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DOI:

10.4103/0973-6247.200781

# Blood transfusion safety; current status and challenges in Nigeria

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## Abstract:

The attainment of blood transfusion safety in Nigeria (and probably the rest of Sub-Saharan Africa) remains an uphill task due to a number of factors, ranging from shortage of blood, poor implementation of blood transfusion guidelines, infrastructural deficits to high prevalence of transfusion-transmissible infections (TTIs), particularly hepatitis and human immune deficiency viruses. We reviewed available data on blood transfusion practices and safety in Nigeria using the PubMed, PubMed Central, Google Scholar, and African Index Medicus search engines, through a combination of word and phrases relevant to the subject. The World Health Organization has been in the forefront of efforts to establish safe, available, and affordable blood transfusion services in most parts of Africa through encouraging adequate blood donor recruitment, donor blood testing, and collection as well developing strategies for the rational use of blood. Even though modest improvement has been recorded, particularly with regards to donor blood screening for common TTIs, considerable efforts are needed in the form of robust public enlightenment campaigns (on blood donation) and continuous system improvement to drive the current transfusion practices in the country toward safety and self-sustenance.

## Key words:

Blood safety, national blood policy, transfusion transmissible infections, voluntary blood donation

## Adequate blood supply and health indices

The World Health Organization (WHO) had projected that Sub-Saharan Africa will attain sustainable blood transfusion safety by the year 2012, through the implementation of sets of policies geared toward provision of safe, affordable, and readily available blood units in hospitals to serve the needs of patients.<sup>[1,2]</sup> Up till now, however, this goal is far from achieved in Nigeria and a number of other African countries, with attendant negative impact on health indices. Effective healthcare delivery globally is known to be supported by a robust supply of safe blood units which could indeed be lifesaving in a number of clinical scenarios. Correspondingly, from the road traffic accident victim with acute hemorrhage at the emergency room to the obstetric patient with antepartum/postpartum hemorrhage or the under-five child presenting with anemic heart failure, prompt administration of appropriate units of blood could well make the difference between life and avoidable demise. Earlier, extensive inquests into the causes of the high maternal mortality in Nigeria and Sub-Saharan Africa had highlighted the huge contribution of the very ineffective

blood transfusion services.<sup>[3,4]</sup> The maternal mortality rate in Nigeria (630 deaths/100,000 live births) is unacceptably high and indeed ranks high among contemporary developing economies.<sup>[5]</sup> It is, therefore, instructive to emphasize that the expected improvement in the low health indices in Nigeria (particularly high maternal and infant mortalities) may continue unrealized until significant improvements take place in the country's blood transfusion services.

We searched PubMed, PubMed Central, Google Scholar, and the African Index Medicus electronic databases, using a number of word and phrase combinations: "Blood safety," "transfusion practices," "blood donation," "donor screening," "transfusion-transmissible infections (TTIs)" "transfusion(s)," "developing countries," and "Nigeria." The information from these publications was discussed in this review and recommendations made based on identified gaps in efforts toward achieving blood transfusion safety in Nigeria.

## The National Blood Policy

Nigeria established a National blood transfusion policy through a published set of guidelines in December 2006. The publication was a fall-out

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**How to cite this article:** Aneke JC, Okocha CE. Blood transfusion safety; current status and challenges in Nigeria. *Asian J Transfus Sci* 2017;11:1-5.

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Submission: 10-01-2016  
Accepted: 19-05-2016

of the baseline survey on blood transfusion practices which was earlier conducted in the country in August 2005. Salient conclusions from the survey included:<sup>[6]</sup>

- Only half a million units of blood were collected from both private and public sources in 2004
- At the time of the survey, blood need in Nigeria was estimated to be 1.5 million units
- In the public sector, the donor population was made up of 25% commercial donors and 75% of replacement donors. Voluntary unpaid donors were negligible
- In the private sector, the donor population was made up of 75% commercial donors and 25% of replacement donors. Voluntary unpaid donors were insignificant.

The National blood policy is essentially made up of sets of action plans which are all geared toward the provision of safe, available, and affordable blood donor units, where and when they might be needed in the country. It is structured into blood transfusion services under the following strata [Table 1]; (i) the national blood transfusion service (NBTS), (ii) the zonal blood service centers, (iii) state and local government areas blood service centers, (iv) the armed forces blood service, and (v) private and other nongovernmental health establishments.<sup>[6]</sup> The essence of the above stratification was to ensure universal coverage of the country, right to local government councils.

**Forms of blood donation in Nigeria**

There are 3 main classifications of blood donors in Nigeria; the voluntary (nonremunerated) donors, family (replacement) donors and commercial (paid) donors.<sup>[7]</sup>

The voluntary donors are the altruistic individuals who donate blood with the sole aim of saving a life, without regard to any form of inducement. They are usually mobilized through the mass media or blood donation drives to schools, churches and mosques. An earlier study had hypothesized that the dearth of voluntary donors in Nigeria and Sub-Saharan Africa is probably associated with the fact that the mentality of altruism (regarding blood donation) is not yet generally accepted in the typical African culture, compared to what is obtainable in the most developed countries.<sup>[8]</sup>

The family (replacement) donors include those that donate for a hospitalized family member, friend, or associate and is largely nonremunerated, depending entirely on the good will

**Table 1: Levels of organization and function of the National Blood Policy**

Levels of organization	Functions of each level of organization
The National Blood Transfusion Services	Blood donor recruitment
The Zonal Blood Service Centers	Processing of blood
State and Local Government Areas Blood Service Centers	Appropriate use of blood
The Armed Forces Blood Service	Personnel and human resource development
Private and other nongovernmental health establishments	Technology and research Funding Quality assurance Records and data system Equipment and consumables Legislation

of friends and family members. Osaro *et al.* had concluded that the continued importance of family donors in Sub-Saharan Africa could be linked to the fact that it may actually cost less to procure and is also well adapted to the extended family support system of many Nigerian and African communities.<sup>[8]</sup>

Persistent blood shortages coupled with increased poverty in Nigeria (and most African countries) created another population of donors who give blood strictly for financial gratification; these constitute the commercial (paid) donors. These have continued to increase in number and prominence in Nigeria, fuelled by the very huge deficit in blood supply and utilization. Ahmed *et al.* succinctly captured this phenomenon in a report among blood donors seen at the University of Maiduguri Teaching Hospital, Northeast Nigeria over a 12 years period.<sup>[7]</sup> They observed a progressive decrease in the percentage of voluntary blood donation, over the study period, from 31% to 5%, against an increase from 20% to 63% in the frequency of commercial blood donation.<sup>[7]</sup> The above study equally emphasized the wide gap between blood supply and demand in Nigeria by showing that the mean annual increment in the number of blood donations (4%) was well below the mean annual increment in in-patient numbers (11%).<sup>[7]</sup> Similarly, Emeribe *et al.* chronicled blood donation and distribution in a 400-bed teaching hospital in South-South Nigeria and reported that the general blood supply was unacceptably low, whereas the surgical departments (surgery and obstetrics and gynecology) utilized a larger pool of all donated blood (70.4%) over the study period of 4 years.<sup>[9]</sup> These observations unarguably show the blood donation dynamics and similarly offer some insight into the problems bedeviling the attainment of blood transfusion safety in the country, which is mainly poor supply of donor units. Commercial (paid) blood donors, therefore, flourished and thrived in this atmosphere of supply deficit, to the detriment of blood transfusion safety in the country.

**Current Status/Challenges**

**High prevalence of transfusion-transmissible infections**

The high prevalence of TTIs in blood donors and the general population in Nigeria has unarguably impacted negatively on blood transfusion safety. Indeed, prevalence rates as high as 18%, 23%, and 12.3% for the human immunodeficiency virus (HIV), hepatitis B virus and hepatitis C virus (HCV) respectively have been reported among prison inmates in Nasarawa, North-central Nigeria.<sup>[10]</sup> The prevalence rates of some TTIs across different parts of the country are shown in Table 2.

**High frequency of commercial blood donation**

The WHO has consistently emphasized blood sourcing from voluntary, nonremunerated blood donors, due to their markedly reduced chances of harboring and transferring TTIs.<sup>[11]</sup> This recommendation has been reiterated and supported by an increasing body of evidence from Nigerian researchers.<sup>[12-14]</sup> Unfortunately, several studies in Nigeria in the last couple of years have shown that voluntary blood donors constituted but a small fraction of the blood donor pool, this obviously has grave implications for transfusion safety.<sup>[7,9,12-14]</sup> Allain, in his seminal work, chronicled the social demographic information of blood donors in Sub-Saharan

**Table 2: Prevalence of transfusion-transmissible infections among Nigerian population**

Location of study	Year of study	Study population	TTIs studied	Prevalence rates (%)	References
Nnewi (Southeast Nigeria)	2015	Blood donors	HIV, HBV, HCV, Syphilis	HIV=1.4 HBV=2.0 HCV=2.0 Syphilis=0.1	Okocha <i>et al.</i> <sup>[14]</sup>
Ile-Ife (Southwest Nigeria)	2015	Sickle cell disease patients	HIV, HBV, HCV	HIV=2.4 HBV=2.4 HCV=7.3	Bolarinwa <i>et al.</i> <sup>[18]</sup>
Zaria (North-central Nigeria)	2013	General population	HBV	12.5	Aminu <i>et al.</i> <sup>[33]</sup>
Benin City (Midwestern Nigeria)	2013	Sickle cell disease patients	HBV	29.2	Okocha <i>et al.</i> <sup>[17]</sup>
Ido-Ekiti (Southwest Nigeria)	2012	Blood donors	HIV, HBV, HCV	HIV=5 HBV=7.9 HCV=7.3	Kassim <i>et al.</i> <sup>[16]</sup>
Nnewi (Southeast Nigeria)	2011	Antenatal patients	HBV	8.3	Eke <i>et al.</i> <sup>[34]</sup>
Keffi (North-central Nigeria)	2010	General population	HBV HCV	HBV=13.2 HCV=13.2	Pennap <i>et al.</i> <sup>[35]</sup>
Benin City (Mid-western Nigeria)	2010	General population	Syphilis	15.4	Ophori <i>et al.</i> <sup>[37]</sup>
Nasarawa (North Central Nigeria)	2009	General population (Prisoners)	HIV, HBV, HCV	HIV=18 HBV=23 HCV=12.3	Adoga <i>et al.</i> <sup>[10]</sup>
Osogbo (Southwest Nigeria)	2009	Blood donors	HIV, HBV, HCV, Syphilis	HIV=3.1 HBV=18.6 HCV=6.0 Syphilis=1.1	Buseri <i>et al.</i> <sup>[13]</sup>
Port Harcourt (South-South Nigeria)	2008	Blood donors	HCV	5.0	Jeremiah <i>et al.</i> <sup>[12]</sup>
National	2007	General population	HIV	3.1	UNAIDS <sup>[38]</sup>
Port Harcourt (South-South Nigeria)	2006	General population	HCV	3.0	Ejele <i>et al.</i> <sup>[36]</sup>
Ilorin (North Central Nigeria)	1996	Blood donors and outpatients	HBV	23.4	Bada <i>et al.</i> <sup>[39]</sup>

TTIs: Transfusion-transmissible infections, HIV: Human immunodeficiency virus, HBV: Hepatitis B virus, HCV: Hepatitis C virus

Africa and reported that commercial blood donors were all males while the median ages of voluntary and family donors were 18 years and 30 years, respectively.<sup>[15]</sup> Similar studies in Nigeria had equally identified a male dominated donor pool as well as young adults as the predominant donor age group; these mirror the more active age and gender stratum of the Nigerian population.<sup>[13,14]</sup> Unfortunately, this age distribution has also been associated with the highest carriage rates of TTIs (arising most probably from increased involvement in high-risk sexual behaviors and experimentation), this, therefore, poses a huge challenge to the country's efforts toward attaining blood transfusion safety.<sup>[16-18]</sup>

### Supply deficits

According to the NBTS, Nigeria, with a population of over 150 million people uses about 1.5 million units of blood every year to cater for the health needs of its citizens.<sup>[6]</sup> This well approximates to far less than a pint of blood per person and further highlights a very poor blood supply chain in the country.<sup>[7,9]</sup> It, therefore, implies that the present pool of mainly commercial blood and family donors cannot bridge the nation's blood supply deficits, in fact, poor blood supply is probably the key hindrance to the smooth operations of the National blood transfusion policy aimed toward boosting transfusion safety in the country.<sup>[6]</sup> A number of studies have shown why Nigerians will not voluntarily and regularly donate blood, as is obtainable in more developed countries. Olaiya *et al.* evaluated the attitude of individuals in Lagos (Southwest Nigeria) toward blood donation and identified a number of factors, ranging from fear of contacting TTIs (52.4%) to fear of side effects such as weight loss (23.8%), sudden death (3.3%), sexual failure

(5.9%), high blood pressure (5.2%) and convulsions (1.5%) as impediments to blood donation.<sup>[19]</sup> A similar study in Calabar, South-South Nigeria identified diverse religious beliefs as the most common reason for refusal of blood donation.<sup>[20]</sup>

### Donor unit screening

Current NBTS guideline mandates the screening of all donors units for anti HCV, hepatitis B surface antigen, anti HIV, and syphilis, using a combination of rapid qualitative immunochromatographic test kits, enzyme-linked immunosorbent assays and antigen assays.<sup>[6]</sup> While this is the practice in most of the blood banks in the country (particularly those attached to tertiary hospitals), however, nucleic acid tests (NATs) are not yet universally available for TTIs testing. NATs have the added advantage of increasing the detection of TTIs, especially during the window periods.<sup>[21]</sup>

### Red cell sensitization

Multiple red cell transfusion could predispose to the formation of clinically significant titers of lytic antibodies which may cause hemolytic disease of the newborn (HDN) or hemolytic transfusion reactions.<sup>[22]</sup> Patients with hemoglobinopathies and others that require lifesaving regular blood transfusions are thus at a particularly high risk of red cell sensitization by alloantibodies. This remains a significant hindrance to transfusion safety in Nigeria, a situation that is further complicated by the fact that the means of investigating for fetomaternal bleeds and HDN prophylaxis for at-risk groups are not universally available.<sup>[8]</sup> The magnitude of red cell sensitization in Nigeria was highlighted in the independent reports of Ugwu (Benin City, Midwestern Nigeria), Kangiwa

(Enugu, Southeast Nigeria), and Jeremiah (Port Harcourt, South-South Nigeria) in which prevalence rates of 9.3%, 18.7%, and 3.4%, respectively were observed in multiply transfused patient populations.<sup>[22-24]</sup>

### Poor utilization of autologous blood transfusions

The use of autologous blood transfusion has been noted to improve transfusion safety as a result of the significantly reduced chances of blood transfusion reactions, red cell sensitization to alloantibodies and transmission of TTIs.<sup>[25]</sup> Studies in Nigeria showed that this practice is both a safe and cost effective way of improving blood supply and safety and therefore needs to be encouraged.<sup>[26-28]</sup> Obed *et al.* evaluated the rate of autologous blood transfusion at the University of Maiduguri Teaching Hospital, Maiduguri, Northeast Nigeria among Obstetric patients and reported an overall prevalence rate of 20.7%, out of which preoperative blood donation accounted for 95.8% whereas 6.4% of the units were predeposited.<sup>[27]</sup> The rate of autologous blood transfusion was even lower in a study conducted at Zaria, North Central Nigeria (0.58%).<sup>[28]</sup>

Intraoperative cell salvage which involves the aseptic collection of blood lost during or after surgical operations with the aim of re-infusing same into patients has been shown to be a feasible way to reduce the risks associated with homologous blood transfusions in Nigeria.<sup>[29]</sup> This is particularly important in patients with blunt abdominal trauma or ruptured ectopic gestation. The practice of intraoperative cell salvage in Nigeria is low currently, a multicenter study that involved surgeons and anesthetists reported usage rate of just 0.01%.<sup>[30]</sup>

### Erythropoietin use

Erythropoietin is a 30.4-kDa glycoprotein hormone produced by the kidney and liver which has a stimulant effect on erythropoiesis by inhibiting apoptosis of erythroid precursors, particularly at the colony-forming units-erythroid stage.<sup>[31]</sup> When given to appropriately selected patients, it has been found to significantly boost the hemoglobin concentration, thereby reducing the transfusion requirements during surgery. Udosen *et al.* had reported successful surgery facilitated by the use of erythropoietin resulting in hemoglobin concentration increase from 70 g/L to 140 g/L, over a period of 6 weeks, in a patient (of Jehovah's Witness faith) in Calabar, South-South Nigeria.<sup>[32]</sup> There is indeed paucity of report on the use of erythropoietin in Nigerian patients, and this most probably indicates that the practice is relatively unpopular.

### Recommendations

#### *Intense mass mobilization and campaign*

Increasing the pool of voluntary blood donors in Nigeria is the key to bridging the blood supply gap and could translate into better blood transfusion safety. A number of studies have identified some factors that appear to hinder people from donating blood in the country, an intense campaign using the mass/social media is therefore recommended to counter these erroneous ingrained belief systems. More so, adequate emphasis should be given to voluntary blood donation and intensive education on the risks and means of acquiring TTIs (during such enlightenment campaigns) with a view to reversing the high dependence on commercial blood donation and reducing the high prevalence rates of TTIs.

### *Strengthening donor blood screening and cross-matching protocols*

Donor blood screening should be further strengthened, while NATs should be made more universally available in the blood banks in the country. Moreover, antibody screening and identification should be made routine, particularly for at-risk groups.

### *Alternatives to homologous transfusions*

Encouraging the use of autologous blood transfusion and erythropoietin could go a long way in reducing overdependence on homologous blood transfusion (along with the potential risks it possesses) and the frequency of transfusions in Nigeria.

## Conclusion

Urgent concerted action is needed in Nigeria to correct the blood supply deficit and increase the pool of voluntary (nonremunerated) blood donors. This is expected to significantly improve blood transfusion safety and positively impact on health indices in the country. More so, encouraging more universal use of autologous blood transfusion, intraoperative cell salvage and erythropoietin is imperative to reduce the huge demand on homologous blood.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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