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Transfusion Medicine in Sub-Saharan Africa: Conference Summary

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ABSTRACT

In November 2014, a 3-day conference devoted to transfusion medicine in sub-Saharan Africa was held in Kampala, Uganda. Faculty from academic institutions in Uganda provided a broad overview of issues pertinent to transfusion medicine in Africa. The conference consisted of lectures, demonstrations, and discussions followed by 5 small group workshops held at the Uganda Blood Transfusion Service Laboratories, the Ugandan Cancer Institute, and the Mulago National Referral Hospital. Highlighted topics included the challenges posed by increasing clinical demands for blood, the need for better patient identification at the time of transfusion, inadequate application of the antiglobulin reagent during pretransfusion testing, concern regarding proper recognition and evaluation of transfusion reactions, the expanded role for nurse leadership as a means to improve patient outcomes, and the need for an epidemiologic map of blood usage in Africa. Specialty areas of focus included the potential for broader application of transcranial Doppler and hydroxyurea therapy in sickle cell disease, African-specific guidelines for transfusion support of cancer patients, the challenges of transfusion support in trauma, and the importance of African-centered clinical research in pediatric and obstetric transfusion medicine. The course concluded by summarizing the benefits derived from an organized quality program that extended from the donor to the recipient. As an educational tool, the slide-audio presentation of the lectures will be made freely available at the International Society of Blood Transfusion Academy Web site: http://www.isbtweb.org/academy/.

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Transfusion in Sub-Saharan Africa: Past, Present and Future

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Dr Walter "Sunny" Dzik opened the conference with data from the World Health Organization (WHO) indicating that the greatest growth in world population during the century would occur in Africa. Africa's growing population will bring increased health care demands that will depend upon transfusion services supported by a well-educated transfusion medicine professional community. Dr Dzik reviewed the history of transfusion in sub-Saharan Africa, which was characterized by a series of expansions and contractions [1]. Transfusion practice grew gradually between World War I and the period of African national independence in the 1960s. After independence, blood services grew dramatically with collections peaking in the late 1970s. Then, as a consequence of the tragedy of HIV and regional civil strife, a decade of struggle and decline followed. A period of dramatic, robust recovery began in the 1990s and continues to this day. With support through both national and international investment, a growing professional force devoted to transfusion care has raised blood services in sub-Saharan Africa to the highest levels in history. Despite this achievement, demand still outstrips supply, and ample opportunity for progress remains.

Currently, West Africa faces an extreme crisis from the devastation of an epidemic of the Ebola virus (Fig 1). While a shocked and saddened world looks on, West Africa struggles to adjust. Health care workers on the front lines have been especially courageous. Transfusion of convalescent plasma has received considerable attention as a possible therapy for Ebola. The rationale derives, in part, from an experience in the 1995 Ebola outbreak in Kikwit, Democratic Republic of the Congo. Five individuals each donated 150 to 450 mL of blood, which was transfused to 8 recipients who were seriously ill at the time of transfusion. Although the overall mortality of the 316 cases was 80%, the mortality of the transfused recipients was only 12% [2]. Although the outcomes were encouraging, a careful look at the clinical report demonstrates that the recipients may have naturally seroconverted before the transfusions were given.

Dr Dzik completed his remarks focusing on a bright future for transfusion medicine in sub-Saharan Africa, signaling 3 forces that would promote progress [3]: First, "leap frog" technology will undoubtedly advance African transfusion care in unforeseen ways. For example, the recent development of a noninvasive measurement of hemoglobin using a smart phone [4] could have an obvious impact on red blood cell (RBC) transfusion. Second, clinical research will advance patient outcomes, and Dr Dzik pointed to several active clinical trials underway in Africa that would be discussed by subsequent speakers. Finally, education would be key to building the profession of the future. Addressing those in attendance, he expressed the hope that the bright future of sub-Saharan transfusion medicine would begin now.

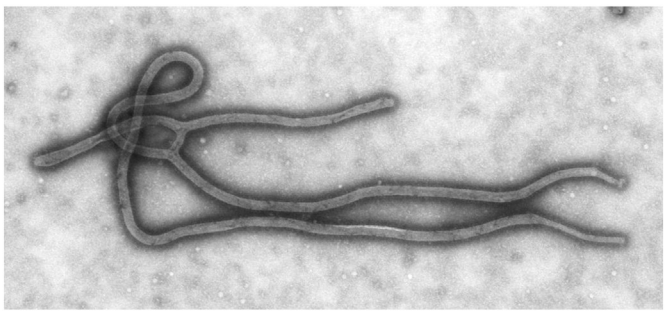


Fig 1. Ebola virus (photo credit: Cynthia Goldsmith, PHIL ID# 1832, Public Health Image Library [http://phil.cdc.gov], Centers for Disease Control and Prevention [http://www.cdc.gov]).

Donor Mobilization and Blood Collection

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Kampala, Uganda

The conference formal presentations appropriately began with a detailed review of the progress made and the challenges still confronting the collection and distribution of an adequate national supply of safe blood in developing nations. Recent data suggest that 100 000 000 U of blood are collected globally each year. Although high-income nations use half of this blood, they account for less than 20% of the global population. High-income countries collect 37 donations per 1000 population, whereas low-income nations are able to collect only one-tenth this amount, 3.9 donations per 1000 population [5].

Dr Dorothy Kyeyune, an international leader in this field, provided a detailed description of the blood supply in Uganda. She began by endorsing voluntary, repeated, nonrenumerated blood donations. She drew a contrast between voluntary donations and family replacement donations or paid commercial donations. In developing nations, where the risk of transfusion-transmitted infections is particularly high, building a stable national blood supply rests upon the foundation of repeated donations by safe donors.

In Uganda, demand for blood is substantial due to the high birthrate and the prevalence of malaria. National statistics suggest that 45% of blood is used to treat children younger than 5 years, most with severe malaria anemia. Thirty percent of blood is used for women at the time of childbirth. To keep up with this demand, the Uganda Blood Transfusion Service has 7 regional blood banks and 22 mobile collection teams distributed throughout the nation. See Figure 2.

Blood collections have nearly doubled in the last decade and reached 200 000 annual collections in 2011. Dr Kyeyune detailed a broad range of strategies that have been used to attain the blood collection goals. These strategies have included targeting low-risk donor populations; collaborating with media outlets for education; and securing funding to provide the needed infrastructure, staff, and supplies required for sustained growth. Despite the measurable success, blood shortages still remain in Uganda. In the most recent year, the supply fell short of demand by approximately 10%. Seasonal shortages, for example, when schools and colleges are not in session, place greater strain on the system. To meet demands, additional donor sources are needed, and Dr Kyeyune described the process used to mobilize new donors in northern Uganda. The collaborative efforts of blood services and community leaders resulted in thousands of additional donations such that in March and April 2014, for the first time, blood demands in the northern Ugandan city of Gulu were met completely by the local supply.

Dr Kyeyune closed her presentation with a view to the next decade. She noted that a single unit of blood was more expensive than a 1-week course of even the most expensive antibiotic. Funding is, therefore, essential for a sustainable national blood supply. Advances in blood services in Uganda have been supported in part through the President's Emergency Plan for AIDS Relief. Reduction in President's Emergency Plan for AIDS Relief support, expected to occur in the future, will need to be replaced by other sources of funding if progress is to be sustained. She expressed hope for continued development of new financial partnerships to bring the message of the importance of blood donation even closer to the population of her country. She anticipated greater reach and efficiency of existing teams and looked forward to a future when all Ugandan patients would have full access to a ready supply of safe transfusion care.

Blood Component Preparation

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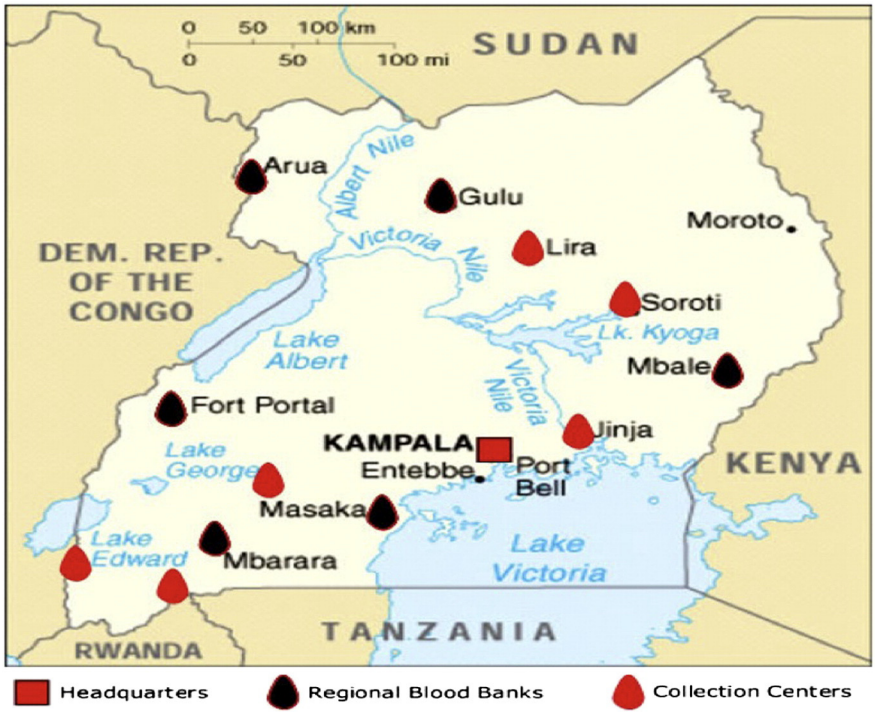


Fig 2. Donation sites throughout Uganda. Used with permission of the Uganda Blood Transfusion Service.

Ms Grace Otekat began by establishing the importance of component preparation in developing nations. Although whole blood is widely used throughout sub-Saharan Africa and is well suited to specific clinical situations [6], the preparation of blood components offers several advantages. Component preparation allows the 3 major blood constituents—RBCs, platelets (PLTs), and plasma—to be stored under temperature and chemical conditions that are optimal for their conservation and effectiveness. Component separation also allows patients to receive only that fraction of the blood which they actually need. Finally, and of significant importance in developing nations, component preparation allows several patients to be helped by 1 donation.

Large-scale component production requires a considerable investment of capital. Critical equipment includes floor model centrifuges, freezers, refrigerators, PLT incubators, sufficient equipment for cold chain transport of components, and biomedical engineering staff to maintain the equipment. A good source of constant electric power is needed to maintain storage temperatures. Equally important, component preparation requires a consistency of technique that demands detailed procedures, a quality control program, and a well-trained and dedicated staff. Ms Otekat reviewed the properties of each of the major blood preparations: whole blood, RBCs, PLT concentrates, frozen plasma, and cryoprecipitate. She detailed the characteristics, storage requirements, shelf-life, and indications for transfusion. Looking to the future, she anticipated that blood component production would increase in developing nations as investments in blood services seek to maximize the yield from donors. In particular, cryoprecipitate may serve as a source of factor VIII and fibrinogen that is more cost-effective than commercial concentrates. Demand for whole bloodderived PLTs is likely to be much stronger than apheresis PLTs given their equivalent hemostatic efficacy and the high production cost of apheresis products. Prestorage leukoreduction, although not widely practiced in developing nations, is currently being done as a research activity at the Uganda Blood Transfusion Service and is an area for potential future component development.

Pretransfusion Testing and Alloimmunization

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Dr Bernard Natukunda began by highlighting the connection between alloimmunization to red cell antigens and the role of pretransfusion testing. In Europe and America, rates of red cell alloimmunization are 18% to 76% among patients with sickle cell disease (SCD), but only 5% to 20% among other multiply-transfused recipients [7]. The higher incidence of alloimmunization among sickle cell patients may be due, in part, to genetic differences in red cell antigens between white blood donors and recipients of African heritage. This disparity would not apply to sickle cell patients transfused in sub-Saharan Africa. Indeed, studies of alloimmunization in Africa observe no difference in the rate of red cell sensitization between sickle cell patients and other multiply-transfused patients. In Uganda, Dr Natukunda et al [8] studied 428 transfused sickle cell patients and found that 6.1% had clinically significant RBC alloantibodies. Despite the measurable rate of red cell alloimmunization, pretransfusion testing in many sub-Saharan nations remains rudimentary, consisting of forward typing only for ABO and D antigens and saline crossmatches performed at room temperature.

Dr Natukunda next turned attention to the elements of optimal pretransfusion testing. These include positive patient identification of the intended recipient and submission of a properly labeled blood sample and blood requisition, a review of transfusion records for evidence of previous test results, ABO (forward and reverse) and RhD grouping of the recipient, an antiglobulin-enhanced red cell antibody screen, antibody identification for those patients with a positive screen, selection of appropriate components for transfusion, compatibility testing, and proper labeling of units and records of blood release. There is ample room for improvement in many developing nations for each of these basic elements in pretransfusion care. A substantial technical advance

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in test sensitivity would result from application of the antihuman globulin reagent currently in scarce supply in developing countries.

Dr Natukunda closed with his vision for the future of pretransfusion testing in sub-Saharan Africa. For patients with SCD, cancer, and other multiply-transfused recipients, 3 steps would be required: ABO and RhD grouping, antihuman globulin-enhanced screening, and a room temperature crossmatch if the antibody screen is negative. For those with a positive antibody screen, antibody identification should be performed by staff with sufficient training. For other blood recipients at lower risk for alloimmunization, an antiglobulin-enhanced crossmatch should be done. Such efforts combined with proper testing of blood donors and with proper bedside patient identification will reduce the incidence of acute and delayed hemolytic transfusion reactions.

Acute Transfusion Reactions

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Dr Heather Hume began by presenting 4 recent cases, which illustrated different examples of acute transfusion reactions: a woman with acute dyspnea and hypertension during transfusion; a woman with new onset of chills, rigors, and anxiety during transfusion; a child with acute deterioration of vital signs after a PLT transfusion; and a 6-year-old boy with vomiting and abdominal pain shortly after starting an RBC transfusion. The audience was asked to select the likely cause of these events. She focused on the presenting signs and symptoms of the most dangerous reactions: acute hemolytic reactions, transfusion-associated circulatory overload (TACO), transfusion-related acute lung injury, bacterial contamination, and anaphylaxis [9].

The importance of human error as a cause of ABO-incompatible transfusions was emphasized. Bacterial overgrowth, especially in PLT products, can also result in fatal reactions, which can, on occasion, be prevented by simple visual inspection of the PLT bag. She reviewed the differential diagnosis of acute dyspnea occurring within 6 hours of a transfusion sorting out the recognition of TACO and transfusion-related acute lung injury. She then turned to allergic reactions describing their frequency and causes. Dr Hume closed her presentation by returning to the 4 cases presented at the beginning, providing the answers to the cases: the woman with dyspnea and hypertension was an example of TACO; the woman with new onset of chills, rigors, and anxiety during transfusion experienced a major acute hemolytic reaction (ABO error); the child with acute deterioration of vital signs after a PLT transfusion had received bacterially contaminated PLTs; and the 6-year-old boy with vomiting and abdominal pain shortly after starting an RBC transfusion was another example of ABO incompatibility due to human error.

Transfusion in SCD

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Dr Kasirye offered a review of transfusion practice in SCD based on a recent summary of evidence-based management published from the National Institutes of Health (NIH) Heart Lung and Blood Institute [10]. Many of the NIH recommendations can be applied to the care of sickle cell patients in sub-Saharan Africa. Notable differences, however, are the limited availability of hydroxy urea for high-risk patients and the lack of access in Africa to red cell exchange—a recommended treatment for acute stroke and severe acute chest syndrome. The NIH panel recommended some form of transfusion intervention for other complications of SCD including hepatic or splenic sequestration, intrahepatic cholestasis, multisystem organ failure, aplastic crisis, and symptomatic anemia. The panel offered a strong recommendation, based on moderate evidence, for simple transfusion to a hemoglobin level of 10 g/dL before general anesthesia. This recommendation was based, in part, on the results of the Transfusion Alternatives Preoperatively in Sickle Cell Disease trial [11], which was a small ($n = 67$) randomized controlled trial of preoperative vs no preoperative transfusion and which found that patients randomized to no preoperative transfusion experienced a higher frequency of sickle cell–related complications including acute chest syndrome. Based on the results of the STOP study [12], the National Heart, Lung, and Blood Institute (NHLBI) expert panel offered a strong recommendation in favor of either exchange transfusion or simple transfusion for children with elevated transcranial Doppler readings [13]. See Figure 3. Such children are known to be at increased risk for stroke. Dr Kasirye noted that this was not yet realistic throughout sub-Saharan Africa because of lack of Doppler technology. Finally, the NHLBI expert panel noted some sickle cell syndromes that should normally not warrant transfusion therapy. These included uncomplicated painful crisis, asymptomatic anemia, and acute kidney injury.

Dr Kasirye then reviewed complications of transfusion therapy more commonly encountered among sickle cell patients. These include iron overload, hyperviscosity syndrome, alloimmunization to multiple red cell antigens, and the hyperhemolytic syndrome. Hyperviscosity syndrome presents as headache, increased blood pressure, altered level of consciousness, seizures, or stroke after aggressive RBC transfusion. The condition results from the fact that cells that sickle contribute disproportionately to blood viscosity and from the presence of vasculopathy in sickle cell patients. As a result, it is recommended that transfusion targets should not greatly exceed 10 g/dL. Delayed hemolytic reactions in SCD may go unrecognized, especially when they present with signs otherwise seen in sickle cell patients such as fever, pain, jaundice, and anemia. In some cases, delayed hemolytic reactions trigger the rather unique syndrome of hyperhemolysis in which the patient's alloimmune response spreads to include destruction of the patient's own red cells as well as destruction of otherwise compatible transfused cells [14]. Dr Kasirye closed his session noting that 2 technologies—immunohematology testing enhanced by Coombs' serum and transcranial Doppler technology—represent achievable "next steps" in the advance of sickle cell care. As in any part of the world, sickle cell patients are best served by dedicated specialty clinics where the unique features of their clinical disorder receive tailored expert care.

Transfusion Therapy in Cancer Medicine

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Dr Henry Ddungu opened his presentation noting estimates that major cancers affect more than 700 000 patients in sub-Saharan Africa each year [15]. Because the burden of disease in developing nations is high, cancer treatment is expected to increase the demand for blood support. Indeed, recent studies of blood utilization reflect changes in sub-Saharan health care. A recent study of 91 207 transfusions in Namibia found significant blood use outside the traditional indications of postpartum bleeding and malaria anemia [16]. Similar findings were recently reported in a smaller study at Mulago Hospital in Uganda where cancer treatment was the biggest single user of RBCs accounting for 27% of all RBC usage [17]. Given the high demand and reduced blood supply in sub-Saharan Africa, Dr Ddungu argued in favor of unique strategies for blood support of cancer patients that were specific to the African region.

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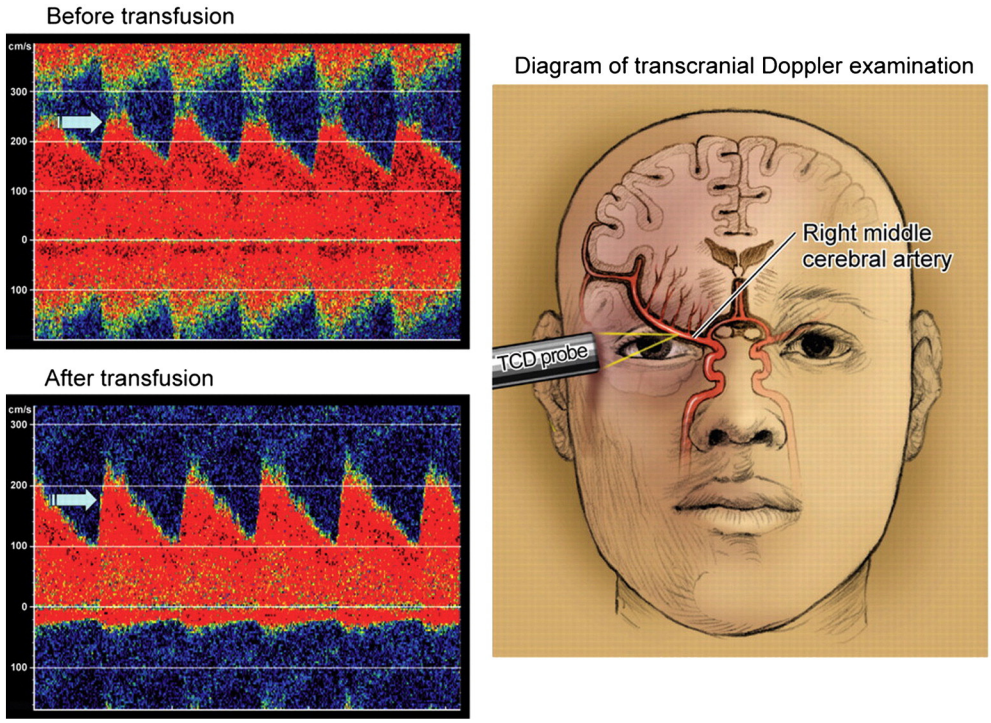


Fig 3. Doppler ultrasound in the management of sickle cell disease. Professional illustration by Kenneth Probst from reference [13].

Traditional indications for RBC transfusion in cancer patients focus on triggers in the 7 to 10 g/dL range [18]. However, Dr Ddungu pointed to 10 major randomized trials, collectively representing more than 6700 enrolled patients with a wide range of clinical conditions, which indicate that a conservative strategy for RBC transfusion was not inferior. See Table 1. These findings are of particular importance for regions of the world where blood is in short supply. In addition to using blood more wisely, Dr Ddungu pointed to the potential for medications to augment red cell production and thus further reduce transfusion demand. Of particular interest for cancer care in sub-Saharan Africa is the possibility that supplemental iron or erythropoietin (or both) might further reduce the demand for RBCs [19,20].

Turning to PLT support, Dr Ddungu noted that the shortfall between supply and demand was even more pronounced for PLTs than for RBCs. For example, at Uganda's national cancer institute, daily demand for PLTs is approximately 6 times higher than supply. He reviewed recent randomized trials, which provide strong evidence in favor of a more conservative prophylactic use of PLTs. These included the PLT dose study (PLADO) [21], the TOPPS trial [22], and the Wandt trial [23]. Finally, although not yet supported by randomized trial data, there is considerable interest surrounding the use of antifibrinolytic agents to reduce bleeding in thrombocytopenic patients undergoing cancer chemotherapy [24]. These low-cost agents may represent a breakthrough in hemostatic support especially in regions where PLT concentrates are in short supply.

Table 1
Summary of randomized trials on the "trigger value" for RBC transfusion

Author	Name	Setting	Trigger (g/dL)	n
Hebert, 1999	TRIC	Adult ICU	7 vs 9	838
Kirpalami, 2006	PINT	Infants <1 kg	10 vs 12	457
Lacroix, 2007	–	Pediatric ICU	7 vs 9.5	637
Hajjar, 2010	TRAC	Cardiac surgery	8 vs 10	502
Cooper, 2011	CRIT	Acute MI	8 vs 10	45
Carson, 2011	FOCUS	Hip surgery	8 vs 10	2,016
Villanueva, 2013	–	UGI bleed	7 vs 9	921
Walsh, 2013	RELIEVE	Older ICU patients	7 vs 9	100
Robertson, 2014	–	Traumatic brain injury	7 vs 10	200
Holst, 2014	TRISS	Septic shock	7 vs 9	998

Abbreviations: *ICU*, intensive care unit; *MI*, myocardial infarction; *UGI*, upper gastrointestinal.

Transfusion in Trauma

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Dr Isaac Kajja began his remarks to the audience with chilling statistics indicating that trauma is a neglected epidemic in developing countries. World Health Organization estimates that trauma results in more than 5 million deaths each year, roughly equal to the number of deaths from HIV-AIDS, malaria, and tuberculosis combined [25]. More than 90% of trauma deaths occur in low- and middle-income countries. Trauma adds to a vicious cycle of economic and social burden upon individuals, communities, and society. In developing countries, traffic road accidents are a major cause of trauma, and funding for safe roadways is insufficient. For example, 1 study estimated that per capita annual government expenditure for road safety was just $0.07 in Pakistan and $0.09 in Uganda [26].

Trauma care is changing and demands a broad clinical team including anesthesiologists, surgeons, nurses, radiology, surgical services, laboratory, transfusion services, and critical care. However, maintaining readiness of multispecialty care for episodic and unpredictable events represents a challenge that is common worldwide. Our understanding of the coagulopathy of trauma is also evolving. Prior notions that coagulopathy resulted from hemodilution have given way to a more sophisticated model based on endothelial response to shock [27]. Features of this model include the early explosive release of tissue-type plasminogen activator, which converts plasminogen to plasmin. Plasmin, in turn, localizes on fibrin clots resulting in unstable clots that lyse and break down. In more extreme cases, plasmin will cleave circulating fibrinogen resulting in hypofibrinogenemia. See Figure 4. The importance of fibrinolysis during the acute coagulopathy of trauma was verified by the CRASH-2 trial [28]. CRASH-2 was a large, multicenter,

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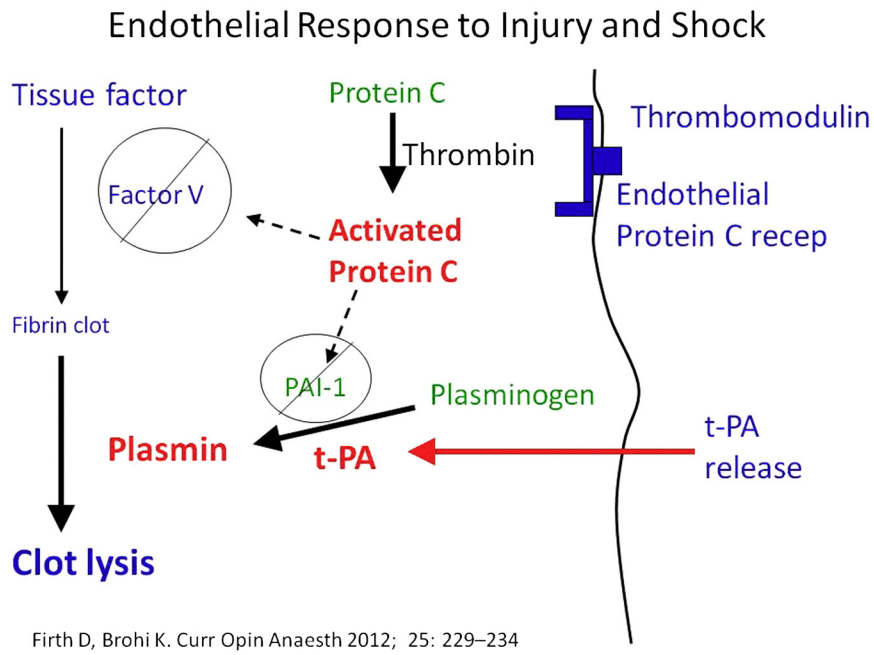


Fig 4. Coagulopathy of acute trauma. Endothelial activation, triggered by shock and tissue trauma, activates protein C and releases tissue-type plasminogen activator both of which contribute to reduced hemostasis.

international trauma trial, which enrolled more than 20 000 trauma patients in 40 nations and randomized them to immediate care with tranexamic acid or placebo. Patients assigned to receive tranexamic acid demonstrated statistically significant improved survival and reduced death due to bleeding.

Transfusion support of trauma is also changing. Whether more aggressive use of plasma would improve outcomes was investigated by the Pragmatic Randomized Optimal Platelet and Plasma Ratios trial [29]. This multicenter prospective randomized controlled trial compared a blood resuscitation strategy using 1 fresh frozen plasma, 1 U of PLTs, and 1 U of RBCs (1:1:1) to an alternative strategy that used 1 fresh frozen plasma, 1 U of PLTs, and 2 U of RBCs (1:1:2). The study found no significant differences in mortality at either 24 hours or 30 days and failed to demonstrate that the 1:1:1 strategy provided a survival advantage compared with the 1:1:2 strategy. Other studies are being organized to understand whether thromboelastography is superior to traditional coagulation testing as a guide to blood component resuscitation. Regardless of the results of these studies, Dr Kajja noted that important challenges confront blood support for trauma in sub-Saharan Africa. There are limited inventories of blood in most hospitals, and blood transfusions services are not well adapted to support massive transfusion. He highlighted the lack of a sufficient number of transfusion medicine specialists, the very limited knowledge of clinicians in the principles and practice of modern transfusion medicine, and the need to improve organizational capacity of transfusion medicine within hospitals.

Dr Kajja closed by identifying 5 areas for targeted progress: governmental commitment to support investment in improved health care, partnerships between transfusion programs and other national programs (such as those devoted to HIV/AIDS or malaria) where transfusion support is needed, university and vocational training specifically devoted to transfusion and laboratory medicine, a stronger dialogue between blood suppliers and blood prescribers, and trauma research designed to establish priorities for change. A detailed epidemiologic map of trends in blood use over time in sub-Saharan Africa would provide valuable data for meeting present-day challenges and forecasting future needs.

Transfusion in Pediatrics

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Kampala, Uganda

Dr Aggrey Dhabangi focused on 3 aspects of pediatric transfusion medicine: guidelines for transfusion, practical considerations regarding transfusion administration, and new advances on the horizon of care. He began by reviewing the physiology of oxygen delivery to tissues and the importance of considering all 3 components of oxygen delivery: oxygen supply to the blood, hemoglobin content, and cardiovascular

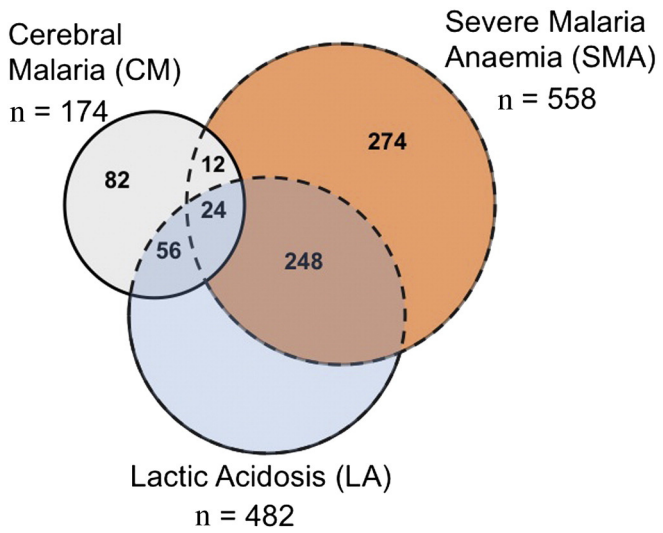


Fig 5. Major clinical syndromes among 850 children with severe *Plasmodium falciparum* malaria in Uganda. The number of children affected with each syndrome is shown within each section. Severe malaria anemia accounts for 558 (65%) of cases. Data from reference [30].

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function with adequate tissue perfusion. In sub-Saharan Africa, guidelines for pediatric RBC transfusion are largely based on experience in the treatment of severe malaria anemia [30], defined as a hemoglobin level less than 5 g/dL, and the most common severe syndrome of malaria. See Figure 5.

The WHO offers clinical guidance for RBC transfusion in children [31]. Dr Dhabangi noted that important details in the WHO guidelines were developed largely by expert consensus and in the absence of randomized trial evidence. This was particularly evident in the area of moderate anemia where clinical indicators other than the blood hemoglobin concentration are likely to influence the decision to transfuse RBCs. He urged continued clinical research to understand best practice in pediatric transfusion medicine.

Dr Dhabangi then reviewed his approach to the details of blood transfusion in pediatrics. Despite years of pediatric transfusions in sub-Saharan Africa, the relative value of whole blood vs packed RBC transfusion remains unclear. Also unresolved is the most appropriate volume of blood to administer to an urgently ill child. Transfusion volumes range from 10 to 20 mL/kg over 2 to 4 hours. Blood is often given by simple gravity drip, which can lead to inaccurate rates of infusion. He pointed to unpublished data from his own research demonstrating that 10 mL/kg of packed RBCs may often be insufficient for those children who present with profound anemia (hemoglobin <3 g/dL) compared with those presenting with moderate anemia (5-7 g/dL). See Figure 6.

Several features are unique to pediatric transfusion in sub-Saharan Africa [31]: Children in Africa often present to hospital with truly profound anemia (hemoglobin <3 g/dL). Although the presenting tachycardia and air hunger can be misinterpreted as heart failure prompting treatment with diuretics, respiratory distress is more often a sign of significant lactic acidosis. Moreover, African children coming to hospital have usually been ill for days and are often hypovolemic, thus rendering diuretics inappropriate. ABO errors represent a risk given the clinical urgency of the transfusion episodes, and finally, time is critical. Data from the FEAST trial document that delays in administration of RBCs of only a few hours in a child with profound anemia are associated with a fatal outcome [32]. Indeed, because many transfusions for children are given in urgent clinical settings, careful clinical monitoring during and after the transfusion is essential. Increasingly, point-of-care devices, which can quickly check a finger-stick hemoglobin level, are available to guide transfusion therapy. In closing, Dr Dhabangi summarized exciting randomized clinical trials now underway. These include the TRACT trial (clinical trial no. NCT 01461590), which will explore the optimal volume of blood transfusion in acute pediatric anemia, and the Transfusion in Anemia trial (clinical trial no. NCT 01586923), which is examining whether prolonged storage RBCs deliver oxygen to tissues as well as short storage RBCs.

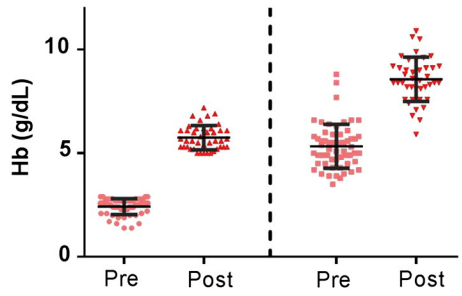


Fig 6. Risk of undertransfusion is reflected in the response to transfusion in Ugandan children given RBCs according to recommended guidelines. Those with very severe anemia (left panel) remain quite anemic even after transfusion. Unpublished data from Aggrey Dhabangi, Mulago Hospital, Uganda.

Transfusion in Obstetrics

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Dr Godfrey Mugyenyi summarized the causes, assessment, and treatment of postpartum hemorrhage (PPH). Worldwide, in 2013, an estimated 290 000 women died in childbirth with 25% to 33% of these fatalities from bleeding [33]. The burden of PPH is especially heavy in sub-Saharan Africa, which accounts for 62% of all maternal deaths. The average time from onset of PPH to death is 3 hours. It is among the quickest of maternal killers.

Postpartum hemorrhage is defined by WHO as loss of greater than 500 mL after vaginal delivery or greater than 1000 mL after caesarian delivery, although measuring blood loss during labor is difficult. Most PPH results from 1 of the "four Ts": loss of uterine Tone; Trauma to the birth canal; Tissue (such as retained placenta), or Thrombin (hemostatic breakdown from disseminated intravascular coagulation). Several categories of patients are known to be at increased risk for PPH. These include those with placenta previa; mothers with more than 2 prior uterine surgeries; mothers with triplets; grand multiparity; women with placenta accreta, increta, or percreta; and those with a history of prior PPH [34].

Dr Mugyenyi summarized the management of PPH, which begins with preparedness for all parturient women. Given the urgency for transfusion in severe PPH, patients known to be at risk must have blood grouping and crossmatching done in advance. Once PPH is recognized and the 4 Ts (see above) are systematically investigated, oxytocin/syntocinon is standard care for improving uterine tone. Evacuation of retained placental contents and surgical repair of birth canal trauma are done. In severe cases, bleeding can be reduced with the use of intrauterine balloon tamponade. See Figure 7.

Additional local treatments include compression sutures of the uterus, iliac artery ligation, and hysterectomy. Blood transfusion becomes essential in severe PPH. Whole blood is used because there is usually no access to fresh frozen plasma to treat coagulopathy. Laboratory monitoring during massive transfusion is desirable (goal-directed resuscitation) but is frequently not available in sub-Saharan Africa. In the absence of such data, WHO criteria for severe PPH can be used as a trigger for supplemental PLTs, fresh frozen plasma, and cryoprecipitate [34].

Dr Mugyenyi presented results from studies done at Mbarara Regional Referral hospital in southwestern Uganda where he works. These included a study comparing sublingual misoprostol vs intramuscular oxytocin for prevention of PPH [35] and a study reporting that PPH accounted for

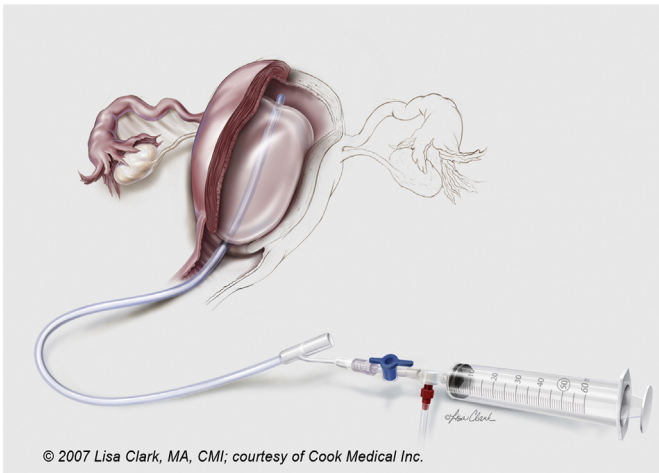


Fig 7. A Bakri balloon. Photo credit: Professional illustration by Mary Clark.

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a substantial proportion of blood usage at Mbarara Hospital exceeding demands by cancer, trauma, surgery, or SCD [36]. Dr Mugyenyi concluded by presenting the design of the WOMAN trial currently underway. WOMAN (clinical trial no. NCT 00872469) is an international multicenter large randomized clinical trial testing whether tranexamic acid will improve outcomes in PPH. As of January 2015, the trial had enrolled 15 000 of the anticipated 20 000 women. The results of this study are eagerly anticipated.

Nursing Care During Blood Transfusions

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Ms Claire Seguin's presentation drew upon her dual role as a practicing oncology nurse at Massachusetts General Hospital and as a manager of clinical compliance. She presented 3 concepts to the audience: an overview of best practices during blood transfusion, the role of the nurse as a leader in safe transfusion practice, and the importance of a work environment that promotes professional nursing development. Nurses in the United States have complex responsibilities ranging from direct comfort and treatment of patients to participation in systems of care upon which hospitals depend for accreditation. Success in these different roles is achieved upon aligning the goals of nursing with the goals of the hospital.

Patient safety is paramount during blood transfusion. Acute severe hemolytic transfusion reactions due to ABO incompatibility have been reported to most often result from errors of patient identification at the bedside [37]. In North America and Europe, positive patient identification using wristbands that display 2 independent identifiers (usually the full name and medical record number) is standard procedure. Positive patient identification benefits not only transfusion care but reduces errors in medication administration and errors in diagnostics. This is an opportune area for improvement in sub-Saharan Africa. A second leading adverse event during transfusion is volume overload. Protection against rapid infusion of too much volume can be achieved, in part, with the use of electromechanical infusion pumps that give nurses more control over intravenous fluid administration. Patient safety also requires knowledgeable monitoring by nurses during transfusion. Nurses trained in transfusion are generally the first to recognize adverse transfusion events giving the patient the best chance for early treatment. Simple procedures, such as monitoring and documenting vital signs and level of consciousness at regular time intervals during the transfusion, are standard procedure in North America and Europe and represent another opportunity for nursing leadership in sub-Saharan Africa. Knowledgeable monitoring of vital signs provides a straightforward approach to early recognition of potentially severe transfusion reactions such as those resulting from hemolysis, volume overload, allergic reactions, and bacterial contaminated blood products. See Table 2.

Ms Seguin next directed her attention to the role of nurses as leaders in health care. In modern nursing, leadership structures drive "nursing processes," which, in turn, result in measureable patient outcomes. By monitoring key outcomes, structures can be periodically improved, processes upgraded, and the performance of the health care team improved. A well-recognized performance improvement process is based on the "Plan, Do, Check, Act" model in which organizations agree on metrics that define quality care, implement changes, and repeatedly check the new innovations for evidence of success. Ms Seguin illustrated the performance improvement process with a recent example from her hospital that focused on improved documentation of patient monitoring during transfusion.

In closing, she directed her comments to the importance of a working environment that promotes professional success. Characteristics of the ideal environment for nurse leaders include autonomy, mutual respect in the doctor-nurse relationship, control over nursing practices, and communication of patient care information. She noted exciting opportunities for nurses throughout sub-Saharan Africa to take a leadership role in transfusion practice—not only through active participation in local hospital transfusion committees but also through engagement with professional societies such as the African Society of Blood Transfusion and international connections with nurse leaders worldwide.

Quality: Ensuring Integrity From Arm to Arm

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The final presentation of the symposium was delivered by Ms Linda Barnes who spoke on the topic of quality management in transfusion medicine. She began with the concept that a quality system extends from the donor's arm to the recipient's arm and included not only an adequate and available supply of blood but also its safety and its efficacy at the bedside [38]. The challenges confronting transfusion medicine in sub-Saharan Africa increase the risk of transfusion and make implementation of quality management that much more important. Ms Barnes noted that recommendations from WHO repeatedly include implementation of effective quality systems in transfusion. Such implementation requires leadership from a quality champion with responsibility and authority who is willing to integrate activity across an entire organization. She then went on to describe how the numerous processes related to blood services can each be connected through an overall structure of quality management. Within this structure, 2 large categories emerge: quality blood processes and quality care processes. These categories, which center on the product and the patient respectively, contain numerous process steps each with a quality system consideration. The goal is to integrate them into 1 single organizational culture.

Ms Barnes affirmed that the value of quality management is represented by measurable reduction in transfusion risk. Examples include lower rates of transfusion-transmitted infections, lower rates of noninfectious hazards of transfusion, less frequent blood shortages, fewer errors, products with greater efficacy, and better patient outcomes. The perspective is one of continuous improvement supported by an organization that provides sufficient resources to achieve its goal. In closing, Ms Barnes emphasized the need for multidisciplinary collaboration. Examples in transfusion medicine include blood

Table 2
Signs and symptoms of acute transfusion reactions

	Hemolysis	Volume overload	Allergic	Bacterial contaminated
General	Anxious	Anxious	Anxious	Anxious
Blood pressure	Variable	Elevated	Normal or low	Normal or low
Pulse	Variable	Elevated	Variable	Elevated
Respiratory rate	Variable	Elevated	Normal or wheezing	Elevated
Temperature	Fever, chills	–	–	Fever, chills
Skin	–	–	Hives, itchy	Flushed
Other	Pain: back, chest, or i.v. site	Short of breath; wheezes; sits upright; hypoxia	Hypoxia variable	Discolored unit possible

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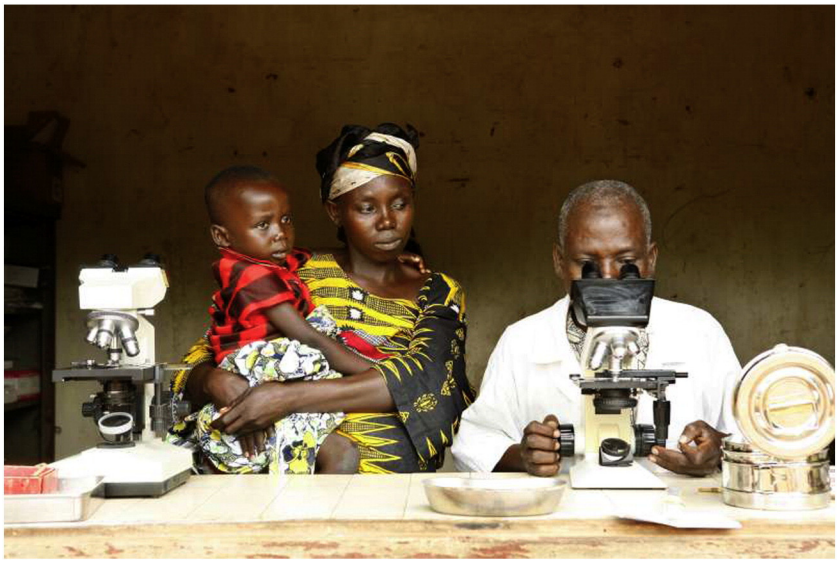


Fig 8. A child is screened for malaria while the mother looks on. Photo credit: H. Caux, August 2007, UNHCR, http://www.unhcr.fr/5315fe85c.html.

utilization committees, cross-institutional projects that join blood supplier to hospital blood users, and collaborations between blood services and leaders outside of health care. An increase in quality is fundamental to the advancement of the profession, to improved blood services, to a more abundant and safer blood supply, and to improved patient outcomes. Ms Barnes concluded her remarks by emphasizing that leadership drives at all levels of an organization. She challenged each of us to be those leaders.

Summary

The conference on transfusion medicine in sub-Saharan Africa provided an opportunity for academics from East Africa to share their knowledge regarding the current status and future direction of transfusion medicine in this region of the world. With the goal of fostering education for all regarding the practice of transfusion in Africa and improving the health care of patients in need of transfusion (Fig 8), the audio and slide content of the conference will be made freely available at the Web site of the International Society of Blood Transfusion Academy (http://www.isbtweb.org/academy/) with links to other organizations devoted to transfusion medicine professionals.

Conflict of Interest

The authors declare no conflict of interest, and the views expressed are their own. The financial supporters of the conference had no influence on the selection of speakers, content of the presentations, or summary manuscript.

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