Blood management: transfusion medicine comes of age

Blood transfusions happen in more than 10% of all hospital stays that include a procedure. The American Medical Association[1] identified overuse of five medical treatments—blood transfusions, along with cardiac stents, ear tubes, antibiotics, and the induction of birth in pregnant women—and highlighted the danger of unnecessary transfusions. Although blood transfusions are believed to be lifesaving, this assumption has never been shown in a controlled clinical trial; blood transfusions have been described as "unavoidably, unsafe, and inherently dangerous" in the US Blood Shield laws.[2] Thus, perceived benefits relative to the known risks of a blood transfusion are important elements in discussions with patients about informed consent, especially in management of anaemia with alternatives to blood transfusion.[3]

Transfusion-transmitted infections have been a worry, especially in the 1980s with the recognition of transfusion-associated HIV and the risk of transmission of hepatitis C virus.[4] Transmission of known viral agents has decreased and responses to emerging infectious diseases transmitted by blood transfusion have been rapid (figure). Concomitantly, the 2011–12 annual report of transfusion fatalities by the US Food and Drug Administration Center for Biologics Evaluation and Research showed a decrease in all-cause deaths related to transfusion, with only 30 deaths attributable to transfusion reported in the USA in 2011.[5] Between 20x07 and 2011, transfusion-related acute lung injury caused the highest percentage (43%) of reported fatalities, followed by haemolytic transfusion reactions (23%) caused by non-ABO (13%) or ABO (10%) incompatibilities.

Increasing evidence suggests that patients have additional adverse clinical outcomes (ie, increased morbidity and mortality) associated with blood transfusions.[6] The panel lists risks that include not only known transmissible pathogens for infectious disease, transfusion reactions, transfusion-related acute lung injury, errors in blood administration, and circulatory overload; but also potential, as yet undefined, risks such as immunomodulation (eg, perioperative infection or tumour progression), unknown risks (emerging pathogens such as new variant Creutzfeldt-Jakob disease and West Nile virus),[4] and risks associated with duration of blood storage lesions in patients undergoing cardiac surgery.[7] The potential threat of xenotropic murine leukemia virus-related virus (XMRV), for example, required extensive research to determine that its presence in the blood of patients with chronic fatigue syndrome could not be reproducibly confirmed, and that blood donor screening is not warranted.[8]

These considerations have given rise to the specialty of blood management, supported by corresponding initiatives to "promote the appropriate use of blood and blood components, with a goal of minimizing their use". This movement has been motivated by the need to improve blood safety and patient outcomes, preserve the blood inventory, and constrain escalating costs.[9] Patient blood management has been recognised by WHO as a means to "promote the availability of transfusion alternatives".[10] In 2010, blood management was cited as one of the ten key advances in transfusion medicine in the past 50 years.[11]

Awareness of risks, costs, and the effect on blood inventory has led providers to look at institution-based

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See **Series** pages 1845, 1855, and 1866

For the **Agency for Healthcare Research and Quality's 2009 Healthcare Cost and Utilization Project report** see http://www.hcup-us.ahrq.gov/reports/factsandfigures/2009/section3_TOC.jsp

For the **Society for the Advancement of Blood Management (SABM)** see http://www.sabm.org

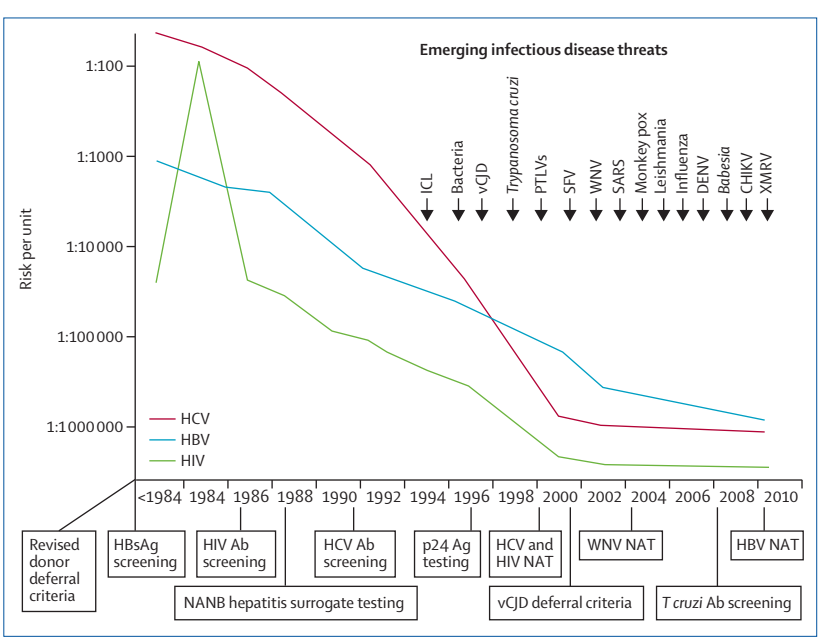

Figure: **Risks of major transfusion-transmitted viruses related to interventions, and accelerating rate of emerging infectious diseases of concern to blood safety**

Evolution of the risks of transmission by blood transfusion for HIV, hepatitis B virus, and hepatitis C virus. Major interventions to reduce risks are shown below the time line on the X axis. Emerging infectious disease threats in the past 20 years are shown above in the top right quadrant of the figure. HBsAg=hepatitis B surface antigen. Ab=antibody. NANB=non-A, non-B hepatitis. Ag=antigen. HCV=hepatitis C virus. NAT=nucleic acid testing. HBV=hepatitis B virus. ICL=idiopathic CD4 T-lymphocytopenia. vCJD=variant Creutzfeldt-Jakob disease. PTLVs=primate T lymphotropic viruses. SFV=simian foamy virus. WNV=West Nile virus. SARS=severe acute respiratory syndrome. DENV=dengue virus. CHIKV=chikungunya virus. XMRV=xenotropic murine leukaemia virus-related virus. Reproduced with permission from reference 4.

***Panel:* Potential risks of blood transfusion**

1 Infectious agents
- Transfusion-transmitted disease for which donors are tested*
  - Hepatitis B virus (1970 [surface antigen]; 1986–87 [core antibody]; 2009 [nucleic acid])
  - HIV (1985 [antibody]; 1999 [nucleic acid])
  - Hepatitis C virus (1986–87 [alanine aminotransferase]; 1990 [antibody]; 1999 [nucleic acid])
  - Human T-cell lymphotropic virus (1988 [antibody])
  - West Nile virus (2003 [nucleic acid])
  - Bacteria (in platelets only; 2004)
  - *Trypanosoma cruzi* (2007 [antibody])
  - Cytomegalovirus
  - Syphilis
- Transfusion-transmitted disease for which donors are not routinely tested
  - Hepatitis A virus
  - Parvovirus B19
  - Dengue fever virus
  - Malaria
  - *Babesia* spp
  - *Plasmodium* spp
  - *Leishmania* spp
  - *Brucella* spp
  - New variant Creutzfeldt-Jakob disease prions
  - Unknown pathogens

2 Transfusion reactions
3 Alloimmunisation
4 Medical errors (wrong blood to patient because of mislabelled specimen or patient misidentification)
5 Transfusion-associated acute lung injury
6 Transfusion-associated circulatory overload
7 Iron overload
8 Immunomodulation
9 Storage lesions (age of blood)

*The target of the screening assay (antibody, microbial antigen, or microbial nucleic acid) and the year of assay implementation are shown in parentheses. Updated from reference 3.

initiatives in patient blood management, such as the use of guidelines restricting use of transfusion to improve blood use.[12] Patient blood management encompasses an evidence-based medical and surgical approach that is multidisciplinary (ie, including transfusion medicine specialists, surgeons, anaesthesiologists, and critical care specialists) and multiprofessional (ie, including physicians, nurses, pump technologists, and pharmacists). In this approach, preventive strategies are emphasised to identify, assess, and manage anaemia in medical[13] and surgical[14] patients, including use of pharmacological interventions[15] and the avoidance of unnecessary diagnostic teting to minimise iatrogenic blood loss;[16] to optimise homoeostasis[17] and use of point-of-care testing;[18] and to establish clinical practice guidelines for blood transfusions. With recent development of quality–performance indicators for patient blood management by health-care institutions and accreditation organisations,[3] the accompanying Clinical Series in *The Lancet* is appropriate and timely, and looks at the effect of patient blood management on three areas of transfusion medicine: blood utilisation, alternatives to blood, and inventory management of the blood supply.

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I declare that I have no conflicts of interest.

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