STATE OF THE U.S. BLOOD SUPPLY
Highlights from 2007 National Blood Collection and Utilization Survey

AMERICAN RED CROSS DONOR HEMOVIGILANCE PROGRAM

CHANGES IN BLOOD DONATIONS

TECHNIQUE TO GROW BLOOD FROM STEM CELLS DEVELOPED IN LABORATORY

NEW vCJD STUDIES

In reviewing the survey results, please note that blood center data was not weighted for non-response in the 2004 data. The 2006 data were weighted to represent the full national supply. Therefore, the 2004 collection totals may be slightly underrepresented, making the increase between the years seem greater than it was.

Notable findings from the 2007 NBCUS and comparisons with the 2005 report were as follows:

- Total WB/RBC collections in 2006 increased from 2004 by 5.8%, to 16.2 million units.
- Total WB/RBC transfusions in the same period increased by 3.3%, to 14.7 million units.
- Autologous collections declined significantly by 26.9% to 335,000 units.
- The margin between test-negative allogeneic WB/RBC units collected and those transfused in 2006 was 1,227,000 units.
- RBC apheresis collections were significantly higher by 96.4% for a total of 1.6 million units.
- Test losses declined significantly to 151,000 units.
- The total number of all components transfused in 2006 was 30,044,000.
- There was a statistically significant 20.3% decrease in the number of outdated WB/RBC units.
- The transfusion of whole-blood-derived platelet concentrates continued to decrease (-15.7%), while the use of apheresis platelets increased by 9.0%.
- A total of 492 hospitals reported the cancellation of elective surgery on one or more days due to blood inventory shortages. This affected 412 patients, 25% fewer than in 2004.
- The average hospital cost of unit of RBCs increased by 6.4%.
- The WB/RBC collection rate per thousand US donor population (estimated at 18-64 years of age) was 84.1 units in 2006, compared to 83.1 in 2004.
- The WB/RBC transfusion rate of 48.9 units per thousand US population, compared to 49.6 in 2004.
- The transfusion of leukocyte-reduced (LR) components decreased 12.1%—9.9% for prestorage LR components and 52.7% for poststorage LR components.
- The rate of adverse transfusion reactions reported to the hospital transfusion service was 0.32%.
- The rate of severe donor reactions was 0.07%.
- Of 9,553,000 allogeneic donors who successfully gave blood, 28.5% were first-time donors and 71.5% were repeat donors.
- The donation rate for repeat donors was 1.7 donations per donor in 2006.

An estimated total of 72,000 transfusion-related adverse reactions were reported for 2006. These were defined as events that required any diagnostic or therapeutic intervention. This represents an adverse reaction rate of approximately 0.32% of all components transfused. This rate is on the lower end of rates reported by hemovigilance systems in other countries, with rates of 0.3% to 0.7%. Of the adverse events reported, 1,522 were reported as transfusion-related acute lung injury (TRALI). The frequency of TRALI is generally acknowledged to be approximately 1/5,000 transfusions. On the basis of this rate, one would expect approximately three times the rate reported; therefore TRALI appears to be underdiagnosed or underreported, or occurring at a lower frequency than previously reported. There were 11,000 of severe donor adverse events reported by collection organizations for 2006. The rate of severe adverse events was 11,000/16,174,000 collected units.
(0.07%). Severe donor adverse events may be defined as adverse events occurring in donors attributed to the donation process that included, for example, major allergic reaction, arterial puncture, loss of consciousness of a minute or more, loss of consciousness with injury, nerve irritation, etc.

Bacterial contamination of platelets has been one of the most frequent transfusion-associated infection risks. The most common cause of bacterial contamination is the inoculation of bacteria on the skin surface at the time the needle is inserted into the arm at donation.

As an additional mechanism to prevent bacterial contamination, collection of blood components using unit diversion devices has been implemented at some institutions. This device, integrated with the blood collection pouch, diverts the initial aliquot of blood into a separate but connected pouch. In so doing, the possibility that a skin plug harboring bacteria will contaminate the collection bag is reduced. In 2006, half (50.4%) of all institutions used diversion devices for collecting apheresis platelet; 37.6% used them for whole blood collections.

**Blood Inventory Shortages**

The survey found a total of 117 hospitals (6.89%) reported that elective surgery was postponed on one or more days in 2006 because of blood inventory shortages. This represented considerably fewer hospitals reporting surgery delays than in 2004 and 2001.

Hospitals indicated separately that the total number of surgical procedures that were postponed was 412 compared with 546 in 2004. This is a decrease of 25%. Numbers of surgeries postponed varied widely among hospital strata, but hospitals performing between 1,400 and 2,399 surgeries reported the highest numbers of surgeries postponed because of blood shortages.

Hospitals indicated the number of days in which nonsurgical blood requests were not met. Of responding hospitals, 13.5% (231/1707) experienced at least one day in which nonsurgical blood needs could not be met vs 16.0% (257/1604) in 2004. The total number of days reported was 5,460 and the range was 1 to 365. There is a slight increase in the mean number of days of unmet nonsurgical needs for all respondents between 2004 (19.27) and 2006 (22.0). Six hospitals reported 365 days in which nonsurgical blood requests were not met in 2006, whereas eight reported an entire year of unmet need in 2004.

Also, hospitals were asked to indicate the number of days on which the regular or standing order was incomplete. The total number of days was 44,910. On any given day, 123 hospitals are without their standing order. It is likely that most facilities estimated this number given the round values that were reported. This data element is probably best used as an indicator of customer service.

Although standing orders were incomplete on numerous occasions, the more important variables are the number of postponed surgeries (a 25% improvement over 2004) and the unmet nonsurgical blood need (2.5% fewer hospitals reporting, although those reporting unmet need reported an overall increase of 2.7 days).
Bacterial Testing

The 2007 NBCUS found only 27.3% of the institutions performed bacterial testing of platelets in 2006. Of the 127 blood centers responding, 117 (92.1%) reported testing; however, only 29.6% of hospitals reported testing.

Respondents were asked to indicate the test methods for platelet components. Among the 74% reporting testing of apheresis platelets, 35% of respondents reported using culture-based testing. Of those reporting testing of whole-blood-derived platelets singly (96%), 67% reported using pH methods and another 34% reported using glucose methods (respondents were told to check all that apply). Swirling methods were chosen by 15% and culture-based testing by 12% of those reporting. Among the 75% reporting on pooled whole-blood-derived platelets, the most common method was pH testing for bacterial contamination (18%).

Approximately 1,485,000 units were tested for bacteria in 2006. Culture-based methods accounted for 57% of the units tested (826,000) and for 283 (52.4%) of the 540 confirmed positives. Blood centers accounted for 87% of the culture-based testing and for only 26.3% of the alternative method testing. Considerably more false-positive results (12,000) were reported with alternative methods of testing (1.8% vs 0.15% reported for culture-based testing).

Therapeutic Apheresis

A total of 27.2% of facilities reported that they perform therapeutic apheresis procedures. Among blood centers, 52.8% provide therapeutic apheresis and among hospitals, 26.4% perform these services. The total number of therapeutic apheresis procedures was 112,109, 20% (22,821) by blood centers and 80% (89,288) by hospitals. The specific indication for which the most facilities reported performing therapeutic apheresis was thrombotic thrombocytopenic purpura treatment, with 25,791 procedures (23% of all therapeutic apheresis procedures). There were 16,706 procedures for hemochromatosis and 10,798 procedures for myasthenia gravis (15% and 10% of all therapeutic apheresis procedures, respectively). Other therapeutic apheresis procedures were performed for Guillain-Barré syndrome, with less than 5% of all reported procedures. An additional 42,744 procedures were categorized as “other” (38% of all therapeutic apheresis procedures).

Crossmatch Procedures

Weighted hospital data on crossmatch procedures indicate that 18,774,000 procedures were performed in 2006, compared to 11,221,000, an increase of 67.3%. Of the crossmatch procedures reported, serologic methods were estimated to account for 93.6% and only 4.4% were estimated to be performed electronically.

Red Cell Age

The survey reported the estimated mean age was 16.4 days and the mean calculated age was 19.5 days at transfusion. Only 7.8% (or 45 hospitals) were able to calculate and report the component age at transfusion.
Maintaining a safe, stable, and adequate blood supply is the mission of American Red Cross Blood Services. Extensive Red Cross data provided the opportunity to assess both long-term and short-term trends in the variation of weekly blood donations.

Overall trends and week-to-week variation in donation rates were assessed in volunteer, whole-blood donations from 1995 to 2005 among three Red Cross donor regions: the Connecticut region, the Greater Chesapeake and Potomac (Maryland) region, and the Southern California region, adjusting for population change, calendar time, age, sex, and donor region.

Weekly donation rates varied widely by region, ranging from 3.5 donations per 10,000 persons in Southern California to 10.2 donations per 10,000 in Connecticut.

Week-to-week variation in donation rates within each region was also quite high. Typical swings in weekly donation rates ranged from 38 percent in Connecticut to 56 percent in Southern California. Week-to-week variation was also 103 percent higher (95% confidence interval [CI], 87%-120%) among 18- to 24-year-old donors, compared to 25- to 44-year-olds, ranging from 32 to 49 percent.

By comparison, week-to-week variation among adults 25 and older was more stable, ranging from 16 to 21 percent.

This study suggests that there is a great deal of variation in donation rates, particularly among the youngest donors. Improving recruitment and retention among these donors will be critical to maintaining an adequate blood supply as the donor population ages.


This graph illustrates the variation of blood donation rates at Red Cross blood centers in Connecticut, Maryland, and Southern California.
In what may be the first step of growing transfusable red blood cells (RBCs) in the laboratory, a U.S.-based research team developed a technique to grow large quantities of blood in the laboratory using human embryonic stem cells (hESCs), but experts cautioned that although this achievement represented a significant technical advance, the new approach required several key improvements before it could be considered a realistic alternative to donor blood.

The efficient and controlled differentiation of hESCs into homogeneous RBC populations has not been previously achieved. Researchers described for the first time the generation of RBCs from hESCs with oxygen-transporting capacity, and the functional properties of these cells are similar to those of normal RBLs. Multiple stem cell lines were stimulated to undergo differentiation in vitro to form functional RBCs (blood types A, B, O, and both Rh+ and Rh-) on a large scale under conditions suitable for scale-up and clinical translation. Although alternative sources of progenitors for the generation of large-scale transfusable RBCs have been investigated, including cord blood, bone marrow and peripheral blood, it is clear that even after expansion and differentiation, these sources represent donor-limited sources of RBCs.

Researchers had previously grown blood cells from hESCs, but never achieved this “enucleation” step, which stops cells from dividing and becoming cancerous. The researchers believe it is essential to grow the blood cells on connective “stromal” cells from the bone marrow, where blood cells are made in the body. Tests on the red blood cells suggest that they deliver oxygen just as efficiently as donated red blood cells. The team was also able to produce the red blood cells in bulk, creating populations of as many as 100 billion cells. However, the team has not yet been able to make O Rh negative red blood cells, since this blood type is determined by the genes of the hESCs, and none of the hESC lines approved for use in the United States are O Rh negative.
The researchers theorize that it may be possible to develop O Rh negative blood using skin cells from O Rh negative donors. Previous research has shown that adult cells can be "reprogrammed" to return to an embryonic state by using viruses to insert genes that erase a cell’s developmental history. Like hESCs, such "induced pluripotent stem cells" (iPSCs) can be transformed into other cell types. Since they have the advantage of not requiring an embryo, iPSCs could potentially be used to make blood of all types without the moral dilemmas associated with using embryos.

The research team plans to begin animal testing. See http://bloodjournal.hematologylibrary.org/papbyrecent.dtl

On October 31, 2007, a Working Group on Transfusion Recipient Epidemiology and Outcomes Research was convened by the National Heart, Lung and Blood Institute (NHLBI). This group was asked to discuss the current status of the field, identify critical research needs, and make recommendations to the NHLBI program staff.

In considering the standard blood products – red blood cells (RBCs), platelets (PLTs), FFP, and cryoprecipitate – optimal use in different circumstances is in constant evolution and is ideally data driven. Recent data, mostly from trauma surgery on combatants in the Middle East conflicts, support the idea that massive transfusion protocols for trauma centers in the United States (as well perhaps as some high-risk obstetric centers) should likely be modified to increase the ratio of PLTs, plasma, and cryoprecipitate transfusion to RBC transfusion.

The Committee found a highly structured recipient epidemiology and clinical and laboratory outcomes program that would characterize transfusion practices and recipient outcomes in adult patients as a function of transfusion practices would significantly advance US public health. Such a program could have mixed representation from a variety of types of medical institutions and a link to blood centers, thus allowing detailed information on donors of products used for transfusion, the processes used in their manufacture, and the conditions of their storage. The Committee also suggested that a neonatal and pediatric epidemiology and clinical and laboratory outcomes recipient program similar to that described previously for adults would be of high importance.

It was suggested that the adult and pediatric or neonatal programs should be structured in a way that allows consideration of a number of specific areas including cardiovascular surgery; trauma and massive transfusion; sickle cell anemia; transfusion of neonates, children, and the elderly; and transfusion alternatives.

Each year, the American Red Cross (ARC) has nearly 7 million encounters with individuals who present to donate Whole Blood WB or apheresis components to provide more than 40 percent of the US blood supply. The American Red Cross (ARC) initiated a comprehensive donor hemovigilance program in 2003. The ARC established a national hemovigilance program to systematically analyze donor complications at its 36 blood regions. Blood centers should continuously strive to improve the donation experience for all donors and should have an effective and comprehensive program to monitor donor complications as the keystone of a donor safety program. The importance of donor adverse reactions has been highlighted in the recent efforts by the AABB to initiate a US biovigilance program. The American Red Cross experience now provides a model system to assess the advantages and limitations of a national donor hemovigilance program.

The blood supply depends entirely on the daily commitment of altruistic volunteers, who ostensibly gain little personal benefit from blood donation but are exposed to potential risk of discomfort, complications, and in rare cases, injury resulting from the collection procedure. Approximately 2 to 6 percent of all presenting donors experience a complication, most of which previously have been classified as light, mild, or minor reactions that resolve promptly but are still unpleasant for the donor. Serious injury occurs infrequently, but typically results from a loss of consciousness (LOC), either at the donation site or after leaving the premises. Donor characteristics that correlate with higher syncopal complication rates after whole blood (WB) donation include young age, first-time donation status, low weight or total blood volume, female sex, and Caucasian race, although these may not all be independent predictors of reactions. Changing population and donor demographics during the period 1996 through 2005 revealed that blood collection from young donors, aged 16 to 19 years, was increasing whereas blood donation rates by older individuals was declining.

Every month, the hemovigilance program at the ARC National Headquarters Medical Office compiles and analyzes data on donor complications following WB and automated procedures that are either documented by collections staff at the time of donation or reported by the donor or a third party after the donation event, including cases that receive outside medical care. All major reactions that occur at the donation site and all
reactions that are reported to the blood center after the donor leaves the site are captured on a standard case report form, investigated, and reviewed by the blood center physician and reported in a tally on a monthly basis to the National Medical Office. If a donor is referred for outside medical care by staff or later reports that he or she sought or received care from any outside health care provider, the complete blood donation record is reviewed by the National Medical Office and is maintained in a separate database. In this report, the actual medical care provided is not further differentiated and varies considerably from simple reassurance or advice to apply warm packs for the resolution of hematoma to administration of intravenous fluids and hospitalization.

The AABB has proposed the establishment of a national biovigilance program that would include a donor adverse reaction component. The national collection of donor complication data is currently constrained by the different definitions of reactions and data collection procedures in use by blood centers in the United States, which prevents direct comparisons between the complication rates reported by various blood collection agencies. The American Red Cross has found that even in a large multi-center system utilizing standardized protocols, considerable variability is apparent in reported reaction rates among different regional blood centers. Reaction rates are known to vary with donor age, gender, race, weight, and first-time donation status. A major source of the variability American Red Cross scientists observed between regions related to donor demographics, as evident by the strong correlation of higher reaction rates with the higher proportion of young donors in spring and fall compared to summer and winter. Nevertheless, the Red Cross showed that the blood region was also independently associated with complications separate from donor characteristics (age, donation status, and sex), suggesting that regional practices may affect the likelihood of reactions or the recognition and reporting of those reactions. Regional variability likely cannot be eliminated because of the inherent subjectivity in evaluating and recording donor complications. Any comparison of complication rates between different regional centers, for example, to evaluate staff performance or compare collection equipment, could be misleading. Despite the variability among regions, data from an individual region or a small subset of regions in a more controlled operational trial have proven useful to evaluate donor complications associated with implementation of new collection procedures or new equipment. Further analysis of the regional variability may provide insight into practices consistently associated with lower complication rates.

The American Red Cross experience also delineates the limitations of a national hemovigilance program and identifies opportunities for future improvement that may be tracked by the program. The approach to classify the type of complication rather than to capture specific signs or symptoms simplifies data collection, but the American Red Cross recognizes that our definitions of donor complications are not mutually exclusive; for example, donors in the prolonged recovery category may also have had LOC as a feature of their reaction. This redundancy leads to having more than one code that can be used to describe a reaction; in addition, more than one type of reaction is possible. In both circumstances, staff is instructed to record the reaction based on the most severe symptoms. This subjectivity in evaluation and imprecision in coding undoubtedly contributes to regional reporting variability.

The utility of collecting systemwide data on hematomas and minor presyncopal reactions and the relevance of a distinction between short LOC and long LOC have been questioned. Hemovigilance efforts of a national system should be focused on moderate and severe reactions, which are more medically
In the United States, syphilis testing has traditionally consisted of initial screening with an inexpensive nontreponemal test, then retesting reactive specimens with a more specific, and more expensive, treponemal test. When both test results are reactive, they indicate present or past infection. However, for economic reasons, some high-volume clinical laboratories have begun using automated treponemal tests, such as automated enzyme immunoassays (EIAs) or immunochromoluminescence tests, and have reversed the testing sequence: first screening with a treponemal test and then retesting reactive results with a nontreponemal test. This approach has introduced complexities in test interpretation that did not exist with the traditional sequence. Specifically, screening with a treponemal test sometimes identifies persons who are reactive to the treponemal test but nonreactive to the nontreponemal test. No formal recommendations exist regarding how such results derived from this new testing sequence should be interpreted, or how patients with such results should be managed. The United States Centers for Disease Control and Prevention (CDC) recently made these recommendations for interpreting *T. pallidum* test results:

- When results are reactive to both treponemal and RPR tests, persons should be considered to have untreated syphilis unless it is ruled out by treatment history.

- When results are reactive to the treponemal test but nonreactive to the RPR test, persons with a history of previous treatment will require no further management. For persons without a history of treatment, a second, different treponemal test should be performed. If the second treponemal test is nonreactive, the clinician may decide that no further evaluation or treatment is indicated, or may choose to perform a third treponemal test to help resolve the discrepancy. If the second treponemal test is reactive, clinicians should discuss the possibility of infection and offer treatment to patients who have not been previously treated. Unless history or results of a physical examination suggest a recent infection, such patients are unlikely to be infectious and should be treated for late latent infections, even though they do not meet the surveillance case definition.

The CDC concluded that the reversal of the traditional syphilis screening sequence has been driven by economics. For high-volume laboratories, an automated treponemal test can be less expensive than using an RPR test for the initial screening. An important consequence of this reversal is the identification of a combination of reactive and nonreactive test results that would not otherwise have been identified. The clinical interpretation of these results is complicated by the lack of standardized follow-up testing algorithms among laboratories, and by the lack of an evidence base with which to judge the merits of each algorithm. Consequently, use of a reversed sequence of syphilis testing might result in overdiagnosis and overtreatment of syphilis in some clinical settings.

NEW STUDY SUPPORTS IMPORTANCE OF vCJD PRECAUTIONS

A nine-year study of sheep has added to the evidence that variant Creutzfeldt-Jakob disease (vCJD) can be transmitted through blood transfusion in humans. The likelihood of Bovine Spongiform Encephalopathy (BSE) being transmitted between sheep through transfusion of infected sheep blood was 36 per cent, according to a study published in Blood, the journal of the American Society of Hematology.

The authors of the study contend that the findings underline the importance of precautions against vCJD transmission, such as the United Kingdom governmental decision in 2004 to ban blood donations from anyone who had received a blood transfusion since 1980.

The study looked at BSE transmission between sheep through infected blood with the aim of quantifying how vCJD - the human form of Bovine Spongiform Encephalopathy (BSE) - could be spread through transfusions.

Researchers (Fiona Houston, Nora Hunter and colleagues) at the Neuropathogenesis Unit at the Institute of Animal Health, The Roslin Institute, University of Edinburgh, found that the likelihood of BSE being transmitted between sheep through transfusion of infected sheep blood was 36 per cent, with rates of 43 per cent found for scrapie. Of 22 sheep that received BSE infected blood, eight showed evidence of infection. Nine out of 21 sheep receiving scrapie-infected blood developed the disease.

Fiona Houston, who led the research, said: “It is apparent that the stage of disease incubation in infected donors played a large role in the likelihood of transmission. The longer that BSE or scrapie had been carried by donors, the greater the likelihood of the disease being transmitted with transfusions of infected blood.”

There are concerns that 4,000 people could be carrying the disease in the UK, which could then be transmitted through infected blood causing further infections.

Scientists are working to develop a test for vCJD that can be used before symptoms develop and a filter is also being trialed to remove prions – infective proteins – from donated blood.

BSE is one of a group of rare neurodegenerative disorders called transmissible spongiform encephalopathies (TSEs), which include scrapie and vCJD.

To date, 167 cases of vCJD have been recorded in the United Kingdom, of which three patients are thought to have received vCJD through infected blood.


SCIENTISTS DISCOVER NEW PRION DISEASE

A new prion disease that is distinct from but resembles known forms of CJD, Creutzfeldt-Jakob disease, has been discovered in the United States, affecting 16 people, 10 of whom died after gradually losing their mental and motor functions and being unable to think, speak or move.

Case Western researchers discovered a novel prion disease characterized by distinct histopathological and immunostaining features, and associated with an abnormal isoform of the prion protein (PrP) that, contrary to the common prion diseases, is predominantly sensitive to protease digestion.

Eleven subjects were investigated at the University National Prion Disease Pathology Surveillance Center for clinical, histopathological, immunohistochemical, genotypical, and PrP characteristics.

The type of spongiform degeneration, the PrP immunostaining pattern, and the presence of microplaques distinguished these cases from those with known prion diseases. Typical protease-resistant PrP was undetectable in the cerebral neocortex with standard diagnostic procedures. After enrichment, abnormal PrP was detected at concentrations 16 times lower than common prion diseases; it included nearly 4 times less protease-resistant PrP, which formed a distinct electrophoretic profile.

NEW BROCHURES AVAILABLE

“What If I Need Blood?”, a brochure which answers commonly asked questions and explains the transfusion options for patients, is available through your American Red Cross Representative.

The brochure is available in both English and Spanish.

The second edition of “Practice Guidelines for Blood Transfusion: A Compilation of Peer-Reviewed Literature” is available through your American Red Cross Blood Services representative.

This pocket guide is a concise transfusion medicine resource, providing guidelines for some of the more commonly encountered clinical situations.

“A Guide to American Red Cross Reference Laboratory Services” A new guide describing the many services offered by the American Red Cross Immunohematology Reference Laboratories is now available.

THE AMERICAN RED CROSS DONOR HEMOVIGILANCE PROGRAM IS DEDICATED TO THE RISKS OF BLOOD DONATION, CONTINUED

relevant than minor complications and require aggregation of data to evaluate trends and the effect of interventions on rare events. However, the common, minor reactions may provide important information if their rate serves as an indirect measure of the risk of more serious complications in individual blood centers. For example, an intervention that achieves even a small reduction in symptomatic (syncopal-type) reactions may predict a comparable reduction in the infrequent, but more serious syncopal-type complications including LOC with injury. This assumption, while logical, has not yet been proven because a large data set is needed to evaluate the effect of any preventive measure on infrequent but medically more serious complications. Regardless, even the common, mild complications are unpleasant for the donor and reduce the likelihood of return donation thereby serving as a surrogate measure of the donation experience. Finally, we noted lower complication rates in young donors (<20 years) donating RBCs by apheresis compared to WB donations, providing a rationale for further study and for possibly expanding apheresis RBC donation programs in colleges and high schools.

Although blood collection establishments will likely not be able to eliminate all risk to healthy volunteer donors, they should continually foster a culture of safety and make a concerted effort to reduce the rate of donor complications, not only for the donors’ health and well-being but also to enhance the likelihood of their future donation. The ARC hemovigilance program provides estimates of the current risks associated with WB and automated collection procedures and lays the foundation of our efforts to improve the donation experience. Establishment of a national donor hemovigilance system may afford an opportunity for systematic improvement in donor safety in every collection center. The American Red Cross experience, however, cautions against direct comparison of different blood centers in the absence of risk adjustment for donor demographics and consideration of differences in the identification, classification, and reporting of injuries.


REMEMBER THESE WEBSITES

Immunohematology Publication
www.redcross.org/pubs/immuno

Reimbursement
www.redcross.org/services/biomed/profess/reimbursement.html

ISBT 128
www.redcross.org/services/biomed/0,1082,0_310_00.html

PLUS
Fall 2008, Volume Two, Issue Three

American Red Cross