Standardizing the Combat Trauma Registry Insights and Lessons Learned

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Joint Trauma System

Background

The Joint Trauma System (JTS) has been a significant innovation in military medical care over the past two decades. The JTS informs clinical care best practices by developing Clinical Practice Guidelines for deployed forces using the Department of Defense Trauma Registry (DODTR). The Joint Trauma System has the most comprehensive trauma registry in the world with 149,000 cases, 95,000 patients, 38,000 of which are active duty, and has published over 400 articles over the last 20 years, resulting in evidence based medical performance optimization.

While the most rich and robust source of combat causality care in the world, the Department of Defense trauma registry must modernize in order to meet the needs of large-scale combat operations. Large-scale combat operations predict 1,000 patients a day for 30 days, and current abstraction rates are only two to three cases a day. The variety of data sources, formats, timing, and gaps in data pose substantial risks to mission effectiveness and operational efficiency.

To address these issues, the Department of Defense and the Joint Trauma System is undergoing a modernization effort to create a battlefield learning healthcare system that maximizes combat casualty care outcomes through evidence-based performance improvement.
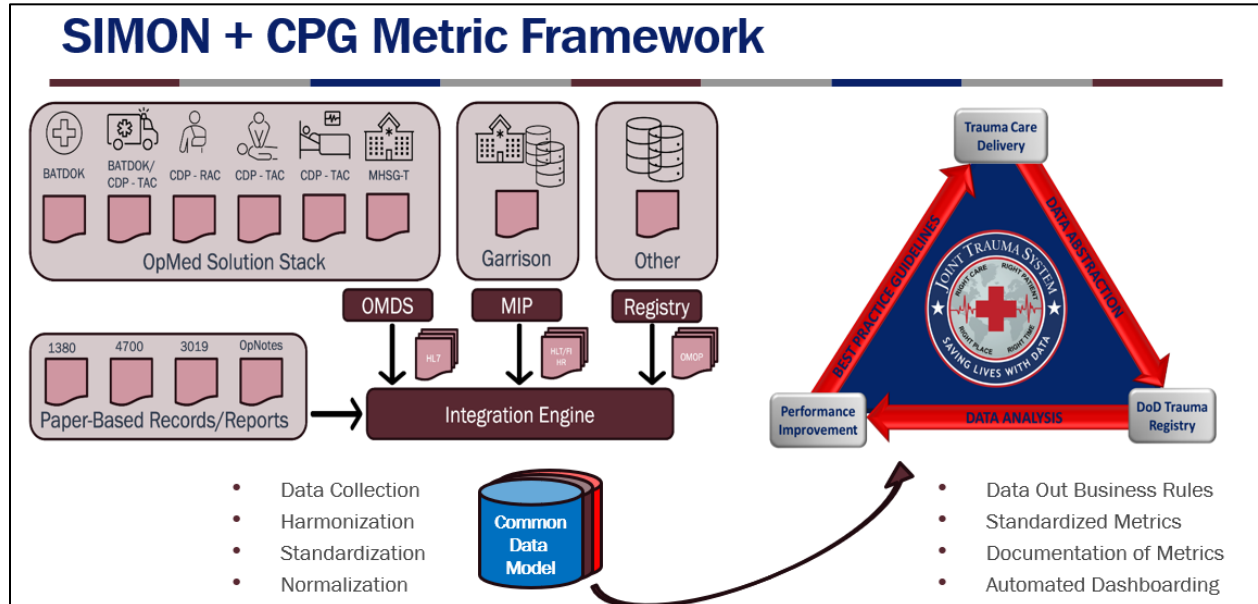

Figure 1: System for Injury Monitoring and Outcomes Nexus CPG Metric Framework

Figure 1 describes the overall framework for the joint trauma system modernization effort. It starts by identifying all of the data sources of interest from the operational medicine continuum of care, stateside data repositories, and legacy data stores. Data will be extracted via HL7 and FHIR messages,

unstructured formats such as emails, text messages, and other communication modalities, into a central data storage, orchestration, and processing layer. Then, data will be ETLed into the OMOP common data model for cohort generation, organization, analysis, and synthesis of data to gain insight and investigation. Artificial intelligence and machine learning models will be layered on top of this framework to generate new clinical practice guidelines, predictive decision support tools, and combatant command dashboards.
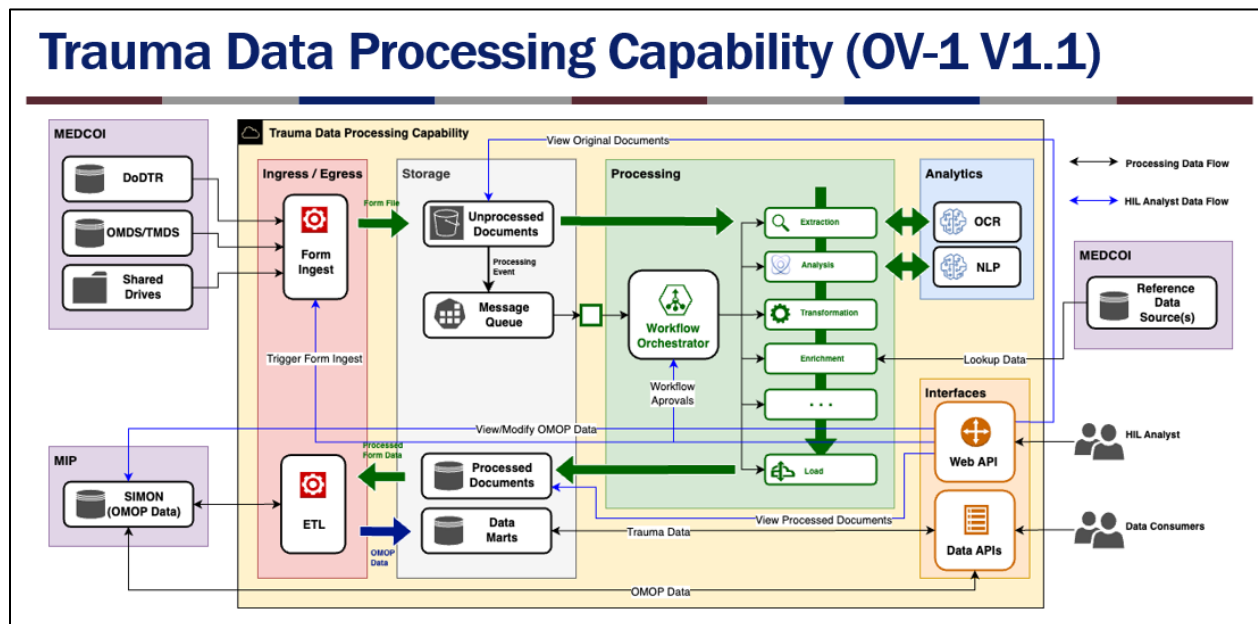

Figure 2 Operational View of the SIMON Trauma Data Processing Capability

This diagram reflects our modernization pipeline. The System for Injury Monitoring and Outcomes Nexus is the Joint Trauma System's modernization effort. It starts with identifying all data from key sources to include the Department of Defense Trauma Registries, Operational Medicine Systems of Record, and Legacy Repository of Stored Paper Documentation. Each of our key electronic and paper forms will be identified, ingested, extracted, transformed, and loaded into the orchestration layer of our new data pipeline. A suite of tools configured for optical character recognition and natural language processes will be configured for detailed step-by-step functions to identify the proper form type, valid data elements within that form, and have a human in the loop review accuracy of encoded data. All annotations will be stored in a temporary database that will get reconciled with the patient and encounter level data and then sent to a common data model that houses the OMOP structure. From here, various cohorts of interest, to include our current six registries, can be generated from specific clinical criteria and disease processes of interest. Visualization tools such as dashboards, clinical practice guidelines, and reports can be generated for key stakeholders to include clinicians, researchers, and combatant commanders.

Methods

The System for Injury Monitoring and Outcomes Nexus is the Joint Trauma System's modernization effort. It starts with identifying all data from key sources to include the Department of Defense Trauma

Registries, Operational Medicine Systems of Record, and Legacy Repository of Stored Paper Documentation. Each of our key electronic and paper forms will be identified, ingested, extracted, transformed, and loaded into the orchestration layer of our new data pipeline. Since the Observational Medical Outcomes Partnership (OMOP) Common Data Model (CDM) has a fixed, standard structure, it will allow for consistent mapping between multiple sources of data. [1] The OMOP CDM will be used to develop our cohorts of interest. Visualization tools such as dashboards, clinical practice guidelines, and reports can be generated for key stakeholders to include clinicians, researchers, and combatant commanders.

The DODTR's approximately 95,000 injury events and 150,000 records were summarized and exported into a scan report shown in Table 1. The open-source ODHSI were used to extract, transform and load DODTR data into the OMOP structure and format. Institutional Review Board was not necessary for this internal retrospective observational study which contains no identifying protected health information.

Results

Category	Sub Tabs	Sub Section	Data Elements	Pick List	Checkbox	BIU Checkbox	Coded Menu	Integer	Float	Date/Time	Memo	Text	Auto Populate
Arrival Tranpsort	1	1	1	0	0	1	0	0	0	0	0	0	0
Arrival Transport	7	2	98	29	0	11	4	22	10	11	1	9	5
BINDER NTDB/TQIP	1	1	4	4	0	0	0	0	0	0	0	0	0
Blood/Fluids	3	1	37	2	0	8	0	21	1	1	0	0	4
Demographic	3	2	48	10	1	3	3	10	0	2	1	8	10
Discharge	3	2	83	32	0	10	2	17	6	2	0	5	7
Dx	8	1	39	4	0	8	7	4	0	2	1	0	14
ED	5	1	94	29	0	12	4	18	9	12	0	2	6
General Info	2	1	6	0	0	0	0	0	0	0	0	0	0
Injury	6	2	72	16	2	22	7	13	0	2	2	4	4
Memo	3	1	16	1	1	2	0	0	0	0	4	0	7
NTDB/TQIP Trauma Record	3	1	55	26	0	3	1	18	0	8	0	0	0
PI	4	1	33	9	0	6	3	0	0	6	6	2	1
Procedures	2	1	35	8	0	18	3	1	0	3	1	1	0
Provider/Consult	1	1	3	1	0	0	1	0	0	1	0	0	0
Pt Tracking	3	1	8	2	0	0	0	0	0	5	0	3	0
Trauma Data	1	1	1	0	0	0	0	0	0	0	0	0	1
Total	56	21	633	173	4	104	35	124	26	55	16	34	59

Table 1: An overview of the tables, fields data elements in the DODTR GUI.

This study represents the first documented trauma registry in the world to transitions to the OMOP CDM. The OMOP Common Data Model presents a potential solution to help with these data quality problems that the Joint Trauma System faces. In the process of transitioning our legacy data into the OMOP CDM, we found the journey to be iterative, challenging, and enlightening. We had 97% conformance, compliance, and plausibility from our QA assessments. We ended up needing 2,200 custom fields, and we

were successfully able to create a single-threaded R-based, research-ready Common Data Model representation of the Department of Defense Trauma Registry for inclusion in a synthetic data generation research study.

Conclusion

This is a novel approach to mapping trauma domain specific diagnosis and procedures to the OMOP CDM. Our study demonstrates a novel approach to mapping unique trauma conventions, definitions and source values into a CDM not specifically designed for trauma. The utility of this study lies in the generalizability to any trauma center in the world that wants to generate reliable, repeatable, network studies using a research-ready common data model.

References

[1] Voss EA, Makadia R, Matcho A, et al. Feasibility and utility of applications of the common data model to multiple, disparate observational health databases. J Am Med Inform Assoc 22(3):553–64, (2015).