Safety of the united states blood supply

The Safety of the United States Blood Supply: a Historical, Current, and Future Perspective

The safety of the United States blood supply is a progressive accomplishment of science and medicine. A unit of blood has been of insurmountable value to patients throughout the development of transfusion medicine in the United States. The increasing use of blood and blood products to maintain the health and wellness of the population has brought to light many concerns on the safety of the practice. Thus, the institutionalization and development of blood safety protocols began. In order to truly appreciate the ingenuity of the scientific process a discussion of the progress of historical safety improvements, current safety practices, and future safety developments will follow.

Various civilizations have viewed blood as a vital medicinal source of health and wellness. Although primitive and misguided, the usefulness of blood has not been unnoticed for centuries. Bathing in pools of blood to cure illness was not unheard of in ancient Egypt; in Roman culture spectators of gladiator events would rush to the floor of an arena to drink the blood of the dying so as to absorb strength (Worsnop). From these primitive beginnings, science has taken hold and developed new knowledge about blood as an organ. Of the most significant developments in modern blood medicine and safety, Karl Landsteiner in 1901 began the discovery of blood cell antigens by naming the ABO blood group system (Services). This discovery allowed for compatibility testing that is standard in today’s practices, and decreased the rate of deadly transfusion reactions in his time. Following this

development, the research, and discovery of other antigen groupings and the understanding of the anatomical

and physiological functions of blood and its uses and pitfalls took off in a race of scientific discovery.

Blood became less of an enigma as time grew on, and as such it and the components derived from each unit became increasingly used creating a need to extend the longevity of its viability. The first significant step toward this goal was the development of anticoagulant to preserve blood for extended use. This discovery accompanied with the utilization of sterile interconnected plastic storage bags, replacing glass, allowed for the current extended shelf life of whole blood and its various products without allowing the possibility of contamination or exposure. (Services). These improvements in longevity; and the successful recovery of patients receiving transfusions led to new discoveries of long-term negative effects including disease transmission. In the spirit of true innovation, research and development began both on statistical prevalence of disease in various populations and on how to detect these transmissible pathogens. The population analysis allowed for advancements in donor selection including the development of the donor questionnaire and a deferral system. Nucleic acid technology has become the standard of pathogen detection in donated units of blood for several diseases with the main transmissible pathogen focus being on HIV, Hepatitis C, and West Nile Virus (Services). The use of this methodology to create the safest possible donation population, and then to screen out any donated products that may be contaminated has brought the United States blood supply

into its current state of being considered one of, if not the undisputed, safest blood supply worldwide.

Today, the process for blood collection, testing, storage, and use is standard across the various blood centers in the United States. At each donation, donors are asked a series of questions involving their physical state, sexual history, and other habitual behaviors so as to establish a risk level for each person to refine the donor pool to only those least likely to possess transmissible disease pathogens All blood and blood derived products are monitored under the Federal Food and Drug Administration (FDA). As such, the FDA has set a list of required testing and processing instructions for each blood unit from the moment it is drawn until the receiving patient is successfully released after transfusion (US Food and Drug Administration). This strict monitoring has allowed the actual risk percentage of developing an infection of a transmissible organism to drop to 1 in 2 million transfusions (Services). Still, as the future progresses, new programs to combat other potential threats to the blood supply are being developed.

The forefront of new research is on developing methods to detect various non-screened pathogens including babesiosis and Creutzfeldt-Jacobs Disease (CJD) (Services). The screening protocol of all blood and blood products has astronomically reduced the amount of transfusion complications caused by the actual transfusion of blood. Now, the development of education and standardization of the protocol for giving a transfusion and all the staff involved in that process is beginning because the largest threat to the safety of transfusion medicine is human error. In fact, compared to the 1 in 2 million chance of contracting HIV, the risk of erroneous administration is

observed for 1 in 19, 000 red blood cell units. (Linden JV). These errors are attributed to the pre-clinical process as well as isolated mistakes made in the blood bank department. Several complications occur due to multiple errors in both of these areas (Linden JV). Unfortunately, the safety of the United States blood supply is not only dependent on the safety of donating or on receiving a unit of blood, but also on its availability.

“ Each year some 5 million Americans receive a blood transfusion, a life saving procedure to replace blood lost after surgery, serious injury, childbirth, or illness” (Blood Tranfusions: Extra Steps to Ensure Saftey). This staggering statistic has left the medical community and blood suppliers concerned at the decreased rate of donations. Limited donation can be attributed to many factors; protection of the quality of the blood donated, the change of paid donation to volunteer donation, as well as a general lack of public support. Creating a safe product for patients is a top priority for the U. S., which is an honorable goal. However, in order to provide the least risky donation population, donor questionnaires and screening tests often eliminate donors unnecessarily without allowing for an opportunity for reentry into eligibility. A compounding issue is seen with the removal of a monetary incentive for giving blood. This change in process is attributed to a sharp decrease in pathogen infected collected units, but also creates the requirement of a donor giving blood simply for the act of doing so. An increasing concern is that as the generation of World War II ages the “ current generation is less altruistic and thus less likely to donate” (Gary M. Brittenham). The lack of a feeling of community responsibility in the younger generation of eligible donors can be blamed on several societal

developments including the lack of large employers to host blood drives, limited donation hours that are inconvenient for typical 9-5 employees, and the shift in the image of donation that has persisted and continues to be a challenge to blood donation centers. A change in American economy infrastructure from manufacturing plants and factories to smaller businesses has removed the opportunity for donation drives that are conveniently placed at a large portion of the population’s workplace. Now many donations require a trip to a donation center or blood drive, this combined with a smaller work environment that is less forgiving for allowing coverage for a person to donate has left the 9-5 population inconvenienced and therefore less likely to donate. Another contributing factor is a general decrease in public approval; the AIDs epidemic “ soiled” the image of donation from giving the “ gift of life to a risk to be avoided” (Gary M. Brittenham). Fear of infection transmission not only to the recipient, but also to the donor spread throughout the public in a wild fire of propaganda, and public opinion of the act of donation shifted, and has never quite recovered. These issues are not unnoticed, nor are they being neglected. The future is bright; each obstacle faced by the medical community allows for the creation of new and unique solutions every day.

The world of medicine is constantly evolving, and with it transfusion medicine is continually changing. Nucleic acid screening tests are the current standard; however, they are fallible and false negatives are a threat to donation recipients while false positive results influence the available donor pool. In order to combat these issues; new technologies in NAT screens are being developed to distinguish between positive active infections versus

positive reactions from immunization allowing for more donors to be eligible for donation (Services). Pathogen reduction technology is the new hope for safe transfusion technology; it has the potential not only to prevent bacterial contamination and viral infection, but also to eliminate the need for donation deferrals. Reduction techniques are being developed that use chemicals and UV light to eliminate new viral pathogens and there is hope for furthering these advances in the future (Blood Transfusions: Extra Steps to Ensure Safety). A growing concern is that with new technology there comes a higher price tag (Ortolon) as it would be nearly impossible for a technology to exist that would be effective on all types of blood components; however, " if patent pathogen inactivation techniques that preserve blood function, and do not evidence some new toxic risk can be created, the developed world, which embraces the myth of [zero] risk transfusion, will likely adopt them almost regardless of cost." (Barbara J. Bryant). In direct competition with pathogen reduction techniques is the development of blood substitutes or manufactured blood units. Current research is pointing in the direction of stem cell stimulation to create manufactured blood products from progenitor stem cells (Services) or chemically manufactured substitutes for use in emergency or isolated areas where blood may be required including active combat, and natural disasters that do not have optimal storage available. These new and exciting developments in research are not quite the reality of today's world and until then, the name of the game is to make the best of the current system.

Proposals to increase donations, and to make the most of donations that currently occur are varied. Of the most promising, blood management

system placement and selected expansion of the donor pool are topping the list. The most convincing argument for the implementation of an authoritative blood management program consisting of full time transfusion directors, a transfusion safety officer, and a compliance officer in all transfusions centers is simply “ the safest unit of blood is the one you don’t get” stated beautifully by the blood bank manager at Yale University (Blood Transfusions: Extra Steps to Ensure Safety). Simply, changing the diagnostic criteria for blood transfusion from recovery success and hemoglobin goal ranges to anemia prevention, blood salvaging, and minimizing blood loss may aide in conserving blood supply (Blood Transfusions: Extra Steps to Ensure Safety). This program is known to be effective due to data from following no blood recovery due to religious preference has shown an equal recovery rate for these patients even following surgeries involving greater blood loss. The patient blood management program could save an already limited supply as well as reduce safety concerns involved with a transfusion (Patrick Meybohm). Controlling the demand for supply is of value, but demand will exist regardless of these efforts. This realization has led to the exploration of expanding the donor pool to selective members of population. The least controversial of these suggestions involves limiting deferrals of women based on low hemoglobin values. Multiple solutions to this problem include varying hemoglobin ranges based on local laboratory norms instead of insisting on a universal norm (Newman), and an iron supplementation program that allows women to receive 52 low toxicity risk iron supplements to be taken each day until the next eligible donation date as long as the women agree to donate a minimum of 2 units per year (Gary M. Brittenham). Preventing deferrals not only guarantees a donation at the time, but also the

likelihood that the donor will return. Statistics on return rates of donors after deferral include a 29% drop in repeat donors, and a 68% drop in first-time donors (Newman). This may seem like a small group to target for increased donation; however, women of childbearing age are a significant 45% of the dedicated donor population. Other potential avenues to expand donor pools include removing the FDA required labeling of hereditary hemochromatosis donated units to prevent unwanted discrimination and creating an incentive program to maintain appropriate hematocrit levels in the population free of charge in exchange for donating their blood to the supply (Gary M. Brittenham), as well as adjusting the donor questionnaire to remove men who have sex with men questions to generalized sex risk behaviors for both heterosexual and homosexual persons (Koerth-Baker). Both suggestions involve changing a huge portion of the created safety infrastructure that may be more unlikely to happen due to the proven decrease in transfusion associated infection transmission risk.

The safety of the United States blood supply is a multilevel controlled system that has proven to decrease negative effects of transfusions received across the country. The ingenuity of the United States medicinal community, scientific community, and general population has proven to be one of the greatest sources for advancement in the world. The continued efforts at each level of transfusion therapy in the past, today, and that are planned for the future will without a doubt continue to improve the world and be the main stay of blood bank technology and safety.

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