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Distribution of ABO and Rhesus Blood Group Patterns Among Patients and Voluntary Blood Donors Attending David Umahi Federal University Teaching Hospital, Uburu, Ebonyi State, Nigeria

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KEYWORDS:

ABO blood group, Rhesus factor, Blood transfusion, Nigeria, Blood donors, Hemolytic reaction.

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ABSTRACT

Background: The human ABO type has three alleles (A, B and O); a phenomenon called multi-alleism. Its phenotype could be O, A, B or AB. The composition of an individual's blood type is always based on inheritance of gene on chromosome 9(9q34) which encodes glycosyl transferases that transfer some oligosaccharide residues to the H antigen, resulting in the formation of antigens for the A and B blood groups but the blood group O lacks such activity. The Rh blood type (Rhesus) is also very important in blood transfusion biology. It is very polymorphic as it contains more than forty-four (44) different antigens.
Having adequate information about the distribution and the variations of the different blood groups and Rhesus factor in a population is very critical for the clinical infrastructure of that population, And in a populous and richly diverse country like Nigeria

Aims: To determine ABO and Rhesus Blood Group Patterns Among Hospital Patients and voluntary blood donors that attended David Umahi Federal University Teaching Hospital, Uburu, Ebonyi state, Nigeria between November 2022 to December 2023.

Methodology: The data was collected from the record of the blood donors and patients screened from November, 2022 to December, 2023 in David Umahi Federal University Teaching Hospital, Uburu, a tertiary healthcare facility in Ebonyi State, South Eastern Nigeria.
Blood samples were collected via venipuncture while the *ABO* sampling was carried out by the standard rapid tile method.

Result: The study was comprised of 237 samples of 70.5% (167) of external blood donors and 30% (70) of the participants were patients of the hospital patients. 76.4% were males while 23.6% were females, with an age range of 17 to 59 years.
Blood group *O* was found to be highest occurring accounting for 53.2% followed by *A*, *B* and *AB* in that order .Most of the blood groups were found to be *Rhesus* positive (95.8%) while only a minority were *Rhesus* negative (4.2%) among the study population.

Conclusion: This findings will be useful in health care planning, genetic counseling and running of an organized, efficient and safe blood transfusion services. Routine screening of blood group *O* for hemolysin is recommended to prevent hemolytic transfusion reaction. *Rhesus* negative blood group were

found to be few. Institution of blood donor registry is also recommended for easy accessibility to rhesus negative blood for transfusion especially in cases of emergency and also to prevent hemolytic disease of the fetus and newborn.

INTRODUCTION

In the world of healthcare and medical science, one of the most important scientific discoveries ever made is that of the various blood group systems and their respective antigens. Before the discovery of ABO blood groups, high mortality rates were recorded during blood transfusions because there was no knowledge of the difference in the blood composition of the human population [1] A subsequent study carried out by Landsteiner in 1901 [2], made it possible to classify blood into ABO classes (A, B and O) based on the presence or absence of surface antigens on the red blood cell (RBC). The blood group *AB* was discovered later in 1902 [3] .These discoveries reduced the mortality rate recorded during blood transfusion.

The human ABO type has three alleles (A, B and O); a phenomenon called multi-alleism. Its phenotype could be O, A, B or AB. The composition of an individual's blood type is always based on inheritance of gene on chromosome 9(9q34) which encodes glycosyl transferases that transfer some oligosaccharide residues to the H antigen, resulting in the formation of antigens for the A and B blood groups but the blood group O lacks such activity [4].

The Rh blood type (Rhesus) is also very important in blood transfusion biology. It is very polymorphic as it contains more than forty-four (44) different antigens. The most clinically significant polymorphism is the presence or absence of the Rh (D) antigen on the red blood cell (RBC). Out of forty-three (43), the International society of blood transfusion (ISBT) outlined nine (9) specific blood group systems, clinically significant in hemolytic transfusion reactions (HTR) as well as hemolytic disease in fetuses and newborns (HDFN) [5]. These blood group systems are *ABO, Rhesus, Kell, Duffy, Kidd, MNS, P, Lewis,* and *Lutheran* [6]. Antigens of the *ABO*, *Rhesus*, and *Kell* blood group systems are important in clinical transfusion practices and they are highly immunogenic [6].

A, B and O (H) are complex oligosaccharide (carbohydrate) molecules positioned strategically on the extracellular surface of the red blood cell (RBC) membrane and they determine the antigens on ABO blood group respectively [7].

In the *ABO* system, individuals are grouped into four major blood groups namely, A, B, AB and O based on the type of antigen present on the red blood cell surface while in the *Rhesus* system, they are classified into *Rhesus* positive and *Rhesus* negative based on the presence or absence of the Rh protein on the surface of the red blood cell respectively [8].

The *ABO* and *rhesus* blood groups are the most important in transfusion medicine as well as parental testing, legal medicine, and in population genetic study.

Recent data also suggests that the ABO blood group plays a pivotal role in various human diseases such as diabetes as well as carcinoma, cardiovascular diseases, neoplastic and infectious disorders [9]. From the foregoing, we can deduce that ABO and Rh blood groups polymorphism are valuable and indispensable tools in contemporary medicine, population genetics and anthropology.

Due to the significance of the blood group systems, a wide range of studies have been conducted in various countries to determine the frequency of *ABO* and *Rhesus* blood groups with diverging phenotypic results across various ethnic populations in different geographical regions.

Nigeria is a populous country comprising of different ethnic groups. And due to this diversity, a number of studies have been conducted in hopes of discovering a pattern in blood group distribution among people in Nigeria. These studies include a 2017 study which investigated the distribution and gene frequencies of *ABO* and Rh blood group systems in the six geopolitical zones of Nigeria, with the data collated revealing that the blood group *O* was predominant in the sample collected [1]. Other studies in the Niger Delta region of Nigeria on multi ethnic populations also showed a prevalence of blood group *O* [10, 11].

Despite the wide-spread awareness and subsequent research on the *ABO* and *Rh* blood group systems in other parts of Nigeria and the world as a whole, there is limited data regarding of the distribution of the *ABO* and *Rh* blood group systems in Ebonyi State as earlier serological data available was a 2015 study on prevalence of blood group among students of Ebonyi State University which found blood group O to be the most common while blood group AB was the least frequent[12].

A comparative study carried out in a nearby community between the pupils of Holy Family Nursery and Primary school, Onicha Igboeze in Ebonyi State and students of the University of Nigeria, Nsukka (UNN) in Enugu State which showed that blood group, *O* has a higher prevalence while the blood group *AB* was the least prevalent (Ikechukwu *et al*, 2019) [13,14].

There is paucity of information on the distribution of *ABO* blood group and *Rhesus* factor in Uburu as a community in Ebonyi State. The present study was therefore carried out to determine the distribution of *ABO* and *Rhesus* blood groups among patients and voluntary blood donors attending the David Umahi Federal University Teaching Hospital, Uburu in Ohaozara Local Government Area, Ebonyi State, Nigeria. This will avail information on the distribution pattern of these blood groups which may help to improve blood transfusion services in the hospital which could in turn prevent hemolytic transfusion reactions and death, as well as make for easy accessibility of blood donors for transfusion especially in cases of emergency.

MATERIALS/METHOD

STUDY DESIGN

This was a retrospective study of the *ABO* and *Rhesus* blood groups of donors and patients screened from November, 2022 to December, 2023 in David Umahi Federal University Teaching Hospital, Uburu (DUFUTH). It is a tertiary healthcare facility in Ebonyi State, South Eastern Nigeria.

SAMPLE COLLECTION

Following dully explained procedures to the participants and consent taken from the participants, blood samples were collected via venipuncture after sterilizing the cubital fosa with methylated spirit into vacutainer tubes

INCLUSION CRITERIA

All records of donors and patients who under went grouping and crossmatching of blood at the hospital blood bank were used for this study.

EXCLUSION CRITERIA

All cases of missing records, duplications and incomplete records were excluded from from this study.

BLOOD GROUPING AND INTERPRETATION

The *blood* typing was carried out by the standard rapid tile method. This involved mixing 20% of patient's cells with one volume of commercially obtained human Murine Monoclonal Anti-*A* and Anti-*B* sera on an opal glass tile. The cells and sera in each square were mixed and the tile rocked gently. This was then viewed with the aid of good light within 2 to 5 minutes and the presence or absence of agglutination noted. Agglutination of blood cells in anti-*A* serum indicated blood group *A* and agglutination of blood cells in anti-*B* serum indicated blood group *B*. Agglutination of cell in both anti-*A* and anti-*B* sera indicated blood group *O* while no agglutination in both anti-*A* and anti-*B* sera indicated blood group *AB*. The agglutination of blood cell in anti-D serum indicated rhesus positive (+) and no agglutination indicated rhesus negative (-).Control REF17317 was used.

PRINCIPLES OF PROCEDURES

The determinatoion of ABO blood group is characterized by demonstrating the presence of antigens A and/or B on the surface of the human red blood cells and by detecting the presence or absence of the anti-A and/or anti-B antibodies in the palsma. Is is pertinent to identify the erythrocytes antigens using known anti-A and and anti-B ,then confirm the results by verifying the presence of the corresponding antibodies in the plasma from the ytest blood using known red blood cells A1 and B (reverse group) .Also, testimg of the red blood cells with anti A,B reagent facilitates the recognition of certain weak subgrouos and is sometimes used as confirmation of thye treactions obtained with anti-A and anti-B reagents.

After the A and B antigens of the ABO blood group system, D is the most important blood group antigen in routine blood banking. Unlike antibodies of the ABO system, those of the Rh system do not occur naturally in the serum, but are most often the result of exposure to the antigen during pregnancy or through transfusion. The presence or absence of the D antigen is determined by testing the red blood cells with Anti-D. Agglutination indicates that the test cells are D positive. No agglutination indicates that the test cells are D negative. The term "weak D" is used to describe forms of the D antigen that may not be agglutinated directly by Anti-D reagents. The red blood cells of donors are required to be tested for weak D before being classified as D negative. After the D antigen, the other most important antigens in the Rh system are C, E, c and e. These antigens are not as immunogenic as D, but may cause rapid destruction of red blood cells in the presence of the corresponding antibody. Positive results indicate the presence of the antigen, while negative results indicate the absence of the antigen on the red blood cells. It is significant to identify the presence of these antigens when selecting blood for transfusion to patients with these antibodies.

QUALITY CONTROL

A positive and negative control were done at the beginning and end of each sample for quality control following the manufacturer's instructions. These control samples were selected to verify positive and negative reactions with the reagent. The positive controls produced positive (+) reactions and the negative controls produced negative (-) reactions with the reagent and all forms of contaminations were carefully avoided.

DATA COLLECTION

Overall, 237 data comprise of patients and donors within the study period at David Umahi Federal University Teaching Hospital were recovered and used for the study. See table 1,2 and fig. 1 for the distributions

DATA ANALYSIS

The collected data were entered into an Excel spreadsheet, and imported to the statistical package for social science version 26 (SPSS Inc. Chicago, IL, USA) for analysis. The data was analyzed using descriptive statistical analysis utilizing absolute frequencies and percentages, and the results were organized in Tables and charts. *P*-value of <0.05 was considered statistically significant with a 95% confidence level.

RESULTS

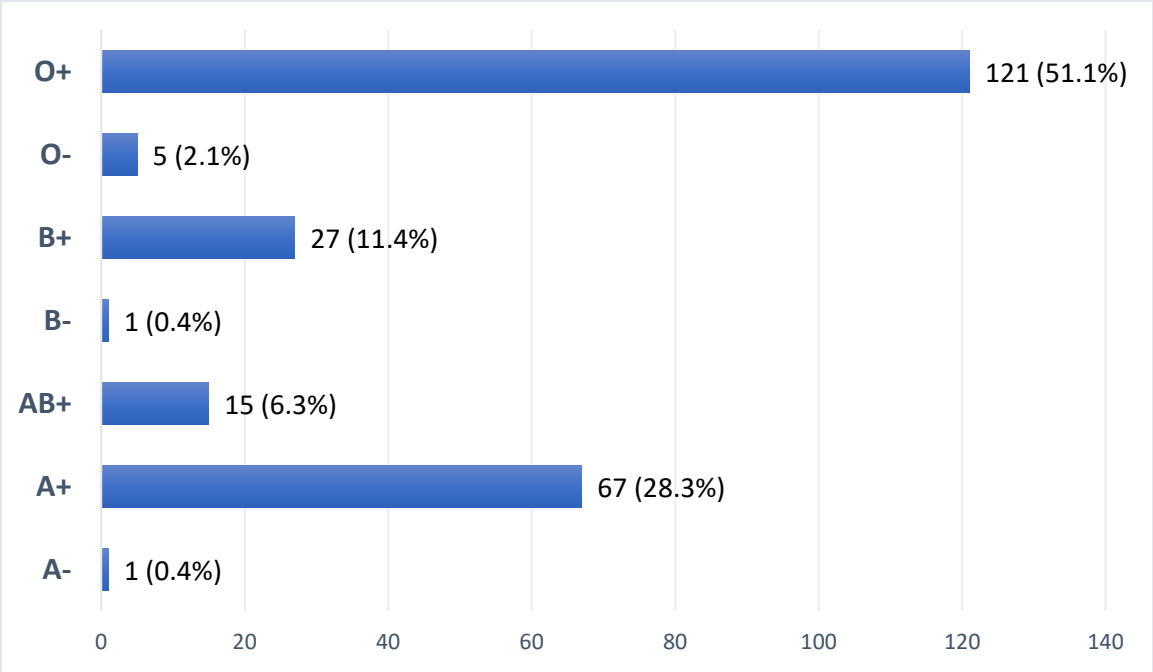
Two hundred and thirty-seven (237) records recovered from the Haematological Unit of the Medical Laboratory Sciences Department of the hospital accounting for both hospital patients and donors

Table 1: Socio-demographic characteristics of participants

Socio-demographic characteristics		
Age	***Frequency (N = 237)***	***Percentage (%)***
0 - 17 years	21	8.9
18 - 29 years	65	27.4
30 - 39 years	102	43.0
40 - 49 years	34	14.3
50 - 59 years	15	6.3
Mean ± sd age	32.79 ± 11.80	
Sex		
Male	181	76.4
Female	56	23.6

A higher proportion, 43.0% (102) of the respondents were between the ages of 30 – 39 years while 27.4%(65) were between the ages of 18 – 29 years. The mean ± SD age was 32.23 ± 9.74 years. Around two-thirds, 67.5% (27) of the respondents were male while 32.5%(13) of them were female. See table 1

Figure 1: Blood Types of the participants



A higher proportion; 51.1% (121) of the respondents had an *O+* blood type, with 28.3%(67) of the respondents belonging to an *A+* blood type while the *B-* and *A-* both had the lowest frequency; 0.4%(1.0). AB- was not found among the donors and patients. See fig 1

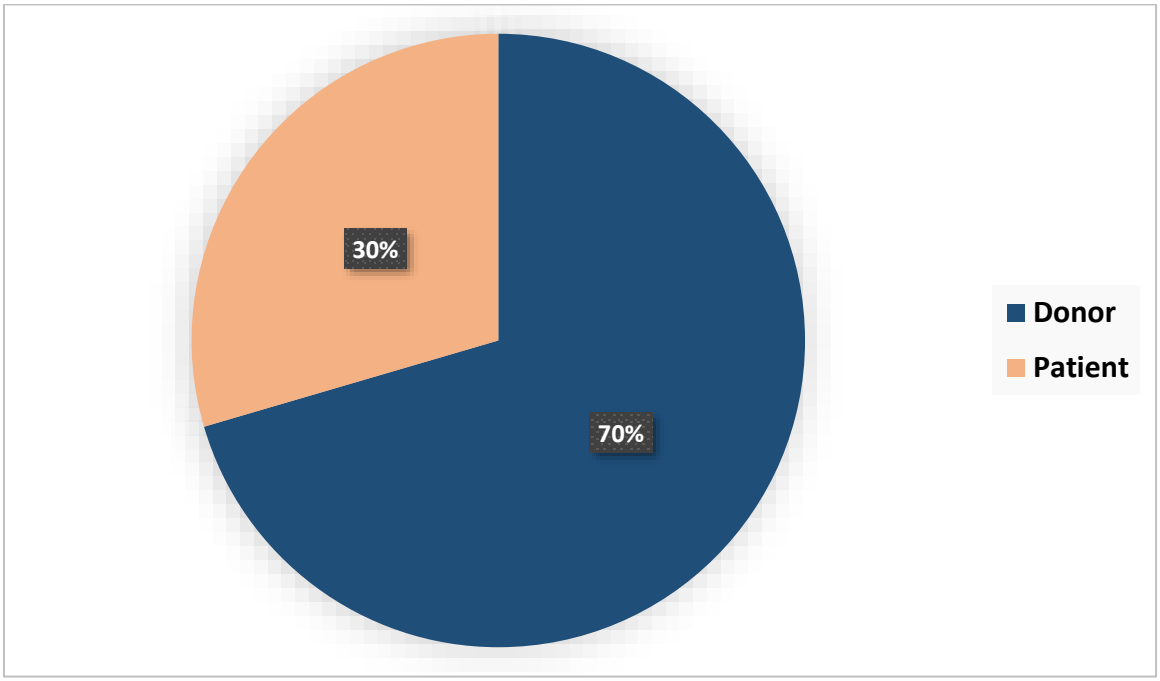
Table 2: Blood group and Rhesus characteristics of participants

Haematological Characteristics		
Blood group	***Frequency (N = 237)***	***Percentage (%)***
A	68	28.7
B	28	11.8
AB	15	6.3
O	126	53.2

Rhesus Factor		
positive	227	95.8
negative	10	4.2

Majority of the respondents; 95.8% (227) of the respondents had a positive rhesus factor while 10 (4.2%) of the respondents had a negative rhesus factor.

Figure 2: Hospital Status of participants



A little over two-thirds. 70.5% (167) of the participants were external blood donors while 30% (70) of the participants were patients of the hospital.

Table 3: Statistical relationship between socio-demographic and hospital status of participants

Age groups (years)	***Donor n (%)***	***Patient n (%)***	***Test statistics***	***p-value***
<18 years	3 (14.3)	18 (85.7)	$\chi 2 = 43.573$	**<0.001**
18-29 years	55 (84.6)	10 (15.4)		
30-39 years	76 (74.5)	26 (25.5)		
40-49 years	26 (76.5)	8 (23.5)		
50-59 years	7 (46.7)	8 (53.3)		
Mean age ± SD	32.87 ± 8.92	32.58 ± 16.86	T-statistics = 0.030	0.863
Sex				
Male	144 (79.6)	37 (20.4)	$\chi 2 = 30.438$	**<0.001**
Female	23 (41.1)	33 (58.9)		

Majority, precisely 84.6% (55) of the participants between the ages of 18 – 29 years were blood donors, while majority, 85.7% (18) of the participants were less than 18 years of age. There was a statistically significant relationship between the age group and hospital status of the participants ($\chi 2 = 43.573$, **p<0.001**). However, there was no statistically significant relationship between the Mean age ± SD ages of the participants in the respective donor and patient groups (T-statistics = 0.030, p =0.863). A higher proportion, 79.6% (144) of the male respondents were blood donors while, a higher proportion, 58,9% (33) of the female respondents were patients. There was a statistically significant relationship between the age group and hospital status of the participants ($\chi 2 = 30.438$, **p<0.001**).

Table 4: Blood group and Rhesus Characteristics and hospital status of participants

Blood Type	**Donor n (%)**	**Patient n (%)**	**Test statistics**	**p-value**
A-	0 (0.0)	1 (100.0)	Fischer's Exact test = 24.878	**<0.001**
A+	39 (58.2)	28 (41.8)		
AB+	7 (46.7)	8 (53.3)		
B-	1 (100.0)	0 (0.0)		
B+	15 (55.6)	12 (44.4)		
O-	5 (100.0)	0 (0.0)		
O+	100 (82.6)	21 (17.4)		
Blood Group				
A	39 (57.4)	29 (42.6)	$\chi 2$ =22.112	**<0.001**
B	16 (57.1)	12 (42.9)		
AB	7 (46.7)	8 (53.3)		
O	105 (83.3)	21 (16.7)		
Rhesus Factor				
positive	158 (69.6)	69 (30.4)	$\chi 2$ =1.915	0.289
negative	9 (90)	1 (10)		

There was a statistically significant relationship between the blood types and hospital status of the participants (Fischer's Exact = 24.878, **p<0.001**).

There was a statistically significant relationship between the blood group and hospital status of the participants ($\chi 2$ =22.112, **p<0.001**).

There was no statistically significant relationship between the *Rhesus* factor and hospital status of the participants ($\chi 2$ = 1.915, p = 0.289).

RATIONAL FOR FISCHER'S TEST

Fischer's test is used to determine if there is statistical significance associated between two variables. It is more reliable when the expected cell counts in a contingency table are low. Because our cell counts are low , therefore fisher's test is was used.

DISCUSSION

A 2017 study investigated the distribution and gene frequencies of *ABO* and Rh blood group systems in most parts of Nigeria with representatives in each of the six geopolitical zones. The data collated revealed that the *ABO* blood group frequencies were found in the order: *O* > *A* > *B* > *AB* (52.93%, 22.77%, 20.64% and 3.66%) respectively among Nigeria population [15.]

Another study in the Niger Delta region of Nigeria on multi ethnic populations such as students in tertiary institutions showed a prevalence of blood group *O* > *A* > *B* > *AB* [11, 10], blood donors and hospital patients [16] all show similar distribution pattern of blood group.

In this study, blood group *O* was found to be the most common, followed by group *A*, then *B*, while the least frequent was blood group *AB*. This agrees with the report of previous studies which also found blood group *O* to be the most common while blood group *AB* was the least frequent [14, 17].

The high prevalence of blood group *O* means that blood group *O* has a selective advantage and will be passed on to the subsequent generations more than the three remaining blood groups.

The trend of *ABO* distribution in the given population was *O* > *A* > *B* >*AB*. This trend was similarly reported by other researchers across Nigeria [18, 12].

The same was reported in Teaching Hospitals in Ebonyi, Benin, Niger Delta University and Bowen University respectively [19, 11, 16]. However, this observation contradicts the findings of Olaniyan et al[20], in FCT Nigeria and Musa et al[18] in Sokoto both of who found blood group B to be more prevalent than blood group A among the populations studied.

In some other parts of the world some studies have reported either blood group A or B to be the most prevalent blood group. Sharma et al [6], reported blood group B as the most prevalent one in India. Similarly, Khan et al [21], showed the frequency of blood group B to be the highest among the Pakistan population studied.

Such contradictions are probably due to geographical environment and ethnic groups in the study populations. Moreover, it shows that specific *ABO* blood groups might be distributed in different regions. Blood group *O* was regarded as a universal donor suitable to be given to anybody with any other blood group apart from group *O*. It has been documented that some blood group O individuals

have high titre of hemolysin; an anti-A and anti-B antibody and so can cause hemolytic transfusion reaction and death when such blood group *O* is transfused to anybody with any other blood type apart from group *O*[22]. Since majority of the study population have blood group O, there may be need for routine screening for hemolysin among blood group *O* individuals.

The study also found that blood group *O* has the highest frequency among the males and females, followed by blood group *A*, *B* and *AB* in that order.

This follows a similar pattern of *ABO* blood group distribution discovered in previous studies[16].

However, some other studies reported blood group *A* to be the most frequent among males and blood group *B*, the highest frequency among females[23, 24].

Most of the male and females were found to have *rhesus* positive blood group as also reported by previous studies[16, 25].

This shows that inheritance of *ABO* and *rhesus* blood groups are not sex-linked[9]. Among the study population, most of them were *Rhesus* positive while only a minority was *rhesus* negative.

These findings confirmed the trend of relatively low incidence of *Rhesus* negativity in Nigeria and beyond[10].

CONCLUSION

Blood group *O* was found to be highest occurring among the study population with a percentage of 52.6%, followed by *A*, *B* and *AB* in that order. Most of them were found to be *Rhesus* positive while only a minority were *Rhesus* negative. This finding will be useful in health care planning, genetic counseling and running of an organized, efficient and safe blood transfusion services. Routine screening of blood group *O* for hemolysin is recommended to prevent hemolytic transfusion reaction. *Rhesus* negative blood group were found to be few. Institution of blood donor registry is also recommended for easy accessibility to rhesus negative blood for transfusion especially in cases of emergency and also to prevent hemolytic disease of the fetus and newborn.

DECLARATION OF CONFLICT OF INTEREST

There is no conflict of interest with respect to authorship, and/or publication of this article.

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