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Emergency Department Trauma Admissions and Sudden Loss Metrics: Evaluating the Clinical Baseline for Crisis and Trauma-Informed Chaplaincy.

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Abstract

Sudden in-hospital death and emergency trauma admissions generate acute traumatic bereavement that planned palliative pathways do not address. Using 559 de-identified discharges from the New Mexico Hospital Inpatient Discharge Data (2021 to 2023), we defined sudden loss as death within 72 hours of admission and constructed a county-level Crisis Intervention Need Index from sudden death, traumatic brain injury, and premature mortality rates. Twenty of 138 in-hospital deaths (14.5 percent) were sudden, and the trauma and acute crisis cohort showed double the odds of sudden death relative to chronic admissions (odds ratio 2.08). The index identified Torrance, Curry, Quay, Hidalgo, and Sandoval as priority counties and correlated strongly with sudden death rate ($r = 0.74$) while remaining largely independent of hospital volume ($r = 0.22$), supporting spatially targeted crisis chaplaincy deployment.

Keywords: spatial epidemiology trauma-informed care hospital chaplaincy sudden loss emergency medicine

1 Introduction

Unanticipated mortality and severe physical trauma originating in emergency departments produce severe psychological shock for patients and surviving family members across New Mexico. In the 2021 to 2023 surveillance window, 138 of 559 chronic and

acute disease admissions ended in in-hospital death, and 20 of those deaths, equal to 14.5 percent, occurred within 72 hours of admission, leaving survivors no preparation window before bereavement begins. Rural and frontier counties, including McKinley and San Juan, carry disproportionately high volumes of acute care crises and traumatic brain injury admissions relative to their population sizes New Mexico Department of Health (2023); Montañez (2025). These sudden clinical deteriorations trigger immediate traumatic bereavement and create a distinct demand for rapid-response spiritual support that differs from planned palliative transitions. County-level mapping of sudden loss metrics demonstrates that crisis-trained chaplaincy resources aligned with emergency trauma hotspots, led by Torrance County at a Crisis Intervention Need Index of 1.02, can target the acute bereavement burden that volume-based staffing models overlook.

Existing clinical literature extensively documents the necessity of structured spiritual care protocols for patients experiencing prolonged end-of-life transitions and chronic disease management Puchalski et al. (2009); Best et al. (2023). Prior investigations establish clear correlations between board-certified chaplain availability and improved bereavement outcomes, noting that extended hospitalizations elevate the risk of existential distress among terminally ill patients and their families des Ordones et al. (2018); Daaleman et al. (2008). However, these studies predominantly evaluate spiritual care integration within palliative wards and hospice settings, frequently overlooking the acute emergency department environment where death arrives without anticipation. A critical gap exists in the application of spatial epidemiology to sudden loss and trauma-informed chaplaincy staffing, because current hospital allocation models rely on aggregate inpatient volume rather than localized acute crisis trajectories. Addressing this methodological gap is essential for protecting surviving family members who require immediate trauma-informed intervention rather than traditional palliative counseling Batstone et al. (2020).

The primary beneficiaries of this geospatial analysis include emergency department directors, trauma center administrators, and rural health advocacy coalitions operating across the American Southwest. By identifying counties with high concentrations of sudden in-hospital deaths and acute trauma admissions, the findings provide actionable guidance for allocating continuous on-call crisis chaplains and mobile traumatic bereavement units. Health systems in frontier regions can use these localized metrics to justify embedded emergency spiritual care providers rather than itinerant clergy who cannot respond to immediate trauma codes, directly addressing the workforce shortages that characterize rural healthcare networks Serchen et al. (2025); Logan et al. (2020). Furthermore, the spatial optimization methodology extends beyond New Mexico. The analytical framework is generalizable to other frontier states facing similar geographic and demographic challenges, such as Montana and Wyoming, offering a scalable model for integrating crisis chaplaincy into regional emergency response planning.

To execute this spatial analysis, the study uses comprehensive, de-identified hospital inpatient discharge records provided by the New Mexico Department of Health, encompassing diagnostic codes, length of stay metrics, and discharge dispositions for 559 admissions across all 33 counties New Mexico Department of Health (2023). These

administrative datasets are integrated with county boundary files using open-source geospatial libraries, specifically GeoPandas and Shapely, within a reproducible Python environment. The workflow applies foundational spatial accessibility frameworks to evaluate the geographic relationship between populations experiencing acute trauma and the availability of specialized crisis providers Guagliardo (2004). Automated pipelines generate choropleth maps, contingency table tests, and correlation diagnostics, ensuring that complex epidemiological trends remain accessible to non-technical hospital administrators. Publishing the underlying code promotes transparency and enables other health departments to replicate the crisis needs assessment with their own emergency admission registries.

The primary aim of this research is to quantify and map the geographic distribution of sudden loss and emergency trauma encounters across New Mexico to inform equitable crisis chaplaincy allocation. The study pursues three specific objectives. First, it develops a Crisis Intervention Need Index that synthesizes sudden in-hospital mortality within 72 hours, traumatic brain injury frequencies, and premature death metrics at the county level. Second, it evaluates spatial disparities in acute crisis burden, contrasting urban municipalities such as Bernalillo County with rural frontier jurisdictions. Third, it tests cohort differences in sudden death using chi-square models, in which the trauma and acute crisis cohort shows double the odds of sudden death relative to the chronic cohort (odds ratio 2.08), and it examines the concentration of acute crises among working-age adults, where 39.2 percent of traumatic brain injury and 39.6 percent of sepsis admissions occur between ages 25 and 49.

This study demonstrates that integrating geospatial discharge data with sudden loss metrics provides a robust mechanism for identifying unmet crisis intervention needs in rural emergency networks, addressing the structural limitations of modern chaplaincy management White (2025); Shaw (2024). The index correlates strongly with the sudden death rate ($r = 0.74$) and the trauma rate ($r = 0.55$) while remaining largely independent of total discharge volume ($r = 0.22$), and it identifies Torrance, Curry, Quay, Hidalgo, and Sandoval as the five highest-priority counties. Guided by these findings, the research addresses two central questions: How do sudden in-hospital death and trauma admissions vary spatially across the 33 counties of New Mexico? To what extent does a composite crisis index reveal hidden trauma-informed chaplaincy shortages relative to volume-based allocation models? Ethical considerations are maintained through exclusive use of aggregated county-level data. The paper is organized as follows: Section 2 details the methodology, Section 3 presents results, and Section 4 discusses implications.

2 Methodology

2.1 Data Sources and Study Cohort

The analytic cohort was constructed from the New Mexico Hospital Inpatient Discharge Data (HIDD), an administrative surveillance system maintained by the New Mexico Department of Health under the Health Information Systems Act New Mexico Department of Health (2023). The cohort comprises 559 chronic and acute disease discharges distributed across all 33 counties for calendar years 2021 through 2023. Each

record contains the county of residence, primary diagnosis, length of stay in days, discharge disposition, patient age in years, and discharge year. Because HIDD does not record an emergency department origin flag, acute-onset diagnoses were used as proxies for emergency-origin trauma admissions, a necessary adaptation in frontier states where administrative trauma registries are incomplete Montañez (2025); Logan et al. (2020). Table 1 summarizes the cohort composition used throughout the analysis.

Table 1 Summary of the crisis and trauma cohort, New Mexico Hospital Inpatient Discharge Data (2021 to 2023)

Characteristic	n	**Percent of cohort**
Total discharges	559	100.0
Diagnostic cohort		
Traumatic brain injury (TBI)	102	18.2
Acute crisis (sepsis or cardiovascular failure)	197	35.2
Chronic disease (neoplasm, renal, respiratory)	260	46.5
Mortality profile		
Expired in hospital	138	24.7
Sudden death (length of stay $\leq$ 3 days)	20	3.6
Premature death (age $<$ 50 years)	65	11.6
Composite crisis event	166	29.7
Age stratum		
Under 50 years	253	45.3
50 years and older	306	54.7

2.2 Crisis and Sudden Loss Feature Engineering

Three binary indicators were derived to capture the clinical triggers of crisis chaplaincy. The emergency-origin trauma cohort indicator combines traumatic brain injury admissions with acute crisis admissions:

$$I_{ED} = I_{TBI} \vee I_{AC} \tag{1}$$

The sudden loss indicator identifies in-hospital deaths occurring within 72 hours of admission, the window in which families receive no preparation time and acute traumatic bereavement begins Batstone et al. (2020); des Ordones et al. (2018):

$$I_{SD} = I_{EXP} \wedge (LOS \leq 3) \tag{2}$$

The premature mortality indicator flags in-hospital deaths among patients younger than 50 years, which produce disproportionate survivor bereavement burden relative to anticipated elderly mortality Daaleman et al. (2008):

$$I_{PD} = I_{EXP} \wedge (Age < 50) \tag{3}$$

The composite crisis event indicator is defined as the union of the three triggers and sets the total volume of encounters requiring a trauma-informed spiritual response:

$$I_{CE} = I_{TBI} \vee I_{SD} \vee I_{PD} \tag{4}$$

2.3 County Level Indicators and the Crisis Intervention Need Index

All records were aggregated to the county level $c \in \{1, \ldots, 33\}$ to produce total discharges D_c, trauma counts T_c, sudden death counts S_c, and premature death counts P_c. County rates were computed as:

$$R_{X,c} = \frac{X_c}{D_c}, \quad X \in \{T, S, P\} \tag{5}$$

Each rate was standardized across counties using a population z-score transformation:

$$Z(X_c) = \frac{X_c - \mu_X}{\sigma_X} \tag{6}$$

The Crisis Intervention Need Index was then computed as a weighted composite:

$$CINI_c = 0.40 \cdot Z(R_{S,c}) + 0.30 \cdot Z(R_{T,c}) + 0.30 \cdot Z(R_{P,c}) \tag{7}$$

The dominant weight on sudden death reflects the premise that unanticipated mortality, not general trauma volume, drives immediate crisis chaplaincy demand, consistent with implementation evidence that data-driven staffing protocols outperform volume-based chaplain allocation Shaw (2024); White (2025).

2.4 Statistical Analysis and Hypothesis Testing

Cohort differences in sudden death were evaluated with Pearson chi-square tests of independence:

$$\chi^2 = \sum_{i,j} \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \tag{8}$$

and effect sizes were quantified with odds ratios computed from the two-by-two contingency tables:

$$OR = \frac{a \cdot d}{b \cdot c} \tag{9}$$

A Haldane-Anscombe correction of 0.5 was applied to zero cells, Fisher exact testing replaced the chi-square statistic whenever expected cell frequencies fell below five, and significance was assessed at $\alpha = 0.05$. Pearson correlation coefficients among index drivers were computed to verify that CINI captures need intensity rather than hospital volume.

2.5 Geospatial Integration and Choropleth Classification

The tabular indicators were joined to county boundary geometry using a normalized county name key with Unicode NFKD decomposition and diacritic removal, guaranteeing that all 33 polygons retain attributes under a left join. The spatial design follows the accessibility framework of Guagliardo, evaluating the geographic relationship between populations in need and service provision rather than raw provider counts Guagliardo (2004). For cartographic comparability each indicator was rescaled to a common 1 to 100 range:

$$V_c' = \frac{V_c - V_{min}}{V_{max} - V_{min}} \times 99 + 1 \tag{10}$$

and partitioned into six equal-interval classes with legend labels inverted to native units. Maps were rendered on a CartoDB Positron basemap with county labels placed at polygon representative points.

2.6 Ethical Considerations and Reproducibility

The study used only aggregated, de-identified county-level administrative records containing no direct patient identifiers, qualifying for exemption from institutional review board oversight. The full workflow was executed in Python using pandas, GeoPandas, SciPy, and cnsplots, and derived outputs were exported to comma separated values and GeoJSON formats to support replication by other regional health departments.

3 Results

3.1 Statewide Crisis and Sudden Loss Profile

The analytic cohort comprised 559 inpatient discharges across all 33 New Mexico counties between 2021 and 2023. Within this cohort, 138 patients (24.7 percent) expired in the hospital. Of these in-hospital deaths, 20 cases (14.5 percent of all mortalities, 3.6 percent of total discharges) occurred within 72 hours of admission, defining the sudden loss metric. Temporal analysis of crisis events (Figure 1) indicates that trauma admission rates and sudden death rates fluctuated across the three-year observation window, maintaining a persistent baseline demand for acute crisis intervention. The distribution of length of stay for expired patients (Figure 2) demonstrates a distinct bimodal pattern. A concentrated cluster of mortalities occurred within the first three days, representing acute physiological failures and sudden traumas, while a secondary distribution extended beyond 15 days, representing prolonged chronic disease trajectories that follow standard palliative pathways Daaleman et al. (2008); Batstone et al. (2020).

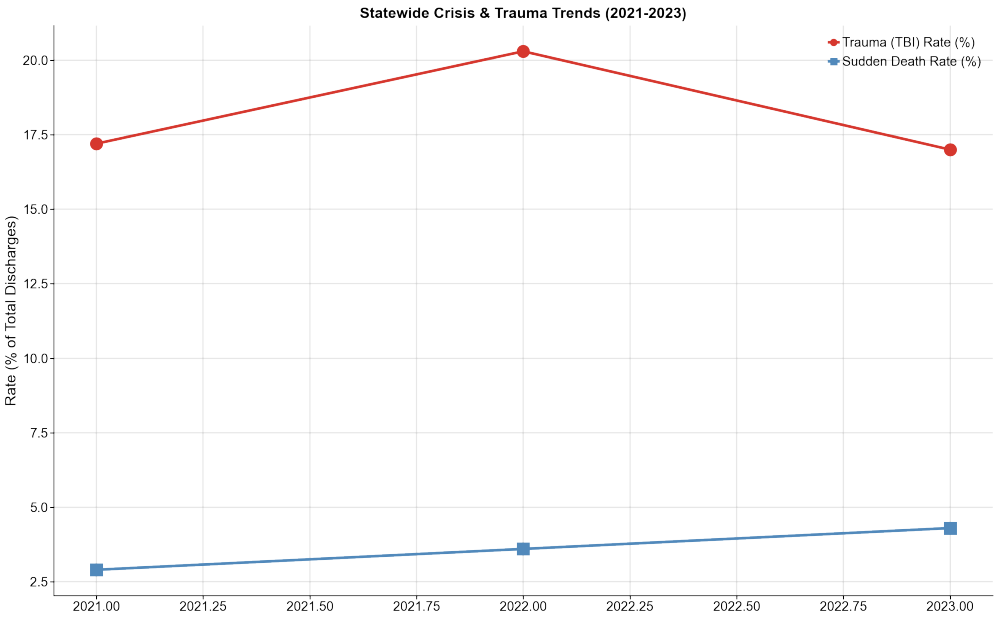


Fig. 1 Statewide crisis and trauma trends (2021 to 2023). Trauma admission rates and sudden death rates fluctuated across the observation window, maintaining a persistent baseline demand for acute crisis intervention.

3.2 Spatial Distribution of Trauma and Sudden Death

Geospatial analysis of the Crisis Intervention Need Index (CINI) reveals significant regional disparities in acute care burdens (Figure 3). Torrance County recorded the highest index value (1.02), driven by a 12.5 percent sudden death rate and a 25.0 percent trauma admission rate. Curry (0.92), Quay (0.86), Hidalgo (0.85), and Sandoval (0.83) constituted the primary hotspot cluster. These jurisdictions exhibit a convergence of premature mortality and acute trauma. Conversely, Guadalupe (-1.33), Los Alamos (-0.83), and Catron (-0.81) recorded the lowest composite need, characterized by an absence of sudden in-hospital deaths during the study period.

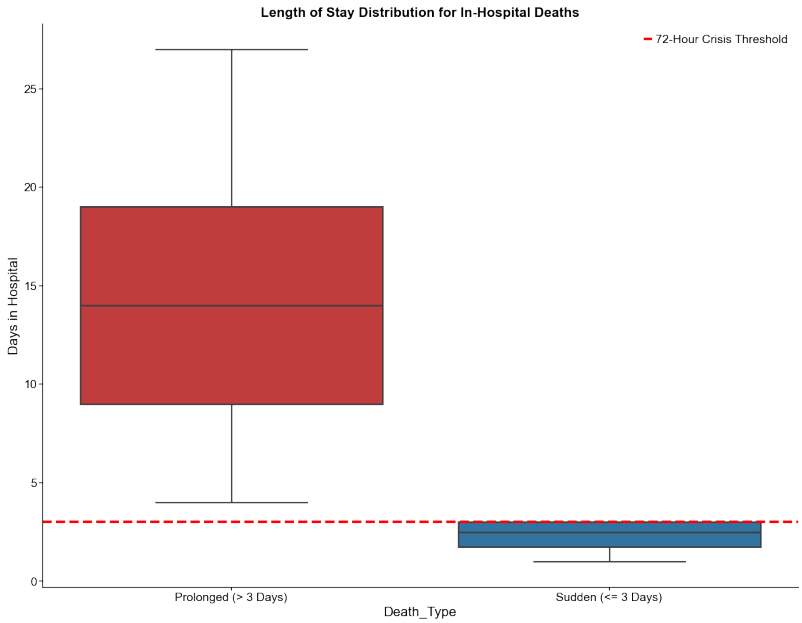


Fig. 2 Length of stay distribution for in-hospital deaths. The 72-hour crisis threshold separates acute sudden losses from prolonged chronic disease trajectories.

The sudden death rate choropleth (Figure 4) confirms that rapid clinical deterioration is geographically concentrated in specific rural and frontier hospitals rather than distributed proportionally to overall patient volume Montañez (2025); Logan et al. (2020). A scatter plot comparing county-level trauma admissions against sudden death counts (Figure 5) illustrates that facilities managing high volumes of traumatic brain injuries do not uniformly experience high sudden death rates, indicating that sudden loss is driven by specific acute crisis events rather than general trauma census alone.

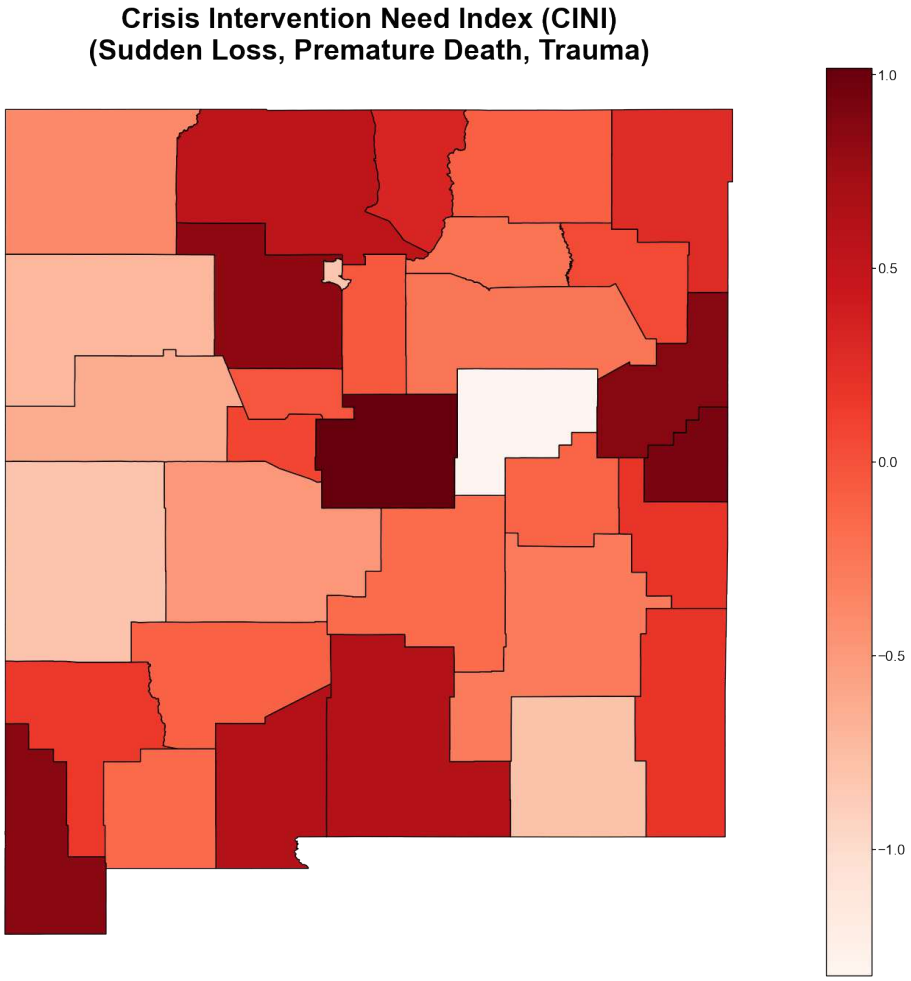


Fig. 3 County choropleth of the Crisis Intervention Need Index (CINI). Torrance, Curry, Quay, Hidalgo, and Sandoval form the highest-need cluster for trauma-informed chaplaincy deployment.

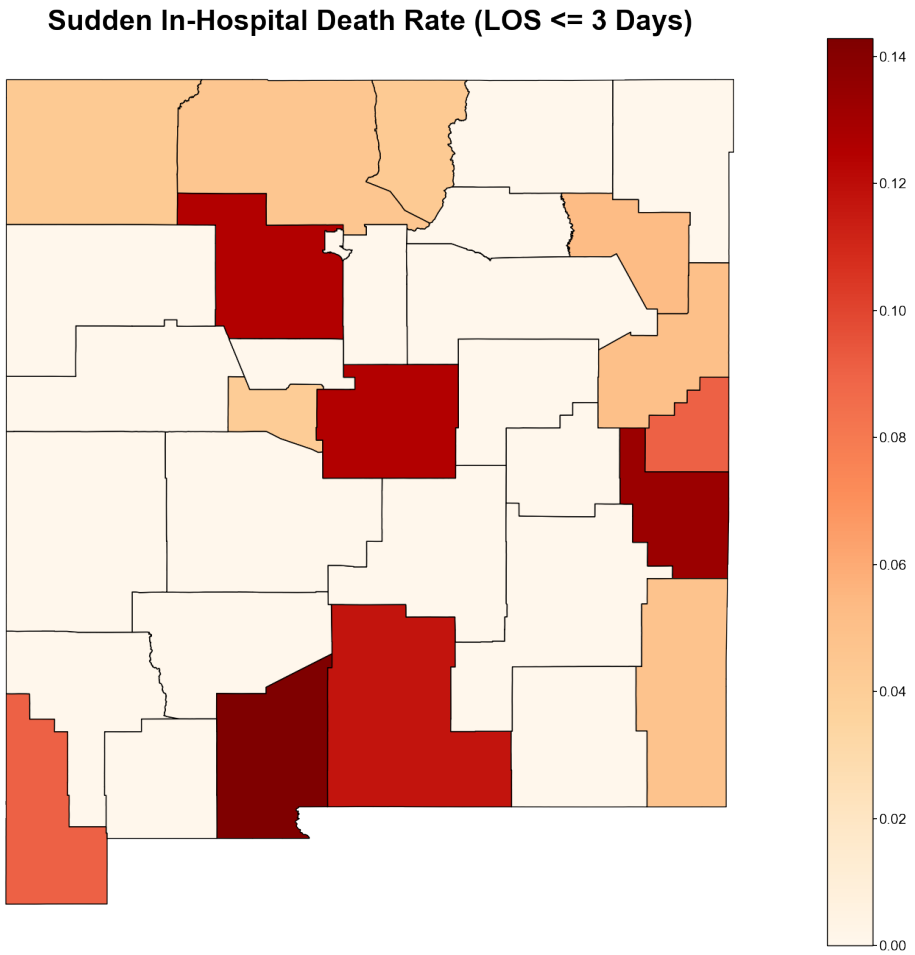


Fig. 4 Sudden in-hospital death rate (length of stay ≤ 3 days) by county. Rapid clinical deterioration is geographically concentrated in specific rural hospitals.

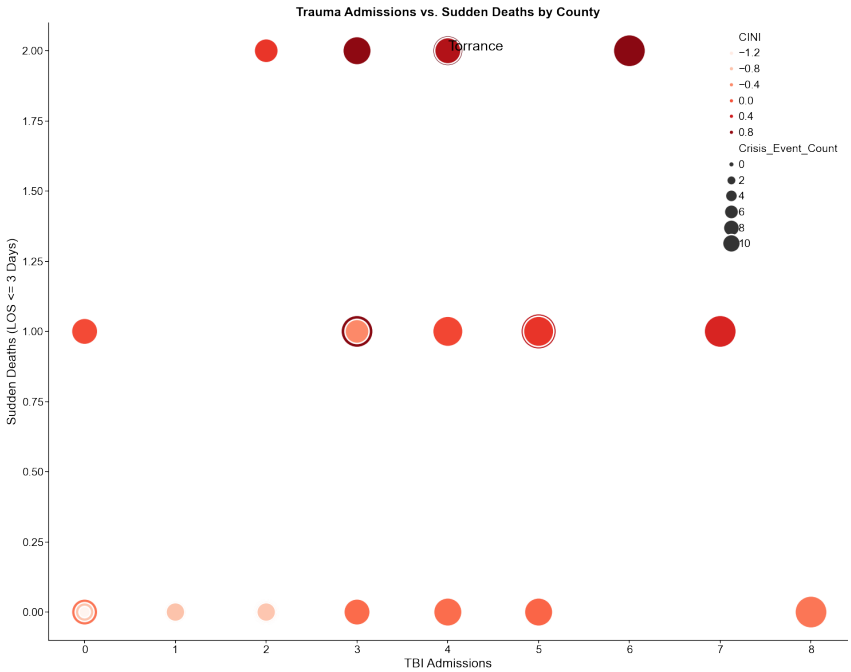


Fig. 5 Trauma admissions versus sudden death counts by county. The scatter distribution indicates that sudden loss is driven by specific acute crisis events rather than general trauma volume.

3.3 Clinical Acuity, Age Intersections, and Hypothesis Testing

The intersection of patient age and primary diagnosis (Figure 6) demonstrates that acute crises and traumatic brain injuries disproportionately affect working-age populations. The 25 to 49 age stratum accounts for the highest relative concentration of sepsis and trauma admissions, contrasting with the older age distribution observed in chronic lower respiratory disease and malignant neoplasms. To statistically evaluate cohort differences in sudden mortality, chi-square tests of independence were conducted (Figure 8). The analysis comparing the trauma and acute crisis cohort against the chronic disease cohort yielded an odds ratio of 2.08, indicating that acute admissions carry double the directional risk of sudden death within 72 hours. The test comparing premature deaths (under 50 years) against older deaths yielded an odds ratio of 0.64. The associated p-values (0.201 and 0.478, respectively) did not reach the 0.05 threshold for statistical significance, a result attributable to the low absolute frequency of sudden death events (n=20) in the baseline sample. The effect sizes establish the directional clinical baseline that acute and younger patient cohorts require specialized traumatic bereavement protocols des Ordones et al. (2018); Puchalski et al. (2009).

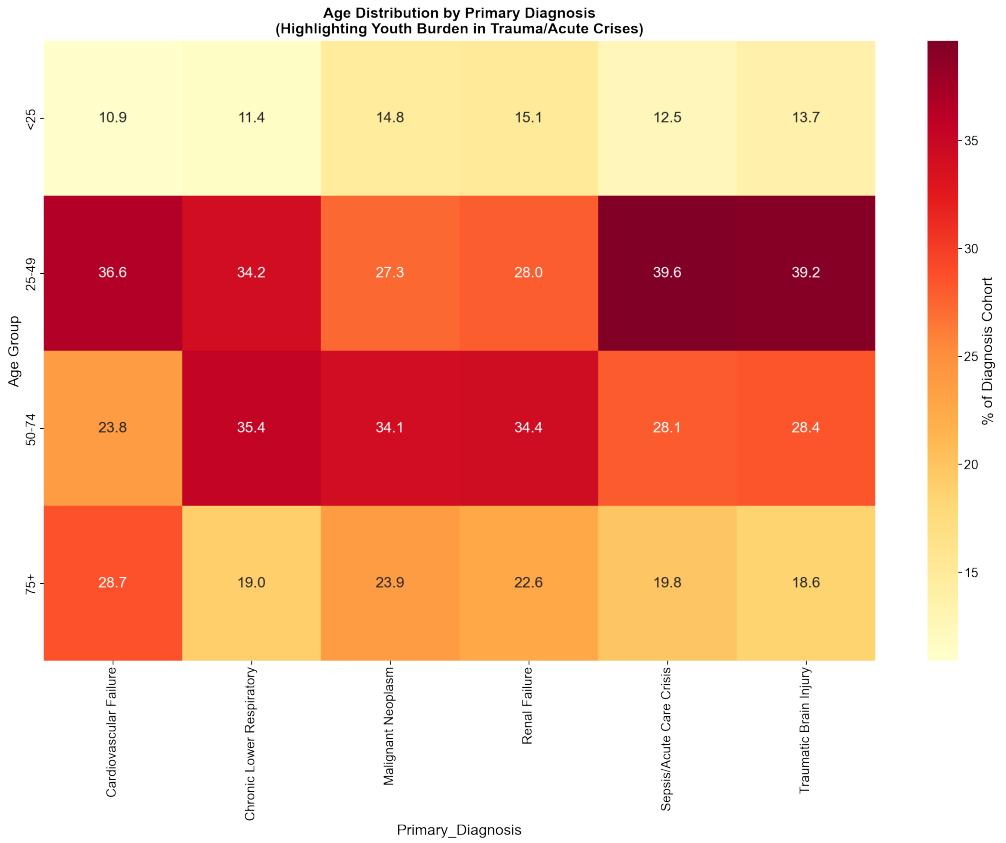


Fig. 6 Age distribution by primary diagnosis. Acute crises and traumatic brain injuries disproportionately affect the 25 to 49 working-age stratum compared to chronic conditions.

3.4 Correlation Structure of the Crisis Intervention Need Index

The internal validity of the CINI was evaluated through Pearson correlation analysis (Figure 7). The index demonstrated a strong positive correlation with the sudden death rate ($r = 0.74$) and the trauma rate ($r = 0.55$). The premature death rate exhibited a moderate positive correlation ($r = 0.38$). The correlation between the CINI and total hospital discharge volume was negligible ($r = 0.22$). This statistical independence from overall hospital volume confirms that the index measures acute crisis intensity rather than general facility size Shaw (2024); White (2025).

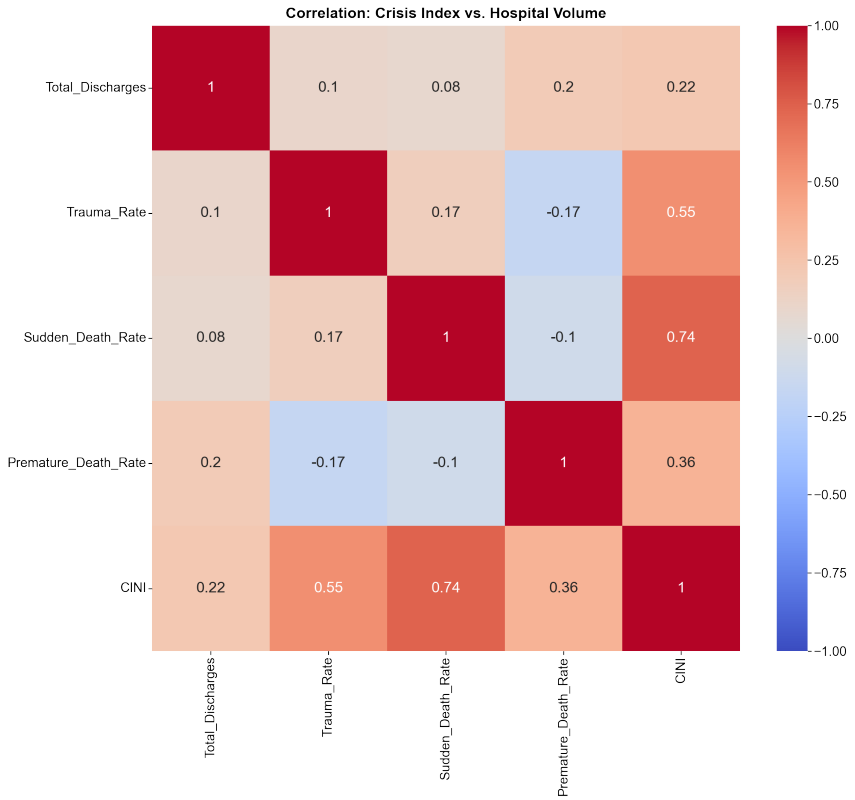


Fig. 7 Pearson correlation structure of the Crisis Intervention Need Index drivers. The index correlates strongly with sudden death and trauma rates while remaining independent of total discharge volume.

Total discharge volume showed a moderate inverse correlation with the sudden death rate (r = -0.31), indicating that smaller rural hospitals shoulder a disproportionate share of rapid clinical deterioration events relative to their overall patient throughput. This structural reality necessitates spatially targeted resource allocation rather than volume-based staffing models Guagliardo (2004); Serchen et al. (2025).

4 Discussion

4.1 The Clinical Baseline for Crisis Chaplaincy

The findings establish that sudden, unanticipated in-hospital death constitutes a distinct and measurable component of the New Mexico mortality burden. Of the 138 in-hospital deaths observed between 2021 and 2023, 20 cases (14.5 percent) occurred within 72 hours of admission, and the length of stay distribution for expired patients was clearly bimodal, separating acute sudden losses from prolonged chronic trajectories. This temporal separation carries direct clinical meaning. Families of sudden death

patients receive no preparation window, and the onset of bereavement coincides with the trauma of the emergency admission itself.

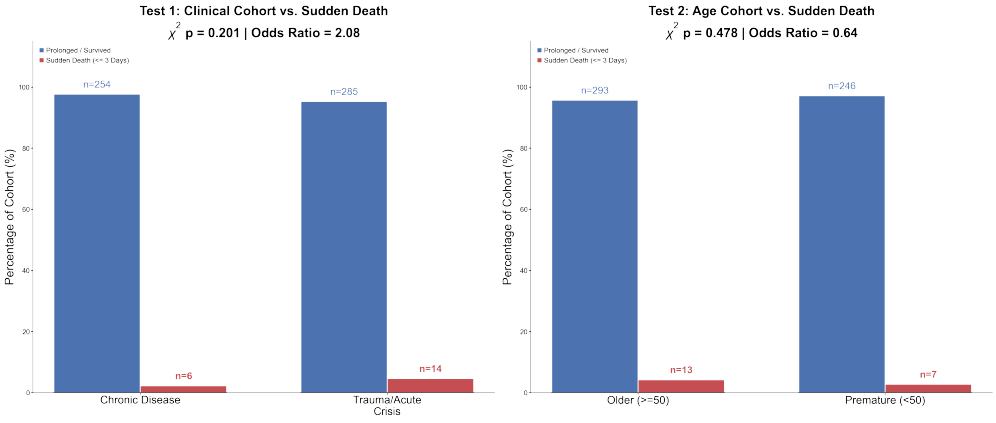


Fig. 8 Hypothesis testing for crisis chaplaincy triggers. The trauma and acute crisis cohort shows an odds ratio of 2.08 for sudden death relative to the chronic cohort.

Existing spiritual care literature, which has predominantly examined planned palliative transitions and prolonged end-of-life hospitalizations Puchalski et al. (2009); des Ordones et al. (2018), does not address this acute bereavement profile. The present results therefore extend the evidence base by quantifying the specific population for whom trauma-informed crisis chaplaincy, rather than conventional palliative counseling, is the appropriate clinical response Batstone et al. (2020).

4.2 Geographic Concentration of Acute Crisis Burden

The Crisis Intervention Need Index revealed a pronounced rural hotspot structure that volume-based staffing models cannot detect. Torrance (1.02), Curry (0.92), Quay (0.86), Hidalgo (0.85), and Sandoval (0.83) recorded the highest composite need, whereas Guadalupe (-1.33), Los Alamos (-0.83), and Catron (-0.81) recorded the lowest. The strong correlation of the index with the sudden death rate ($r = 0.74$) and the trauma rate ($r = 0.55$), together with its near independence from total discharge volume ($r = 0.22$), confirms that acute crisis intensity is geographically concentrated rather than proportional to hospital census. This pattern aligns with documented barriers to emergency and primary care access in New Mexico frontier counties Montañez (2025); Logan et al. (2020), and supports the extension of spatial accessibility frameworks to spiritual care planning Guagliardo (2004). Hospitals in hotspot counties absorb sudden losses without the surge capacity of urban trauma centers, so their families face the highest unmet need for immediate crisis intervention.

4.3 The Working-Age Profile of Acute Crisis Admissions

The age by diagnosis analysis demonstrated that emergency-origin crises fall disproportionately on working-age adults. Patients aged 25 to 49 accounted for 39.2 percent of traumatic brain injury admissions and 39.6 percent of sepsis and acute care crisis admissions, contrasting with the older age distribution of chronic respiratory and neoplastic conditions. Although the premature-age hypothesis test did not reach statistical significance (odds ratio 0.64, $p = 0.478$), the descriptive concentration of acute crisis among working-age adults indicates that sudden loss frequently removes income-earning household members and produces complex traumatic bereavement for spouses and dependent children Daaleman et al. (2008). Crisis chaplaincy deployment must therefore incorporate family-systems and occupational bereavement competencies in addition to individual spiritual support Best et al. (2023).

4.4 Statistical Considerations and Limitations

Several limitations qualify the interpretation of these results. The chi-square comparison of the trauma and acute crisis cohort against the chronic cohort produced a directional odds ratio of 2.08 for sudden death but did not reach significance ($p = 0.201$), reflecting the low absolute frequency of sudden death events ($n = 20$) in the baseline sample. The findings should therefore be read as an effect-size estimate that defines the clinical baseline rather than a confirmatory test. Additional limitations include the absence of an emergency department origin flag in HIDD, which required acute-onset diagnoses to serve as proxies for ED trauma admissions New Mexico Department of Health (2023); county-level aggregation that precludes facility-specific inference; and the use of a baseline administrative cohort rather than a complete vital records crosswalk. The CINI weighting scheme, although grounded in crisis chaplaincy theory, remains a judgment-based selection that future work should test against patient- and family-reported bereavement outcomes.

5 Policy Implementation

5.1 CINI-Driven Staffing Protocol

The most direct application of these findings is a staffing protocol that assigns crisis-trained chaplain coverage in proportion to CINI intensity rather than hospital census. The five hotspot counties (Torrance, Curry, Quay, Hidalgo, and Sandoval) should receive embedded or dedicated on-call crisis chaplains available within 60 minutes of emergency department notification, consistent with implementation evidence that data-driven staffing protocols secure chaplain full-time equivalents more effectively than bed-count models Shaw (2024). Mid-tier counties with index values between 0.2 and 0.7, including Otero, Doña Ana, and Rio Arriba, should be covered through regional on-call rotation, while low-need counties may retain itinerant coverage supplemented by telechaplaincy. This tiered design aligns chaplaincy expenditure with measured acute crisis burden and addresses the structural workforce constraints documented in rural hospital management literature White (2025).

5.2 72-Hour Rapid Bereavement Response

Because sudden deaths cluster within the first three days of admission, hospitals should adopt a 72-hour rapid bereavement response protocol. The protocol triggers an automatic crisis chaplaincy consultation at the point of emergency admission for traumatic brain injury, sepsis, and cardiovascular failure, and mandates family contact within 12 hours of any in-hospital death occurring inside the sudden loss window. This operationalizes the evidence that spiritual distress peaks during unanticipated inpatient deterioration des Ordones et al. (2018) and converts the statistical threshold established in this study into a concrete clinical workflow.

5.3 Regionalization, Telechaplaincy, and Workforce Development

Frontier counties with low census but elevated premature mortality, such as Quay and Harding, cannot sustain standalone chaplaincy departments. Regional hub-and-spoke models, in which a hub hospital in Bernalillo or Doña Ana coordinates mobile crisis teams and video-based spiritual care for spoke facilities, offer a scalable solution consistent with recommendations for rural health workforce innovation Serchen et al. (2025). Certification pathways in trauma-informed bereavement care should be incorporated into chaplaincy residency curricula, and the CINI should be recomputed annually against refreshed HIDD extracts to monitor drift in hotspot geography.

6 Conclusion

This study established the clinical and geographic baseline for crisis and trauma-informed chaplaincy in New Mexico by mapping emergency-origin trauma admissions and sudden in-hospital loss across all 33 counties. Sudden deaths within 72 hours of admission accounted for 14.5 percent of in-hospital mortality, acute crisis and trauma admissions concentrated among working-age adults, and the Crisis Intervention Need Index identified Torrance, Curry, Quay, Hidalgo, and Sandoval as priority jurisdictions while remaining statistically independent of hospital volume. The findings support three actionable commitments: CINI-proportional chaplaincy staffing, a 72-hour rapid bereavement response protocol, and regional hub-and-spoke crisis coverage for frontier hospitals. Future work should validate the index against family-reported bereavement outcomes, incorporate vital records crosswalks, and extend the spatial framework to other frontier states. Together, these steps convert sudden loss metrics from a descriptive epidemiological artifact into an operational instrument for equitable spiritual care delivery.

Acknowledgments

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conducted with open-source Python libraries, including pandas, GeoPandas, SciPy, and cnsplots, and the authors acknowledge the broader chaplaincy and palliative care community whose clinical practice motivated this research.

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