Exploring an Imputation Strategy for TQIP ICU Days from Hospital Data

Lisa Over, MLIS[1], Kuo-Ting Huang, PhD[1], Bryan A. Cotton, MD MPH[2], Andrew Dennis, DO[3], Francis Guyette, MD[4], Brian Harbrecht, MD[5], Bellal A. Joseph, MD[6], Ernest Eugene Moore, MD[7], Daniel G. Ostermayer, MD[2], Silvia Owusu-Ansah, MD MPH[4], Mayur B. Patel, MD MPH[8], Martin Schreiber, MD[9], Samual R. Todd, MD[10], Chad T. Wilson, MD[11], Stephen R. Wisniewski, PhD[1], Jason Lee Sperry, MD MPH[4]

[1]University of Pittsburgh, [2]University of Houston School of Medicine, [3]Cook County Health, [4]University of Pittsburgh School of Medicine, [5]University of Louisville School of Medicine, [6]University of Arizona Tucson College of Medicine, [7]University of Colorado Denver Health, [8]Vanderbilt University Medical Center, [9]Oregon Health & Science University, [10]Grady Memorial Hospital, [11]Baylor College of Medicine

Introduction

Linking Investigations in Trauma and Emergency Services (LITES) is a network of medical providers working in collaboration to assess treatment and outcomes for trauma patients.

LITES Task Order One (TO-001) is a LITES study that aims to determine if the variation in injury characteristics and treatment practices is significant across LITES network institutions and regions. Three sources of data are collected from each LITES network site:

- Trauma Quality Improvement Program (TQIP) datasets
- In-hospital electronic health records (EHR)
- Electronic health records from pre-hospital transport services

The data are used to assess variation in injuries, management practices, and outcomes and to classify each death as preventable or not.

Study Objective

The TQIP dataset has 77,538 records. Table 1 outlines the discrepancy and agreement between TQIP and in-hospital data.

There is a discrepancy between TQIP and in-hospital data about whether 504 patients were in the ICU.

For 404 patients, the TQIP values are 0 and not valid according to the NTDS Data Dictionary.[1]

Table 1: TQIP values by In-hospital ICU status.

In-hospital ICU status	TQIP reports ICU days = null	TQIP reports ICU days = 0
Patients in ICU	100	404
Patients not in ICU	518	0

In-hospital records agree with TQIP that 518 patients were not in the ICU.

The objective is to estimate ICU length of stay (LOS) from in-hospital location records and estimate Lin's Concordant Correlation Coefficient (CCC) to assess agreement with TQIP reported ICU days.

Current Approach

Current practice is to impute missing ICU days with TQIP ventilation days.

- ICU and ventilator days are highly correlated with r=0.87.

- Figure 1 shows that the observations are not aligned with the line of equality and that ventilation days underestimates the ICU length of stay.

Method

Evaluate

1. **Evaluate the 504 records where in-hospital location records and TQIP disagree.** Table 2 shows that, together, TQIP ventilation days and in-hospital location data indicate that these patients were in the ICU.
2. **Evaluate the 518 records where in-hospital locations records and TQIP agree.** Table 2 shows that, together, TQIP ventilation days and in-hospital location data indicate that these patients were not in the ICU.

Estimate

3. **Estimate ICU LOS using a record-by-record count of days from in-hospital ICU location records.** An algorithm iterates over each record, subtracts the begin date from the end date, and sums over these counts for each set of patient records.

Verify

4. **Verify the algorithm by comparing two methods for calculating hospital LOS.** A record-by-record count of days compared to the difference between the earliest and latest dates from all in-hospital location records resulted in a 98.4% match. The 1.6% incorrectly estimated hospital days are underestimates caused by gaps in dates.

Compare

5. **Evaluate agreement between the estimated ICU LOS and TQIP ICU LOS using Lin's Concordant Correlation Coefficient (CCC).** From a selection of 11,149 records where ICU LOS and ventilation days are greater than zero, a random sample of 1,115 was drawn to evaluate agreement using the CCC.

Table 2: Summary of TQIP ventilation days by agreement with in-hospital ICU records.

ICU status	Total Records	Average ventilation days (SD)	25th, 50th, 75th, 85th of ventilation days
TQIP ICU days are 0 or null, but in-hospital ICU records exist	504	7.14 (9.18)	1, 4, 8, 14
TQIP ICU days are null, and in-hospital ICU records do not exist	518	1.21 (0.98)	1, 1, 1, 1

Table 3: Summary of ICU LOS for 1,022 problematic TQIP records with 504 in the ICU according to in-hospital records.

	Average ICU days (SD)	25th, 50th, 75th of ICU days
New Method	12.17 (10.88)	5, 9, 16
Current Approach	7.14 (9.18)	1, 4, 8

Table 4: Summary of ICU LOS for TQIP ICU days, record-by-record count of in-hospital location data, and TQIP ventilator days with sample data (n=1,115).

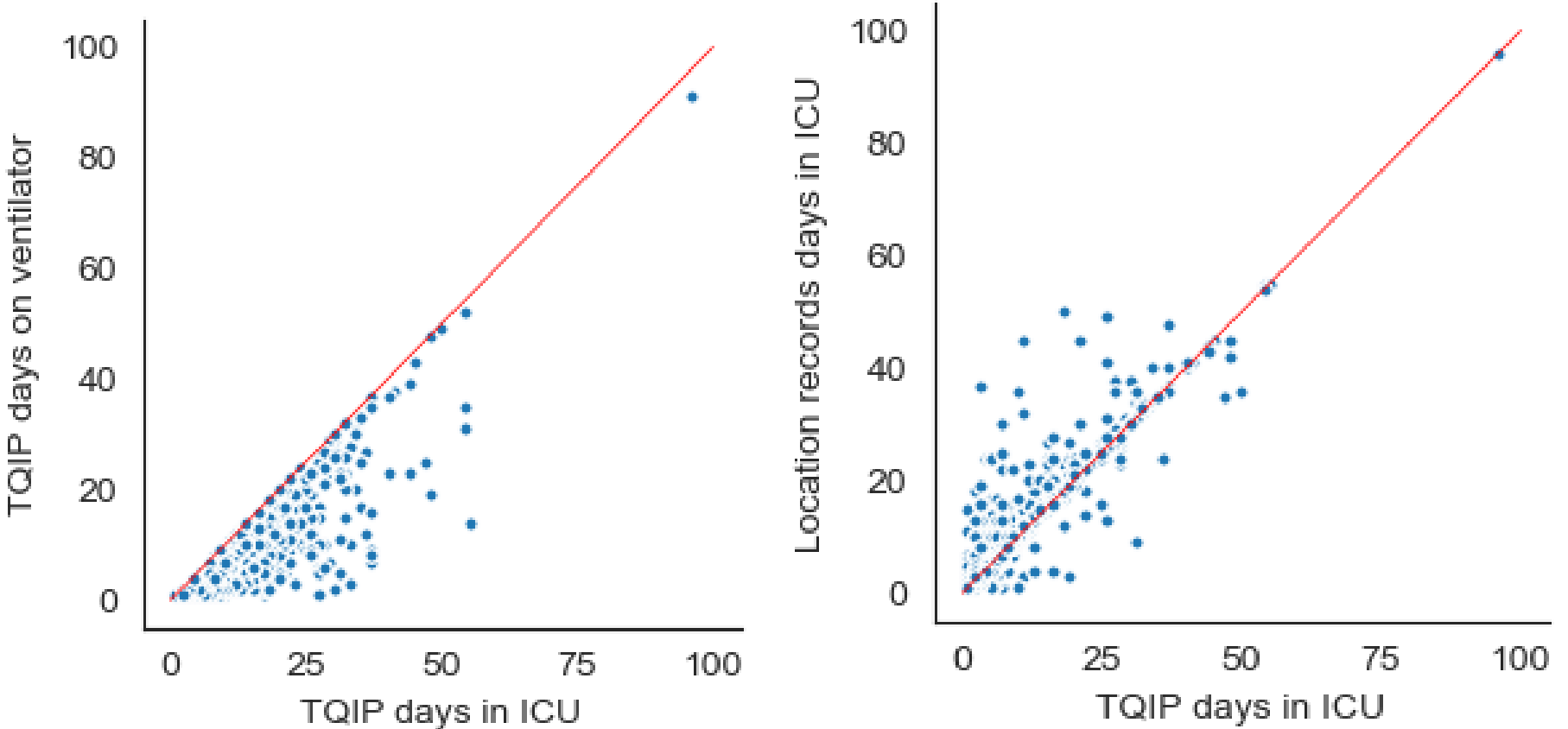|	Average ICU days (SD)	25th, 50th, 75th of ICU days
TQIP ICU LOS	9.07 (9.26)	3, 6, 12
New Method	10.05 (9.69)	3, 7, 13
Current Approach	5.98 (7.19)	2, 3, 8

Results

Figure 1: TQIP days in ICU by TQIP days on ventilator with 45° line with sample data (n=1,115).

Figure 2: TQIP days in ICU by record-by-record count of days in ICU from in-hospital location records with 45° line with sample data (n=1,115).

Table 5: Lin's Concordant Correlation Coefficient (CCC) with 95% confidence interval with sample data (n=1,115).

	CCC	95% CI
New Method	0.86	(0.85, 0.88)
Current Approach	0.72	(0.69, 0.74)

Conclusion

- The data show better agreement between TQIP ICU LOS and the estimated ICU LOS from in-hospital location records (CCC=0.86) than between TQIP ICU LOS and TQIP ventilation days (CCC=0.72).

- Based on the results from this study, we can impute TQIP ICU LOS when records meet these criteria:

  - In-hospital records indicate patients were in the ICU.
  - TQIP ventilation days are greater than 0.
  - TQIP ICU days are 0 or null.

Acknowledgements

References

[1]National Trauma Data Standard: Data Dictionary 2022 Admissions. (2021). American College of Surgeons. 130.

University of PITTSBURGH

Contact: Lisa Over, lisa.over@pitt.edu