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Reporting of Sepsis Cases for Performance Measurement versus for Reimbursement in New York State

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Abstract

Objective—Under “Rory’s Regulations”, New York State Article 28 acute care hospitals were mandated to implement sepsis protocols and report patient-level data. This study sought to determine how well cases reported under state mandate align with discharge records in a state-wide administrative database.

Design—Observational cohort study.

Setting—First 27 months of mandated sepsis reporting (April 1, 2014 to June 30, 2016).

Patients—Hospitalizations with sepsis at New York State Article 28 acute care hospitals.

Intervention—Sepsis regulations with mandated reporting.

Measurements and Main Results—We compared cases reported to the NYSDOH Sepsis Clinical Database with discharge records in the Statewide Planning and Research Cooperative System (SPARCS) database. We classified discharges as (1) “coded sepsis discharges” – a

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diagnosis code for severe sepsis or septic shock, and (2) “possible sepsis discharges”, using Dombrovskiy and Angus criteria.

Of 111,816 sepsis cases reported to the NYSDOH Sepsis Clinical Database, 105,722 (94.5%) were matched to discharge records in SPARCS. The percentage of coded sepsis discharges reported increased from 67.5% in the first quarter to 81.3% in the final quarter of the study period (mean 77.7%). Accounting for unmatched cases, as many as 82.7% of coded sepsis discharges were potentially reported, while at least 17.3% were unreported. Compared to unreported discharges, reported discharges had higher rates of acute organ dysfunction (*e.g.* cardiovascular dysfunction 63.0% vs. 51.8%, $p<0.001$) and higher in-hospital mortality (30.2% vs 26.1%, $p<0.001$). Hospital characteristics (*e.g.* number of beds, teaching status, volume of sepsis cases) were similar between hospitals with a higher versus lower percent of discharges reported, $p>0.05$ for all. Hospitals' percent of discharges reported was not correlated with risk-adjusted mortality of their submitted cases (Pearson correlation coefficient 0.11, $p=0.17$).

Conclusions—Approximately 4 of 5 discharges with a diagnosis code of severe sepsis or septic shock in the SPARCS data were reported in the NYSDOH Sepsis Clinical Database. Incomplete reporting appears to be driven more by under-recognition than attempts to game the system, with minimal bias to risk-adjusted hospital performance measurement.

Keywords

government regulation; epidemiology; hospital mortality; quality of healthcare

Introduction

Sepsis contributes to one out of every two to three hospital deaths¹ and is the most costly cause of hospitalization in the US². In New York State alone, approximately 50,000 adults are diagnosed with severe sepsis or septic shock annually, of which 30% die (NYSDOH all-payer inpatient hospital discharge data). Responding to mounting evidence that timely treatment saves lives³, New York State enacted sepsis regulations in 2013 (“Rory's Regulations”) requiring all hospitals to develop and implement protocols for screening, early recognition, and prompt treatment of patients with severe sepsis and septic shock⁴. In addition, hospitals were required to report patient-level data to the New York State Department of Health (NYSDOH) beginning in 2014 as part of a NYSDOH sepsis clinical database.

However, a key challenge to realizing the potential benefit of any quality improvement initiative, such as Rory's Regulations, is ensuring that all eligible cases are recognized and reported^{5,6}—or at the very least, ensuring that the reported cases are representative of all cases. The challenge of accurate and representative case identification also affects the value other initiatives, such as the Centers for Medicare and Medicaid Services' (CMS) new SEP-1 quality measure⁷. In sepsis, a condition for which no gold-standard for diagnosis exists, it is unknown how well cases reported under state mandate align with sepsis discharges identified in a state-wide database.

In order to investigate the extent to which performance measurement and quality improvement efforts were potentially hampered by strategic or random under-reporting, we measured the concordance between sepsis cases reported to the NYSDOH Sepsis Clinical Database under Rory's Regulations and discharges with sepsis identified in a state-wide all-payer discharge database, the Statewide Planning and Research Cooperative System (SPARCS)⁸. We examined variation in the percentage of discharges with sepsis in SPARCS that were reported over time and across hospitals. We also compared reported and unreported discharges, and sought to understand potential mechanisms for variation in reporting.

Methods

Context

In 2013, New York State enacted sepsis regulations requiring all hospitals to implement protocols for early recognition and treatment of patients with severe sepsis and septic shock^{9,10}. Starting in 2014, NY hospitals were required to submit patient-level data to the NYSDOH Sepsis Clinical Database for each inpatient and emergency department (ED) discharge with severe sepsis or septic shock by Sepsis-2 definitions¹¹ for performance evaluation. In 2017, NYSDOH began public reporting of sepsis treatment and risk-adjusted outcomes by hospital¹². There were no financial incentives or penalties associated with reporting, or with sepsis treatment or outcomes.

Hospitals were encouraged to use both prospective assessment of clinical data and retrospective assessment of administrative data for case-finding, although the actual method(s) of case ascertainment varied by hospital. The state audited a random 10% of cases submitted to the NYSDOH Sepsis Clinical Database using manual chart review and provided feedback to hospitals regarding data quality. (Audit results are presented in a prior publication¹³). To promote complete reporting, the NYSDOH also examined the NYSDOH Sepsis Clinical Database and SPARCS discharge records after the first year of reporting to screen for potential missed cases. Hospitals were notified of potential missed cases, and given the opportunity to review their results and instructions to submit any cases that should have been reported.

Study Populations

We examined all adult sepsis cases reported to the NYSDOH Sepsis Clinical Database from April 1, 2014 to June 30, 2016. We compared these reported sepsis cases to sepsis discharges identified from inpatient and ED discharge records in SPARCS. Since 1979, SPARCS has collected patient-level data on demographics, diagnoses and treatments, services, and charges for each New York State Article 28 acute care inpatient hospital stay and ED visit in the state of New York⁸.

Because there is no optimal practice for identifying sepsis hospitalizations in administrative data^{14,15}, we used three identification methods (eTable 1, Online Supplement). Our primary analysis examined inpatient and ED discharge records with a primary or secondary ICD-9-CM diagnosis code for severe sepsis (995.92) or septic shock (785.52)—which we call

“coded sepsis discharges”. In a prior study, this approach had a positive predictive value of 100.0% (95%CI: 76.8%, 100.0%) relative to structured chart review by trained hospitalists¹⁴. However, because the sensitivity of this approach is low, we also performed sensitivity analyses using Dombrovskiy¹⁶ and modified Angus criteria¹⁷ (Online Supplement, Appendix 1). When necessary, we converted ICD-10-CM diagnosis codes to ICD-9-CM codes prior to applying these criteria (Online Supplement, Appendix 1).

Hospitalizations with an inter-hospital transfer were considered as separate hospitalizations since referring and receiving hospitals were each required to submit data to SPARCS and to the NYSDOH Sepsis Clinical Database.

Matching Reported Sepsis Cases to Discharge Records

We used a hierarchical deterministic algorithm to match cases in the NYSDOH Sepsis Clinical Database to discharge records in SPARCS using unique patient identifiers, unique facility identifiers, and other variables (*e.g.* dates of service, discharge location) common to both datasets (eTable 2, Online Supplement).

Statistical Analyses

To determine completeness of reporting, we measured the proportion (95% CI) of coded sepsis discharges in SPARCS that were reported to the NYSDOH Sepsis Clinical Database overall, by quarter, and by hospital. In sensitivity analyses, we estimated the total number of unreported discharges using Dombrovskiy¹⁶ and modified Angus¹⁷ criteria for identifying sepsis discharges (Appendix 1, Online Supplement).

To explore patterns of incomplete reporting, we compared the characteristics, crude in-hospital mortality, and adjusted in-hospital mortality of reported versus unreported sepsis discharges. We also compared the characteristics of hospitals that reported a higher versus lower percent of their sepsis discharges. Adjusted analyses accounted for age, gender, race, payer, and individual Charlson comorbidities^{18,19}. In a separate analysis, we also accounted for individual acute organ dysfunctions coded during the hospitalization, applying the acute organ dysfunction codes used by Dombrovskiy¹⁶.

To assess whether incomplete reporting may have biased the findings of New York's mandated sepsis reporting, we measured the relationship between reporting and outcomes. Specifically, we measured: (1) the correlation between a hospital's percent of coded sepsis discharges reported and the proportion of reported cases that had a sepsis protocol initiated (excluding patients that fell into at least one of several allowable categories for exclusion, including a clinical contraindication to treatment), and (2) the correlation between hospitals' proportion of coded sepsis discharges reported and adjusted mortality (again excluding patients meeting exclusion criteria). For this analysis, we excluded hospitals with fewer than 25 coded sepsis discharges in SPARCS to avoid spurious associations due to small numbers.

To compare characteristics of reported versus unreported discharges, we used chi-square, z-tests, and non-parametric tests as appropriate for the distribution of the outcome. We used two-sided significance testing and considered a $p < 0.05$ significant. Analyses were completed

using SAS®, version 9.4. This study was reviewed and deemed exempt by the New York State Department of Health Institutional Review Board.

Results

111,816 adult sepsis cases were reported to the NYSDOH Sepsis Clinical Database during the study period. Of these, 105,722 (94.5%) were matched to an inpatient or ED discharge record in the SPARCS database (Figure 1; eTable 2, Online Supplement), while 6,094 (5.5%) of the reported cases could not be matched to a discharge record. Of the 105,722 matched cases, 95,355 (90.2%) had a diagnosis code for severe sepsis or septic shock at some position in the SPARCS discharge record—that is, were coded sepsis discharges (eTable 3, Online Supplement). Just 629 (0.6%) reported cases had a principal diagnosis code of severe sepsis or septic shock, while 71,674 (75.2%) had a principal diagnosis of sepsis.

Of the 10,367 matched cases without any diagnosis code for severe sepsis or septic shock, 5,663 (54.6%) met criteria for possible sepsis by either Dombrovskiy or Angus criteria, and an additional 2,946 (28.4%) had a principal diagnosis code for infection. Only 1,147 (1.1%) of the 105,722 matched cases had no diagnosis code for sepsis or infection.

Completeness of Reporting

Of the 122,684 coded sepsis discharges in SPARCS during the study period, 95,355 (77.7%) were matched to the NYSDOH Sepsis Clinical Database, and therefore confirmed as being reported to the NYSDOH as part of the sepsis initiative (Table 1). Assuming the 6,094 unmatched cases in the NYSDOH Sepsis Clinical Database exist in SPARCS and are coded as severe sepsis or septic shock but remained unmatched due to the deterministic matching algorithm, as many as 101,449 (82.7%) coded sepsis discharges in SPARCS were potentially reported. Conversely, between 21,235 (17.3%) and 27,329 (22.3%) coded sepsis discharges in SPARCS were not reported to the NYSDOH Sepsis Clinical Database. In sensitivity analyses using Angus and Dombrovskiy criteria, an estimated 31,826 and 38,055 discharges, respectively, were unreported.

Over time, the proportion of coded sepsis discharges in SPARCS that were reported to the NYSDOH Sepsis Clinical Database increased. 8,664 of 12,835 (67.5%, 95%CI: 66.7%, 68.3%) coded sepsis discharges were reported in the second quarter of 2014, compared to 11,170 of 13,764 (81.1%, 95%CI: 80.6%, 82.0%) in the second quarter of 2015. Thereafter, the percentage of coded sepsis discharges reported remained consistently above 80%.

Characteristics of Reported versus Unreported Sepsis Discharges

Reported sepsis discharges had higher rates of acute organ dysfunction (Table 2, eTable 4). For example, 63.0% versus 51.8% had acute cardiovascular dysfunction, $p<0.001$; 59.9% versus 56.0% had acute renal dysfunction, $p<0.001$; and 43.1% versus 40.9% had acute respiratory dysfunction, $p<0.001$. Reported discharges were more likely to have a all patients refined diagnosis-related group (APR DRG) of “Septicemia and Disseminated Infections”, 62.9% versus 58.0%, $p<0.001$.

Crude in-hospital mortality was higher in reported versus unreported sepsis discharges, 30.2% (95%CI: 29.9%, 30.5%) versus 26.1% (95%CI: 25.6%, 26.6%), $p<0.001$] (Table 2). In sensitivity analyses using Dombrovskiy or modified Angus criteria, in-hospital mortality was also higher versus unreported discharges (eTable 5). In-hospital mortality declined over time for both reported and unreported discharges (eFigure 2). After adjustment for age, race, gender, payer, and co-morbidities, in-hospital mortality remained higher in the reported versus unreported discharges, 30.7% (29.4%, 32.1%) versus 26.6% (25.5%, 27.8%), $p=0.002$. However, after also adjusting for acute organ dysfunctions, the difference in mortality was no longer significant [30.1% (29.2%, 31.0%) versus 28.8% (28.0%, 29.7%), $p=0.20$].

Characteristics of Hospitals with Higher versus Lower Percent Reported

Across hospitals, the percent of coded sepsis discharges in SPARCS that were reported to the NYSDOH Sepsis Clinical Database varied from 0.0% to 100.0%, median 84.8%. Among hospitals with at least 25 discharges, the percent reported ranged from 0.0% to 100.0%, median 86.1%. When comparing hospitals in the first versus fourth quartile of percent reported, there were no differences in hospital size, sepsis case volume, teaching status, or urban versus rural location, $p>0.05$ for each (Table 3).

Relationship between Completeness of Reporting and Outcomes

There was very weak correlation between a hospital's percent of coded sepsis discharges reported and percent of reported cases with a sepsis protocol initiated (Pearson correlation coefficient -0.23, $p=0.003$) (eFigure 1). There was no correlation between the percent reported and risk-adjusted mortality at the hospital level (Pearson correlation coefficient 0.11, $p=0.17$) (Figure 2).

Discussion

New York State introduced regulations ("Rory's Regulations") in 2013 to improve state-wide sepsis care. In this study, we examined the first 27 months of mandated reporting to evaluate how often inpatient and ED discharges with a diagnosis code of severe sepsis or septic shock were reported to the NYSDOH Sepsis Clinical Database. We found that about 4 out of 5 discharges with a diagnosis of severe sepsis or septic shock were reported to the NYSDOH Sepsis Clinical Database, which is used to evaluate hospital performance on quality metrics. The percentage of cases reported increased steadily during the first year of mandated reporting, plateauing at just above 80% during the second year. However, there was wide variation in the percent reported across hospitals.

When comparing reported versus unreported discharges, we found little evidence that incomplete reporting was driven by an attempt to bias the state's measurement of sepsis outcomes. Reported discharges had higher rates of acute organ dysfunction, higher in-hospital mortality, and were more likely to have a sepsis APR DRG, suggesting that hospitals did not selectively report discharges with better outcomes²⁰. Rather, our findings suggest that under-reporting occurred due to non-strategic omission of less sick patients. We suspect that this occurred due to under-recognition of less ill or less obviously septic

patients. In addition, the incomplete reporting of patients who were ultimately coded as having severe sepsis or septic shock reflects the disconnect between clinical care, quality reporting, and coding practices at individual hospitals.

Furthermore, while the percent of sepsis discharges reported varied across hospitals, there was little evidence that incomplete reporting biased the assessment of individual hospitals' performance. The percent of sepsis discharges reported was poorly correlated with the rate of protocol initiation among eligible reported cases. Moreover, we found no correlation between the percent of discharges reported and risk-adjusted in-hospital mortality.

Beyond measuring the percentage of sepsis discharges that were unreported, we also estimated the number of *all* sepsis discharges—coded or not—that went unreported. Based on the number of discharges meeting Dombrovskiy and Angus criteria, and associated positive predictive values for these definitions^{14,15}, we estimate that an additional 10,000-16,000 discharges may have had sepsis over the course of the 2-year reporting period, but were neither coded as such in SPARCS nor reported to the NYSDOH Sepsis Clinical Database. This degree of under-recognition is not surprising, as sepsis diagnosis has poor inter-rater reliability, even among experienced clinicians²¹.

The potential underreporting of lower-risk sepsis discharges can be interpreted from two angles. On the one hand, it is important to identify patients who present with less severe forms of sepsis since these patients account for about half of all sepsis-related hospital deaths¹. For this reason, at least one large healthcare system has implemented a sepsis treatment initiative that specifically targets lower-risk sepsis patients²². On the other hand, the underreporting of lower-risk sepsis discharges did not appear to bias the measurement of individual hospital performance, as we found no correlation between hospitals' completeness of reporting and risk-adjusted mortality of reported cases.

Physician recognition of critical illness syndromes (such as sepsis^{23,24} and acute respiratory distress syndrome^{25,26}) is known to be low—particularly among patients with lower illness severity. For this reason, experts have argued that sepsis mandates should explicitly address diagnostic inaccuracy²⁷. Our findings suggest that less severely ill patients, or those with less obvious clinical presentations of sepsis, were indeed less likely to be reported under New York's mandate.

New York invested substantial resources into evaluating and promoting the quality of the data submitted to the NYSDOH Sepsis Clinical Database. A full 10% of submitted cases were audited, and hospitals were notified of potential unreported cases after the first year. However, despite these efforts, one in five discharges with a diagnosis of severe sepsis or septic shock went unreported. These findings suggest that states and hospital systems considering similar initiatives should consider auditing a sample of unreported cases meeting Dombrovskiy or modified Angus criteria in order to assess and promote completeness of sepsis recognition and reporting.

Our findings should be interpreted in the context of several limitations. First, there is no optimal method for determining which discharges in SPARCS should have been reported to the NYSDOH Sepsis Clinical Database. There is no gold standard definition of sepsis with

perfect reliability²⁸, either prospectively or retrospectively. Moreover, physician agreement on diagnosis is poor²¹. ICD-9-CM definitions may misclassify patients in both directions, resulting in both false negative and false positive cases^{15,29}. For this reason, we used several common definitions to identify sepsis cases in discharge records, including diagnosis codes for severe sepsis or septic shock, Dombrovskiy criteria, and modified Angus criteria. We applied positive predictive values for these definitions, based on previously published validation studies—but coding practices are known to change over time³⁰ and may have changed as a direct result of the mandate. However, the three approaches resulted in fairly similar estimates of the number of unreported cases (20,000 to 35,000 sepsis discharges during the study period), adding credibility to these findings.

Beyond the limitations of claims-based identification methods, there was incomplete linkage of cases in the NYSDOH Sepsis Clinical Database to discharge records in SPARCS. We performed a hierarchical match to link as many cases as possible, but 5.5% of cases in the NYSDOH Sepsis Clinical Database remained unmatched. This rate of non-match is common when merging such large databases, which inherently contain errors³¹. We accounted for the unmatched cases so that they did not inflate our estimates of unreported discharges. However, since there is no way to distinguish unmatched versus unreported SPARCS discharges, the incomplete match rate likely diminished our ability to detect differences in the characteristics of reported versus unreported discharges, and to measure the relationship between hospital-level reporting and outcomes.

Our study must also be considered within the context of New York's regulations, which had no financial incentives associated with reporting, sepsis treatment, or sepsis outcomes. It is possible that the completeness and representativeness of reported cases would be different under a pay-for-performance scenario.

Conclusion

In this study of the first 27 months of mandated reporting of sepsis cases in New York, we found that approximately 4 of 5 discharges with a diagnosis code for severe sepsis or septic shock in SPARCS were reported to the NYSDOH Sepsis Clinical Database and subsequently used for performance measurement. An estimated additional 10,000-16,000 discharges may have had sepsis, but were neither coded nor reported. Incomplete reporting appears to be driven more by under-recognition than attempts to game the system, with minimal bias to hospital performance measurement.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1. Data Linkage

This figure depicts linkage between SPARCS and the NYSDOH Sepsis Clinical Database.

Key Terms:

- **Coded sepsis discharge:** an inpatient or emergency department discharge record in SPARCS with a diagnosis code for severe sepsis or septic shock.
- **Reported Sepsis Discharge:** An inpatient or emergency department discharge record in SPARCS that was reported to NYSDOH Sepsis Clinical Database for under mandated sepsis reporting. Only discharge records that were matched to the NYSDOH Sepsis Clinical Database could be confirmed as reported.
- **Unreported Sepsis Discharge:** An inpatient or emergency department discharge record in SPARCS with a diagnosis code for severe sepsis or septic shock that was not reported to NYSDOH for performance measurement under mandated sepsis reporting.
- **Matched Sepsis Case:** A case submitted to NYSDOH Sepsis Clinical Database and matched to an inpatient or emergency department discharge record in SPARCS.
- **Unmatched Sepsis Case:** A case submitted to NYSDOH Sepsis Clinical Database that could not be matched to an inpatient or emergency department discharge record in the SPARCS.

Abbreviations: PPV, positive predictive value; SPARCS, Statewide Planning and Research Cooperative System

Figure 2. Correlation between Hospital-Level Reporting and Risk-Adjusted Mortality Rate
This figure depicts the correlation between individual hospitals' percentage of sepsis cases reports with risk-adjusted in-hospital mortality.

Table 1
Percentage of Discharge Records in SPARCS that were reported to NYSDOH Sepsis Clinical Database During the Study Period

Sepsis Definition	Discharges in SPARCS meeting this definition, N	Discharges in SPARCS meeting this definition and matched to Sepsis Clinical Database * (and therefore confirmed as being reported, N (% of all discharges meeting this definition))	Discharges in SPARCS meeting this definition that were matched to Sepsis Clinical Database and had a sepsis protocol initiated, N (%)
Principal Diagnosis of Severe Sepsis or Septic Shock	Inpatient Discharges: 729 ED Discharges: 103 Total: 832	598 (82.0%) 31 (30.1%) 629 (75.6%)	511 (70.1%) 19 (18.4%) 530 (63.7%)
Any Diagnosis of Severe Sepsis or Septic Shock	Inpatient Discharges: 121,717 ED Discharges: 967 Total: 122,684	94,969 (78.0%) 386 (39.9%) 95,355 (77.7%)	74,634 (61.3%) 272 (28.1%) 74,906 (61.1%)
Dombrovskiy Criteria	Inpatient Discharges: 194,067 ED Discharges: 1,873 Total: 195,940	92,635 (47.7%) 374 (20.0%) 93,009 (47.5%)	72,880 (37.6%) 269 (14.4%) 73,149 (37.3%)
Modified Angus Criteria	Inpatient Discharges: 452,769 ED Discharges: 9,074 Total: 461,843	100,204 (22.1%) 429 (4.7%) 100,633 (21.8%)	78,970 (17.4%) 311 (3.4%) 79,281 (17.2%)

* Discharges in SPARCS that were matched to NYSDOH Sepsis Clinical Database were confirmed as reported. Because 6,094 cases in the Clinical Database could not be matched to a corresponding discharge in SPARCS, the actual number reported may be higher.

Table 2
Characteristics of Discharges with a Diagnosis of Severe Sepsis or Septic Shock (Coded Sepsis Discharges), by Reporting Status

Patient Characteristics	Unreported Discharges (Coded Sepsis Discharges in SPARCS that were notmatched to Sepsis Clinical Database) (N=27,329 Total Discharges) (N=26,748 Inpatient Discharges)	Reported Discharges (Coded Sepsis Discharges in SPARCS Matched to Sepsis Clinical Database, and therefore confirmed as reported) (N=95,355 Total Discharges) (N=94,969 Inpatient Discharges)	<i>p</i>
Acute Organ Dysfunctions			
Respiratory, N (%)	11,188 (40.9%)	41,133 (43.1%)	<0.001
Cardiovascular, N (%)	14,155 (51.8%)	60,099 (63.0%)	<0.001
Coagulation, N (%)	4,323 (15.8%)	17,930 (18.8%)	<0.001
Renal, N (%)	15,302 (56.0%)	57,085 (59.9%)	<0.001
Hepatic, N (%)	1,615 (5.9%)	6,972 (7.3%)	<0.001
Central Nervous System, N (%)	6,002 (22.0%)	20,752 (21.8%)	0.48
In-Hospital Mortality			
Crude, mean (95% CI)	26.1% (25.6%, 26.6%)	30.2% (29.9%, 30.5%)	<0.001
Partially adjusted*, mean (95% CI)	26.6% (25.5%, 27.8%)	30.7% (29.4%, 32.1%)	0.002
Fully adjusted**, mean (95% CI)	28.8% (28.8%, 29.7%)	30.1% (29.2%, 31.0%)	0.20
Diagnosis-Related Grouping (DRG), with Severity of Illness (SOI), N (%) (For Inpatient Discharges Only)			<0.001
<i>APR-DRG 720: Septicemia and Disseminated Infections</i>	<i>15,521 (58.0%)</i>	<i>59,734 (62.9%)</i>	
SOI Level 4 (Extreme)	8,800 (32.9%)	36,385 (38.3%)	
SOI Level 3 (Major)	5,778 (21.6%)	20,568 (21.7%)	
SOI Level 2 (Moderate)	891 (3.3%)	2,646 (2.8%)	
SOI Level 1 (Minor)	52 (0.2%)	135 (0.1%)	
<i>APR-DRG 710: Infectious & Parasitic Diseases Including HIV with O.R. Procedure</i>	<i>2,316 (8.7%)</i>	<i>9,114 (9.6%)</i>	
SOI Level 4 (Extreme)	1,731 (6.5%)	7,410 (7.8%)	
SOI Level 3 (Major)	542 (2.0%)	1,574 (1.7%)	
SOI Level 2 (Moderate)	43 (0.2%)	116 (0.1%)	
SOI Level 1 (Minor)	0 (0.0%)	14 (0.0%)	
<i>APR-DRG 005: Tracheostomy with MV 96+ Hours Without Extensive Procedure</i>	<i>876 (3.3%)</i>	<i>2,521 (2.7%)</i>	
SOI Level 4 (Extreme)	844 (3.2%)	2,468 (2.6%)	
SOI Level 3 (Major)	31 (0.1%)	51 (0.1%)	
SOI Level 2 (Moderate)	1 (0.0%)	2 (0.0%)	
SOI Level 1 (Minor)	0 (0.0%)	0 (0.0%)	
<i>APR-DRG 004: Tracheostomy with MV 96+ Hours with Extensive Procedure or ECMO</i>	<i>676 (2.5%)</i>	<i>2,177 (2.3%)</i>	
SOI Level 4 (Extreme)	670 (2.5%)	2,161 (2.3%)	
SOI Level 3 (Major)	5 (0.0%)	16 (0.0%)	

Patient Characteristics	Unreported Discharges (Coded Sepsis Discharges in SPARCS that were notmatched to Sepsis Clinical Database) (N=27,329 Total Discharges) (N=26,748 Inpatient Discharges)	Reported Discharges (Coded Sepsis Discharges in SPARCSMatched to Sepsis Clinical Database, and therefore confirmed as reported) (N=95,355 Total Discharges) (N=94,969 Inpatient Discharges)	<i>p</i>
SOI Level 2 (Moderate)	1 (0.0%)	0 (0.0%)	
SOI Level 1 (Minor)	0 (0.0%)	0 (0.0%)	
<i>Other</i>	7,359 (27.5%)	21,423 (22.6%)	

Abbreviations: APR-DRG: All Patient Refined-Diagnosis Related Group; SOI: Severity of Illness

Partially adjusted mortality adjusted for age, sex, race, pater, and, Charlson co-morbidities. Charlson comorbidities and index were calculated from each SPARCS discharge record using the method of Deyo¹. Fully adjusted mortality also adjusted for acute organ dysfunctions, abstracted from each SPARCS discharge record using the method of Dombrovskiy².

Table 3
Hospital Characteristics, by Quartile of Discharges Reported

Hospital Characteristics	Quartile 1 Hospitals (N=41 Hospitals)	Quartile 4 Hospitals (N=41 Hospitals)	<i>p</i>
Percentage of coded sepsis discharges reported, median	47.8%	96.4%	<0.001
Volume of Sepsis Cases			0.71
0 to 199	19 (46.3%)	15 (36.6%)	
200 to 399	10 (24.4%)	13 (31.7%)	
400 to 599	4 (9.8%)	7 (17.1%)	
600 to 799	5 (12.2%)	3 (7.3%)	
800 or more	3 (7.3%)	3 (7.3%)	
Number of Certified Beds			0.12
0 to 199	16 (39.0%)	10 (24.4%)	
200 to 399	16 (39.0%)	18 (43.9%)	
400 to 599	5 (12.2%)	9 (21.9%)	
600 to 799	1 (2.4%)	4 (9.8%)	
800 or more	3 (7.3%)	0 (0.0%)	
Area, N (%)			0.56
Metro	33 (80.5%)	35 (85.4%)	
Rural	8 (19.5%)	6 (14.6%)	
Teaching Facility, N (%)			0.65
No	15 (36.6%)	17 (41.5%)	
Yes	26 (63.4%)	24 (58.5%)	

Percentage of coded sepsis cases reported is the number of cases submitted to the NYSDOH Sepsis Clinical Database divided by the total number of coded sepsis cases. Only hospitals with 25 or more discharges with severe sepsis or septic shock during the study period were considered for inclusion in this table. Volume of sepsis cases is defined as the average yearly number of coded sepsis cases during the study period. Area is based on Rural Urban Commuting Area(RUCA) codes^{PM1}. Teaching facilities is defined as a hospital or medical center that provides clinical education and training to future and current physicians, and that receives Medicaid reimbursement for direct or indirect graduate medical education.

1. USDA ERS - Rural-Urban Commuting Area Codes [Internet]. [cited 2017 Nov 28]; Available from: <https://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes/>