

RESEARCH LETTERS

Role of Transfusion in the Development of Urinary Tract-Related Bloodstream Infection

There is a growing body of evidence that transfusion alters host defenses against infection.¹ A meta-analysis of randomized controlled trials demonstrated that a restrictive approach to red blood cell (RBC) transfusion decreases the risk of infection by 24%.² This evidence has prompted changes in guidelines for the use of RBC transfusion.³ The objective of this investigation was to examine whether transfusion affects the risk of developing a bloodstream infection from a urinary source.

Methods. A matched case-control study was conducted at the University of Michigan Health System, Ann Arbor, from January 1, 2000, through September 30, 2008. Cases (n=299) were adults who had both a positive urine and blood culture with the same microorganism during hospitalization. Patients with a positive urine culture within the first 2 days of admission or who were admitted for septicemia or bacteremia were excluded. Controls (n=670) were selected by incidence density sampling and included adults with a positive urine culture who were at risk of a bloodstream infection but did not develop such an infection. Controls were matched to each case by calendar time (within 120 days) when the bloodstream infection occurred in the case. At maximum, there were 4 controls per case but, owing to constraints of the control definition, some cases were matched to 1 to 3 con-

trols. A similar period was compared for cases and controls. That is, if the urinary tract-related bloodstream infection occurred on the 20th day after hospital admission for the case, a similar period was evaluated in the matched control (from admission to the 20th day of hospitalization). For purposes of this investigation, this day was labeled the "index date."

Information was extracted from electronic medical records, with additional medical chart review by an infectious diseases physician. Conditional logistic regression was used, which accounted for the matched design. Adjusted models included RBC, platelets, fresh-frozen plasma, medication use during the 2 days prior to the index date (antibacterial, antifungal, antimicrobial, antiviral, statin, insulin, and immunosuppressants), age, race, sex, surgery (cardiovascular, gastrointestinal, or other), cardiovascular disease, cancer, and diabetes mellitus. To evaluate possible nonlinear associations between the volume of blood component and the outcome, fractional polynomials were used. For those analyses in which the age of the RBC unit was evaluated, some patients received multiple units, and therefore we used the expiration date for the oldest RBC unit given.

This study was approved by the University of Michigan Health System institutional review board.

Results. Cases were younger than controls ($P=.001$) and were more likely to be male ($P<.001$). For those patients who developed a bloodstream infection, the median time between admission and bloodstream infection was 13 days. Patients with a principal diagnosis of cancer were significantly more likely to develop urinary tract-related bloodstream infection ($P=.001$), as were patients who underwent surgery ($P<.001$). Approxi-

Table. Relative Odds of Developing a Urinary Tract-Related Bloodstream Infection by Type of Blood Component Received

Blood Component	No.	Volume, Median [IQR], L ^a	OR (95% CI)	
			Unadjusted	Adjusted ^b
RBCs (yes/no)	969	1.4 [0.7-3.0]	6.20 (4.24-9.06)	4.84 (2.90-8.06)
RBCs without PLT or FFP (yes/no) ^c	707	0.7 [0.7-1.4]	3.92 (2.36-6.51)	4.80 (2.49-9.25)
RBCs length of storage, wk	441	1.4 [0.7-3.0]	1.31 (1.09-1.58)	1.63 (1.12-2.38) ^d
PLTs (yes/no)	969	0.7 [0.5-1.7]	5.25 (3.55-7.76)	1.28 (0.69-2.36)
PLTs, L	969	0.7 [0.5-1.7]	1.62 (1.36-1.94)	1.15 (0.98-1.36)
FFP (yes/no)	969	1.5 [0.6-2.9]	3.42 (2.31-5.07)	1.66 (0.93-2.94)
FFP, L	969	1.5 [0.6-2.9]	1.39 (1.22-1.59)	1.14 (0.99-1.33)

Abbreviations: CI, confidence interval; FFP, fresh-frozen plasma; IQR, interquartile range; OR, odd ratio; PLTs, platelets; RBCs, red blood cells.

^aMedian volume and interquartile range for those who received the blood component.

^bModels included RBC, PLT, FFP, age (centered on mean), sex, race, medications (antibacterials, antimicrobials, antifungals, antivirals, immunosuppressants, insulin, statin), diabetes, cardiovascular disease, cancer, and surgery (cardiovascular, digestive tract, other).

^cPatients who received PLT or FFP were excluded.

^dAdjusted model also included volume (liters) of RBC units. Only subjects receiving RBC were included.

mately a third of patients who developed urinary tract-related bloodstream infection (32.4%) died while in the hospital, compared with 4.5% in the controls ($P < .001$).

There was a significant relationship between RBC transfusion prior to the bloodstream infection but not platelet or fresh-frozen plasma transfusion (**Table**). The odds of developing a bloodstream infection were 4.84 times greater in patients who received a RBC transfusion compared with those who did not. When patients receiving platelet or fresh-frozen plasma transfusions were excluded, the odds of developing a bloodstream infection were 4.80 times greater in those who received an RBC transfusion. There was a significant dose response; for those receiving RBCs, the probability of developing a bloodstream infection rose as the total volume of RBC transfusion increased during hospitalization. However, the relationship was nonlinear, such that the greatest unit increase in the probability of bloodstream infection occurred between 1 U (250 mL) and 2 U of RBCs (odds ratio, 1.97 for 500 vs 250 mL) and then gradually increased with greater RBC volume.

Prolonged RBC storage was associated with an increased likelihood of infection. In patients who received RBC transfusion, the odds of developing a bloodstream infection increased by 63% for every week of increased storage (Table). There was a significant correlation between the length of hospital stay and the age of the RBCs received in the case group (Spearman ρ , 0.21; $P = .003$) and in the control group (Spearman ρ , 0.15; $P = .02$).

Comment. This study provides evidence that an infection originating in the urinary tract may be more likely to spread to the bloodstream in patients who receive a RBC transfusion. The odds of developing bloodstream infection increased nearly 5-fold with receipt of RBC transfusion. A dose response was evident. A Cochrane meta-analysis of 4 randomized controlled trials designed to test the effect of RBC transfusion on infection (1788 patients) yielded results congruent to our study; restrictive RBC transfusion strategies reduced the rate of infection by 24%.² However, our study was observational, and as such, there is a possibility of residual confounding.

Our findings also suggest that in patients given a RBC transfusion, the risk of urinary tract-related bloodstream infection increases with the length of RBC storage, independent of the total volume of RBCs received. Changes in the morphology and biochemistry of stored RBCs have been extensively documented.⁴ Evidence regarding the effects of aged RBC transfusion is conflicting and therefore, there are trials under way to assess hypotheses related to the age of RBCs.⁵

In conclusion, the decision to order a RBC transfusion in a patient with a urinary tract infection should involve careful deliberation, keeping in mind updated evidence-based guidelines. Our results suggest that if a RBC transfusion is needed, administering 1 U of RBCs instead of the usual 2 U of RBCs at a given time may confer less potential risk of bloodstream infection. Our study also indicates that older RBCs may pose a greater infec-

tion risk, although ongoing randomized controlled trials should provide additional insight.

Mary A. M. Rogers, PhD
Neil Blumberg, MD
Joanna M. Heal, MD
Latoya Kuhn, MPH
M. Todd Greene, PhD
Emily Shuman, MD
Carol E. Chenoweth, MD
Robert Chang, MD
Sanjay Saint, MD, MPH

Author Affiliations: Department of Internal Medicine (Drs Rogers, Greene, Shuman, Chenoweth, Chang, and Saint) and Department of Infection Control and Epidemiology (Dr Chenoweth), University of Michigan Health System, Ann Arbor; Department of Pathology and Laboratory Medicine, University of Rochester Medical Center, Rochester, New York (Dr Blumberg); Department of Medicine, Hematology-Oncology Unit, University of Rochester, Rochester (Dr Heal); and Health Services Research & Development, Ann Arbor Veterans Affairs Medical Center, Ann Arbor (Ms Kuhn and Dr Saint)

Correspondence: Dr Rogers, Department of Internal Medicine, University of Michigan, 300 N Ingalls, Room 7E07, Ann Arbor, MI 48109 (maryroge@umich.edu).

Author Contributions: Dr Rogers had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Rogers, Blumberg, Kuhn, Chenoweth, and Saint. *Acquisition of data:* Rogers and Shuman. *Analysis and interpretation of data:* Rogers, Blumberg, Heal, Kuhn, Greene, Chenoweth, and Chang. *Drafting of the manuscript:* Rogers, Blumberg, Heal, Kuhn, and Chenoweth. *Critical revision of the manuscript for important intellectual content:* Rogers, Blumberg, Heal, Greene, Shuman, Chenoweth, Chang, and Saint. *Statistical analysis:* Rogers, Kuhn, and Greene. *Obtained funding:* Rogers and Saint. *Administrative, technical, and material support:* Shuman. *Study supervision:* Rogers, Shuman, and Saint.

Financial Disclosure: None reported.

Funding/Support: This project was funded by grant DK078717 from The National Institute of Diabetes and Digestive and Kidney Diseases. It was also supported in part by grants HL078603, HL095467, and HL100051 from the National Heart, Lung, and Blood Institute.

Role of the Sponsors: Other than initial scientific review and approval for funding, the National Institutes of Health had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript.

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Variations in Structure and Content of Online Social Networks for Patients With Diabetes

With the exponential growth of Facebook and other social networking sites, patients are increasingly seeking information and emotional support online, from other patients.^{1,2} Recent qualitative studies highlight the great potential that online social networks represent as a source of information and encouragement in chronic disease management.³⁻⁵ However, recent research has also identified potential pitfalls in these unregulated sites.^{3,6} More than 25% of posts on Facebook sites for diabetic individuals were promotional in nature, largely directing patients to learn about products not approved by the Food and Drug Administration, and substantial efforts to gather data from Web site participants were noted.³ These findings underscore the need to guarantee the authenticity of participants and to ensure that online social networks are safe locations for patients to share information.

We know little about how commonly used sites validate the authenticity of participants' claimed identities or how they provide oversight over the content posted by participants. In addition, little is known about the structure of communication, the sources of funding, and the presence or use of advertising on these sites. Accordingly, we conducted a survey of online social networking sites to explore characteristics of these communities and to better inform physicians and patients about the choices available to them.

Methods. Search Criteria and Methodology. We identified the most commonly used online social networking Web sites focused on diabetes, a common but complex chronic condition. On November 17, 2010, using Google search methodology, we used the Boolean terms *social network AND diabetes* without language or geographic search modifiers and selected the top 300 results for further classification.^{7,8} We excluded any link to a secondary source (news, academic, or blog article), yielding 23 Web sites. Using a modified 3-part definition of social network sites developed by Boyd and Ellison⁹ as inclusion criteria, we identified 15 social networking sites as our final sample.

Social Network Web Site Assessment. Each Web site was evaluated and data was abstracted by 2 reviewers (W.H.S. and K.S.). The frequency of use of each site was determined using statistics listed on the Web site or by communicating with site administrators. We evaluated membership requirements and authenticity checks for each site. We assessed health professional participation and oversight on each site by evaluating the source and nature of their role. We also assessed the presence, source, and content of advertising on each site by clicking on each tab on the site once and clicking through each advertise-

ment once. We identified the source of funding for each site, when reported.

Results. Membership ranged from 3074 to more than 300 000 patients; 3 sites had more than 150 000 members, 8 had more than 10 000 members, while 2 were confidential and 1 was unavailable (**Table**). Eighty percent of the sites linked directly to Facebook and 67% linked to Twitter. All but 2 of the sites had an explicit membership process, a requirement to post a comment. Yet the information required for membership was minimal and ranged from simply providing a user name and e-mail address to offering limited information about the presence and type of diabetes or relationship to a patient with diabetes. Only 1 site (<http://www.tudidiabetes.org>) required an extensive profile to be sent to the site administrator for approval.

The level and type of health professional participation varied substantially across the sites. Site administrators reviewed the content of posts in 67% of sites we evaluated, and in 47%, administrators responded directly to questions from the members. Physicians were available to answer questions in 33% of the sites but systematically scanned postings and offered feedback in only 7% of postings. More than half of the sites used diabetes educators to answer member questions, and in 13% they scanned member discussions. Oversight practices also varied across the sites. In some (13%), there was no apparent policing of the sites. In others (67%), site administrators regulated postings to assure the validity of information purveyed, while others (7%) deleted any postings that appeared to be promoting any particular product. In 33% of sites, participants self-policed discussions and reported any activity thought to represent misconduct.

All the sites featured a discussion or question forum to facilitate communication. In some (67%), the topics were entirely member driven. In others, a moderator or site employee posted topics that any member could respond to. Staff members helped to categorize conversations in most (53%) sites, either by requiring members to post their discussions into prespecified categories or by categorizing posts once they were placed on the sites. One site required initial posts in each discussion thread to be phrased as a question. Forty percent of sites featured online "chatting"—opportunities that permit smaller groups to communicate directly. In addition, 93% of the sites featured blogging (online journals from individuals).

Industry advertising was permitted on all but 3 of the sites (**Table**). Half of the sites featured advertising from pharmaceutical manufacturers, 67% from diabetes device manufacturers, 13% from insurers, 67% featured products related to diet and exercise for diabetics, and 13% included advertising for not-for-profit services or foundations. Overall, 13% of the sites we evaluated either included no advertising or only not-for-profit advertising. Sources of funding for the sites varied dramatically, ranging from foundation sponsorship, industry sponsorship, advertisements, Web host sponsors, and voluntary donations. Three sites had no industry sponsorship.