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# Is it time to measure complications from the National Trauma Data Bank? A longitudinal analysis of recent reporting trends

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## Abstract

**BACKGROUND:** Payers have approached select complications as never events, yet there is rationale that achieving a zero incidence of these events is impractical. Prior 2005 National Trauma Data Bank (NTDB) analysis showed high rates (37%) of centers reporting no complications data making national estimates for determining standardized complication rates difficult to ascertain.

**METHODS:** The 2008–2012 NTDB National Sample Program nationally weighted files were used to calculate yearly national estimates. Rates were compared in all centers and those reporting complications data. Hospital characteristics were compared using Student *t* test. In 2011, an *other complication* category was introduced; overall rates were calculated with and without this category. Yearly estimates were reported for patients receiving care within centers reporting complications data.

**RESULTS:** From 2008–2012 NTDB, there were raw data on 3,657,884 patients. A total of 594,894 patients (16.3%) experienced one or more complications (82.7% one complication; 17.3% two or more complications). Excluding the other complication category, the overall weighted rate was 8.4% to 9.2%. Pneumonia was the most common complication (2.7–3.0%), occurring at twice the 2005 rate. The number of centers reporting no complications data dropped to 8.1% in 2011 (2008, 14.5%; 2009, 18.2%; 2010, 15.9%; 2012, 8.9%). By 2012, nearly all level I centers reported complications, whereas 46.4% of level IVs reported none (I 0.5%, II 2.7%, III 8.5%, $p = 0.04$). Data were reported the least frequently in nonteaching hospitals (15.8%, $p = 0.007$), those in the South (19.6%, $p = 0.007$), and those with less than 200 beds (23.6%, $p = 0.005$).

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**CONCLUSION:** Overall rates of complications from 2008 to 2012 were nearly twofold higher than 2005 data. Reporting has increased, and NTDB may provide a valuable platform for establishing rational and achievable measures for specific complications.

**LEVEL OF EVIDENCE:** Prognostic and epidemiological, level IV.

### Keywords

Trauma; quality improvement; benchmarking; complication; NTBD

In the United States, injury is the leading cause of death (59%) for people 1 to44 years of age[1] and is responsible for 10%of all deaths worldwide.[2] The national economic burden of trauma is staggering; the total lifetime medical and work loss costs due to injury in the United States were US $671 billion in 2013, with nonfatal injuries accounting for over US $457 billion[3,4] and often resulting in enduring mental, physical, and economic difficulties for these patients. Given the enormous costs of injury care in this country, there has been an increasing focus on the development of more effective means to measure and improve care.

To allow comparison of yearly national rates of incident conditions, a stratified sample of 100 Level I and II trauma centers was developed by American College of Surgeons (ACS) and the Centers for Disease Control and Prevention (CDC); this database, the National Trauma Data Bank- National Sample Program (NTDB-NSP), provides nationwide standard estimates of injury care to facilitate research in injury surveillance, outcomes, and assessment and is derived from the country-wide National Trauma Data Bank (NTDB).

The Centers for Medicare and Medicaid Services, in addition to many other pay-for-performance programs, have begun augmenting payment for patient care based on inpatient complications,[5] with the establishment of select complications as *never events* for which zero incidence is the objective. Prior NTDB analysis through 2005 showed high rates (37%) of centers reporting no complications data,[6] making national estimates for determining external benchmarks on in-hospital complications difficult to ascertain. We compared NTDB-NSP data from 2008 to 2012 with the 2005 reported data to assess the differences in comorbid conditions and in-hospital complication reporting among trauma centers. We hypothesized that, given the increased interest in never events and pay for performance, complication reporting in the NTDB would be increased compared with historic data, with increased reporting of complication rates and comorbid conditions.

## PATIENTS AND METHODS

The NTDB files from the admission years 2008 to 2012 were analyzed, including the subfiles containing diagnoses, procedure codes, preexisting comorbidities, complications, and facility information. The 2008–2012 NTDB Research Data Set was used to determine patient demographics, the number and type of comorbidities reported, and facility characteristics for those reporting complications data. The Research Data Set of the NTDB represents raw data on all patients reported to the NTDB. Differences in demographics and facilities were compared using analysis of variance and Student *t* test, respectfully. As previously reported by Kardooni et al.,[6] the same methodology was undertaken wherein

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facilities that reported at least one complication were compared with those that did not report any complications. To quantify the difference in reporting rates across facilities, separate reporting rates were calculated for all facilities in addition to only those facilities reporting complications data. Hospital information was compared using Student *t* test, including trauma level designation, teaching status, geographic region, number of adult hospital beds, and presence of a Trauma Intensive Care Unit. An ($\alpha$) less than 0.05 was considered significant. All analysis was performed using Stata version 14 (StataCorp, College Station, TX).

### Changes to the NTDB in Reporting Complications Data

The NTDB criteria for reporting complications coding were consistent between 2008 and 2010; however, in 2011, the NTDB eliminated eight specific categories of complications and initiated data collection on five additional complications (Table, Supplemental Digital Content 1: NTDB Complication Categories 2008–2012, http://links.lww.com/TA/B239). One of the newly added complications, urinary tract infection, had been collected in 2005 and in years prior but was not reported from 2008 to 2010. In 2011, an *other complication* category was also introduced. To evaluate the impact of the introduction of an other complication category, the overall complication rates were calculated with and without it for comparison.

### Determining Weighted National Rates of Complications

To calculate yearly national estimates of weighted rates of complications, the NTDB-NSP was used for 2008 to 2012. Sample weights provided by the NTDB-NSP were used to calculate the national estimates to adjust for sampling.[7] Rates were compared across all centers and also among only those reporting complications data. For complications reported in 2005 and 2012, difference in complication rates was compared using Student *t* test. The trend in overall complication rates reported from 2005 to 2012 was analyzed using linear regression excluding the other category.

## RESULTS

From 2008 to 2012, the NTDB contained raw data on 3,657,884 trauma patients (Table 1). Over the 5 years studied, there were increasing numbers of patients reported to the NTDB ($p = 0.016$). There were also increasing numbers of participating hospitals and trauma centers over this time period. In 2009, 567 hospitals reported data to NTDB (186 level I centers, 192 level II centers); in 2010, 697 hospitals (219 level I centers, 239 level II centers); in 2011, 744 hospitals (228 level I centers, 251 level II centers); and in 2012, 805 hospitals (235 level I centers, 267 level II centers). The cohort was primarily male (>60%), aged 20 to 40 years, with blunt mechanism of injury (>80%). Traumatic injury was reported less often in those younger than 20 years ($p = 0.002$) and 20 to 40 years old ($p = 0.042$), while it was more common in those 60 to 80 years old ($p = 0.002$) and older than 80 years ($p = 0.041$). Therewere no differences in race categories; however, there was a decrease in injuries reported for those with Hispanic ethnicity ($p = 0.012$). Fewer traumatic brain injuries were reported ($p = 0.036$), but there was no difference in mechanism.

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## Comorbid Conditions

Data regarding the status of comorbid conditions were available in more than 90% of patients (Table 1). There was a statistically significant increase in patients who reported one or more comorbid conditions from 2008 to 2012 ($p = 0.014$). By 2012, 55.3% of patients had at least one preexisting comorbidity and 29% had two or more reported comorbid conditions (Table 1). Hypertension was the most common comorbidity each year and increased significantly over the study period ($p = 0.009$). By 2012, current smoker status and diabetes were the next most frequent comorbidities with respiratory disease, alcoholism, major psychiatric illness and drug abuse/dependency (both newly added in 2012) also comprising more than 5% of the types of comorbidities reported (Table 2).

More specifically, smoking nearly tripled over the study period ($p = 0.005$). Increasing trends in reporting of comorbidities were also observed for respiratory disease ($p = 0.001$), functionally dependent health status ($p = 0.026$), recent angina ($p = 0.049$), and revascularization/amputation for peripheral vascular disease ($p = 0.006$). Although the absolute number of patients with a preexisting code status of do not resuscitate at the time of the incident trauma event was low, there was a statistically significant increase over the study period ($p = 0.006$).

## Complication Reporting by Facility

Trends in complications data reporting were analyzed by facility. The number of centers reporting no complications data dropped to a low of 8.1% in 2011 (2008, 14.5%; 2009,18.2%; 2010, 15.9%; 2012, 8.9%) (Fig. 1). By 2012, nearly all level I centers reported complications data whereas46.4% of level IV centers reported none (level I, 0.5%; level II, 2.7%; level III, 8.5%; $p = 0.041$). Similarly, by 2012, nearly all university hospitals reported complication data while it was reported least frequently in nonteaching hospitals (15.8%, $p = 0.007$). There were significant geographic and hospital size differences noted in reporting; complications data were reported least frequently in centers located in the South (19.6%, $p = 0.007$), and those with less than 200 beds (23.6%, $p = 0.005$) (Table 3).

## Complication Rates

Of the total cohort, 16.3% (n = 594,894) were reported to have experienced one or more complication; 82.7% had at least one complication, and 17.3% had two or more complications during their admission. Excluding the other complication category introduced in 2011, the overall weighted rate was 8.4% to 9.2% (Table 4). In comparing historical 2005 data to 2012, there was an increase in overall complications reported ($p = 0.033$, Table 4). However, there was no observed significant difference in the trend of complication reporting from 2008 to 2012 ($p = 0.226$). Pneumonia was the most frequent complication reported each year (2.7–3.0%), and the rate from 2008 to 2012 was nearly twice as high (2.7–3.0%) as the rate reported in 2005 (1.4%). Similarly, the 2008 to 2012 rates of acute respiratory distress syndrome (ARDS) and deep vein thrombosis (DVT) were also more than twice the reported 2005 rate. From 2008 to 2012, there were no statistically significant differences between most subtypes of complications except for DVT ($p = 0.047$). There was also a decrease in the rate of sepsis from 0.9% in 2008 to 0.4% in 2012 that did not reach statistical significance ($p = 0.057$).

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## DISCUSSION

This study found that overall complication rates from 2008 to 2012 were twofold higher than the 2005 historic data. The overall weighted complication rate from 2008 to 2012 was8.4% to 9.2%, double the 2005 reported rate (4.9%). Similarly, among the most common complications reported each year (pneumonia, urinary tract infection [UTI], ARDS, and DVT), the rates from 2008 to 2012 were nearly twice as high as the rates reported in 2005. Although the subtypes of complications reported since 2005 were not statistically different except for DVT, the overall complication rates reported did increase significantly ($p = 0.033$). However, when comparing the trends from 2008 to 2012 only, there was no statistically significant difference in overall complication rates ($p = 0.226$) nor in the rate of newly included in-hospital complications introduced after 2005, such as decubitus ulcer, renal failure, sepsis, and pulmonary embolism. Given the consistency of complication rates over the most recent five years, the change from 2005 likely reflects improved data quality and reporting instead of any real increase in national complication rates.

In addition to the finding of increased complication reporting, there were also changes in the reporting trends of comorbid conditions. The incidence of nearly all specific comorbid conditions increased, also likely because of improved data reporting. Significant increases in incidence of specific complications such as current smoker status (4.7% in 2008 to 14.5% in 2012) are also thought to reflect improved data quality and fidelity, as the CDC reports over the same time period indicate that current smoking has declined from 20.9% in 2005 to 15.1% in 2015.[8] Furthermore, the NTBD coding has evolved to better capture the presence of underlying disease, exemplified by the additions in 2012 of specific diagnoses such as major psychiatric illness, drug abuse/dependency, and dementia, all of which were among the top 10 comorbid conditions reported by NTDB in 2012 and likely replacing the nonspecific diagnosis of impaired sensorium with 0% rate reported in 2012 (from 5.5% in 2011). Moreover, increased reporting of comorbidities could be because of increased prevalence of comorbidities in our aging trauma population, supported by significantly increased age in this population as noted in Table 1. Age is an important independent predictor of mortality after injury and associated with increased complications, longer hospital stays, and increased cost.[9,10]

This study also showed significant differences in reporting between institutions based on a variety of center characteristics. Complications data were reported in nearly all level I and II trauma centers, university institutions, and larger hospitals with more than 400 beds. Conversely, facilities that did not report complications data were more likely to be level IV designation, nonteaching institutions, located in the South and smaller facilities with less than or equal to 200 beds. The etiology of nonreporting has not been studied, and therefore, it is not possible to definitively determine the etiology of this trend. It is possible that level IV centers actually do have less complications because they typically see a less injured patient population. However, these centers are often excluded from research analyses, making it difficult to elucidate the underlying reasoning. It is not possible to know if this is because there are no complications to report, or if there were complications, but level IV centers lacked capacity to capture these complications. Similar findings have been reported

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in prior analyses[6] and may contribute to skewed facility participation that undermine the validity of benchmarking efforts.

The rise in complications reported over the past decade parallels the growth and visibility of the quality movement. In 1999, the Institute of Medicine published the landmark *To Err is Human* report, concluding that 98,000 Americans die each year from preventable medical errors,[11] spurring an ever burgeoning movement to improve quality of care by avoidance of complications, thereby saving lives and reducing costs. Over the past decade, health care payers have adopted value-based purchasing schema to focus on driving higher quality care through pay for performance programs and avoidance of specific hospital-acquired conditions (HACs)[12–17]; designating select patient complications as never events, despite clinical rationale that achieving a zero incidence of these events in trauma care may be impractical due to unmodifiable patient and injury characteristics. Furthermore, the link between trauma outcomes, HACs, and cost containment has not been well described nor systematically studied.

Under current pay for performance programs, the assumption is that HACs are always preventable in all patients, thus the term *never event*. Nevertheless, single-center studies have suggested that HACs are actually fairly common in trauma patients,[18–21] in stark contrast to the rates reported for medical patients that approach zero with initiatives such as ventilatorassociated pneumonia care bundles.[22] For instance, recent studies have demonstrated no difference in trauma center ventilatorassociated pneumonia rates with regards to care bundle adherence, reflecting the minimal impact of such initiatives and process measures in the care of injured patients.[20,21] Achieving a nonzero complication rate assumes that risk is entirely alleviated by care, which does not account for confounding between patient characteristics, comorbidities, injury patterns, and systems of care that are clinically relevant following injury. Furthermore, benchmarking analysis with mortality based outcomes alone did not identify centers with high complication rates, highlighting the importance of measuring performance via multiple quality indicators.[9] Currently, no specific accepted benchmarks exist for most targeted complications including HACs. As health care payers and stakeholders emphasize the need to achieve zero rates of complications, it is fundamentally imperative that the trauma community have a role in establishing national benchmarks for specific complications of interest that are clinically rational and achievable in the context of caring for injured patients.[23]

The establishment of a robust national trauma registry has undergone multiple iterations. The NTDB was established by the ACS in 1994; at the outset, a wide swath of data contributions were accepted to this registry with few checks on the data validity or completeness. The NTDB contains more than 7 million records[24]; the databank has been used in over 250 studies[25] and is the largest repository of trauma data in the United States. To allow comparison of yearly national rates of incident conditions, a stratified sample of 100 level I and II trauma centers was developed by ACS and CDC in 2008; this database, NTDB-NSP, standardizes data collection across all reporting hospitals. Trauma registry data are collected and analyzed by every trauma center yearly, and data must be collected in compliance with the National Trauma Data Standard (NTDS) and submitted to the NTDB[26];

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at a minimum, trauma centers and state agencies are instructed to collect the NTDS data set and the NTDS is used as the standard for data definitions in trauma.

The ACS TQIP was developed in 2009 by the ACS Committee on Trauma (ACS COT) to deliver risk-adjusted benchmarking data for level I and II trauma centers.[27] For all level I, II, and III trauma centers, each trauma registry must submit required data components to the NTDB and use a risk-adjusted benchmarking system to measure outcomes and clinical performance, such as ACS-TQIP[26]; the NTDB is not risk-adjusted and as such, starting in 2017, all trauma centers were required to participate in TQIP.[28] As such, currently, all COT verified centers belong to ACS TQIP, submitting to NTDB and ACS TQIP. All nonverified centers can voluntarily belong to ACS TQIP and can also voluntarily submit to the NTDB. With ACS TQIP, progressive electronic data audit checks were created and have become more robust over time; however, even these efforts have no capacity tovalidate the trauma registry data against the definite patient data in the medical record. ACS-TQIP uses external benchmarking on patient outcomes between hospitals to facilitate direct comparisons in performance and identify needs for improved institutional quality of care.[29] Thus far, external benchmarking schema such as ACS TQIP have primarily been used for comparson of in-hospital mortality outcomes[30]; however, the methodology is increasingly important in the era of value-based purchasing.

In trauma care, the only mechanisms currently used for standardization of care are the ACS TQIP and registry data, including the NTDB. Each entity offers unique, valuable, and complimentary information; ACS TQIP primarily focuses on the achievement of evidence-based process measures and metrics for comparison among trauma centers, whereas the NTDB is composed of both raw and weighted data, allowing for longitudinal analysis of incidence in conditions of interest, although the NTDB has not been validated with regards to complication reporting. Accurate and valid data reporting is the foundation to developing substantive, evidence-based quality assessments and performance metrics. Complications are known to be more common in trauma patients compared with general surgery patients, and comparisons with the NSQIP methodology have suggested that complications have been historically underreported in the NTBD.[31] Prior analysis has also shown significant variability in reporting of complications data in the NTBD, increasing the potential for bias and undermining efforts to determine appropriate benchmarks.[6] In contrast, this most recent analysis of the NTDB suggests that there have been improvements in reporting of complications data, but gaps remain.

Without an external standard to compare the NTDB data with, it is currently not known if these trends in reporting reflect true increases in complications and thus changes in quality of care or rather an increase in capture of data. This coupled with the disincentive to perform surveillance for many complications makes using registry based data like the NTDB problematic for benchmarking performance. This surveillance bias is particularly problematic for complications such as UTI and DVT, which are almost certainly underreported in this dataset. Establishing the current state of the fidelity of any data source used to identify minimum acceptable complication rates is a fundamental limitation that continues to face the trauma field.

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Risk adjustment has presented its own challenges especially in the trauma population where a certain (and unknown) percentage of patients will have comorbidities important in outcome, but those comorbidities were never reported. Although we believe standardization of from the NTDB is still problematic, the purpose of this study was to see if the quality of the NTDB data has evolved with the external pressure of the marketplace on minimizing complications and value based care. This study demonstrates that some improvements have been made in reporting but there are still significant gap areas including the role of surveillance bias for many commonly reported outcomes. It does however provide context for understanding the types of patients we are caring for and the evolving demographics of the patient populations we see. Furthermore, it helps to strengthen the argument that a zero complication rate is impractical in the trauma patient population.

Over the study period, there was a growing emphasis in the trauma field on collection of complications. Although it was not mandatory during the time of the study for centers to participate in ACS-TQIP, there was a movement to increase awareness of the program and voluntary participation that could have had a halo effect on NTDB capture. The NTDB is not risk-adjusted, and as such, starting in 2017, it became mandatory for all trauma centers to participate in ACS-TQIP,[28] which includes the main NTDB components. This mandate may help to address the data quality problem within the NTDB. Historically, trauma centers voluntarily participating in the NTDB were advised to collect data in compliance with the NTDS.[26] However, there were no checks on either accuracy or reliability of the data. There were also no standard definitions for complications or the process by which the data were extracted from clinical records until 2008. Collectively, this creates significant opportunity for bias that makes benchmarking more difficult.

Despite standardization via the NTDS and the broader implementation of ACS TQIP, the burden and cost of maintaining an accurate trauma registry have largely fallen upon individual institutions to hire trauma registrars or nurse coordinators to maintain the trauma registries. Diagnoses and procedures are coded using *International Classification of Diseases* coding with disease severity often coded using the Abbreviated Injury Scale (AIS) code. The trauma registry staff collect, encode, and input data about patient demographics, hospital course, diagnoses, procedures, and complications, manually extracting data from the medical record and radiology reports. Despite the complexity of the creating and maintaining such a registry, there is currently no mandatory process for certification or education. To ensure data completeness, the NTDB requires a number of critical fields to be entered to include patient record into the database. While missing data are inescapable in collecting large amounts of retrospective data, availability of the means to identify and correct errors is important to improve the quality of the data set. Despite data standardization with the NTDS, there is still significant variability among institutions and errors can lead to incorrect information and distort study results.

Despite the limitations of the NTDB, the measurable increase in comorbidity and complication reporting found in this study suggests that the quality of the data contained in the NTDB may have improved significantly over time. Hence, the fidelity of the NTBD data set has reached a level not previously appreciated. This improvement however does not overcome the continued challenges with surveillance bias and the lack of an external

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criterion standard for comparison. Even with the ACS-TQIP data submission process that involves electronic data audits to reduce missing or out of range data, the ACS COT notes that TQIP participation by itself does not ensure data validity across the entire spectrum of information contained in the hospital trauma registry, as ongoing and persistent evaluation and review are critical to confirm the reliability and quality of any local registry data. As of yet, the NTDB and ACS-TQIP continue to be limited by the lack of data validation and will require a more rigorous process for the data to have credibility for national benchmarking. The development of standardized data definitions with NTDS and more universal participation in ACS-TQIP is an important starting metric, but a more robust data validation program will require greater support from the ACS COT in all centers.

## CONCLUSIONS

Given the stark human and economic cost of injury care in the United States, improving trauma outcomes is a critically important task. The results of this study show significantly increased reporting of complications data from 2008 to 2012 in NTDB, but major gaps remain.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## DISCLOSURE

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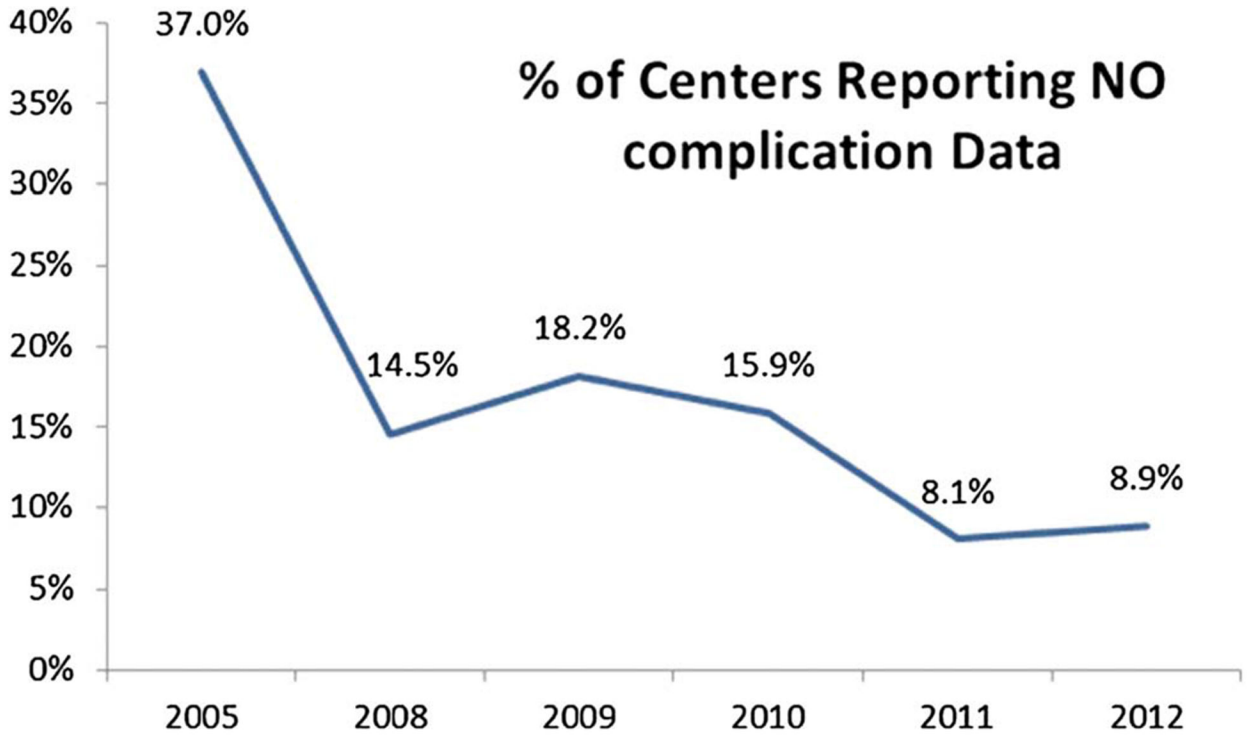


**Figure 1.**
Percent of centers reporting no complication data to NTBD from 2005 to 2012.

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**TABLE 1.**

Demographics and Comorbidities Reported From NTDB 2008–2012

| | 2008 | 2009 | 2010 | 2011 | 2012 | *P* |
|---|---|---|---|---|---|---|
| Total patients | 640,116 | 630,134 | 697,023 | 762,464 | 770,354 | 0.016 |
| Age, y | | | | | | |
| <20 | 16.2% | 15.5% | 14.6% | 14.1% | 13.4% | 0.002 |
| 20–40 | 31.3% | 31.3% | 31.0% | 29.6% | 29.8% | 0.042 |
| 40–60 | 26.8% | 27.2% | 26.7% | 26.2% | 26.6% | 0.271 |
| 60–80 | 16.3% | 16.9% | 17.4% | 18.6% | 19.6% | 0.002 |
| >80 | 9.4% | 9.1% | 9.6% | 10.6% | 10.7% | 0.041 |
| Male | 64.9% | 64.8% | 64.3% | 62.7% | 62.9% | 0.027 |
| Race | | | | | | |
| White | 72.1% | 68.5% | 68.3% | 73.8% | 70.2% | 0.872 |
| Black/African American | 14.0% | 16.2% | 16.0% | 14.2% | 15.4% | 0.842 |
| Asian | 1.7% | 1.6% | 1.5% | 1.8% | 1.9% | 0.285 |
| Hawaiian/Pacific Islander | 0.2% | 0.3% | 0.4% | 0.3% | 0.3% | 0.450 |
| American Indian | 0.5% | 1.3% | 1.2% | 1.1% | 0.5% | 0.897 |
| Other | 11.5% | 12.0% | 12.7% | 8.8% | 11.7% | 0.628 |
| Hispanic ethnicity | 18.9% | 17.0% | 15.8% | 11.7% | 12.2% | 0.012 |
| Mechanism | | | | | | |
| Blunt | 83.1% | 82.1% | 81.9% | 82.7% | 83.5% | 0.587 |
| Penetrating | 10.5% | 10.7% | 10.5% | 9.5% | 10.0% | 0.176 |
| Burn | 2.2% | 2.2% | 2.1% | 2.6% | 2.1% | 0.806 |
| Other/unspecified | 4.0% | 4.2% | 4.2% | 4.1% | 4.2% | 0.600 |
| Clinical shock (SBP < 90) | 8.3% | 12.2% | 9.1% | 6.2% | 5.6% | 0.200 |
| Traumatic brain injury | 20.0% | 18.8% | 18.0% | 17.3% | 17.7% | 0.036 |
| Comorbidity status | | | | | | |
| % with >1 preexisting comorbidities | 41.5% | 43.1% | 46.3% | 47.7% | 55.3% | 0.014 |
| % with >2 preexisting comorbidities | 17.5% | 18.5% | 20.5% | 22.4% | 29.0% | 0.020 |
| % with comorbidities known | 90.0% | 91.8% | 90.7% | 99.5% | 100.0% | 0.044 |

SBP, systolic blood pressure.

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**TABLE 2.**

Types of Comorbidities Reported From NTDB 2008–2012

| | 2008 | 2009 | 2010 | 2011 | 2012 | *P* |
|---|---|---|---|---|---|---|
| Hypertension requiring medication | 19.8% | 20.6% | 22.6% | 22.6% | 25.4% | 0.009 |
| Alcoholism | 9.2% | 9.2% | 9.4% | 9.2% | 9.4% | 0.308 |
| Diabetes | 8.5% | 8.4% | 8.9% | 9.1% | 10.7% | 0.056 |
| Respiratory disease | 4.8% | 5.5% | 6.1% | 7.4% | 8.4% | 0.001 |
| Current smoker | 4.7% | 8.5% | 10.9% | 11.4% | 14.5% | 0.005 |
| Bleeding disorder | 3.0% | 2.7% | 2.8% | 3.7% | 4.4% | 0.078 |
| Congestive heart failure | 2.9% | 2.4% | 2.4% | 2.8% | 3.1% | 0.497 |
| Obesity | 2.5% | 2.4% | 2.4% | 2.6% | 3.9% | 0.154 |
| CVA, residual neuro deficit | 2.4% | 1.7% | 2.0% | 2.1% | 2.4% | 0.729 |
| Myocardial infarction within 6 mo | 1.6% | 1.2% | 1.5% | 1.3% | 1.3% | 0.412 |
| Functionally dependent health status | 0.4% | 0.5% | 0.6% | 1.0% | 1.7% | 0.026 |
| DNR status | 0.3% | 0.5% | 0.6% | 0.9% | 0.9% | 0.006 |
| Angina within 1 mo | 0.1% | 0.1% | 0.1% | 0.9% | 0.1% | 0.049 |
| Revascularization/amputation for PVD | 0.0% | 0.0% | 0.1% | 0.2% | 0.3% | 0.006 |
| Cirrhosis (added in 2011) | | | | 0.7% | 0.6% | n/a |
| Major psychiatric illness (added in 2012) | | | | | 6.9% | n/a |
| Drug abuse/dependency (added in 2012) | | | | | 5.3% | n/a |
| Dementia (added in 2012) | | | | | 3.3% | n/a |

CVA, cerebrovascular accident; DNR, do not resuscitate; PVD, peripheral vascular disease.

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**TABLE 3.**

Complication Data by Facility From 2012 NTDB

| | Facilities Reporting Complication Data (n = 733), n (%) | Facilities Reporting No Complication Data (n = 72), n (%) | Percent Reporting No Complication Data, % | *P* |
|---|---|---|---|---|
| ACS/state designation | | | | 0.041 |
| Level 1 | 206 (28) | 1(1) | 0.5 | |
| Level II | 255 (35) | 7(10) | 2.7 | |
| Level III | 140 (19) | 13 (18) | 8.5 | |
| Level IV | 52 (6) | 45 (63) | 46.4 | |
| Teaching status | | | | 0.007 |
| University | 211 (29) | 1 (1) | 0.5 | |
| Community | 299 (41) | 29 (40) | 8.8 | |
| Nonteaching | 223 (30) | 42 (58) | 15.8 | |
| Region | | | | 0.007 |
| Northeast | 103 (14) | 3(4) | 2.8 | |
| Midwest | 234 (32) | 10 (14) | 4.1 | |
| South | 222 (30) | 54 (75) | 19.6 | |
| West | 170 (23) | 5(7) | 2.9 | |
| No. adult beds | | | | 0.005 |
| ≤200 | 185 (25) | 57 (79) | 23.6 | |
| 201–400 | 260 (35) | 14 (19) | 5.1 | |
| 401–600 | 160 (22) | 1 (1) | 0.6 | |
| >600 | 128 (17) | 0 (0) | 0.0 | |
| Trauma ICU | | | | 0.412 |
| Yes | 672 (92) | 38 (53) | 4.7 | |
| No | 58 (8) | 34 (47) | 4.2 | |
| Unknown | 3 (0.4) | 0(0) | 0.0 | |

ICU, intensive care unit.

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**TABLE 4.**

Weighted Complication Rates From NTBD-NSP 2005, 2008–2012

| | 2005* | 2008 | 2009 | 2010 | 2011 | 2012 | *P* |
|---|---|---|---|---|---|---|---|
| Overall complication rate | | | | | | | |
| Excluding *other* category | 4.9% | 8.8% | 8.4% | 8.7% | 8.4% | 9.2% | 0.033 |
| Including *other* category | | — | — | — | 32.2% | 26.2% | n/a |
| Pneumonia | 1.4% | 3.0% | 2.9% | 2.8% | 2.7% | 2.8% | 0.100 |
| ARDS | 0.5% | 1.7% | 1.4% | 1.4% | 1.5% | 1.1% | 0.289 |
| DVT | 0.4% | 1.0% | 1.0% | 1.2% | 1.1% | 1.0% | 0.047 |
| Decubitus ulcer | — | 0.9% | 0.6% | 0.5% | 0.6% | 0.5% | 0.128 |
| Acute renal failure | — | 0.9% | 1.0% | 1.1% | 0.9% | 1.0% | 0.761 |
| Sepsis | — | 0.9% | 0.8% | 0.7% | 0.2% | 0.4% | 0.057 |
| PE | — | 0.4% | 0.3% | 0.3% | 0.3% | 0.4% | 1.000 |
| UTI | 1.1% | — | — | — | 1.5% | 2.0% | 0.290 |

PE, pulmonary embolism.