Clinical and Economic Outcomes Associated with Blood Transfusion During Inpatient Hospitalization: An Analysis of the 2004 Healthcare Cost and Utilization Project Nationwide Inpatient Sample Database

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BACKGROUND

- Trauma, surgery, and abnormalities in hemostasis are common causes of excessive bleeding and often precipitate the need for blood transfusion.
- In 2004, over 10 million units of whole blood and red blood cells (RBCs) were provided to an estimated 5.3 million patients in the U.S.
- For some patients, blood transfusion is a necessary and lifesaving intervention; however, many transfusion medicine experts describe blood transfusion as an imperfect solution to managing blood loss.2,3
  - Although blood transfusion has a high therapeutic index, a preponderance of evidence on studies on subgroups of surgical patients suggests that blood transfusion may be an independent risk factor for negative clinical outcomes, including postoperative infection, non-infectious complications, poor postoperative functional recovery, and increased mortality.4,5
- The inherent risks and adverse outcomes associated with blood transfusion necessitate ongoing efforts to raise awareness of the prevalence and clinical impact of blood transfusion in hospitalized patients.
- To date, the association of blood transfusion with negative clinical outcomes has primarily been demonstrated in subsets of surgical patients, including coronary artery bypass graft surgery (CABG), hip and knee replacement, trauma, and colorectal surgery patients.6,7
- To the best of our knowledge, no study has assessed—from a national perspective—prevalence and outcomes associated with blood transfusion across the full spectrum of surgical procedures and clinical conditions warranting inpatient care.

OBJECTIVE

To assess—from a national perspective—prevalence and outcomes associated with blood transfusion across the full spectrum of surgical procedures and clinical conditions warranting inpatient care.

METHODS

Study Design

- In this retrospective, cohort study, the prevalence of blood transfusion, as well as morbidity, mortality, and resource outcomes were examined for all discharges (discharges) in the U.S. in 2004 using the Agency for Healthcare Research and Quality’s (AHRQ) 2004 Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample (NIS) database.2,9
- All discharges from NIS 2004 were categorized into two groups by International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) procedure codes for blood transfusion.
  - Discharges with at least one primary or secondary ICD-9-CM procedure code indicating perioperative autologous transfusion (99.00), transfusion of previously collected autologous blood (99.01), and transfusion of packed cells (99.04) were grouped in a cohort labeled “Transfused”.
  - All other discharges were grouped into a second cohort labeled “Non-Transfused”.
- The 10 most common primary procedures performed during the course of an inpatient stay involving blood transfusion were identified using clinical classification software (CCS) categories.
  - CCS categories are an analytic tool provided by AHRQ to support the HCUP. ICD-9-CM codes are collapsed into a smaller number of clinically meaningful categories that are sometimes more useful for presenting descriptive statistics than are individual ICD-9-CM codes.

Data Collected

- Age, gender, primary payer source, Charlson comorbidity index (one-year mortality risk attributable to comorbidity),10 and admission type were assessed for all discharges and each study cohort.
- Length of stay (LOS), postoperative infections, non-infectious transfusion-related complications, in-hospital mortality, and total charges (hospital bills) were evaluated for all discharges.

Statistical Analyses

- The F-test and the Rao-Scot chi-square test were used to test for differences in means and frequencies, respectively, between the two cohorts.
- Odds ratios for death and infection, as well as incremental between-cohort differences in LOS and total charges were calculated after controlling for age, gender, Charlson comorbidity index, admission type, diagnosis-related group (DRG), payer (for LOS only), and LOS (for total charges only).
- Significance was determined at an alpha level less than 0.05.

RESULTS

Study Sample Composition

- Based on 2004 NIS data, of the estimated 38.7 million discharges in the U.S. in 2004, 5 percent (2 million) were associated with an ICD-9-CM code for blood transfusion.
- The 10 most common CCS categories for procedures performed during the course of hospitalization as a blood transfusion accounted for more than 10 percent of all hospitalizations and 36 percent of hospitalizations in the Transfused cohort.
- Orthopedic, cardiovascular, and colorectal procedures accounted for 13, 7, and 4 percent of discharges associated with blood transfusion (Table 1).
- Blood transfusion occurred with the greatest frequency for discharges associated with hip-related procedures (26% to 29%), followed by CABG (23%).

<table>
<thead>
<tr>
<th>Top 10 Most Common CCS Categories of Procedures Performed During Same Hospitalization as Blood Transfusion (%)</th>
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<tbody>
<tr>
<td>Sub-Category</td>
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<tr>
<td>Orthopedic</td>
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<td>Cardiovascular</td>
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<td>Colorectal</td>
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Outcomes

- LOS, costs, mortality risk, and infection risk were significantly higher in transfused than in non-transfused patients.
- Average LOS was 3 days higher and charges were $8,476 higher for the Transfused cohort (p<0.001; F-test) compared to the Non-Transfused cohort (Table 2).

<table>
<thead>
<tr>
<th>Table 2: Incremental Differences in LOS and Total Charges Between Transfused and Non-Transfused Cohorts</th>
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<tbody>
<tr>
<td>Sub-Category</td>
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<tr>
<td>LOS (days)</td>
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<td>Charges ($1000)</td>
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The Transfused cohort had a 1.6 times higher odds of death (p<0.001; Rao-Scot chi-square test) and a 2.3 times higher odds of infection (p<0.001; Rao-Scot chi-square test) compared to the Non-Transfused cohort (Figure 2).

CONCLUSIONS

- More than 2 million hospitalized patients receive a blood transfusion annually.
- After controlling for potentially confounding variables, transfused patients are at greater risk for adverse events than non-transfused patients.
  - Increased mortality and infection risk, as previously demonstrated in patients undergoing cardiac surgery,4,6
  - Increased hospital resource use.
- The association between blood transfusion and negative clinical outcomes warrants further investigation to better identify the appropriateness of current transfusion triggers and to develop and implement more effective approaches to reduce the non-emergent use of blood in hospitalized patients.
- Raising awareness about the potential negative clinical and economic outcomes of blood transfusion should encourage the adoption of blood conservation techniques and strategies to reduce perioperative blood loss and optimize its management.
- Minimize the inappropriate use of blood, and ultimately, yield meaningful clinical benefits at the individual patient level.

REFERENCES


STUDY LIMITATIONS

- NIS data are derived from discharge record abstractions.
  - Detailed and precise information was not available to validate that a blood transfusion procedure was performed or that a patient actually experienced a negative outcome that was directly attributable to a blood transfusion.
- Cross-sectional survey databases such as NIS do not provide preadmission or post-hospital discharge data.
  - Without this additional data, the nature or severity of blood loss, specific trigger for blood transfusion, or link between procedure and timing of blood transfusion (e.g., pre-, intra-, or post-operative) cannot be accurately determined.
- Blood transfusion procedure codes are likely to be underreported.
  - As such, we may not have captured all relevant cases, which would underestimate the true prevalence of blood transfusion in hospitalized patients, affect demographic composition of the study population, and influence outcomes of interest such as LOS, postoperative infection rates, and mortality.
- The association between blood transfusion type (i.e., autologous versus allogeneic) and clinical outcomes was not assessed.

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