



The blood supply in Sub-Saharan Africa: Needs, challenges, and solutions



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ABSTRACT

Sub-Saharan Africa (SSA) is burdened with a growing population and poor health care resources. Transfusion medicine is uniquely affected for SSA as a result of a combination of factors which put tremendous pressure on the blood supply. In this review, we consider these factors including: malaria, sickle cell anemia, transfusion medicine infrastructure, and past transfusion medicine policies including those which are tied to foreign aid, such as a VNRD-only practice. We also consider how SSA can overcome some of these hurdles to achieve a safe and adequate blood supply for its people through the advent of new vaccines, medications, infrastructure development, policy changes, and education.

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1. Introduction – blood supply and demand (real and theoretical)

Africa is home to one of the largest population masses on the planet. It is also where the majority of the poorest countries in the world are found. The provision of basic health care in Africa is a continuous struggle, and as a part of basic health care, is the prerequisite of a safe and adequate blood supply. This review focuses on the challenges surrounding blood supply and demand with a particular focus on Sub-Saharan Africa (SSA) as well as offers some suggestions for potential improvement. First, and foremost, it should be recognized that the region of SSA is vastly undersupplied with regard to its blood supply. The last population estimate in 2010 for SSA stood at about

856,858,000 million persons [1]. It is estimated that approximately 4 million units of blood are collected in SSA [2]. As shown in Fig. 1, this is less than one-tenth of the world's total blood supply. The donation rate of 1–3% of the population recommended by the WHO suggests that current SSA collections fulfill only 20–50% of its requirements. Given the unique needs of transfusion in SSA outlined below, we will see that the amount of blood available is dwarfed but what is needed.

1.1. Severe malarial anemia

To understand SSA blood usage, we need to focus on the unique indications for transfusion that occur in that part of the world. One of the largest indications for transfusion is anemia associated with malaria infection. Severe anemia associated with malaria is the most common cause of severe anemia in children in SSA and a significant cause of morbidity and mortality [3,4]. There are very few studies giving precise numbers as to how often blood is transfused for severe malarial anemia, but estimates can be made. Marsh et al reported in a study group of 1844 Kenyan chil-

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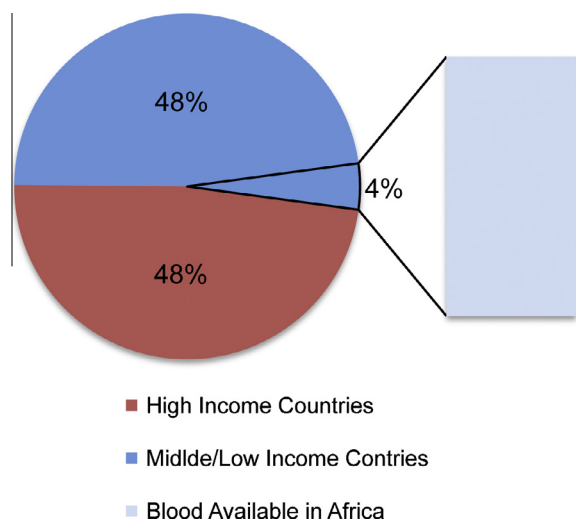


Fig. 1. The number of worldwide donated blood units available (WHO, Blood Safety Fact Sheet, 2011) in comparison to the number of units for Sub-Saharan Africa. The total number of donations equals 92 million worldwide.

dren, a rate of severe malarial anemia (that is a Hgb < 5 g/dl) of 4.7% [5]. Another study evaluated 77 adult patients prospectively who had malaria and found that 10% had severe anemia [6]. In a recent large study of over 1900 children admitted to the hospital with acute malaria in Uganda, 29% were found to have a Hgb < 5 g/dl [7].

The pathophysiology of severe malarial anemia is complex. Although there is red cell lysis driven by erythrocytic parasites, there are other contributing mechanisms such as: age, genetics, reactive oxygen species, co-infections, and iron status [8]. All of these factors contribute to making severe malarial anemia one of the most common indications for transfusion in pediatric hospitals in the developing world. According to the World Malaria Report 2011, there were 110,835,834 cases of suspected malaria and 80,406,314 cases of confirmed malaria in the African region [9]. Using a conservative estimate that 5% of persons with confirmed cases of malaria will develop severe malarial anemia and require a transfusion, we arrive at 4,020,315 cases – a result which uses the entire blood supply on the continent! This is, perhaps, even an underestimate as many individuals with malaria die without ever making it to a malaria treatment center, or go undiagnosed and cannot be accounted for. As one can see, this sole indication puts tremendous pressure on the blood supply.

1.2. Obstetric hemorrhage

Another, major indication for transfusion in SSA is obstetric hemorrhage, one of the most significant causes of maternal mortality worldwide. A reduction in maternal mortality is one of the outcomes of the United Nations Millennium Goals. A recent review shows that there were approximately 343,900 maternal deaths worldwide (although estimates are as high as 394,300 deaths) [10]. One of the main contributors to maternal death is obstetric

hemorrhage with estimates that hemorrhage accounts for 26–33% of maternal deaths [11,12]. Applying this estimate to the total number of maternal deaths means that 89,414–113,487 maternal deaths could be due to hemorrhage worldwide. The data regarding the prevalence of maternal hemorrhage that occurs in for only SSA is limited, but estimates suggest that one-half of maternal deaths occur in SSA [12]; equating to upwards of 56,744 deaths. Other studies attempting to specifically measure maternal hemorrhage in SSA have found an incidence/prevalence range of antepartum or postpartum hemorrhage of 0.05–3.05% with a case-fatality ratio of 2.8–27.3% [13]. The broad range of these statistics is mostly due to the difficulty in collecting data on hemorrhage causing maternal death, and is an approximation at best. These data describe deaths as a final outcome measurement, but another aspect of maternal health that has been considered is that of the “near-miss”; that is a woman who nearly survives death due to chance and luckily received appropriate care at a facility. An attempt to estimate the “near-miss” morbidity that occurs in Africa due to maternal hemorrhage has been made by Bates who, with limited study data, found an average “near-miss” rate due to maternal hemorrhage was 1.2 per 1000 births, although other estimates are as high as 82 per 1000 [11,13].

A more accurate determination of what the transfusion requirements are for pregnant women in SSA, would be determining the rate of postpartum hemorrhage – a clear indication for transfusion. A recent meta-analysis has estimated the rate of postpartum hemorrhage (>500 ml blood loss) at 25.7% in Africa and a rate of 5.1% for severe postpartum hemorrhage (>1000 ml blood loss) [14]. Given that the United Nations database on statistics showed that in 2009 there were 35,672,000 births in Africa, and given the estimated rates of postpartum hemorrhage as mentioned above, the range of mothers which should be transfused for hemorrhage could range from 1,819,272 to 9,164,407! Clearly, many of these cases are not being transfused (due to a limited blood supply) and are probably contributing to the high rates of maternal death seen in SSA.

1.3. Surgery

Other significant conditions that may require transfusion including surgery and trauma which may account for 12% and 18% of the use of red cell transfusions in the developing world respectively [15]. To estimate the amount of blood required for these latter indications is difficult as there are so few data available, but using the SSA 4,000,000 available blood donations collected per year as a baseline, one could approximate that 480,000 and 720,000 units are used for surgery and trauma respectively.

1.4. Sickle cell disease

Sickle cell disease (SCD) is a significant cause of morbidity and mortality in the developing world and the sickle cell gene frequency is up to 40% in SSA [16]. There are over 200,000 new cases of SCD each year in SSA according to the WHO 2006 Sickle-cell anemia report [17]. Some of the many complications of SCD include: pain crisis, splenic cri-

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