

# A Well-Designed Online Transfusion Reaction Reporting System Improves the Estimation of Transfusion Reaction Incidence and Quality of Care in Transfusion Practice

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## Abstract

*Recognizing and reporting a transfusion reaction is important in transfusion practice. However, the actual incidence of transfusion reactions is frequently underestimated. We designed an online transfusion reaction reporting system for nurses who take care of transfusion recipients. The common management before and after transfusion and the 18 most common transfusion reactions were itemized as tick boxes. We found the overall documented incidence of transfusion reaction increased dramatically, from 0.21% to 0.61% per unit of blood, after we started using an online reporting system. Overall, 94% (30/32) of nurses took only 1 week to become familiar with the new system, and 88% (28/32) considered the new system helpful in improving the quality of clinical transfusion care. By using an intranet connection, blood bank physicians can also identify patients who are having a reaction and provide appropriate recommendations immediately. A well-designed online reporting system may improve the ability to estimate the incidence of transfusion reactions and the quality of transfusion care.*

Transfusion is important in modern medicine and can be lifesaving in many situations. Nevertheless, blood transfusion is definitely not risk-free. With the advances in modern blood banking procedures, the risk of transfusion-transmitted viral diseases is much lower. However, noninfectious complications of blood transfusion have become much more common,<sup>1-4</sup> and many blood transfusion reactions persist despite the use of appropriate premedication.<sup>5</sup> Most transfusion reactions are diagnosed by exclusion.

With any significant change in a patient's condition during and/or after transfusion, an investigation should be initiated. A successful investigation of a transfusion reaction starts with close observation and detailed reporting of what happened to the patient during and/or after a transfusion. With this information, blood bank physicians can prompt a laboratory survey and, in a discussion with the primary care team, can clarify the causal relationship between the patient's condition and the transfusion. Eventually, a successful investigation enables blood bank physicians to implement strategies that may help protect patients during subsequent transfusions.

Before 2004, the transfusion reaction report in our institute was totally dependent on the clinical judgment of the nurse who provides care to the transfusion recipient. For a patient with a reaction, the nurse would fill out a "transfusion reaction report form" and submit it to the blood bank. The blood bank technician would notify the blood bank physician to decide whether to initiate a transfusion reaction investigation. Any transfusion for which a transfusion reaction form was not submitted to the blood bank was considered a transfusion with "no" reaction. With the old reporting system, the incidence of transfusion reaction was only 0.71%

per transfusion, or 0.21% per unit of blood, which was much lower than reported in much of the published data.<sup>6-9</sup>

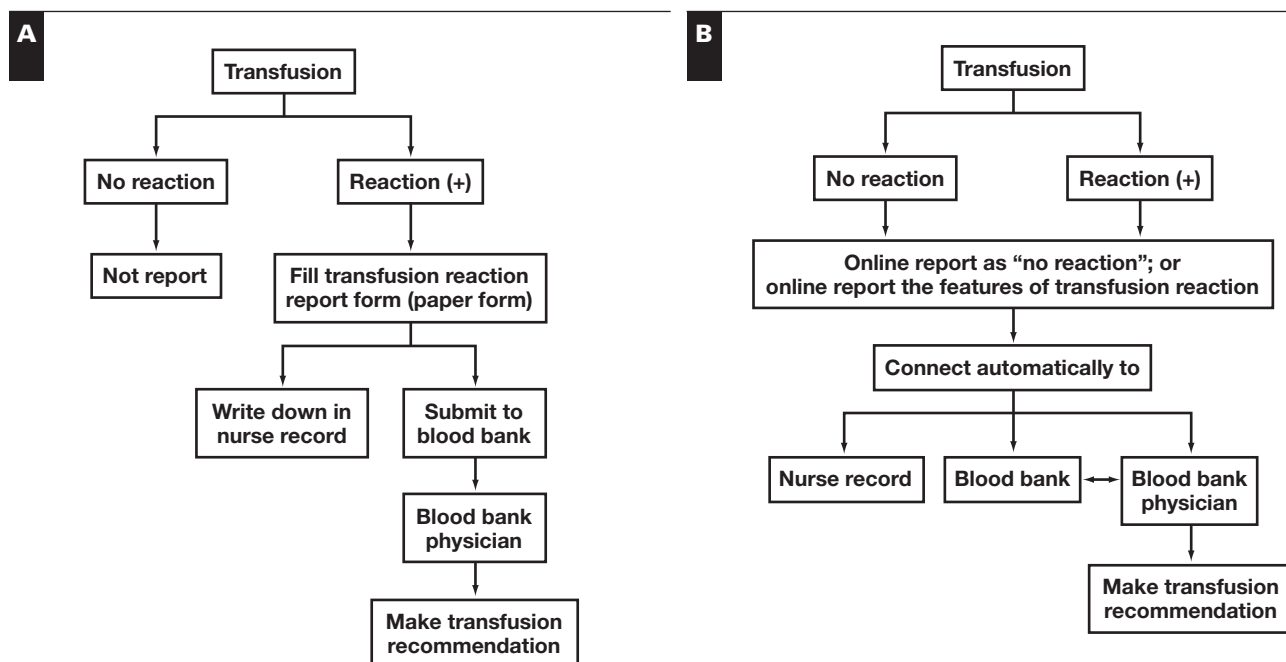
Underreporting was highly suspected yet difficult to prove. In addition, calculating the incidence of transfusion reactions through collecting and analyzing all transfusion reaction report forms was time-consuming for blood bank physicians. It was also difficult for blood bank physicians to conduct an investigation or make a timely recommendation because of the delay in receiving information about a transfusion reaction. On the clinical end, in addition to completing the transfusion reaction report form and submitting it to the blood bank, the nurse also had to make another detailed record in routine nursing notes. To solve these problems, the clinical physicians, nursing staff, blood bank physicians, and experts from the information technology department at our institute collaborated to design a new online transfusion reaction reporting system. We compared the incidence of transfusion reactions based on these 2 reporting systems and further evaluated the convenience and clinical impact of using the online system for transfusion care by sending an anonymous questionnaire to nurses who were experienced with both systems.

## Materials and Methods

The old and new transfusion reaction reporting systems are illustrated in **Figure 1A** and **Figure 1B**, respectively. The new online reporting system is introduced briefly here.

First, we created a Web page for transfusion reaction reporting in our hospital information system. On this Web page, the primary care nurse enters the starting and completion times of the transfusion and the vital signs before starting the transfusion, 15 minutes after starting the transfusion, and after completion of the transfusion. All management before the transfusion (eg, premedication or use of a leukocyte filter), management for a transfusion reaction, and the 18 most common transfusion reactions were itemized as tick boxes, so nurses can simply click on the icon to complete the reporting procedure. For a patient without a transfusion reaction, the nurse could also click in the box for “No” reaction. The English version of the transfusion reaction report Web page is shown in **Figure 2**.

To decrease the workload of nurses and cope with the paperless policy and the development of electronic medical records, all information a nurse enters into the online transfusion reaction reporting system will connect automatically to the nursing record system, so the nurse does not need to make another note of the transfusion reaction. As illustrated in **Figure 1B**, the online reporting system also connects automatically to the blood bank physician system, and if there is a reaction, a sign pops up automatically on the name of the patient who has had the reaction. The blood bank physician can simply click on the patient’s name to see what happened to the patient and then prompt a discussion with the clinical team and initiate an investigation of the transfusion reaction, as necessary.



**Figure 1** **A**, Old paper form transfusion reaction reporting system. **B**, New online transfusion reaction reporting system.

## Online Transfusion Report Form

No. of pregnancy ; Prior transfusion:  Yes  No  
 Time of transfusion start \_\_\_\_\_; Time of transfusion stop \_\_\_\_\_  
 Body temperature/blood pressure/pulse rate before transfusion, 15 minutes after transfusion  
 and after completion of transfusion \_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_  
 Management before transfusion:  No,  steroid,  WBC filter,  
 antihistamine,  diuretics,  irradiation,  others \_\_\_\_\_  
 Transfusion reactions:  Yes  No  
 Time when transfusion reaction developed \_\_\_\_\_  
 Blood bag number of reaction component \_\_\_\_\_  
 Management for transfusion reaction:  No,  steroid,  antihistamine,  
 diuretics,  others \_\_\_\_\_  
 Type of transfusion reaction:  Chill,  Oligouria,  Purpura,  Bleeding,  
 Change of urine color,  Headache,  Fever,  Edema,  skin rash,  
 Chest pain,  Back pain,  Joint pain,  Urticaria,  Jaundice,  
 Nausea/vomiting,  Suspected TRALI  Suspected acute hemolysis  
 Shock,  others \_\_\_\_\_

**Figure 2** English version of the online transfusion reaction reporting system Web page. TRALI, transfusion-related acute lung injury.

To investigate the differences between the 2 systems in reporting a transfusion reaction, the convenience or cumbersome of using the new system, and the impact of using the new system on transfusion care, we designed an anonymous questionnaire and sent it to 40 nurses experienced in both reporting systems. Most were senior nurses working on the hematology-oncology and gastroenterology wards, which represent the top 2 units for blood consumption in our hospital.

The blood supplier in Taiwan, the Taiwan Blood Services Foundation, began providing a few prestorage leukoreduction components in April 2009. With the establishment of our online transfusion reaction reporting system, we also used it to collect data on all transfusion reactions that occurred in April 2009 and examined immediately the impact of using prestorage leukoreduction components on the incidence of transfusion reaction.

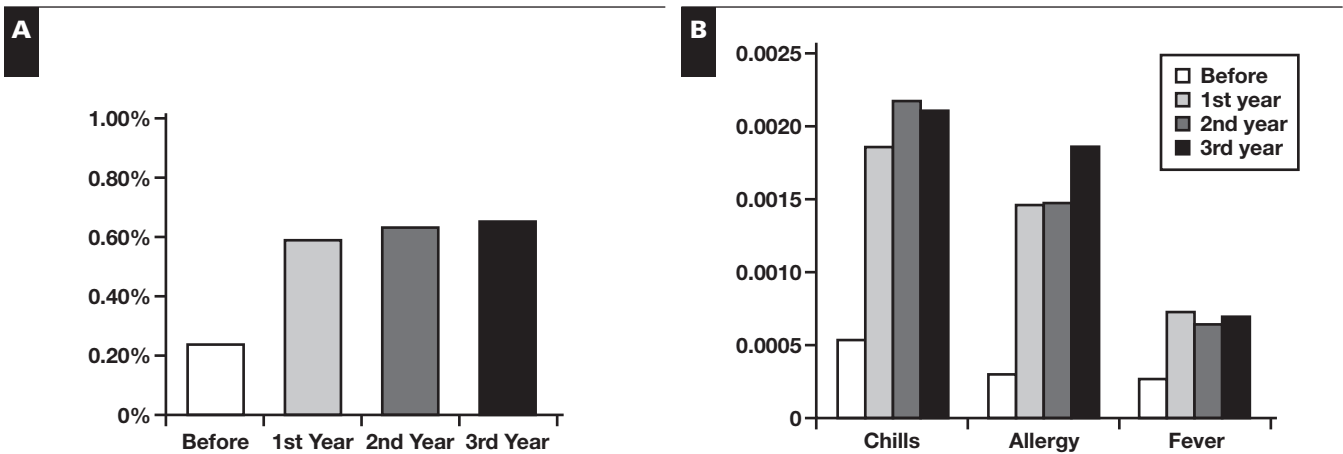
## Results

The development of the new system took almost 6 months. With the establishment of this system, it became easy for blood bank physicians to calculate the overall incidence of transfusion reaction and the incidence of each type of reaction and also to identify a patient with a reaction. Blood bank physicians can now communicate with clinical physicians or nurses immediately and initiate a transfusion reaction investigation without delay. With the use of the new system in the first year, the documented incidence of transfusion reactions increased from 0.21% to 0.61% per unit. The incidence of transfusion reaction per unit remained almost the same in the second and third years **Figure 3A**. When we look

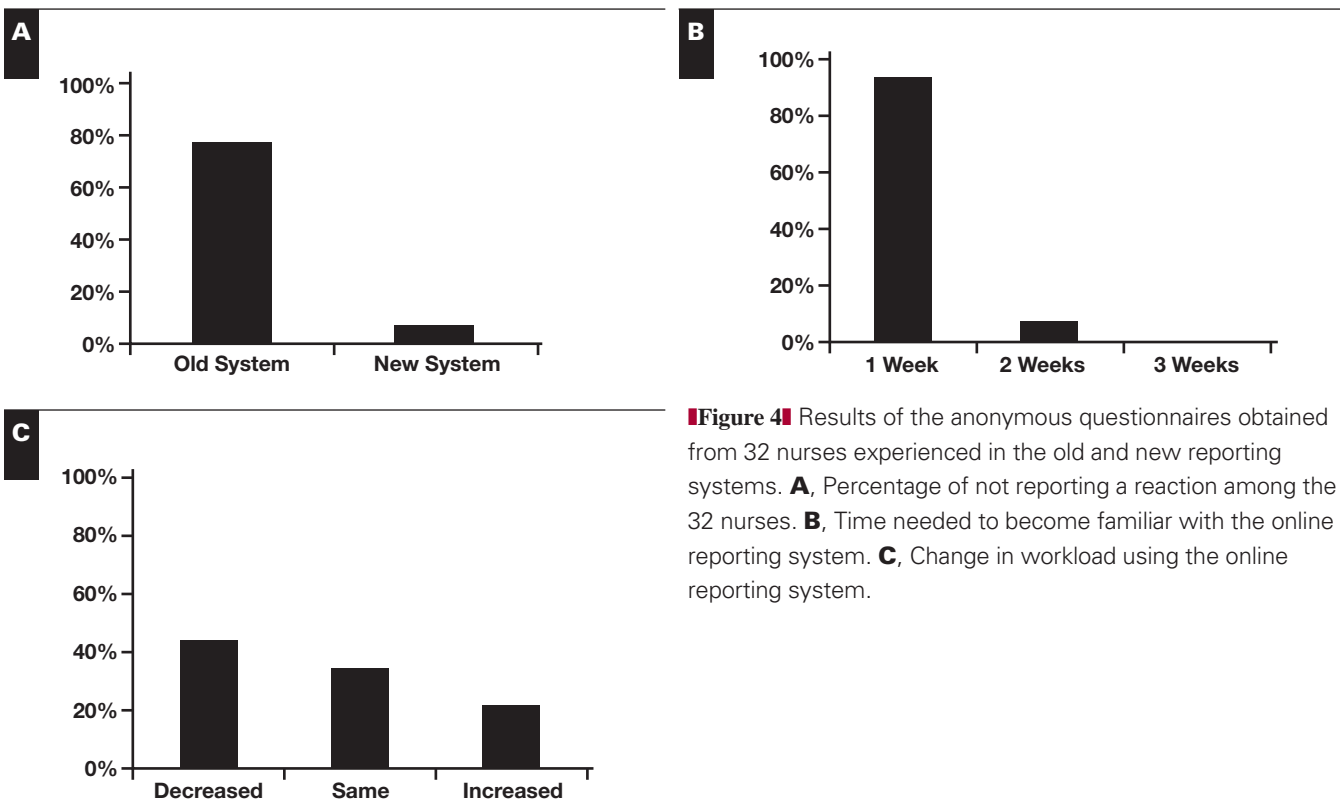
at individual reactions, the incidence of chills, allergy, and fever (nonhemolytic fever reaction) increased from 0.053%, 0.030%, and 0.027% to 0.186%, 0.146%, and 0.072% per unit, respectively, and was also nearly the same in the following 2 years **Figure 3B**.

The anonymous questionnaires were returned by 32 nurses (80%) and analyzed. Of these, 25 nurses (78%) confessed to having not reported a transfusion reaction in the past. However, the incidence of nonreporting decreased to only 6% (2 of 32 nurses) after use of the new reporting system began **Figure 4A**. The new reporting system is user-friendly, with 94% (30/32) of nurses becoming familiar with it within 1 week and another 6% (2/32) within 2 weeks **Figure 4B**. The new reporting system did not increase the workload, as 44% (14/32) and 34% (11/32) of nurses considered the workload to be decreased or the same, respectively. Only 22% of nurses (7/32) thought the workload increased with the new reporting system **Figure 4C**; 94% of nurses (30/32) considered the itemized tick-box design on the Web page of this reporting system to be helpful in the recognition and management of a transfusion reaction; 88% (28/32) considered the new reporting system to be helpful in improving the quality of clinical transfusion care.

With the help of this online transfusion reaction reporting system, we found the overall incidence of transfusion reaction was much lower in patients receiving prestorage leukocyte-depleted components. The incidence rates of reactions per transfusion in patients receiving non-leukocyte-depleted platelets and RBCs and leukocyte-depleted platelets and RBCs were 2.45%, 3.10%, 1.38%, and 0.91%, respectively **Figure 5**.



**Figure 3** **A**, Documented incidence of overall transfusion reactions per unit of blood before and 3 consecutive years after using the new online reporting system. **B**, Documented incidence of chills, allergy, and fever per unit of blood before and 3 consecutive years after using the new online reporting system.



**Figure 4** Results of the anonymous questionnaires obtained from 32 nurses experienced in the old and new reporting systems. **A**, Percentage of not reporting a reaction among the 32 nurses. **B**, Time needed to become familiar with the online reporting system. **C**, Change in workload using the online reporting system.

## Discussion

Transfusion is associated with many adverse reactions, and the accurate estimation of the incidence of transfusion reaction depends on accurate reporting of reactions. The reported incidence of transfusion reactions has varied widely in the published literature. For example, an allergic reaction could be as high as 21% using platelet concentrates<sup>10</sup> and as low as 0.09% using both platelet concentrates and apheresis platelets.<sup>11</sup> Similarly, the reported incidence of febrile

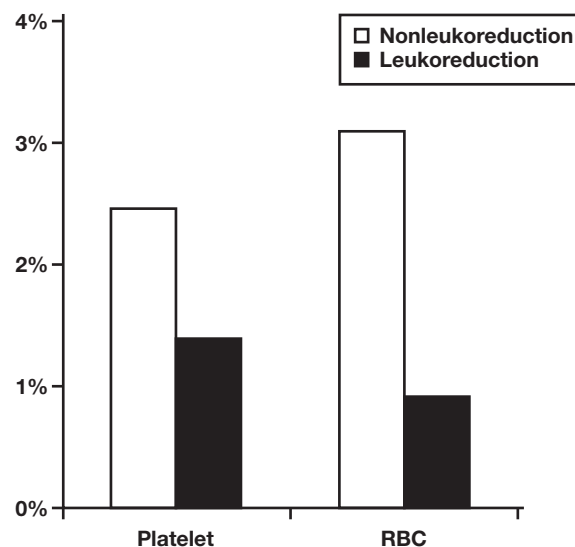
nonhemolytic transfusion reaction has also varied, from 0.09% to more than 21%.<sup>12-15</sup> As reviewed by Geiger and Howard,<sup>5</sup> the huge discrepancy in the reported incidence of transfusion reactions results from multiple factors, potentially including the different blood components used in different studies, the difference in the use of premedication (such as acetaminophen, diphenhydramine, and corticosteroids), and differences in the definition of a reaction. Nevertheless, the difference in the reporting rate is definitely one of the very

important factors contributing to this discrepancy. The relatively low incidence of transfusion reactions in patients with cancer<sup>16</sup> compared with other patient populations may be due to frequent underreporting in this group.<sup>17,18</sup> Improving the reporting system increased the documented immediate transfusion reaction rate from 0.2% to 1.8% in a Japanese study, which highlights the significance of underreporting in the estimation of incidence of transfusion reactions.<sup>19</sup>

China Medical University Hospital, Taichung City, Taiwan, is a comprehensive medical center located in central Taiwan, and the consumption of blood components has been almost 18,000 to 20,000 U each month in recent years. With only 2 blood bank physicians, it is difficult to interact with clinical caregivers immediately when a transfusion reaction develops. It is also almost impossible to estimate the “real” incidence of transfusion reaction based on the reporting system we used in the past. However, with the help of the online transfusion reaction reporting system, it has become easy for us to monitor in real time the transfusion reactions in the hospital and provide appropriate and timely recommendations and education to clinical caregivers. In addition, blood bank physicians can also verify the presence of these reactions. For example, a febrile reaction and transfusion-related acute lung injury can be verified by looking at the change in body temperature and the chest radiograph or arterial blood gas data, which make our transfusion reaction data more consistent and reliable. After using this online reporting system, the reported incidence of transfusion reaction increased almost 4 times and remained roughly the same in the following 2 years. Underreporting was the reason for the big discrepancy in the reported incidence in the same hospital and with the same ethnic patient population, because as many as 78% of nurses confessed to not reporting a transfusion reaction in the past compared with only 6% after using the online reporting system.

Nurses were glad to use this new system because it is user-friendly and transfusion reaction reporting and routine nurse recording can be done at the same time. More important, the itemized transfusion reactions on the Web page of our reporting system enable clinical caregivers, usually nurses, to give more attention to and identify these reactions. As many as 88% of nurses considered the new reporting system to be helpful in improving the quality of clinical transfusion care, specifically, the early identification and management of a transfusion reaction.

With this new system, we can also much more easily evaluate the impact of using different blood components on the incidence of transfusion reactions. For example, when prestorage leukocyte-depleted blood components were first made available in April 2009 in Taiwan, it was important for us to know the impact of using these new blood products on the incidence of transfusion reactions, which was unknown



**Figure 5** Data from our online reporting system show the impact of leukoreduction on the incidence of overall transfusion reaction.

in our Taiwanese ethnic group. By simply retrieving the data from the computer system, we could immediately examine the incidence of transfusion reactions between patients receiving blood components with or without prestorage leukocyte depletion. As expected, the overall incidence of transfusion reaction was much lower in patients receiving prestorage leukocyte-depleted blood components (Figure 5). We are now using this system to evaluate the impact of using acetaminophen, corticosteroid, and diphenhydramine premedication on the incidence of transfusion reactions in Taiwanese people.

The only potential problem with this online reporting system relates to recognizing and underreporting of delayed transfusion reactions. Although these reactions are rare and clinical caregivers can still use the Web page to report such a reaction, it is difficult to find patients with a delayed reaction, such as delayed hemolysis or posttransfusion purpura. Accurately identifying and reporting a case of a delayed reaction can be accomplished only by educating first-line clinical caregivers. We are now putting these topics into our annual transfusion education program.

Complete documentation and reporting of a transfusion reaction is important to identifying the problem and the risk to blood recipients in the transfusion chain. This provides the basis for a successful investigation of transfusion reactions, which may, in turn, lead to an improvement in the safety of subsequent transfusions. We have shown that our online reporting system may improve not only the estimation of the incidence of transfusion reaction but also the quality of transfusion care without increasing the workload of caregivers.

Furthermore, our new system enables us to do transfusion research with a large patient population with more efficiency and confidence.

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