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Pattern of Distribution of ABO and Rhesus D Blood Groups among Blood Donors at the Regional Hospital Bamenda, Cameroon

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Abstract

ABO blood group antigens are sugar molecules on red blood cells formed by enzymes encoded by the *ABO* gene on chromosome 9, while Rhesus (Rh) antigens are proteins encoded by the *RHD* and *RHCE* genes. The objective of the study was to determine the prevalence of ABO and Rhesus D Antigens among blood donors in Bamenda. A descriptive cross-sectional research design was adopted for the study. Ethical clearance was obtained from the Ethical Committee of Catholic University of Cameroon (CATUC), Bamenda and the Ethical Committee of the Regional Hospital Bamenda. Blood groups (ABO and Rh 'D') data were obtained from the Blood Bank Register of Regional Hospital Bamenda. Data were analyzed using Chi square at 95% confidence interval and probability value less than 0.05 was considered statistically significant. Out of 500 blood donors within the study period, demographic data revealed 330 (66.0%) males, 170 (34.0%) females, 210 (42.0%) within the age range of 25–34 years, 180 (36.0%) students, 280 (56.0%) obtained tertiary education, and 350 (70.0%) Christians. The ABO blood group data revealed 328 (65.6%) group 'O', 87 (17.4%) group 'A', 79 (15.8%) group 'B' and 6 (1.2%) group 'AB'. The Rh blood group data revealed 465 (93.0%) Rh 'D' positive and 35 (7.0%) Rh 'D' negative groups. Blood group 'O' showed the most prevalent, followed by groups 'A' and 'B', while group 'AB' showed the least prevalent.

Keywords: *ABO and Rh D Blood groups, Donors, Distribution, Bamenda, Cameroon.*

How to Cite:

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INTRODUCTION

Blood is a vital fluid in the human body that transports oxygen and nutrients to tissues, removes waste products, helps regulate body temperature, and protects against infections. It is composed of red blood cells, white blood cells, platelets, and plasma, each playing an important role in maintaining life, (Betts *et al,* 2022). In humans, blood is classified into different groups based on specific antigens present on the surface of red blood cells, (Liu *et al*, 2024). The most clinically significant blood group systems are the ABO and Rhesus (Rh) systems, (Al Musalhi, *et al*, 2025). Blood groups are essential in blood transfusion practice, as proper matching prevents dangerous transfusion reactions and ensures patient safety, (Romanos-Sirakis and Desai, 2026). ABO blood group antigens are sugar molecules on red blood cells formed by enzymes encoded by the *ABO* gene on chromosome 9, while Rhesus (Rh) antigens are proteins encoded by the *RHD* and *RHCE* genes, (Dean, 2005). Antibodies for ABO develop naturally in infancy via environmental exposure to similar bacterial antigens, whereas Rh antibodies are produced only upon sensitization, (Xiaoxue *et al,* 2025).

The ABO gene has three main alleles: A, B, and O, inherited from parents. The A and B alleles produce specific enzymes (glycosyltransferases) that add specific sugar molecules to the H antigen (a precursor molecule) on the surface of red blood cells, (Dean, 2005). Type A individuals produce the enzyme that adds N cap N *N* -acetyl galactosamine, and Type B adds galactose. Type AB produces both, and Type O is inactive, (Mironov *et al,* 2023). Rhesus antigens are complex membrane proteins, unlike the carbohydrate-based ABO antigens. The most critical antigen is the D protein, encoded by the *RHD* gene, (Asad and Hiba 2020). Presence of the *RHD* gene results in Rh-positive status (D antigen present). Rh-negative status typically results from a deletion of the *RHD* gene, (Franz and Willy, 2020).

Unlike most antibodies, ABO antibodies develop naturally within the first few months to years of life without previous exposure to foreign blood. These antibodies are believed to be produced in response to substances in the environment that possess similar sugar structures to A and B antigens, (Vaschetto, 2025). They are predominantly IgM. Rhesus antibodies do not occur naturally. They are only formed through exposure to Rh-positive blood in a Rh-negative individual, (Yahya *et al*, 2020). This occurs through blood transfusion or when a Rh-negative mother is pregnant with an Rh- positive baby, causing the mother to develop anti-D antibodies. They are primarily IgG, which can cross the placenta.

ABO and Rh(D) blood group distributions vary globally but generally show Type O most common, followed by A, B, and AB least common, with Rh-positive (+) being far more prevalent than Rh-negative (-) (around 90%+ Rh+), (Shan *et al,* 2022). Specific frequencies depend heavily on ethnicity and geographic location, with some groups having very high O (e.g., Native Americans) or A (e.g., Sami) prevalence, while Rh(D) negativity is lower but present in all groups, often with higher rates in O negative individuals, (Doku *et al,* 2022). Some of the factors affecting ABO and Rh(D) blood group distributions include ethnicity, for instance, populations like Native Americans have very high Type O, while some European groups have higher Type A, (Legese *et al,* 2021). Geographically, frequencies shift regionally; for instance, Type B is more common in parts of Asia than in Europe or the

Americas. Rh(D) Negativity are rare overall, O negative (universal donor) is a critical blood type, with Rh- negativity often highest within Type O, (Abir *et al,* (2015).

Statements of the problem

In Baemenda, the demand for blood transfusion continues to increase due to increased cases of accidents and trauma, maternal complications, surgical cases and infectious diseases. However, there is limited local data on the distribution of ABO and Rhesus D blood groups among blood donors. The absence of such data may affect effective blood stock planning and donor selection strategies at health facilities.

Justification of the study

Due to the necessity of specific ethnic or regional data on distribution of ABO and Rh D blood groups, the need for local data on blood group distribution among donors becomes necessary for the research to be conducted. The study will provide baseline data to assist healthcare providers and policy makers in improving transfusion services in Bemanda.

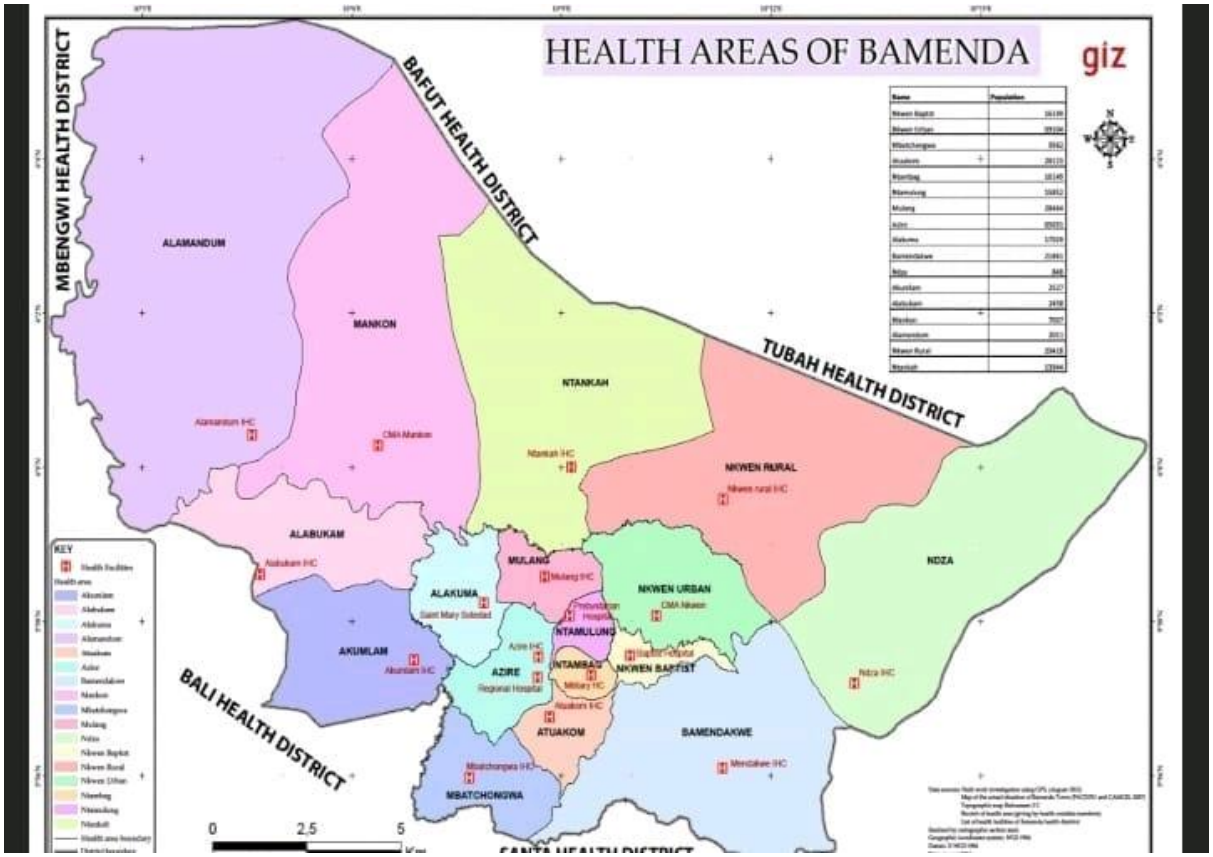
Objective of the study

The objective of the study was to determine the prevalence of ABO and Rhesus D Antigens among blood donors in Bamenda.

MATERIALS AND METHOD

Area of study

The research was conducted at the Bamenda Regional Hospital, located in the Northwest Region of Cameroon. Bamenda is the regional capital and a major health referral center serving both urban and surrounding rural populations. this study was conducted from April 2026 to May 2026.



Sample Size

The sample size was calculated using the Cochran formula for descriptive studies:

$$n = \frac{Z^2 \times p \times q}{d^2}$$

Where:

- n = minimum sample size
- Z = standard normal deviation at 95% confidence level (1.96)
- p = estimated prevalence of the most common blood group (assumed as 0.50 due to lack of local data)
- q = 1 - p
- d = margin of error (0.05)

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.05)^2}$$

n = 384

A minimum sample size of 384 blood donors' data was required to represent the population. However, 500 donor's data were used in the study.

Ethical clearance

Ethical clearance was obtained from the Ethical Review Committee of the Catholic University of Cameroon (CATUC), Bamenda, Administrative authorization and ethical approval were also obtained from the Regional Hospital Bamenda with reference number 0689|D|MINSANTE|SG|DROS. The data used in the present study were available on request.

Data collection

Demographic data were obtained from the Blood Bank Unit Register of the Regional Hospital Bamenda. Confidentiality of donor information was strictly maintained throughout the study.

Statistical analysis

Data were subjected to descriptive statistics and analyzed using Chi square at 95% confidence interval. Probability value less than 0.05 was considered statistically significant. Frequencies and percentages were used to summarize the distribution of ABO and Rh(D) blood groups. Results were presented using tables, charts, and graphs. Statistical analysis was performed using Microsoft Excel 13.

RESULTS

Socio-demographic Characteristics

The socio-demographic characteristics revealed that out of the 500 subjects (donors) recruited in the study, majority 330 (66.0%) were males, 210 (42.0%) were within the ages 25–34 years, 180 (36.0%) were students, 280 (56.0%) had attained tertiary education, and 350 (70.0%) were Christians (table 1).

Distribution of blood groups by gender

The distribution of blood groups by gender revealed that out of the 500 donors recruited in the study, majority 328 (65.6%) were blood group O, 218 (43.6%) were Rh(D) positive males and 102 (20.4%) were Rh(D) positive females. Blood group A were 87 (17.4%) donors, while group B were 79 (15.8%) donors. Blood group AB was the least represented with 6 (1.2%), all being Rh(D) positive (table 2).

Prevalence of ABO blood groups

The prevalence of ABO blood groups revealed that out of the 500 donors recruited in the study, majority 328 (65.6%) were blood group O, followed by 87 (17.4%) blood group A and 79 (15.8%) blood group B, while 6 (1.2%) were blood group AB (figure 1).

Prevalence of Rhesus blood groups

The prevalence of Rhesus D blood groups revealed that out of the 500 donors recruited in the study, majority 465 (93.0%) were Rh(D) positive, while 35 (7.0%) were Rh(D) negative (figure 2).

Table 1: Distribution of Respondents According to Socio-demographic Characteristics

Variable	Characteristics	Frequency (n)	Percentage (%)
Gender	Male	330	66.0
	Female	170	34.0
Total		**500**	**100**
Age Group	18–24	120	24.0
	25–34	210	42.0
	35–44	95	19.0
	45+	75	15.0
Total		**500**	**100**
Profession	Students	180	36.0
	Civil Servants	120	24.0
	Self-employed	100	20.0
	Private Sector	70	14.0
	Unemployed	30	6.0
Total		**500**	**100**
Education Level	Primary	40	8.0
	Secondary	160	32.0
	Tertiary (University)	280	56.0
	No formal education	20	4.0
Total		**500**	**100**
Religion	Christian	350	70.0
	Muslim	120	24.0
	Other	20	4.0
	None	10	2.0
Total		**500**	**100**

Table 2: Distribution of Blood Groups According to gender

Variable	Characteristics	Frequency (n)	Percentage (%)
Blood Group O	Male Rh Positive	218	43.6
	Male Rh Negative	12	2.4
	Female Rh Positive	102	20.4
	Female Rh Negative	8	1.6
	Total	328	65.6
Blood Group A	Male Rh Positive	52	10.4
	Male Rh Negative	6	1.2
	Female Rh Positive	27	5.4
	Female Rh Negative	2	0.4
	Total	87	17.4
Blood Group B	Male Rh Positive	46	9.2
	Male Rh Negative	4	0.8
	Female Rh Positive	26	5.2
	Female Rh Negative	3	0.6
	Total	79	15.8
Blood Group AB	Male Rh Positive	3	0.6
	Male Rh Negative	0	0.0
	Female Rh Positive	3	0.6
	Female Rh Negative	0	0.0
	Total	6	1.2
Total		500	100

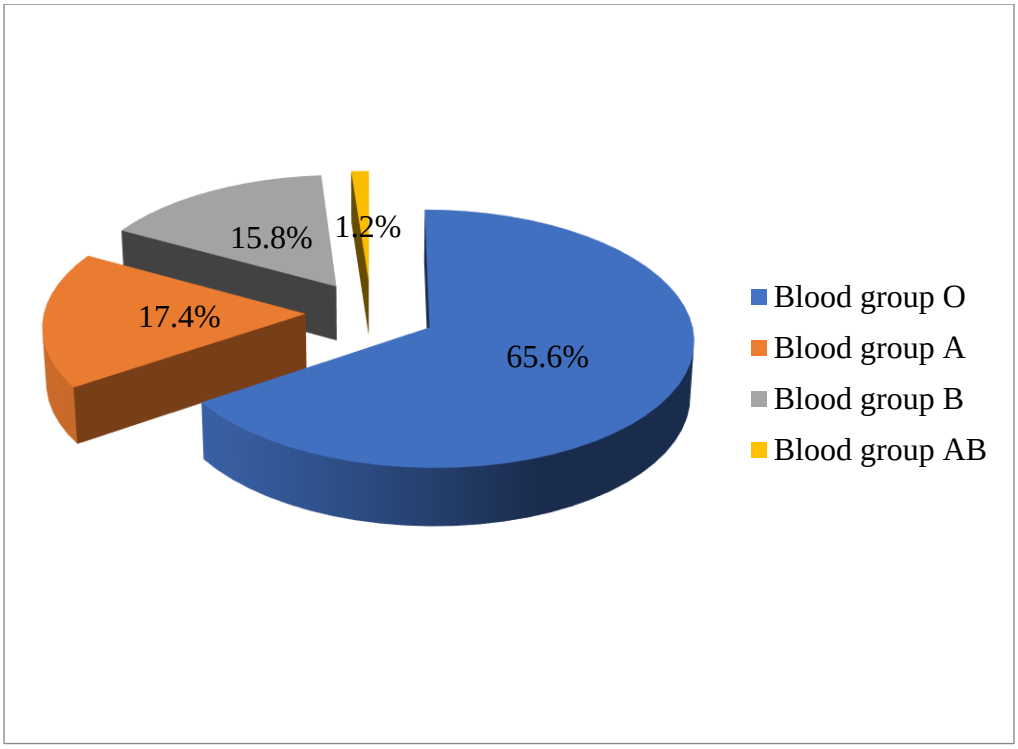


Figure 1: Distribution of Respondents according To Prevalence of ABO blood groups

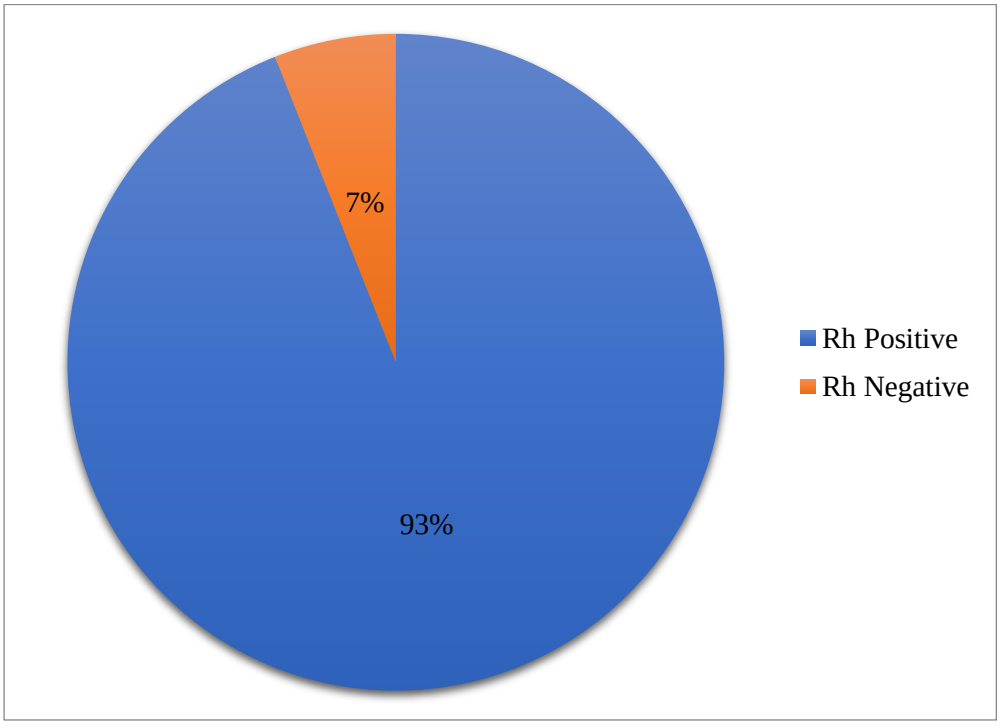


Figure 2: Distribution of Respondents according To Prevalence of Rh(D) blood groups.

DISCUSSION

The observed majority of males donors in the study could be due to the physiological differences which allow males to have more body iron stores for haemoglobin synthesis than the female counterparts. This could also be due to monthly blood loss and pregnancy by females. The observed characteristics was consistent with hospital-based donor studies in Cameroon, where males dominate blood donation due to cultural perceptions and physiological differences, (Rowe *et al,* 2007). Similarly, male predominance has been reported in Nigeria and Ghana, reflecting regional donor demographics, (Ndoula *et al,* 2014; Abbas & Hiba, 2020).

The observed prevalence of ABO blood group indicating group O as the most prevalent (65.6%), followed by A (17.4%), B (15.8%), and AB (1.2%) demonstrated group O as a universal group thereby making the group universal donor. This aligns with global and African data, where O is consistently dominant. In Cameroon, national studies report O at ~41–45%, A at ~32–34%, B at ~15–18%, and AB at ~4–6%, (Abbas & Hiba, 2020). The slightly higher O prevalence in Bamenda (65.6%) may reflect evolutionary selection pressures, particularly malaria protection associated with blood group O, (Rowe *et al,* 2007).

Blood group O was most prevalent among both males and females, with 218 (43.6%) males Rh positive and 102 (20.4%) females Rh positive. Blood group A accounted for 87 (17.4%), B for 79 (15.8%), and AB for 6 (1.2%). These results mirror empirical findings in Bamenda and other African regions, where O+ dominates across genders. The rarity of AB and Rh-negative groups is consistent with global literature, (Rowe *et al,* 2007).

The observed very high Rh D positivity (93.0%) and very low Rh D negativity (7.0%) agrees with global estimates where Rh positivity ranges between 90–95%. In Cameroon, Rh D negativity is reported at ~5–7% confirming the rarity of Rh-negative donors, (Elshazali, *et al,* 2016). The scarcity of Rh-negative blood poses challenges for transfusion safety, especially for Rh negative mothers carrying Rh positive fetuses, as highlighted in empirical literature, Ndoula *et al,* 2014).

Potential limitations to the study were non-availability of records on other blood groups such as Kell, Kidd, Duffy, Wright and so on in the blood bank registry of the hospital. Other limitations include the use of single center and small sample size data due to limited availability of blood donors within the Bemanda population.

Conclusion

The investigation of the pattern of distribution of ABO and Rh(D) blood groups among blood donors at the Regional Hospital Bamenda revealed blood group O as the most prevalent blood group, followed by A, B and AB. The majority of donors were Rh(D) positive. The findings provide useful information for blood bank inventory management, donor recruitment and transfusion services in Bamenda. Further studies involving multiple health facilities and larger populations are recommended."

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RECOMMENDATIONS

Prioritize recruitment of Rh-negative donors to address scarcity.

Maintain adequate inventory of O blood group due to its high demand in emergencies.

Future studies should be conducted in multiple hospitals and regions of Cameroon to provide a broader information of blood group distribution at the national level.

Further research should be extended to pattern of distribution of other clinically significant blood group systems such as Kell, Duffy, Kidd, and MNS, which play important roles in transfusion medicine.

Conflict of interest: Authors declared no conflict of interest

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CATHOLIC UNIVERSITY OF CAMEROON (CATUC), BAMENDA

P. O. Box 782, Bamenda
Tel: (237)243072942.

INSTITUTIONAL REVIEW BOARD (IRB)

March 10, 2026

ETHICAL CLEARANCE

Yufonyuy Nellyne
Department of Medical Laboratory Sciences, CATUC-Bamenda

Ethics Reference No: 103/CATUC-IRB/SHMS/26

Please quote this reference on all correspondence

Project Title: Pattern of distribution of ABO and rhesus blood groups among blood donors in the Regional Hospital Bamenda

Investigator(s) Name(s): YUFONYUY NELLYNE

Your research protocol named above has on this day March 10, 2026, been reviewed by the IRB of the Catholic University of Cameroon in Bamenda with the following remarks:

- 1/. A statement on conflict of interest should be included. 2/. The limitations of methods must be acknowledged.

Therefore, the Chair is satisfied with the decision of the committee and agreed: that there is no objection on ethical grounds to the proposed study. The study is of medical importance; its implementation would contribute significantly to the understanding of the pattern of distribution of ABO and rhesus blood groups among blood donors. Adequate precautions have been taken by the researcher to manage potential risks that may arise in the course of this study. The IRB is therefore pleased to grant approval on the understanding that the research team will strictly abide to the conditions of the approval below:

- Strictly follow the plan of the approved protocol. Any changes to the approved protocol will require prior IRB approval.
- Must promptly report to the IRB: 1/. Any deviations from or changes to the protocol which are made to eliminate immediate hazards to the study participants; 2/. All risks that may be rare or remote and especially those which may entail serious consequences or compromise potential benefits or that which would affect the conduct of the research.
- Must prepare and submit a standard progress report of the research to the IRB, one year from the date of issue of this approval letter. Failure to submit an annual progress report on the study may affect the further conditions of approval.
- Must notify the IRB when the research is completed.

Your approval is provided for one year and may be annually renewed, on condition that a progress report is submitted to the IRB. While the IRB has given its approval for this study on a satisfactory ethical basis, it is still necessary for the investigator to obtain Administrative approval from the relevant directors or health administrations where the work will be carried out.

Sincerely,

Lifoter Kenneth Navti, MS, MPH, PhD
Associate Professor
CHAIR, CATUC-IRB

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MINISTRY OF PUBLIC HEALTH

REGIONAL DELEGATION FOR THE NORTH WEST

N°617 /ATT/NWR/RDPH

BAMENDA, the 30 AVR 2026

THE REGIONAL DELEGATE
Le Délégué Régional
Tel: 233 363 289/674228555

TO WHOM IT MAY CONCERN

Subject: AUTHORIZATION TO CARRY OUT RESEARCH

YUFONYUY NELLYNE B, student at theCatholic University of Cameroon, (CATUC) Bamenda, department of Medical Laboratory Science is authorised to carry out research in the North West Region, on the topic titled; ***"PATTERN OF DISTRIBUTION OF ABO AND Rhesus D BLOOD GROUPS AMONG BLOOD DONORS IN THE REGIONAL HOSPITAL BAMENDA."*** This Research will run from December 2025 to June 2026.

You are therefore requested to offer the necessary support to enable the student achieve the goal of this very important academic exercise, and report to my office any challenges you might face.

FOR THE REGIONAL DELEGATE
AND BY DELEGATION

Dr. Kwarva Ines
MD, MPH (Hons)
CMC N° 10352

Cc. /
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BAMENDA, THE 28 AVR 2025
THE DIRECTOR
LE DIRECTEUR

To: **YUFONYUY NELLIN BERINYUY**
Catholic University of Cameroon
(CATUC) Bamenda

Subject: Agreement in principle to collaborate for the implementation of your research protocol entitled **"Pattern of distribution of ABO and Rhesus blood groups among blood donors in the Bamenda Regional Hospital"**

Dear Sir,

In response to your request, the subject of which is mentioned in the margin,

I have the honour to inform you of my agreement in principle for the use of the protocol for the collection of data within Regional Hospital Bamenda in order to access the **"Pattern of distribution of ABO and Rhesus blood groups among blood donors in the Bamenda Regional Hospital"**

Please note that this agreement in principle does not constitute authorization to conduct this study and must comply with Decision No. 0689/D/MINSANTE/SG/DROS of July 29, 2009 on the conditions for the issuance of the Administrative Authorization for Research in Human Health in Cameroon by the Minister of Public Health. The later which is obtained at the Regional Level from the Regional Delegation of Public Health after obtaining an ethical clearance from the Regional Ethical Committee.

In witness whereof, this letter is hereby issued to serve and be of value as of right.

The Director
Regional Hospital Bamenda

Njunjuah Franklen
GENERAL SUPERVISOR
REGIONAL HOSPITAL BAMENDA

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April 15, 2026

Ref 32/01/26 /PSHMS/eb

From: The Provost
School of Health and Medical Sciences
Catholic University of Cameroon – Bamenda

To whom it may concern

Authorization to Carryout Research for Final Year Project in Medical Laboratory Sciences

This is to attest that the student, **Yufonyuy Nelline Berinyuy** (Mat. No: **345722**), is a final year student of the Department of Medical Laboratory Sciences, School of Health and Medical Sciences, Catholic University of Cameroon Bamenda, and has been authorized to carry out a research project on the topic: ***Pattern of distribution of ABO and rhesus blood groups among blood donors at the Regional Hospital Bamenda.***

This research is carried out in partial fulfilment for the award of a Bachelor of Science Degree in Medical Laboratory Sciences.

We are thus soliciting the necessary collaboration of you and your staff to the student, for this project, in your institution.

Prof. Robert J. I. LEKE
Gynecologist - Obstetrician
MD, DES, CES, FRCS(C), FWACS
Provost - SHMS, CATUC
Bamenda N.W Region CAMEROON

CATUC
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Prof. Emeritus Robert J. I. Leke
School of Health and Medical Sciences

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