
Critically Appraising the Quality of Reporting of American College of Surgeons TQIP Studies in the Era of Large Data Research

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- BACKGROUND:** The American College of Surgeons-Trauma Quality Improvement Program (ACS-TQIP) database is one of the most widely used databases for trauma research. We aimed to critically appraise the quality of the methodological reporting of ACS-TQIP studies.
- STUDY DESIGN:** The ACS-TQIP bibliography was queried for all studies published between January 2018 and January 2021. The quality of data reporting was assessed using the Strengthening the Reporting of Observational studies in Epidemiology-Reporting of Studies Conducted Using Observational Routinely Collected Health Data (STROBE-RECORD) statement and the *JAMA Surgery* checklist. Three items from each tool were not applicable and thus excluded. The quality of reporting was compared between high- and low-impact factor (IF) journals (cutoff for high IF is >90th percentile of all surgical journals).
- RESULTS:** A total of 118 eligible studies were included; 12 (10%) were published in high-IF journals. The median (interquartile range) number of criteria fulfilled was 5 (4–6) for the STROBE-RECORD statement (of 10 items) and 5 (5–6) for the *JAMA Surgery* checklist (of 7 items). Specifically, 73% of studies did not describe the patient population selection process, 61% did not address data cleaning or the implications of missing values, and 76% did not properly state inclusion/exclusion criteria and/or outcome variables. Studies published in high-IF journals had remarkably higher quality of reporting than those in low-IF journals.
- CONCLUSION:** The methodological reporting quality of ACS-TQIP studies remains suboptimal. Future efforts should focus on improving adherence to standard reporting guidelines to mitigate potential bias and improve the reproducibility of published studies. (*J Am Coll Surg* 2022;234:989–998. © 2022 by the American College of Surgeons. Published by Wolters Kluwer Health, Inc. All rights reserved.)
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In 2006, the American College of Surgeons (ACS) Committee on Trauma launched the Trauma Quality Improvement Program (TQIP), a collaborative effort aimed at studying outcomes across multiple trauma centers and enhancing the quality of trauma care across the US and Canada.¹ By providing its participating centers with

data reports, the ACS-TQIP allows hospitals to benchmark outcomes and identify areas for potential improvement. Specifically, measuring a certain trauma center's risk-adjusted outcomes, compared with other comparable centers across North America serves as a stimulus to investigate areas of underperformance and disseminate

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Abbreviations and Acronyms

ACS	= American College of Surgeons
EGS	= emergency general surgery
IF	= impact factor
PRISMA	= Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RECORD	= REporting of Studies Conducted Using Observational Routinely Collected Health Data
STROBE	= STREngthening the Reporting of OBServational studies in Epidemiology
TQIP	= Trauma Quality Improvement Program

best practices in areas of excellence. As such, TQIP has helped advance and optimize the quality of trauma care, serving as a powerful tool for participating centers to both improve performance and develop research.²⁻⁵ In the past few years, the ACS-TQIP has become, along with the National Trauma Data Bank, among the most widely used databases for trauma research. By analyzing patient-level data on more than one million patients at nearly 800 participating facilities across North America, researchers are able to use the ACS-TQIP database to: study nationwide trends in trauma care, develop complex trauma outcome predictors, compare rare interventions, and assess variation in healthcare use and delivery.⁶⁻⁹ The current Participant User File contains information on patient demographics, comorbidities, injury characteristics, prehospital care, procedure details, and hospitalization outcomes.¹⁰

In recent years, several other big databases have been frequently used in surgical research, including the ACS-NSQIP and the National Inpatient Sample. Such increasing reliance on large database research to guide clinical decision-making has resulted in concerns over the rigor, consistency, and reproducibility of the methodologies in published studies. Several guidelines have been released to ameliorate the research quality by setting standards of methodological reporting.¹¹⁻¹³ However, previous studies have revealed that compliance with those guidelines is variable and often suboptimal.¹⁴⁻¹⁶ Despite the rapidly growing ACS-TQIP bibliography, there is little information in the literature on the quality of reporting of studies that use this registry. We thus sought to critically appraise the quality of methodological reporting of recent ACS-TQIP studies.

METHODS**Eligibility criteria**

We conducted a search of the complete list of ACS-TQIP publications from January 2018 to January 2021

using the ACS-TQIP online bibliography,¹⁷ which is frequently updated on the basis of PubMed search results and follow-up surveys sent to researchers who use the database. We confirmed, through an independent search of all ACS-TQIP publications in PubMed from January 2018 to January 2021, that all articles that fulfill our inclusion criteria were included in our study. The ACS-TQIP database was launched in 2006, but few studies were published before 2018. We excluded those studies to eliminate any bias from early exploratory work using the database. Studies that used either the adult or the pediatric ACS-TQIP database were included. We excluded studies that

1. linked or compared the ACS-TQIP to other databases,
2. used state-level TQIP databases (eg the Pennsylvania TQIP),
3. aimed to evaluate and discuss how center-specific ACS-TQIP data were used to help the trauma staff improve the quality of care at their center, or
4. were in the form of editorials, reviews, or commentaries.

Selection of studies

A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)-compliant search was conducted. Two review authors (AG, ME) independently screened the titles and abstracts of the ACS-TQIP bibliography. The full text was retrieved and screened for eligibility when a citation was deemed potentially eligible by at least 1 of the 2 authors. Disagreements were resolved through discussion or by consultation with a third independent reviewer (TM). A summary of the selection process is presented in a PRISMA flow diagram (Fig. 1).

Data extraction and management

The following variables were extracted for each study: title, year of publication, number of citations (as of March 2021), country of affiliation of authors, name of the journal of publication, the impact factor (IF) of the journal as indexed by the 2020 Journal Citation Reports,¹⁸ whether the journal had a policy requiring adherence to reporting statements (eg Strengthening the Reporting of Observational studies in Epidemiology [STROBE], PRISMA, CONSORT), ACS-TQIP database years used, number of patients analyzed, and whether a statement of adherence to reporting guidelines was included in the article. When the study included collaborators from different countries, we recorded the country of the corresponding author.

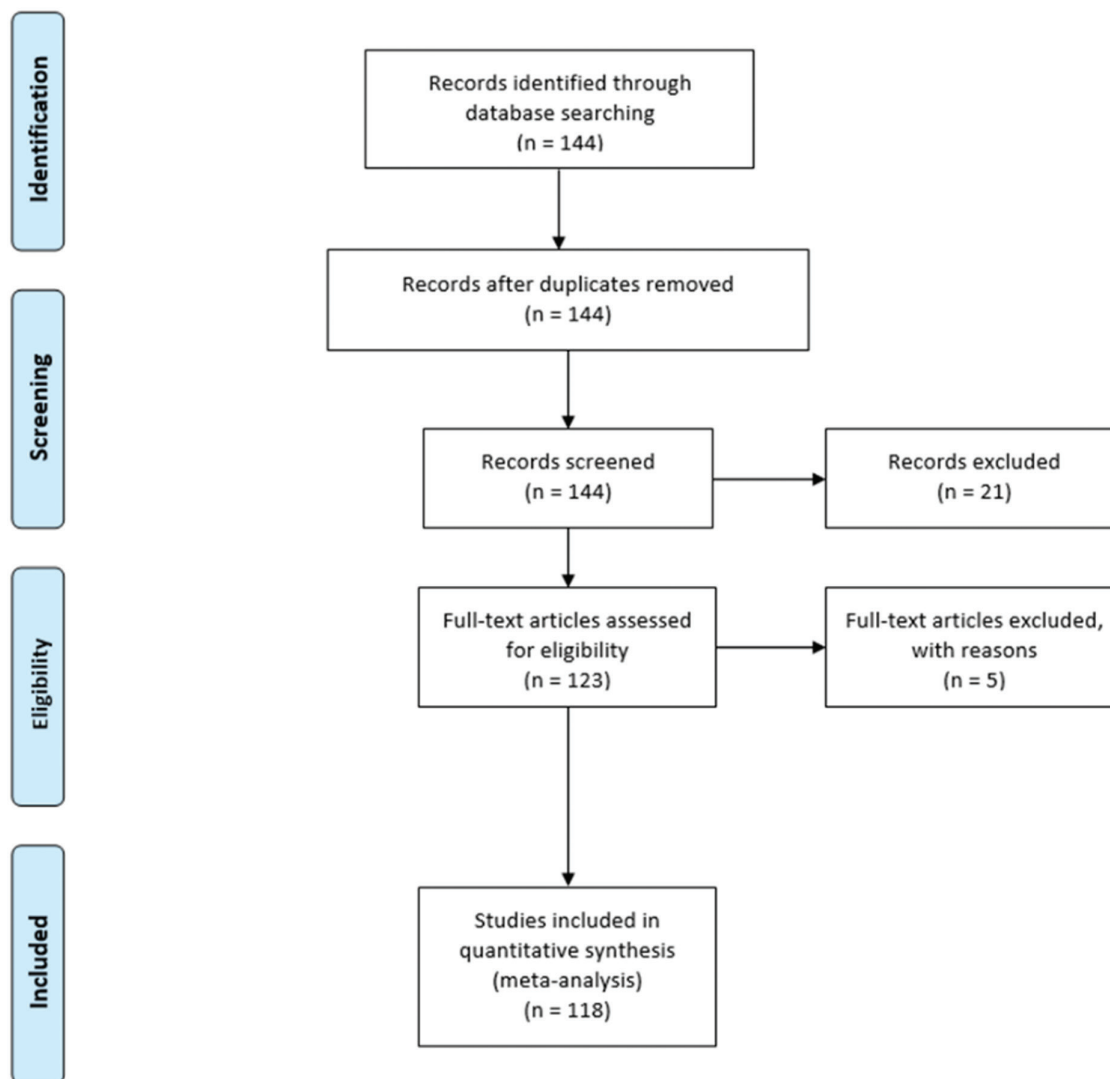


Figure 1. Preferred reporting items for systematic reviews and meta-analyses flow diagram detailing the selection process of studies.

Assessment of methodological reporting quality

Two guidelines were used to assess the quality of reporting of eligible studies. The Reporting of Studies Conducted Using Observational Routinely Collected Health Data (RECORD) Statement was developed in 2015 as an extension of the existing (STROBE) statement to address issues not covered by the latter.^{11,12} The RECORD checklist is specific for observational research that uses routinely collected health data and comprises 13 items including: description of the timeframe of the study, type of data and dataset used, reporting of population selection strategy and process, referencing any validation of population selection, specifying codes to classify exposure, explaining data access and data cleaning methodology, discussing implications of using data that were not collected to

answer the specific research question, and providing access to raw data. The details of the RECORD items are presented in **Supplemental Digital Content 1**, <http://links.lww.com/XCS/A83>.

The Checklist to Elevate the Science of Surgical Database Research was designed by the editors of the journal *JAMA Surgery* to serve as a practical guide for researchers conducting studies on large databases such as the ACS-TQIP and the ACS-NSQIP.¹³ The checklist contains 10 items including: clearly stating the research question and hypothesis, ensuring compliance with the ethics committee, carrying a thorough literature review, assessing the appropriateness of the dataset to answer the research question under study and that data variables have not changed over time, defining eligibility criteria and

outcome variables, explaining procedures to deal with confounders and the effect of missing variables, addressing competing risks, and exploring advancement in knowledge and clinical implications. Details of the checklist criteria are presented in **Supplemental Digital Content 2**, <http://links.lww.com/XCS/A83>.

Data synthesis and statistical analysis

We used the same methodology adopted by Yolcu and colleagues,¹⁹ Khera and colleagues,²⁰ and El Moheb and colleagues.²¹ In summary, the quality of reporting of each study was assessed quantitatively by counting the number of criteria fulfilled with respect to the RECORD statement (of 10) and *JAMA Surgery* checklist (of 7). We excluded studies that linked the ACS-TQIP to other databases, thereby nullifying 3 items from the RECORD statement relating to database linkage. Three items were excluded from the *JAMA Surgery* checklist due to lack of feasibility (carrying a thorough literature review, assessing the appropriateness of the dataset to answer the research question under study, and confirming that data variables have not changed over time). Two of the RECORD statement items concerning population selection were not applicable to studies (n = 57) that used the entire ACS-TQIP dataset. The median RECORD score was calculated by first considering these 2 items as fulfilled, then considering them as unfulfilled, and taking the median value of the 2 numbers. Because all criteria do not have the same impact, our methodology reflects the number of checklist items fulfilled rather than the quality of each study. Following a pilot test, 3 reviewers (AB, DB, and HS) independently scored each article in duplicates. Disagreements were resolved through discussion or with the help of a fourth reviewer (AG). Interrater agreement was calculated for each checklist. The percent agreement for the RECORD statement and the *JAMA Surgery* checklist were 84% and 89%, respectively.

Statistical analysis

The relationship between the RECORD statement and the *JAMA Surgery* checklist scores was assessed by calculating the correlation coefficient r . The total checklist scores and the individual items fulfilled were compared between studies published in high- and low-IF journals. We retrieved the IFs of all surgical journals from the 2020 Journal Citation Reports and calculated the 90th percentile cutoff, which was equal to an IF of 4.306. High IF was defined as an IF above the 90th percentile cutoff. **Supplemental Digital Content 3** at <http://links.lww.com/XCS/A83> describes the IF and reporting policies of all journals that published ACS-TQIP studies. In addition, the quality of reporting

was compared between studies published in journals with and without a policy requiring authors to adhere to reporting statements. Categorical variables are presented as frequencies and percentages. Continuous variables are presented as median and interquartile range. Pearson chi-square test was performed for categorical variables and the Wilcoxon rank-sum test was used for continuous variables. A 2-sided p value less than 0.05 was considered statistically significant for all tests. STATA, version 15.0 (StataCorp) was used for all statistical analyses in this study.

RESULTS

Search results and study characteristics

The study PRISMA flow diagram is presented in [Figure 1](#). A total of 144 studies were identified through our search of the ACS-TQIP bibliography. After full text screening of articles, 118 studies were included in the final analysis.

[Table 1](#) summarizes the characteristics of the included studies. Most studies were conducted in the US (n = 108, 92%). Ninety-four studies (80%) used the adult ACS-TQIP database and 24 (20%) used the pediatric ACS-TQIP database. The 2 most common journals of publication were the *Journal of Trauma and Acute Care Surgery* (n = 21, 18%) and the *Journal of Surgical Research* (n = 20, 17%). The median (interquartile range) impact factor of publishing journals was 2.1 (1.6–3.1), and 12 studies (10%) were published in high-IF journals. Finally, 55 studies (47%) were published in journals that had a policy requiring adherence to reporting guidelines and 8 included a statement of compliance with a reporting guideline in the article.

Fulfillment of criteria in reporting statements

The median scores for the RECORD statement and the *JAMA Surgery* checklist were equal to 5 (4–5) of 10, and 5 (5–6) of 7, respectively. The correlation coefficient r for the relationship between the number of items fulfilled in each checklist was equal to 0.59. [Table 2](#) describes the fulfillment of individual criteria for both adult and pediatric studies. Among the RECORD statement items, most studies discussed the type of data and dataset used (118/118, 100%), addressed the implications of using data not available to answer the specific research question (117/118, 99%), described the timeframe of the study (103/118, 87%), specified the codes used to classify exposure (102/118, 86%), and reported the population selection strategy (42/61, 69%). However, less than half of the studies explained the extent of data access (53/118, 45%) and data cleaning methodology (46/118, 39%).

Table 1. Characteristics of Included Studies

Variable	Adult ACS TQIP (n = 94)	Pediatric ACS TQIP (n = 24)
Year of publication, n (%)		
2018	11 (11.7)	1 (4.2)
2019	32 (34.0)	14 (58.3)
2020	51 (54.3)	8 (33.3)
2021	0 (0.0)	1 (4.2)
Journal, n (%)		
<i>Journal of Trauma & Acute Care Surgery</i>	18 (19.1)	3 (12.5)
<i>Journal of Surgical Research</i>	18 (19.1)	2 (8.3)
<i>Injury</i>	8 (8.5)	1 (4.2)
<i>American Journal of Surgery</i>	7 (7.4)	2 (8.3)
<i>European Journal of Trauma and Emergency Surgery</i>	5 (5.3)	1 (4.2)
<i>Journal of the American College of Surgeons</i>	4 (4.3)	0 (0.0)
<i>The American Surgeon</i>	4 (4.3)	0 (0.0)
<i>Updates in Surgery</i>	4 (4.3)	0 (0.0)
<i>Critical Care Medicine</i>	2 (2.1)	1 (4.2)
<i>Journal of Pediatric Surgery</i>	0 (0.0)	3 (12.5)
<i>Pediatric Surgery International</i>	0 (0.0)	3 (12.5)
<i>Annals of Surgery</i>	1 (1.1)	1 (4.2)
<i>Annals of Vascular Surgery</i>	1 (1.1)	1 (4.2)
<i>JAMA Surgery</i>	2 (2.1)	0 (0.0)
<i>Surgical Infection Society</i>	2 (2.1)	0 (0.0)
<i>Trauma Surgery & Acute Care Open</i>	2 (2.1)	0 (0.0)
<i>Vascular and Endovascular Surgery</i>	2 (2.1)	0 (0.0)
<i>Air Medical Journal</i>	1 (1.1)	0 (0.0)
<i>American Journal of Hospice & Palliative Medicine</i>	1 (1.1)	0 (0.0)
<i>Critical Care</i>	1 (1.1)	0 (0.0)
<i>Journal of Burn Care & Research</i>	1 (1.1)	0 (0.0)
<i>Journal of Child and Adolescent Psychiatric Nursing</i>	0 (0.0)	1 (4.2)
<i>Journal of Emergencies, Trauma, And Shock</i>	1 (1.1)	0 (0.0)
<i>Journal of Intensive Care Medicine</i>	0 (0.0)	1 (4.2)
<i>Journal of Laparoendoscopic & Advanced Surgical Techniques</i>	0 (0.0)	1 (4.2)
<i>Journal of Neurosurgery</i>	1 (1.1)	0 (0.0)
<i>Journal of Neurosurgery. Pediatrics</i>	0 (0.0)	1 (4.2)
<i>Journal of Neurosurgery. Spine</i>	1 (1.1)	0 (0.0)
<i>Journal of Vascular Surgery</i>	1 (1.1)	0 (0.0)
<i>Laryngoscope</i>	1 (1.1)	0 (0.0)
<i>Pediatric Emergency Care</i>	0 (0.0)	1 (4.2)
<i>PLOS One</i>	1 (1.1)	0 (0.0)
<i>Spine</i>	1 (1.1)	0 (0.0)

(Continued)

Table 1. Continued

Variable	Adult ACS TQIP (n = 94)	Pediatric ACS TQIP (n = 24)
<i>The International Journal of Lower Extremity Wounds</i>	1 (1.1)	0 (0.0)
<i>The Journal of Clinical Ethics</i>	0 (0.0)	1 (4.2)
<i>The Surgeon</i>	1 (1.1)	0 (0.0)
<i>World Neurosurgery</i>	1 (1.1)	0 (0.0)
Country of affiliation of authors, n (%)		
US	85 (90.5)	23 (95.8)
Canada	7 (7.4)	1 (4.2)
Sweden	2 (2.1)	0 (0.0)
Journal has policy requiring adherence to reporting guidelines, n (%)	45 (47.9)	10 (41.7)
JCR impact factor, median (IQR)	2.1 (1.8–3.4)	1.8 (1.4–2.1)
High impact factor	10 (10.6)	2 (8.3)
Low impact factor	84 (89.4)	22 (91.7)
Citation rate per year, median (IQR)	1 (0–4)	2 (0–5)
RECORD score (out of 10), median (IQR)	5 (4–6)	5 (4–6)
<i>JAMA Surgery</i> checklist (out of 7), median (IQR)	5 (5–6)	5 (4.5–6)

ACS, American College of Surgeons; IQR, interquartile range; JCR, Journal Citation Reports; RECORD, REporting of studies Conducted using Observational Routinely collected health Data; TQIP, Trauma Quality Improvement Program.

Only 32 of 118 studies (27%) described the population selection process, only 5 studies referenced a validation of population selection, and only 2 provided supplemental access to raw data. Among the *JAMA Surgery* criteria, almost all studies explored advancement in knowledge and clinical implications (117/118, 99%), explained procedures to deal with confounders (115/118, 98%), identified and addressed competing risks (111/118, 94%), and clearly stated the research question and hypothesis (108/118, 92%). Most studies reported compliance with their ethics review committee requirements (93/118, 79%). Less than half the studies discussed the effect of missing data (46/118, 39%), and less than a quarter of them defined eligibility criteria and outcome variables (28/118, 24%).

High vs low IF journals

Of the 118 studies, 12 (10%) were published in high-IF and 106 (90%) were published in low-IF journals. [Table 3](#) and [Supplemental Digital Content 4](#) at <http://links.lww.com/XCS/A83> compare criteria fulfillment by journal IF for adult and pediatric reports, respectively. A greater number of studies published in high-IF journals explained the extent of data access (75% vs 42%, $p = 0.027$) and data

Table 2. Criteria Fulfillment of Adult and Pediatric ACS TQIP Studies

Criteria	Adult ACS TQIP (n = 94)	Pediatric ACS TQIP (n = 24)	p Value
RECORD item			
Discussed type of data or name of dataset in title or abstract	94 (100)	24 (100)	-
Discussed implications of using data not available to answer the specific research question	93 (99)	24 (100)	0.61
Specified codes to classify exposure	84 (89)	18 (75)	0.067
Specified geographical region and timeframe in title or abstract	81 (86)	22 (92)	0.47
Described population selection strategy*	35 (70)	7 (64)	0.68
Discussed extent of data access	39 (41)	14 (58)	0.14
Discussed data cleaning methodology	35 (37)	11 (46)	0.44
Specified population selection process	27 (29)	5 (21)	0.44
Provided validation of population selection*	4 (8)	1 (9)	0.90
Provided supplemental information	0 (0)	2 (8)	0.005†
JAMA Surgery checklist item			
Discussed procedures to deal with confounders	94 (100)	21 (88)	<0.001†
Discussed advancement in knowledge and clinical implications	93 (99)	24 (100)	0.61
Identified and addressed competing risks	89 (95)	22 (92)	0.58
Solid research question and hypothesis	88 (94)	20 (83)	0.11
Statement of compliance with institutional review board	75 (80)	18 (75)	0.61
Discussed effect of missing data	35 (37)	11 (46)	0.44
Defined inclusion/exclusion criteria, outcome variables and included flowchart diagram	23 (24)	5 (21)	0.71

Data presented as n (%).

*Could not be assessed in 57 studies that used the entire ACS TQIP dataset

†p < 0.05.

ACS, American College of Surgeons; RECORD, REporting of studies Conducted using Observational Routinely collected health Data; TQIP, Trauma Quality Improvement Program.

cleaning methodology (67% vs 36%, $p = 0.038$), defined eligibility criteria and outcome variables (50% vs 21%, $p = 0.024$), and discussed the effect of missing data (67% vs 36%, $p = 0.038$). There were no other statistically significant differences between the 2 groups.

Journals with vs without a policy for reporting guidelines

Of the 118 included studies, 55 (47%) were published in journals requiring adherence to reporting guidelines. [Table 4](http://links.lww.com/XCS/A83) and [Supplemental Digital Content 5](#) at <http://links.lww.com/XCS/A83> compare criteria fulfillment in journals with and without a policy requiring adherence to reporting statements for adult and pediatric reports, respectively. Studies published in journals with a policy for reporting guidelines were more likely to describe the population selection strategy (45% vs 27%, $p = 0.02$), whereas studies published in journals without such a policy were more likely to report the extent of data access (54% vs 35%, $p = 0.034$). There were no other statistically significant differences between the groups.

DISCUSSION

During the past 2 decades, there has been a growing interest in big data trauma research specifically using the ACS-TQIP database. In the current review, we present an appraisal of the quality of methodological reporting of published ACS-TQIP studies. We found that the majority of those studies failed to describe the population selection process, provide a validation of population selection, and clearly define eligibility criteria and outcome variables. Studies published in high-IF journals had better adherence to reporting guidelines, but there was no difference in the quality of reporting between articles published in journals with or without policies requiring adherence to reporting statements. The aforementioned suboptimal methodological reporting quality raises concerns over the risk of bias and questions the true reproducibility of these studies. We especially find some of these results concerning because several of these studies can directly impact patient care and future designs of trauma systems. Further efforts should focus on reducing the variability in large data research as well as improving compliance with published reporting guidelines.

Table 3. Criteria Fulfillment of Adult ACS TQIP Studies Published in High- vs Low-Impact Factor Journals

Adult ACS TQIP	Low-IF journal (n = 84)	High-IF journal (n = 10)	p Value
10-Item RECORD statement			
Discussed type of data or name of dataset in title or abstract	84 (100)	10 (100)	–
Specified geographical region and timeframe in title or abstract	71 (85)	10 (100)	0.18
Specified population selection strategy*	29 (67)	6 (86)	0.33
Provided validation of population selection*	3 (7)	1 (14)	0.51
Specified codes to classify exposure	75 (89)	9 (90)	0.94
Discussed extent of data access	31 (37)	8 (80)	0.009†
Discussed data cleaning methodology	28 (33)	7 (70)	0.02†
Described population selection process	22 (26)	5 (50)	0.12
Discussed implications of using data not available to answer the specific research question	83 (99)	10 (100)	0.73
Provided supplemental information	0 (0)	0 (0)	–
7-Item JAMA Surgery checklist			
Solid research question and hypothesis	79 (94)	9 (90)	0.62
Statement of compliance with institutional review board	65 (77)	10 (100)	0.10
Defined inclusion/exclusion criteria, outcome variables and included flowchart diagram	18 (21)	5 (50)	0.05†
Discussed procedures to deal with confounders	84 (100)	10 (100)	–
Identified and addressed competing risks	79 (94)	10 (100)	0.43
Discussed effect of missing data	28 (33)	7 (70)	0.02†
Discussed advancement in knowledge and clinical implications	83 (99)	10 (100)	0.73

Data presented as n (%)

*Could not be assessed in 57 studies that used the entire ACS TQIP dataset.

†p < 0.05

ACS, American College of Surgeons; IF, impact factor; RECORD, REporting of studies Conducted using Observational Routinely collected health Data; TQIP, Trauma Quality Improvement Program

Previous studies in the literature examined the adherence of large database studies to reporting guidelines. El Moheb and colleagues²¹ assessed the quality of reporting of emergency general surgery (EGS) studies that used the ACS-NQIP database. Providing supplemental information was the least fulfilled RECORD item and was absent in 99% of EGS studies. Similarly, this was almost always (98%) overlooked in ACS-TQIP studies. With respect to the *JAMA Surgery* checklist, EGS studies most commonly failed to clearly define eligibility criteria and outcome variables and to include a flowchart diagram (89%). This was also the least fulfilled criterion in our study, absent in 76% of studies. Yolcu and colleagues,¹⁹ on the other hand, described higher compliance with reporting guidelines in neurosurgery articles that used the ACS-NSQIP database. The median scores for the RECORD and *JAMA Surgery* checklists were equal to 9 and 6, respectively, compared with 5 and 5 in our study. The similarly suboptimal quality of EGS ACS-NSQIP studies reported by El Moheb and colleagues²¹ and Trauma ACS-TQIP studies we report here perhaps reflects the overlap between research groups publishing in trauma and EGS, that

is, acute care surgery, and the journals that publish trauma- and EGS-related investigations. Those findings underpin the need to enforce adherence to reporting statements in large database trauma and acute care surgery research.

We found a moderately improved quality of reporting for studies published in high-IF journals. A 2012 study by Bridoux and colleagues²² found a correlation between the journal IF and the methodological and ethical quality of gastrointestinal surgery randomized controlled trials. Specifically, a higher IF predicted better study quality even after adjusting for trial size and sources of funding. Similarly, Ahmed Ali and colleagues²³ demonstrated a moderate improvement in methodological quality of surgical randomized controlled trials published in high-IF journals. In contrast, El Moheb and colleagues²¹ found that the quality of EGS-NSQIP studies remained suboptimal even among those published in high-IF journals. These mixed findings speak to the importance of standardizing not only journal policies on reporting data, but also consistent implementation of such policies in all journals. This is of particular importance because ACS-TQIP articles

Table 4. Criteria Fulfillment of Adult ACS TQIP Studies Published in Journals With and Without Policies Requiring Adherence to Reporting Statements

Adult ACS TQIP	Journals without reporting statement policy (n = 49)	Journals with reporting statement policy (n = 45)	p Value
10-Item RECORD statement			
Discussed type of data or name of dataset in title or abstract	49 (100)	45 (100)	-
Specified geographical region and timeframe in title or abstract	40 (82)	41 (91)	0.18
Specified population selection strategy*	15 (56)	20 (87)	0.02†
Provided validation of population selection*	3 (11)	1 (4)	0.38
Specified codes to classify exposure	43 (88)	41 (91)	0.60
Discussed extent of data access	23 (47)	16 (36)	0.26
Discussed data cleaning methodology	15 (31)	20 (44)	0.17
Described population selection process	11 (22)	16 (36)	0.16
Discussed implications of using data not available to answer the specific research question	48 (98)	45 (100)	0.34
Provided access to supplemental information	0 (0)	0 (0)	-
7-Item JAMA Surgery checklist			
Solid research question and hypothesis	45 (92)	43 (96)	0.46
Statement of compliance with institutional review board	38 (78)	37 (82)	0.57
Defined inclusion/exclusion criteria, outcome variables and included flowchart diagram	9 (18)	14 (31)	0.15
Discussed procedures to deal with confounders	49 (100)	45 (100)	-
Identified and addressed competing risks	46 (94)	43 (96)	0.72
Discussed effect of missing variables	16 (33)	19 (42)	0.34
Discussed advancement in knowledge and clinical implications	48 (98)	45 (100)	0.34

Data presented as n (%).

*Could not be assessed in 57 studies that used the entire ACS TQIP dataset.

†p < 0.05.

ACS, American College of Surgeons; IF, impact factor; RECORD, REporting of studies Conducted using Observational Routinely collected health Data; TQIP, Trauma Quality Improvement Program.

were most commonly published in *Journal of Trauma and Acute Care Surgery* and *Journal of Surgical Research*, and although both journals have lower IFs, they are nonetheless significant to trauma surgeons and should follow a rigorous peer-review process.

Emphasizing the aforementioned, we found no difference between the quality of studies published in journals with and without a policy requiring adherence to reporting guidelines. In addition, only a few articles included a statement of compliance with one of the reporting guidelines. Several studies have previously reported low rates of adherence to reporting guidelines in the literature.^{14,24-26} The STROBE and *JAMA Surgery* statements were put forward with the specific goal of improving the quality of surgery research and a large number of journals require adherence to at least one reporting guideline. However, it is clear that those policies are not strictly enforced. Sharp and colleagues²⁷ surveyed authors of observational studies on their attitude toward and experiences with the STROBE

statement. Their findings suggested significant misunderstandings about STROBE's purpose and content, and an absence of perceived incentive to use it. Surgical journals can remediate this problem by systematically including such a step in the peer-review process and by raising awareness regarding the importance of using reporting guidelines to facilitate study reproducibility and improve the trustworthiness of the data when used in clinical decision-making. Such initiatives are crucial to address skepticism over reporting statements and dismantle the misconceived beliefs that their purpose is purely administrative.

Our study has a few limitations. First, all checklist items are close-ended questions and as such do not capture the comprehensiveness of fulfillment of each criterion. Second, not all criteria have the same impact on the quality of published studies. As a result, our methodology reflects the number of checklist items fulfilled rather than the real quality of each study. Third, a small number of studies used the pediatric ACS-TQIP

database, prohibiting confident generalizations on that cohort. Fourth, we did not analyze individual studies to assess the types of bias introduced by low adherence to reporting guidelines. Fifth, we limited our search to PubMed, and it is possible that other published articles using ACS-TQIP were missed.

CONCLUSIONS

The methodological reporting quality of ACS-TQIP studies remains suboptimal. This can potentially lead to biased results, nonreproducible findings, and questionable trustworthiness of conclusions. Increased attention should be given to the reporting quality of large database trauma research to ensure the highest scientific and ethical standards. Future efforts should focus on improving adherence to standard reporting policies to mitigate potential sources of bias and improve the reproducibility of published studies.

Author Contributions

Study conception and design: Gebran, Mahmoud, El Moheb, Nederpelt, Joseph, Nathens, Kaafarani

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REFERENCES

1. Newgard CD, Fildes JJ, Wu L, et al. Methodology and analytic rationale for the American College of Surgeons Trauma Quality Improvement Program. *J Am Coll Surg* 2013;216:147–157.
2. The American College of Surgeons Trauma Quality Improvement Program. Available at: <https://www.facs.org/quality-programs/trauma/tqip/center-programs/tqip>. Accessed October 7, 2021.
3. Hornor MA, Hoefl C, Nathens AB. Quality benchmarking in trauma: from the NTDB to TQIP. *Curr Trauma Rep* 2018;4:160–169.
4. Blackmore AR, Leonard J, Madayag R, et al. Using the trauma quality improvement program metrics data to enhance clinical practice. *J Trauma Nurs* 2019;26:121–127.
5. Liu JY, Hu QL, Ko CY. Databases for surgical health services research: National Trauma Data Bank and Trauma Quality Improvement Program. *Surgery* 2018;164:919–920.
6. Sakran JV, Nance M, Riall T, et al. Pediatric firearm injuries and fatalities: do racial disparities exist? *Ann Surg* 2020;272:556–561.
7. Maurer LR, Bertsimas D, Bouardi HT, et al. Trauma outcome predictor: an artificial intelligence interactive smartphone tool to predict outcomes in trauma patients. *J Trauma Acute Care Surg* 2021;91:93–99.
8. Benjamin E, Recinos G, Aiolfi A, et al. Pharmacological thromboembolic prophylaxis in traumatic brain injuries: low molecular weight heparin is superior to unfractionated heparin. *Ann Surg* 2017;266:463–469.
9. Joseph B, Zeeshan M, Sakran JV, et al. Nationwide analysis of resuscitative endovascular balloon occlusion of the aorta in civilian trauma. *JAMA Surg* 2019;154:500–508.
10. Trauma Quality Programs (TQP) Participant Use File (PUF) User Manual Admission Year 2019. Available at: https://www.facs.org/-/media/files/quality-programs/trauma/tqip/tqip_puf_user_manual.ashx. Accessed October 7, 2021.
11. Benchimol EI, Smeeth L, Guttman A, et al; RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) statement. *PLoS Med* 2015;12:e1001885.
12. von Elm E, Altman DG, Egger M, et al; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. *Int J Surg* 2014;12:1495–1499.
13. Haider AH, Bilimoria KY, Kibbe MR. A checklist to elevate the science of surgical database research. *JAMA Surg* 2018;153:505–507.
14. Samaan Z, Mbuagbaw L, Kosa D, et al. A systematic scoping review of adherence to reporting guidelines in health care literature. *J Multidiscip Healthc* 2013;6:169–188.
15. Pouwels KB, Widyakusuma NN, Groenwold RH, et al. Quality of reporting of confounding remained suboptimal after the STROBE guideline. *J Clin Epidemiol* 2016;69:217–224.
16. Sharp MK, Tokalić R, Gómez G, et al. A cross-sectional bibliometric study showed suboptimal journal endorsement rates of STROBE and its extensions. *J Clin Epidemiol* 2019;107:42–50.
17. Trauma Quality Improvement Program (TQIP) Bibliography. Available at: https://www.facs.org/-/media/files/quality-programs/trauma/tqip/tqip_bibliography.ashx. Accessed October 7, 2021.
18. Journal Citation Reports. Available at: <https://clarivate.com/webofsciencegroup/solutions/journal-citation-reports/>. Accessed October 7, 2021.
19. Yolcu Y, Wahood W, Alvi MA, et al. Reporting methodology of neurosurgical studies utilizing the American College of Surgeons-National Surgical Quality Improvement Program Database: a systematic review and critical appraisal. *Neurosurgery* 2020;86:46–60.
20. Khera R, Angraal S, Couch T, et al. Adherence to methodological standards in research using the National Inpatient Sample. *JAMA* 2017;318:2011–2018.
21. El Moheb M, Sabbagh H, Badin D, et al. Appraising the quality of reporting of American College of Surgeons NSQIP emergency general surgery studies. *J Am Coll Surg* 2021;232:671–680.

22. Bridoux V, Moutel G, Roman H, et al. Methodological and ethical quality of randomized controlled clinical trials in gastrointestinal surgery. *J Gastrointest Surg* 2012;16:1758–1767.
23. Ahmed Ali U, Reiber BMM, Ten Hove JR, et al. Journal impact factor and methodological quality of surgical randomized controlled trials: an empirical study. *Langenbecks Arch Surg* 2017;402:1015–1022.
24. Balasubramanian SP, Wiener M, Alshameeri Z, et al. Standards of reporting of randomized controlled trials in general surgery: can we do better? *Ann Surg* 2006;244:663–667.
25. Pussegoda K, Turner L, Garritty C, et al. Systematic review adherence to methodological or reporting quality. *Syst Rev* 2017;6:131.
26. Stevens A, Shamseer L, Weinstein E, et al. Relation of completeness of reporting of health research to journals' endorsement of reporting guidelines: systematic review. *BMJ* 2014;348:g3804.
27. Sharp MK, Glonti K, Hren D. Online survey about the STROBE statement highlighted diverging views about its content, purpose, and value. *J Clin Epidemiol* 2020;123:100–106.