ANALYSIS PAPER

Ahead of Admission: Exploring Pre-Hospitalization Health Care Encounters in Sepsis Patients

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EXECUTIVE SUMMARY

Identifying and managing sepsis remains a persistent challenge in health care. As hospitals and others work to detect sepsis earlier and improve patient outcomes, evaluating progress often relies on data from in-hospital interventions and post-discharge outcomes. The Centers for Medicare & Medicaid Services' (CMS') SEP-1 bundle initiative, which focuses on timely recognition and early treatment for severe sepsis and septic shock during hospital encounters, is one such example.

While this approach provides valuable insight into post-sepsis recovery, it overlooks important pre-hospitalization aspects. In this analysis, HQI followed a different approach: adapting CMS' condition-specific readmission methodology to identify emergency department (ED) visits and inpatient (IP) hospitalizations that preceded **index** admissions identified as sepsis cases (per SEP-3 proxy criteria).

HQI's analysis combined data sets from the California Department of Health Care Access and Information (HCAI) Limited Data Sets for 2020 through 2023 with novel, provisional methodologies. The results are a starting point for — not a definitive evaluation of — opportunities for earlier interventions in the care continuum. HQI welcomes feedback and collaboration to help refine the methodology and better understand how preadmission interactions may contribute to proactive sepsis management.

KEY POINTS

- This exploratory analysis tests whether the SEP-3 proxy definition can help identify pre-sepsis encounters at a higher risk of escalation to sepsis.
- Pre-sepsis organ dysfunction encounters return more quickly and in higher proportions than pre-sepsis septicemia encounters, suggesting greater potential as an early warning signal.
- Nearly two-thirds of encounters with undetected pre-sepsis patients result in a return within 14 days, indicating a critical early intervention window where increased monitoring and follow-up could mitigate escalation from pre-sepsis to full sepsis and improve patient outcomes.
- A large number of pre-sepsis encounters are classified as "neither organ dysfunction nor septicemia," which presents an opportunity to identify additional risk factors that could further improve early sepsis detection.

METHODOLOGY

Key Terms

SEP-3 proxy case is an encounter having both a diagnosis code for septicemia/sepsis *and* a diagnosis code for either organ dysfunction or any code for septic shock. To find the full code set, please refer to HQI's website.

Index admission refers to a qualifying ED visit or IP admission meeting the SEP-3 sepsis proxy case definition.

Undetected pre-sepsis encounter refers to an ED or IP encounter that occurred within 30 days prior to an eligible index admission.

Historical year data refers to calendar year 2020-23 encounter data from HCAI.

HQI's Undetected Pre-Sepsis Encounters Methodology

Considering that the SEP-3 proxy case definition requires the presence of both septicemia/sepsis and organ dysfunction diagnosis codes, HQI's initial approach explored whether patterns could be observed in health care encounters prior to the index admission. To do this, we flagged pre-admission records that contained either a septicemia/sepsis code or an organ

dysfunction code — but not both, as the presence of both would meet the SEP-3 proxy case definition and thus qualify as an index admission. This allowed for a focus on encounters that may reflect potential early signs of deterioration or emerging risk, without overlapping with confirmed sepsis hospitalizations. The goal was not to retroactively assign causality or judgment, but rather to identify encounters that may represent potential early signals — however subtle — of sepsis progression. By analyzing these pre-admission events, we aim to generate insights into upstream health care interactions and explore how future work might support earlier recognition and intervention.

Complete Initial Data Processing and Clean Up

Before proceeding with the analysis, HQI standardized and refined the dataset to facilitate a more manageable and accurate evaluation. This involved a five-step process:

1. Aggregate calendar year 2020-23 for inpatient and ED encounters into one dataset.
2. For ED encounters specifically, create two columns for admission and discharge date, and then set both equal to service date before dropping the column. Table 1 shows an example of this step, the rationale for which is that since inpatient records have an admission and discharge date (for continuity between encounter types), it can be said that patients were "admitted" and "discharged" from the ED on the same day. Creating these variables assists with identifying potential transfer chains.

Table 1. *Setting ED Encounters, Admission, and Discharge Dates to 'Service Dates' to Align with Inpatient Formats and Support Transfer Chain Analysis*

Encounter	Admission Date	Discharge Date	Service Date	Encounter	Admission Date	Discharge Date
Emergency			2/1/2020	Emergency	2/1/2020	2/1/2020
Inpatient	1/23/2020	2/3/2020		Inpatient	1/23/2020	2/3/2020
Emergency			3/10/2020	Emergency	3/10/2020	3/10/2020
Emergency			3/27/2020	Emergency	3/27/2020	3/27/2020

3. Remove records with missing record linkage numbers (RLNs), as HQI uses RLNs to track individual patients across hospitals and years and without them, there would be uncertainty around whether the correct individual is being tracked for readmissions.
4. Sort the dataset by RLN and discharge date.
5. Identify and remove transfer chains using two methods.
    a. The first method identifies transfer chains that begin in the ED and continue into an inpatient admission.

    When a patient is admitted to the hospital from the ED, there should be only one combined patient record for that episode of care. To ensure this, HQI follows a series of checks to detect and consolidate cases in which a patient's ED visit transitions into an inpatient admission. Tables 2, 3, and 4 illustrate an example of a patient's record history, the process of flagging relevant records, and the final condensed dataset, respectively. The logic for identifying ED-to-inpatient transfer chains is as follows (see the HCAI format and file specifications for variable details in both the inpatient and outpatient datasets):

    - If encounter = "inpatient" and srcroute_ns (route of admission) = 1 or 2, mark the case as from_ed = 'Y'.
    - Shift the from_ed column up by one row and rename it as to_ip = 'Y'; similarly, shift the days_diff column up by one row and rename it as lead_days_diff.
    - If encounter = "emergency", RLN matches the previous RLN, to_ip = 'Y', and lead_days_diff = 0 or 1, then mark remove = 'Y'.

Note: For the same patient/RLN, if the discharge date of a previous visit is within one calendar day of the subsequent visit's admission date, the records are considered a single episode of care. In these cases, HQI retains

the earliest admission date and applies it to the consolidated record. This process allows multiple admissions and discharges to be chained and recorded as one continuous visit.

Table 2. *Potential Data Subset for Patient A's Inpatient Records Flagging as "from_ed"*

Encounter	RLN	Visit	Admission Date	Discharge Date	DAYS_DIFF	SRCROUTE_NS	FROM_ED
Emergency	A	1	1/22/2020	1/22/2020	.		
Inpatient	A	2	1/23/2020	1/25/2020	1	2	Y
Emergency	A	3	3/2/2020	3/2/2020	.		
Inpatient	A	4	3/3/2020	3/23/2020	0	3	N

Table 3. *Offsetting Patient A's Records ("from_ed" to "to_ip", "days_diff" to "lead_days_diff") and Flagging ED-to-Inpatient Transfer Chains for Removal*

Encounter	RLN	Visit	Admission Date	Discharge Date	FROM_ED	TO_IP	DAYS_ DIFF	LEAD_DAYS_ DIFF	Remove
Emergency	A	1	1/22/2020	1/22/2020		Y		1	Y
Inpatient	A	2	1/23/2020	1/25/2020	Y		1	.	
Emergency	A	3	3/2/2020	3/2/2020		N	.	0	
Inpatient	A	4	3/3/2020	3/23/2020	N		0		

Table 4. *Condensed Records for Patient A, Showing a Single Episode of Care with the Earliest Admission Date Retained Across Transfers*

Encounter	RLN	Visit	Admission Date	Discharge Date	FROM_ED	FROM_IP	LEAD_DAYS_DIFF	Remove
Inpatient	A	2	1/22/2020	1/25/2020	Y		.	
Emergency	A	3	3/2/2020	3/2/2020		N	0	
Inpatient	A	4	3/3/2020	3/23/2020	N			

b. The second method is designed to capture transfer chains missed by the first approach, focusing on inpatient-to-inpatient transfers as well as cases where a patient is seen in the ED and then admitted to the hospital soon after.

CMS defines a transfer as a hospital admission that occurs within one calendar day of discharge from a previous visit. Using this definition, HQI examined the remaining cases to identify direct transfers between inpatient records, as well as situations where a patient was treated and released from the ED, and then subsequently admitted to the hospital within one calendar day. Rather than relying solely on specific transfer criteria, this method reviews sequences of admissions for each patient (using RLN) to find consecutive visits where the discharge date of one record and the admission date of the next are no more than one day apart. When such transfer chains are found, the associated records are merged into a single, continuous episode of care by assigning the admission date from the first visit to the final visit's records and retaining the latest patient record in the chain. This approach ensures that all relevant transfer scenarios — including those involving a brief interval between ED discharge and hospital admission — are accurately identified, consolidated, and represented as single episodes of care.

Table 5. *Identification and Consolidation of Patient A's Transfer Chains Occurring Within One Calendar Day*

Encounter	RLN	Admit Date	Disch Date	Days Difference	Transfer	Encounter	RLN	Admit Date	Disch Date
Inpatient	A	1/12/21	1/15/21	.		Inpatient	A	1/12/21	2/4/21

Emergency	A	1/15/21	1/15/21	0	Y
Inpatient	A	1/16/21	1/29/21	1	Y
Inpatient	A	1/29/21	2/4/21	0	Y

Apply Variable Flags for Sepsis Identification

After removing the transfer chains, HQI used HQI's Proxy Definition for SEP-3 to flag all sepsis cases that meet:

- The septicemia criteria as septicemia = 'Y'
- The organ dysfunction criteria as organdys = 'Y'

It follows that if septicemia = 'Y' and organdys = 'Y', then sepsis = 'Y'. Then, from the resulting sepsis cases, HQI unflagged cases if they met **any** of the following criteria:

- A principal diagnosis of COVID-19 (DIAG_P = 'U071')
- Any secondary diagnosis of COVID-19 that was present on admission (ODIAG# = 'U071' and ODIAG#_POA = 'Y')

The remaining cases were then flagged as index ='Y', and if any index case occurred within 30 days of another index case, HQI unflagged the most recent index case.

Identify Undetected Pre-Sepsis Encounters

Once all sepsis index cases were flagged, HQI searched for the most recent visit that occurred before each sepsis admission. For every case where sepsis = 'Y,' we examined the patient's previous visit to determine whether they were seen for septicemia, organ dysfunction, or neither. Because cases with both septicemia *and* organ dysfunction have sepsis and were already flagged as sepsis = 'Y', this process helped identify undetected pre-sepsis encounters among patients. HQI flagged these pre-sepsis encounters as "is prior visit" to keep track of how many people later developed sepsis and categorized them into septicemia-only, organ dysfunction-only, or neither.

Note: Because some patients are flagged with sepsis in the ED but not admitted to the hospital, index cases *can* occur within the ED instead of only being inpatient encounters. Hence, a pre-sepsis encounter can be an inpatient discharge that was subsequently seen in the ED with sepsis.

Table 6. *Example of Undetected Pre-Sepsis Encounter Flags for Patient A*

Encounter	Visit	Admission Date	Discharge Date	Days_Diff	Index	Sepsis	Septicemia	OrganDys	Is Prior Visit
Inpatient	1	1/12/21	1/20/21	.	Y	Y	Y	Y	
Emergency	2	3/3/21	3/3/21	42				Y	Y
Emergency	3	3/5/21	3/5/21	2	Y	Y	Y	Y	
Inpatient	4	4/3/21	4/6/21	29			Y		Y
Emergency	5	4/9/21	4/9/21	3	Y	Y	Y	Y	
Inpatient	6	6/2/21	6/8/21	68					
Inpatient	7	7/10/21	7/15/12	32	Y	Y	Y	Y	

Below is a visit-by-visit explanation of the example presented in Table 6.

- **Visit 1:** Flagged as an index sepsis case.

- **Visit 2:** Flagged with organ dysfunction only. Also marked as a prior visit to Visit 3, as Visit 3 occurred within 30 days.
- **Visit 3:** Flagged as an index sepsis case.
- **Visit 4:** Flagged with septicemia only. Also marked as a prior visit to Visit 5, as Visit 5 occurred within 30 days.
- **Visit 5:** Flagged as an index sepsis case.
- **Visit 6:** Not flagged for sepsis, septicemia, or organ dysfunction.
- **Visit 7:** Flagged as an index sepsis case.

FINDINGS

Overall Trends in Sepsis Index Visits

The analysis shows that across 2020-23, sepsis index visits have steadily increased, rising from 179,789 in 2020 to 218,650 in 2023, with the vast majority occurring in inpatient settings (Figure 1). Undetected pre-sepsis encounters within 30 days of the index visit also increased during this period, with most of these cases classified as neither septicemia nor organ dysfunction.

Figure 1. *Distribution of Sepsis Index Visits by Location and Year, 2020-23*

Year	Inpatient Sepsis Index Visits	ED Sepsis Index Visits	Total Sepsis Index Visits
2020	170,254	9,535	179,789
2021	175,529	9,753	185,282
2022	187,514	9,480	196,994
2023	209,169	9,481	218,650

Condition-Specific Trends Using the SEP-3 Proxy

This original analysis uses the SEP-3 proxy case definition, where a case with *both* organ dysfunction and septicemia is considered a sepsis case. In this review, HQI explored whether septicemia-only or organ-dysfunction-only cases may have escalated to a sepsis index visit within 30 days, noting that organ dysfunction consistently represented the larger group of the two (Figure 2).

Figure 2. *Distribution of Undetected Pre-Sepsis Encounters Within 30-days of Sepsis Index Visits by Prior Diagnosis Condition and Year, 2020-23*

Year	Total Undetected Pre-Sepsis Encounters	Encounters with Septicemia Only	Encounters with Organ Dysfunction Only	Encounters with *Neither* Septicemia *nor* Organ Dysfunction
2020	49,135	1,831	17,510	29,794
2021	52,698	1,820	19,232	31,646
2022	55,563	1,978	19,888	33,697
2023	62,861	2,106	22,766	37,989

Among same hospital returns, inpatient organ dysfunction cases rose from 9,839 in 2020 to 12,444 in 2023, while septicemia cases increased more modestly from 1,210 to 1,340. Similar trends appeared in the ED, with organ dysfunction cases growing from 2,247 to 2,899 and septicemia from 164 to 177 (Figure 3).

Figure 3. *Distribution of Undetected Pre-Sepsis Encounters with Sepsis Index Visits at the Same Hospital by Prior Diagnosis Condition, Encounter Location, and Year, 2020-23*

Year	To Same Hospital Inpatient			To Same Hospital ED		
	Septicemia Only	Organ Dysfunction Only	Neither	Septicemia Only	Organ Dysfunction Only	Neither
2020	1,210	9,839	5,732	164	2,247	15,054
2021	1,136	10,376	5,718	171	2,521	15,874
2022	1,256	10,741	5,890	146	2,432	17,062
2023	1,340	12,444	6,379	177	2,899	19,640

Different hospital returns followed the same pattern: Inpatient organ dysfunction increased from 4,478 in 2020 to 6,096 in 2023, and septicemia from 361 to 470, with corresponding growth in ED organ dysfunction (946 to 1,327) and ED septicemia (96 to 119) (Figure 4). These trends suggest that organ dysfunction encounters, both inpatient and ED, may be a more frequent precursor to sepsis index visits than septicemia alone, though both have increased steadily over the four-year period.

Figure 4. *Distribution of Undetected Pre-Sepsis Encounters with Sepsis Index Visits at a Different Hospital by Prior Diagnosis Condition, Encounter Location, and Year, 2020-23*

	To Different Hospital Inpatient			To Different Hospital ED		
Year	Septicemia Only	Organ Dysfunction Only	Neither	Septicemia Only	Organ Dysfunction Only	Neither
2020	361	4,478	2,698	96	946	6,310
2021	403	5,197	2,932	110	1,138	7,122
2022	450	5,531	2,984	126	1,184	7,761
2023	470	6,096	3,246	119	1,327	8,724

Timing of Sepsis Index Visits After Pre-Sepsis Encounters

Following the condition-specific analysis above, HQI examined the timing between pre-sepsis encounters and subsequent sepsis index visits. Figure 5 shows the frequency distribution of days to return, with a notable spike early post-discharge. To strengthen this observation, Figure 6 presents the cumulative return percentages, revealing that more than one-third of patients (38.9%) returned within the first week and more than half (51.3%) within just 10 days of their pre-sepsis encounters. By two weeks, nearly two-thirds (64.9%) returned, and by 19 days, the proportion exceeds three-quarters (77.9%).

These findings indicate that escalation from pre-sepsis to full sepsis frequently occurs in a short post-discharge window, suggesting that targeted monitoring and follow-up interventions during the first 10–14 days may provide the greatest opportunity for early detection and treatment.

Figure 5. *Distribution of Days to Return Between Pre-Sepsis Encounters and Sepsis Index Visits* by Year, 2020-23

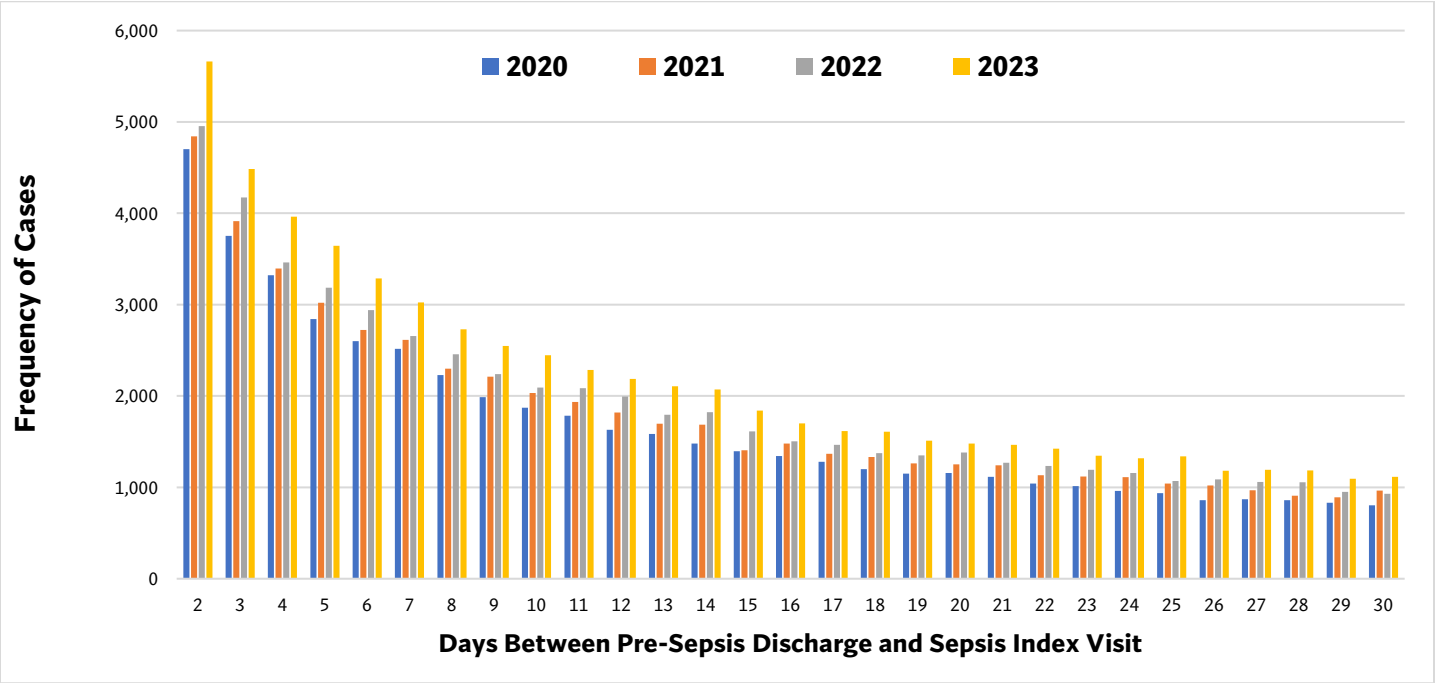

Figure 6. *Cumulative Percentage of Days to Return Between Pre-Sepsis Encounters and Sepsis Index Visits, 2020-23*

Days Between Pre-Sepsis Encounter and Sepsis Index Visit	Cumulative %	Days Between Pre-Sepsis Encounter and Sepsis Index Visit	Cumulative %
2	9.17%	11	54.96%
3	16.60%	12	58.42%
4	23.03%	13	61.68%
5	28.79%	14	64.88%
6	34.04%	15	67.71%
7	38.96%	16	70.45%
8	43.38%	17	73.06%
9	47.46%	18	75.56%
10	51.29%	19	77.95%

The cumulative percentages of organ dysfunction pre-sepsis encounters by year (Figure 7) show that organ dysfunction pre-sepsis encounters have a consistent pattern of early returns, with nearly one-third of patients returning within the first week. By day two, approximately 7% to 8% of patients had already returned, and by day five, about one-quarter had returned. The percentage climbs steadily, reaching roughly 50% by day 10 and approximately 64% by day 14. This consistency across years suggests a stable return pattern, with the majority of early returns occurring within the first week followed by a slower but steady accumulation through the second week.

Figure 7. *Cumulative Percentage of Days to Return Between Organ Dysfunction Pre-Sepsis Encounters and Sepsis Index Visits by Year, 2020-23*

Days to Return	2020	2021	2022	2023
2	7.80%	7.61%	7.03%	7.51%
3	14.79%	14.28%	13.76%	13.75%
4	21.21%	20.24%	19.82%	19.74%
5	26.88%	25.80%	25.34%	25.47%
6	31.97%	31.02%	30.74%	30.84%
7	37.28%	36.18%	35.76%	35.79%
8	41.92%	40.74%	40.54%	40.31%
9	46.18%	44.93%	44.75%	44.49%
10	50.27%	49.15%	48.68%	48.61%
11	54.10%	53.09%	52.43%	52.53%
12	57.69%	56.74%	56.15%	56.29%
13	61.11%	59.98%	59.72%	59.93%
14	64.35%	63.46%	63.23%	63.63%

The cumulative percentages of septicemia pre-sepsis encounters by year (Figure 8) follow a similar early return pattern but at slightly lower cumulative percentages after the first week. Early returns are slightly higher in the initial days — around 8% to 9% by day two — but cumulative growth slows sooner than in organ dysfunction cases. By day five, returns reach about 25% and, by day 10, just under half of the patients have returned. By day 14, cumulative return rates range between 59% and 61% across the years. These findings suggest that while septicemia pre-sepsis encounters escalate at a comparable pace initially, organ dysfunction pre-sepsis encounters tend to accumulate at a higher rate over the two-week period, potentially indicating a greater risk of progression to sepsis.

Figure 8. *Cumulative Percentage of Days to Return Between Septicemia Pre-Sepsis Encounters and Sepsis Index Visits by Year, 2020-23*

Days to Return	2020	2021	2022	2023
2	8.68%	9.56%	8.49%	8.02%
3	15.24%	16.15%	14.81%	14.77%
4	20.32%	21.70%	19.72%	20.37%
5	25.01%	26.21%	25.43%	25.40%
6	30.04%	29.89%	30.43%	29.72%
7	34.57%	35.00%	35.24%	33.90%
8	39.16%	38.19%	38.27%	37.61%
9	43.09%	42.75%	41.91%	41.12%
10	47.57%	46.26%	46.11%	45.16%
11	51.39%	49.73%	49.75%	48.29%
12	54.51%	53.35%	53.24%	51.95%
13	57.51%	56.98%	56.67%	55.89%
14	60.73%	60.49%	60.01%	59.50%

CONCLUSION

This exploratory analysis tested whether the SEP-3 proxy case definition, which requires both septicemia and organ dysfunction, could help identify pre-sepsis encounters at higher risk of progressing to full sepsis visits. The results indicate that both conditions appear in a notable share of pre-sepsis encounters, with organ dysfunction pre-sepsis encounters showing higher cumulative return rates than septicemia pre-sepsis encounters across all years studied. At the same time, a large proportion of pre-sepsis encounters involved *neither* septicemia nor organ dysfunction, highlighting the need to investigate what other diagnoses or clinical factors may be indicators of an escalation to sepsis.

While the methods are provisional, the patterns identified point to opportunities for targeted monitoring and follow-up during the immediate post-discharge period, especially for patients presenting with organ dysfunction. Such strategies may help narrow the gap between initial presentation and sepsis recognition, potentially improving patient outcomes.

Future analysis of the “neither” category could expand early detection efforts by identifying additional risk signals beyond septicemia and organ dysfunction. Understanding these pathways could support broader prevention strategies and more comprehensive intervention models.

These findings also highlight the value of continuing to refine the methodology, integrate clinical data, and collaborate with health care providers to strengthen proactive approaches to sepsis prevention.

Contact Candice Cam, senior data analyst, at ccam@hqinstitute.org with questions.

ABOUT US

The Hospital Quality Institute (HQI) is dedicated to advancing patient safety and quality of care for all Californians. Through strategic partnerships and innovative programs, HQI supports hospitals in achieving excellence by providing data analytics, educational resources, and statewide initiatives focused on performance improvement. HQI oversees and coordinates the Collaborative Health Care Patient Safety Organization (CHPSO).