2C). In contrast, average hospital cost per stay was highest among privately insured patients (\$19,571), followed by Medicaid (\$18,598), and lowest among uninsured patients (\$14,693) (Figure 2D).

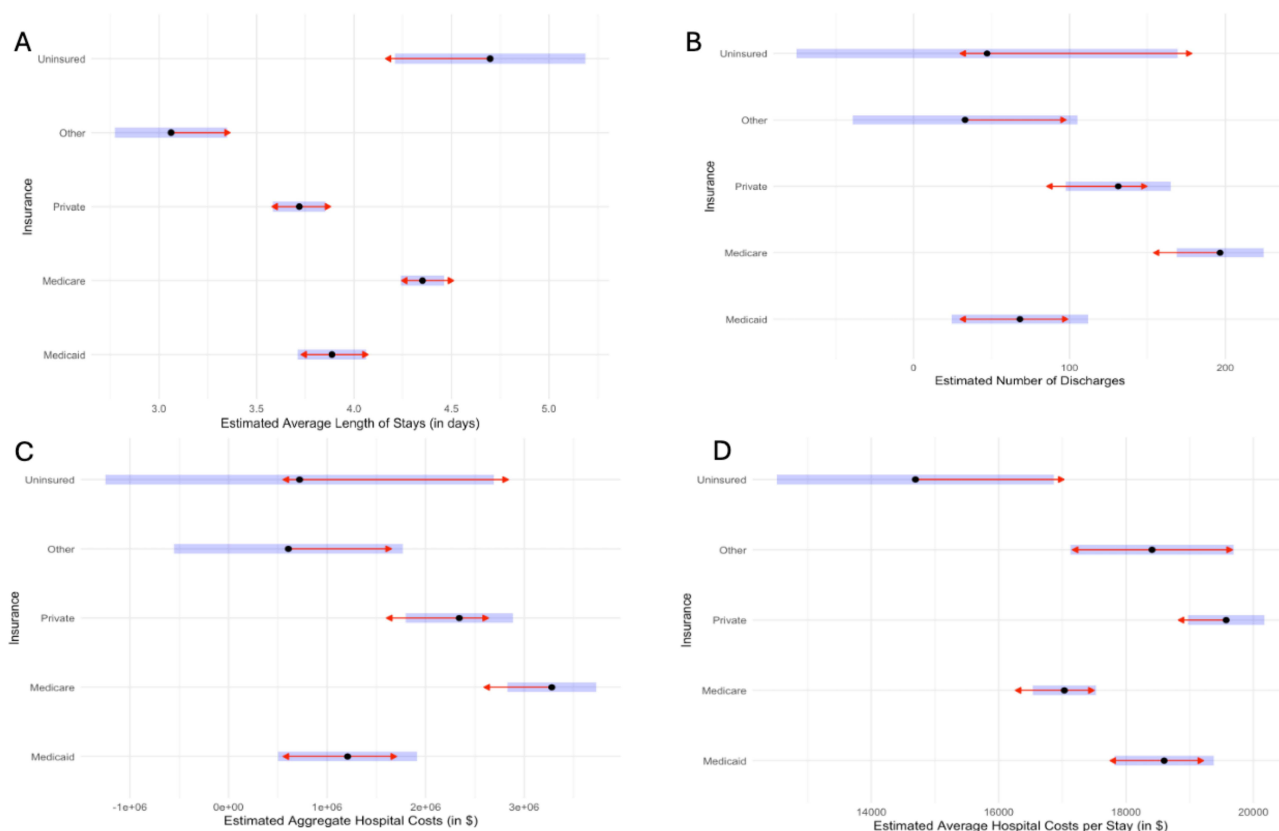


Figure 2 Estimated marginal means for Average LOS (days) (A), Number of Discharges (B), Aggregate Hospital Costs (\$) (C), and Average Hospital Costs per Stay (\$) (D), stratified by insurance type (Medicaid, Medicare, Private, Other; and Uninsured). These plots display statistically adjusted averages that illustrate the distinct patterns associated with each payer group after accounting for clinical and geographic factors.

Three-Way Interactions

A three-way ANOVA test was used to analyze the relationships between Patient Characteristic, Trauma, and Area on key variables. This included LOS, Number of Discharges, and Hospital Costs (average and aggregate) focusing on detecting significant main effects, two-way interactions, and three-way interactions, supported by post-hoc Tukey-adjusted pairwise comparisons. In the rural setting the number of uninsured was not reported by HCUP because it drew from fewer than 2 hospitals or contains fewer than 11 discharges. Therefore, we dropped uninsured category before the analyses. Figures 3 and 4 present three-way stratified estimated marginal means illustrating interactions among hospital location, trauma status, and insurance type for utilization and cost outcomes.

To facilitate conceptual integration of the findings, Figure 5 presents a thematic synthesis of the three primary independent drivers of difference identified in the study.

Discussion

National Benchmarking Context

Our findings from Michigan function as a representative case study when contextualized against national benchmarks. Data from the HCUP Nationwide Inpatient Sample (NIS) indicate that the average length of stay (LOS) for orthopedic hospitalizations in the United States is approximately 3.9 days.¹⁰ This closely parallels the mean LOS observed in Michigan (≈ 4.3 days), particularly given our inclusion of complex traumatic cases that are more likely to require prolonged inpatient care.¹⁴ Nationally, Medicare accounts for the largest share of orthopedic-related expenditures.¹⁰ This pattern mirrored in our analysis, where Medicare was associated with the highest aggregate hospital-level costs (\$3.28 million per hospital on average). In contrast to national reports suggesting higher per-patient costs in rural settings,⁸ we observed no significant difference in per-stay costs between rural and urban hospitals in Michigan. This finding suggests that rural hospitals may maintain cost efficiency by selectively transferring

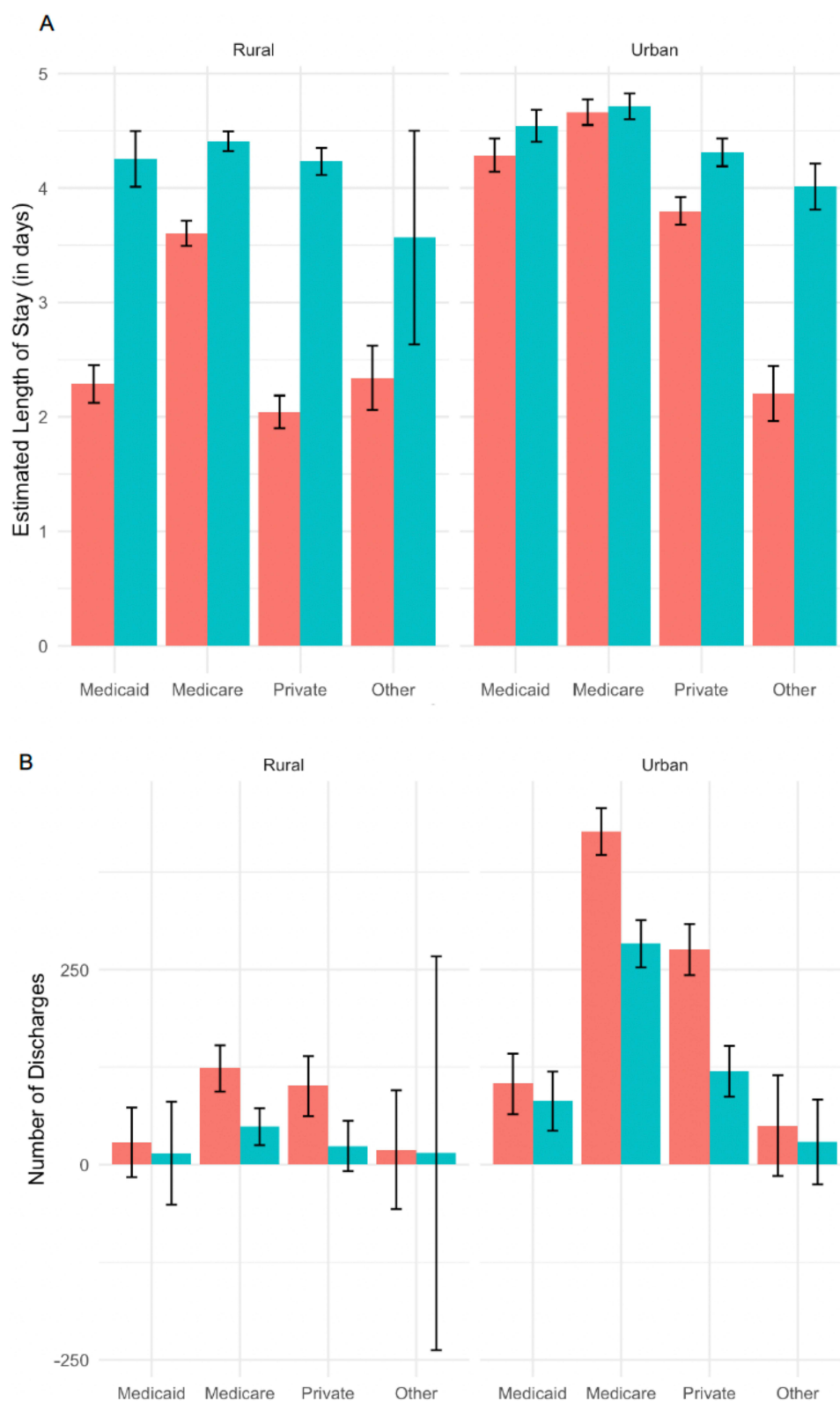


Figure 3 Estimated marginal means for LOS (days) (**A**) and Number of Discharges (**B**), stratified by hospital location (urban vs rural), trauma status (Yes = Trauma, No = non-traumatic), and insurance type (Medicaid, Medicare, Private, Other). Error bars represent confidence intervals. Trauma status legend. Non-traumatic cases are shown in salmon and traumatic cases are shown in teal.

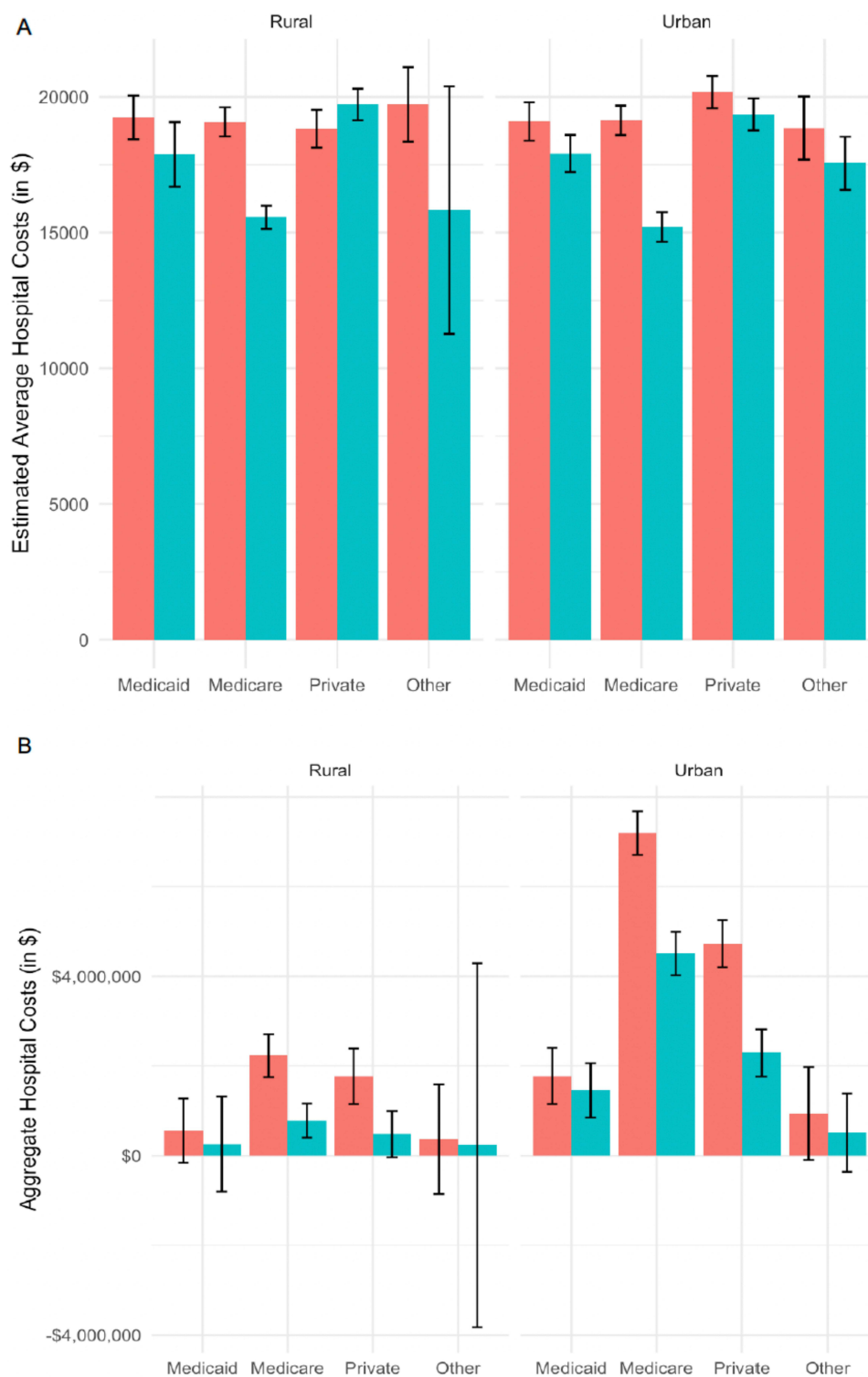


Figure 4 Estimated marginal means for Average Hospital Costs per Stay (\$) (A) and Aggregate Hospital Costs (\$) (B), stratified by hospital location (urban vs rural), trauma status (Yes = Trauma, No = Non-Traumatic), and insurance type (Medicaid, Medicare, Private, Other). Error bars represent confidence intervals. Trauma status legend. Non-traumatic cases are shown in salmon and traumatic cases are shown in teal.

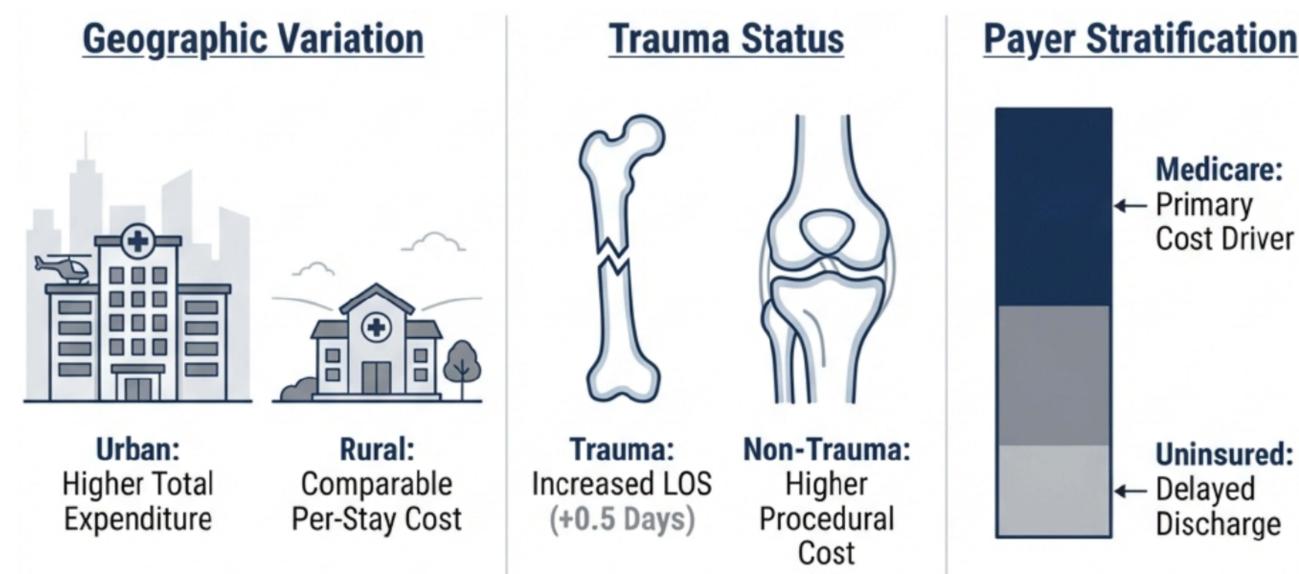


Figure 5 Thematic Summary. This visual abstract synthesizes the three primary independent drivers of difference identified in the study.

higher-acuity cases to urban referral centers, consistent with the structure of tiered trauma systems and regionalized orthopedic care delivery.⁷

Urban vs Rural Analysis

This study provides a detailed epidemiological analysis of orthopedic trauma and non-trauma conditions in urban and rural areas within Michigan. Urban hospitals see greater volumes of orthopedic discharges and incur higher aggregate costs, yet per-visit costs are similar to rural hospitals. We hypothesize that urban hospitals are able to achieve comparable efficiency for orthopedic patients despite the higher patient volumes and total costs. The relative similarity in cost per stay may reflect the ability of urban centers to benefit from economies of scale, access to specialized resources, and greater experience in treating complex orthopedic conditions.

Shorter LOS in rural hospitals vs urban hospitals could plausibly be attributed to limited inpatient capacity, fewer specialized services, or the need to transfer complex cases. This is further supported by discharge rate per 100,000 population data which indicates, higher discharge rates in rural facilities. This may suggest that rural hospitals have limited care provision, while urban hospitals manage higher-acuity cases requiring prolonged care. Additionally, occupational hazards, delayed presentations, and fewer orthopedic specialists in rural areas may contribute to this trend.

Payer Status

Privately insured patients have shorter stays and higher-cost care, while publicly insured and uninsured patients have longer stays but lower-cost per stay. We also found differences related to insurance payer status. Insurance type has been identified as an important determinant of surgical access and outcomes.¹⁵ Patients covered by Medicaid (and other government-sponsored or no insurance) often experience worse postoperative results than those with private insurance.¹⁶ In our study, uninsured patients experienced longer hospital stays than patients with Medicaid, private insurance, or other coverage types, yet, comparable LOS to Medicare.

Medicare patients have higher discharge rates per 100,000 population compared to Medicaid, private, and other insurance groups, raising the possibility that hospitals may prioritize timely discharge for this population, potentially due to bundled payment models.

It is also worth noting that the prolonged LOS among Medicaid and Medicare patients may be influenced by reimbursement policies like the Hospital Readmissions Reduction Program (HRRP), which penalizes excessive 30-day readmissions for select conditions.¹⁷ This policy may encourage hospitals to adopt conservative discharge practices for

high-risk patients, particularly those with Medicaid and Medicare insurance. The lack of significant differences between Medicaid and private insurance discharge rates and LOS suggests that these patients may receive similar inpatient management, despite structural differences in reimbursement policies. Medicare patients have the highest aggregate hospital costs, likely due to longer hospital stays, greater surgical needs, and post-operative complications requiring extended inpatient care. Their prolonged hospitalizations may reflect barriers to timely discharge, such as difficulty securing rehabilitation placements or skilled nursing care.¹⁸ Private insurance patients have higher per-stay costs than Medicare and uninsured groups, which may be due to greater use of advanced surgical techniques, premium implants, and higher reimbursement rates negotiated by hospitals. This trend suggests that treatment intensity and cost of care can vary depending on insurance type, rather than just clinical necessity.

Despite longer hospital stays, uninsured patients have the lowest total hospital costs, possibly due to lower rates of high-cost procedures and financial limitations affecting care decisions. Their extended stays could indicate delayed treatment leading to more severe conditions at admission, as well as discharge barriers due to a lack of follow-up care options.

Limitations

This study has several limitations that should be considered when interpreting the findings. First, the analysis is based on hospital discharges rather than individual patients, therefore patients with multiple hospitalizations during the study period were counted separately. This approach restricts the ability to evaluate longitudinal patient outcomes, readmission patterns, and continuity of care. Secondly, the study utilizes administrative data from HCUP, which, while comprehensive, inherently lacks granular clinical severity scores (eg, ISS) or detailed functional comorbidity indices, limiting the ability to risk-adjust for physiological acuity beyond the primary diagnosis. Crucially, unmeasured social determinants of health (SDOH), such as housing stability, transportation access, and social support, likely influence LOS and discharge patterns but are not captured in this dataset. Consequently, variations in LOS and costs may be influenced by these unmeasured differences in case complexity or hospital-specific protocols.

Third, the classification of urban and rural hospitals was based on county-level designations, which may not fully capture variations within hospitals located in mixed or suburban regions.

Conclusion

Orthopedic care delivery varies significantly by hospital location, trauma status, and insurance coverage. These factors are strongly associated with observed differences in hospital costs, LOS, and discharge patterns. Observed variations may reflect underlying differences in resource availability, access to specialty care, and post-acute care options. These findings suggest that addressing disparities may involve targeted efforts to improve access to specialized care in rural hospitals, optimize discharge processes, and expand rehabilitation services. Policymakers might consider how reimbursement structures align with actual hospital burdens to support equitable access to orthopedic treatment across all patient populations. Future research should focus on patient-level outcomes, long-term recovery and the impact of reimbursement policies on care access and quality. A broader geographic analysis could provide insights into regional variations. Additionally, studies incorporating clinical severity and functional recovery metrics would help clarify the drivers of resource utilization and cost differences.

Data Sharing Statement

The data analyzed in this study are available from the Healthcare Cost and Utilization Project (HCUP) database, sponsored by the Agency for Healthcare Research and Quality (AHRQ). Access to HCUP data requires a data use agreement and is subject to AHRQ policies.

Ethics Approval and Consent to Participate

This study utilized de-identified administrative data from the Healthcare Cost and Utilization Project (HCUP) State Inpatient Database, which contains no direct patient identifiers. The study was submitted to the Michigan State University Institutional Review Board and was determined to be exempt as a secondary analysis of de-identified data.

under US federal regulations governing human subjects research (45 CFR 46). As such, informed consent was not required.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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