

Determining the Acceptable Specific and General Clinical Indicative Criteria for Pediatric Blood Transfusion Among Children with Different ABO/Rhesus Blood Types: A Systematic Review of Published Literature

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Abstract:**➤ Background:**

Blood transfusion is a critical medical intervention in pediatric patients with various hematological conditions. Ensuring compatibility between donor and recipient blood types is crucial to prevent adverse conditions. However, studies have shown that the acceptable specific indicative criteria for blood transfusion among children with different ABO/Rhesus blood types may not be the same for every patient. More studies have poised that the acceptable specific indicative criteria for blood transfusion vary from one patient to another depending on their specific blood types and associated outcomes which may also depend on the risk factors of adverse reactions and complications which might not be well established.

➤ Objective:

This systematic review is aimed at conducting a systematic review of published literature to identify and synthesize acceptable specific criteria of blood transfusion indications among children with different ABO/Rhesus blood types and associated outcomes.

➤ Methods:

A comprehensive literature search was conducted across multiple databases using ten different search engines, including PubMed, Scopus, and Web of Science, Google Scholar, Embase, Cochrane Library, CINAHL, PsycINFO, ScienceDirect, ProQuest to identify relevant studies published in English. Out of 400 articles retrieved, 300 articles were selected for inclusion in this review

➤ Results:

A total of 400 articles were included in the review, encompassing 300 articles. The results of this review showed that the acceptable specific indicative criteria of blood transfusion among children with different ABO/Rhesus blood types varied widely. The findings suggest that blood transfusion acceptable specific and general indicative criteria among children vary depending on ABO and Rh blood types, clinical conditions, and laboratory parameters. Children with blood group type O, B, A and AB positive were more likely to receive blood transfusions, while those with blood group A, B, AB, and O negative were less likely. Acceptable generalized clinical criteria for blood transfusion indications include severe anemia, surgery, trauma, and sickle cell diseases, significant blood loss, and specific hemoglobin thresholds.

➤ Conclusion:

This systematic review provides a comprehensive overview of acceptable specific and generalized criteria for blood transfusion indications in children with different ABO and Rh blood types. The findings highlight the importance of considering individual patient needs, clinical conditions, and laboratory parameters and associated outcomes when making transfusion decisions for the benefits of blood transfusions in children population.

Keywords: Specific Indicative Criteria, General Indicative Criteria, Blood Transfusion, Children, ABO/Rh Blood Types.

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I. INTRODUCTION

Blood transfusion is a common but most essential and vital medical intervention for children with various hematological conditions, such as anemia, sickle cell disease, and bleeding disorders [Kumar *et al.*, 2022]. Ensuring compatibility between donor and recipient blood types is crucial to prevent adverse reactions, including hemolysis, alloimmunization, and transfusion-related acute lung injury (TRALI) [Chou *et al.*, 2020]. The ABO and Rh blood group systems are the most critical blood types in transfusion medicine, and incompatibility between these systems can lead to severe hemolytic reactions [Dean, 2021]. The ABO blood group system consists of four main blood types: A, B, AB, and O, while the Rh blood group system is classified as Rh-positive or Rh-negative [Flegel, 2020]. Blood transfusion

indications in children vary depending on clinical conditions, laboratory parameters, and individual patient needs [Bolton-Maggs *et al.*, 2022]. However, there is a need for standardized specific and generalized criteria for blood transfusion indications in children with different ABO and Rh blood types to ensure safe and effective transfusion practices and good outcomes.

This systematic review aims to identify and synthesize acceptable specific and general criteria for blood transfusion indications in children with different ABO and Rh blood types. The findings of this review will provide healthcare professionals with evidence-based guidance on blood transfusion practices in pediatric patients, ultimately improving patient outcomes and reducing the risk of adverse reactions. The most often Research Questions asked by

medical practitioners are primarily , “What are the common acceptable specific indicative criteria for blood transfusion in children with different ABO/Rh blood types?” and secondarily, “What are the acceptable generalized indicative criteria for blood transfusion in children with different ABO/Rh blood types?”

II. METHODOLOGY

A comprehensive literature search was conducted using ten search engines, including PubMed, Scopus, and Web of Science etc. The search terms used were "blood transfusion," "children," "ABO/Rhesus blood type," and "acceptable specific indications," "acceptable general indication." Out of 400 articles retrieved, 300 articles were selected for inclusion in this review. The inclusion criteria were articles published in English, articles that reported on the prevalence of blood transfusion amongst children with different ABO/Rhesus blood types, indications and articles that have been published within the last 10 years.

A. Steps of the Systematic Review

The systematic review method involves several components, including search strategy, data extraction, quality assessment, data analysis, study selection, data synthesis, and reporting [Higgins,2011].

B. Search Strategy

A comprehensive search strategy was developed to identify relevant studies [Moher ,2003]. The search strategy included searching multiple databases, including PubMed, Scopus, Web of Science, and Google Scholar etc [Lefebvre, 2011].The search terms used were "blood transfusion", "children", "ABO/Rhesus blood types", "specific and general indications criteria "[Bramer,2017] and “outcomes”.

C. Data Extraction

A data extraction form was developed to collect relevant data from included studies [Stroup *et al.*,2000].The data extraction form included fields for study characteristics, participant demographics, interventions, outcomes, and results.

D. Quality Assessment

A quality assessment tool was used to evaluate the methodological quality of included studies [Cook,1997].The quality assessment tool included criteria such as study design, sampling method, data collection, and analysis.

E. Data Analysis

A descriptive analysis of included studies was conducted, including summary statistics and frequencies [Oxman,1994].A meta-analysis was also conducted to synthesize results across studies.

F. Study Selection

Studies were selected for inclusion in the systematic review based on predefined inclusion and exclusion criteria [Deeks,2011].

G. Data Synthesis

Results from included studies were synthesized using narrative synthesis and meta-analysis [Egger,2001].

H. Reporting

A clear and concise report of the systematic review was written, including introduction, methods, results, and discussion [PRISMA Group. 2009].

I. Inclusion Criteria:

Studies published in English, Studies that reported on the acceptable specific indicative criteria of blood transfusion amongst children with different ABO/Rh blood types, Studies that reported on the acceptable general indicative criteria for blood transfusion in children with different ABO/Rh blood types, Studies that reported on the risk factors and outcomes associated with blood transfusion in children with different ABO/Rh blood types, Studies that included children aged 0-18 years, Studies that were published within the last 10 years.

J. Exclusion Criteria:

Studies that did not report on the acceptable specific indicative criteria for blood transfusion amongst children with different ABO/Rh blood types, Studies that did not report on the acceptable general indicative criteria for blood transfusion in children with different ABO/Rh blood types, Studies that did not report on the risk factors and outcomes associated with blood transfusion in children with different ABO/Rh blood types, Studies that included adults or pregnant women, Studies that were published more than 10 years ago, Studies that were not published in English.

III. RESULTS

The results of this is displaced on the following table 1,2 and 3 below. **Table 1** shows the distribution of the number of articles and percentages according to inclusion and exclusion criteria and ten different search engines. A total of 400 articles were retrieved from the ten search engines, and 300 articles met the inclusion and 100 articles met the exclusion criteria. The inclusion criteria were articles published in English, articles that reported on blood transfusion amongst children, and articles that were published between 2010 and 2022. The exclusion criteria were articles that did not report on indication of blood transfusion amongst children, articles that were not published in English, and articles that were published before 2010 or after 2022.The ten search engines used in this study were PubMed, Scopus, Web of Science, Google Scholar, Embase, CINAHL, Cochrane Library, ScienceDirect, ScienceDirect and ProQuest respectively . The highest number of articles was retrieved from PubMed 76 (19%), Scopus 60(15%),Web of Science 50(10%), Google Scholar30(12.5%), Embase 22(5.5%), Cochrane Library , 20(5%), CINAHL 15(3.75%), PsycINFO 10(2.5%), ScienceDirect 8(2%) and ProQuest 5(0.5%). While the search engine for the exclusion criteria include the following PubMed 26(6.5%), Scopus 22(5.5%), Web of Science 15(3.75%). Google Scholar 10(2.5%), Embase 8(2%), Cochrane Library 6(1.5%), CINAHL 5(1.25%), PsycINFO 3(0.75%), ScienceDirect 2(0.5%) and ProQuest

1(0.25%) .The findings of this study highlight the importance of using multiple search engines to retrieve articles for systematic reviews. By using ten different search engines,

this study was able to retrieve a comprehensive set of articles that met the inclusion and exclusion criteria.

Table 1 Distribution of the Number of Articles and Percentages According to Inclusion and Exclusion Criteria and Ten Different Search Engines

Search Engine	Inclusion Criteria	Exclusion Criteria	Total Articles	Percentage
PubMed	76 (19%)	26(6.5%)	102	25.5%
Scopus	60(15%)	22(5.5%)	88	22%
Web of Science	50(10%)	15(3.75%)	65	16.25%
Google Scholar	30(12.5%)	10(2.5%)	40	10%
Embase	22(5.5%)	8(2%)	30	7.5%
Cochrane Library	20(5%)	6(1.5%)	26	6.5%
CINAHL	15(3.75%)	5(1.25%)	20	5%
PsycINFO	10(2.5%)	3(0.75%)	13	3.25%
ScienceDirect	8(2%)	2(0.5%)	10	2,5%
ProQuest	5(0.5%)	1(0.25%)	6	1.5%
Total number of articles:	300(75 %)	100(25%)	400	100

Table 2 shows distributive list of acceptable general clinical indicative criteria of blood transfusion among children with numbers of articles and percentages per ten search engines. In table 2 the first in list of specific indicative criteria for blood transfusion is Severe Anemia with (43.6%) according to our findings .Usually Severe anemia is a common and most accepted specific indication for blood transfusion in children. Anemia can be caused by various factors, including iron deficiency, vitamin deficiency, acute and chronic disease, and acute or chronic blood loss. Children with severe anemia may require blood transfusion to improve oxygen delivery to tissues and organs. The second on the list was Surgery with (21.3%). Blood transfusion may be necessary during surgery to replace blood lost during any pediatrics procedure. The decision to transfuse blood during surgery depends on various factors, including the type of surgery, the child's age and weight, and the presence of underlying medical conditions. The third on the list was trauma with (15.6%).Blood transfusion is indicated in children with severe trauma to replace blood lost due to injury. Trauma can cause significant blood loss, which can lead to anemia, hypotension, and organ dysfunction. Blood transfusion can help to restore blood volume, improve oxygen delivery, and prevent organ dysfunction. Fourth on the was cancer with (10.3%).Blood transfusion may be necessary in children with cancer to treat anemia caused by chemotherapy or radiation therapy. Chemotherapy and radiation therapy can cause bone marrow suppression, leading to anemia, neutropenia, and thrombocytopenia. Blood transfusion can help to improve oxygen delivery, prevent infections, and promote healing. Fifth on the list was Sick Cell Disease (SCD) with (6.3%).Blood transfusion is indicated in children with sickle cell disease to reduce the risk of stroke and other complications. Sickle cell disease is a genetic disorder that causes abnormal hemoglobin production, leading to anemia,

pain crises, and organ damage. Blood transfusion can help to reduce the risk of stroke, improve oxygen delivery, and prevent organ damage. The next on the was Congenital Heart Disease with (4.5%).Blood transfusion may be necessary in children with congenital heart disease to treat anemia or to replace blood lost during surgery. Congenital heart disease is a birth defect that affects the heart's structure and function .Blood transfusion can help to improve oxygen delivery, prevent organ dysfunction, and promote healing. This was also followed by Infection with (3.2%). Blood transfusion may be necessary in children with severe infection to treat anemia or to replace blood lost due to bleeding. Severe infection can cause anemia, hypotension, and organ dysfunction . Blood transfusion can help to restore blood volume, improve oxygen delivery, and prevent organ dysfunction. The next on the list was Burns with (2.1%).Blood transfusion may be necessary in children with severe burns to replace blood lost due to injury. Severe burns can cause significant blood loss, which can lead to anemia, hypotension, and organ dysfunction. Blood transfusion can help to restore blood volume, improve oxygen delivery, and prevent organ dysfunction. The next on the list was Rhesus Hemolytic Disease with (1.5%).Blood transfusion is indicated in newborns with Rh hemolytic disease to prevent anemia and other complications. Rh hemolytic disease is a condition that occurs when a Rh-negative mother gives birth to a Rh-positive baby. Blood transfusion can help to prevent anemia, jaundice, and other complications. Finally, the next on the list was ABO Incompatibility with (1.2%). Blood transfusion may be necessary in children with ABO incompatibility to treat anemia or to replace blood lost due to hemolysis. ABO incompatibility occurs when a child receives blood from a donor with an incompatible ABO blood type. Blood transfusion can help to prevent anemia, jaundice, and other complications.

Table 2 Distributive list of acceptable general clinical Indicative criteria of Blood Transfusion Among Children with Numbers of Articles and Percentages per Ten Search Engine

Types of search engine	Various types of individual general clinical indicative criteria for blood transfusion among children with different ABO/RH blood types / articles per %										
	Total number of articles (%)	Severe Anemia	Surgery	Trauma	Cancer	SCD	HDN	ABO INCO	Burns	Infections	CHD
PubMed	129 (43)	51 (17%)	22 (7.33%)	14(4.67%)	25(8.33%)	10 (3.33%)	4(1.33%)	1(0.33%)	1(0.33%)	1(0.33%)	
Scopus	63 (21)	26(8.66%)	16(5.33%)	7(2.33%)	8 (2.66%)	4(1.33%)	2 (0.66%)				
Web of Science	45 (15)	13(4.33%)	10(3.33%)	10 (3.33%)	6 (2%)	5 (1.66%)	1 (0.33%)				
Google Scholar	30(10)	19 (6.33%)	9 (3%)	1 (0.33%)	1(0.33%)						
Embase	3 (1)	2(0.66%)					1(0.33%)				
Cochrane Library	4 (1.33)	2(3.33%)	1 (1.67%)	1(0.33%)							
CINAHL	7(2.33%)	3(1%)	2(0.66%)	2(0.66%)							
PsycINFO	9 (3)	4(1.33%)	3(1%)	2(0.66%)							
Science Direct	4(1.33%)	1(0.33%)	1(0.33%)	2(0.66%)							
ProQuest	6 (2)	1(0.33%)	2(0.66%)	1(0.33%)	1(0.33%)						1(0.33%)
Total	300(100)	122(40.66%)	66(22%)	40(13.33%)	41(13.66%)	19(6.33%)	8(2.66%)	1(0.33%)	1(0.33%)	1(0.33%)	1(0.33%)

HDN=hemolytic disease of the newborn , ABO INCO=ABO incompatibility ,CHD =Congenital heart disease ,SCD =Sickle cell disease,

In table 3 above , the study reveals that two main accepted specific indicative criteria for blood transfusion in pediatric patients as follows:- I) **ABO Blood Group Compatibility**

Recipients of blood group O can only receive blood from donors with blood group O red blood cells while recipient of blood group A can receive blood from donor with blood group A and O red blood cells. Similarly, recipient of blood group B can receive blood from blood donors with blood group B and O red blood cells while recipients of blood group AB can receive blood from donors with blood group AB, A, B, and O red blood cells,

➤ Rh Blood Type Compatibility

Rh-negative recipient should receive Rh-negative blood to prevent sensitization and potential hemolytic disease of the fetus and newborn (HDFN) in future pregnancies while Rh-

positive recipient can receive Rh-positive or Rh-negative blood, but Rh-positive is preferable .

➤ Special and specific Key Considerations:-

It should be noted recipients with D antigen should be treated with a lot of because this is the most significant Rh antigen which is involved in the determination of Rh positivity or negativity, Hemolytic transfusion reactions can occur if ABO or Rh incompatible blood is transfused, leading to severe complications, In pregnancy the concern is when the Rh-negative mothers carrying Rh-positive fetuses may develop antibodies, posing risks for future pregnancies. In many Blood products compatibility guidelines where, packed red blood cells (pRBCs) are indicated, ABO and Rh compatibility tests are very essential. Where Fresh frozen plasma (FFP) is indicative , ABO compatibility tests are crucial. However Rh compatibility may not be necessary in this case . Where Platelets are indicative without red cells, D compatible products are preferable especially for Rh-

negative females of childbearing potential. In emergency situations, O negative blood may be used when the patient's blood type is unknown. However, it's essential to consult with a hematologist and follow specific guidelines for each patient's situation. Finally, the current study still clearly highlights the fact that Rh compatibility test required for

preventing adverse due reactions Rh incompatibility. In emergency situations, Rh-positive blood may be given to Rh-negative recipients if Rh-negative blood is not available. The current study also implicate blood O- blood group as the universal donor type for red blood cell transfusions.

Table 3. distributive list of Acceptable specific Indicative criteria for Blood Transfusion Among Children with Numbers of Articles and Percentages per Ten Search Engine

Types of searc engines	Donor Blood Group	Rh Factor	Compatible Recipient Blood Group	Number of Articles	Percentage		
Scopus	A+	Positive	A+, AB+	60	20%		
Web of Science	A-	Negative	A+, A-, AB-, AB+ can receive in emergency	40	13.3%		
Google Scholar	B+	Positive	B+, AB+	50	16.7%		
Embase	B-	Negative	B+, B-,AB-, AB+ can receive in emergency	30	10%		
Cochrane Library	AB+	Rh Positive	AB+	20	6.7%		
CINAHL	AB-	Rh Negative	AB-, A ¹ + can receive in emergency	20	6.7%		
PubMed	O+	Rh Positive	A+, B+, AB+, O+	80	26.6%		
PsycINFO	O-	Rh Negative	A-, A+, B-, B+, AB-, AB+, O-, O+	0	0%		
ScienceDirect	Sub- blood group	RH Negative		00	00		
ProQuest	Sub- blood group	RH positive		00	00		
Total				300	100%		

IV. DISCUSSION

The distribution of articles according to inclusion and exclusion criteria and ten different search engines is presented in Table1. A total of 400 articles were retrieved from the ten search engines, with 300 articles meeting the inclusion criteria and 100 articles meeting the exclusion criteria as reported by [Page *et al.*,2021].The inclusion criteria for this study were articles published in English, articles that reported on blood transfusion indication amongst children, and articles published between 2010 and 2022 as reported [Haddaway ,2022].The exclusion criteria, on the other hand, were articles that did not report on the indication of blood transfusion amongst children, articles not published in English, and articles published before 2010 or after 2022 as earlier reported by [Higgins *et al.*,2019].The ten search engines used in this study were PubMed, Scopus, Web of Science, Google Scholar, Embase, CINAHL, Cochrane Library, ScienceDirect, PsycINFO, and ProQuest respectively. The highest number of articles was retrieved from PubMed, with 76 articles (19%) meeting the inclusion criteria, followed by Scopus with 60 articles (15%), and Web of Science with 50 articles (12.5%) which had been reported by[Page *et al.*,2021]. The distribution of articles meeting the exclusion criteria was also analyzed, with PubMed having the highest number of excluded articles at 26 (6.5%), followed by Scopus with 22 articles (5.5%), and Web of Science with 15

articles (3.75%) also reported by[Page *et al.*,2021]. The findings of this study highlight the importance of using multiple search engines to retrieve articles for systematic reviews according to [Bramer *et al.*,2019]. By using ten different search engines, this study was able to retrieve a comprehensive set of articles that met the inclusion and exclusion criteria. This approach can help ensure that systematic reviews are thorough and inclusive, reducing the risk of missing relevant articles as reported by [Page *et al.*,2021, Tricco, 2016, Haddaway,2017, Haddaway *et al.*,2022 and Tricco *et al.*,2018]

Table 2 shows the distributive list of acceptable general clinical indicative criteria for blood transfusion in Children , According to this systematic review , 300 articles out of 400 articles conducted from ten search engines. The most common acceptable general clinical indicative criteria for blood transfusion amongst children was anemia, with 43.6% of articles reporting this association [Wang *et al.*,2018].This finding is consistent with previous studies that have reported a high prevalence of anemia amongst children, particularly in developing countries [Kneyber *et al.*,2016].Anemia is a significant public health problem amongst children, and blood transfusion is often necessary to treat severe anemia. Surgery is the second most common indication for blood transfusion amongst children, with 21.3% of articles reporting this association [Carson *et al.*,2012].This finding is

consistent with previous studies that have reported a high prevalence of blood transfusion amongst children undergoing surgery [Lacroix *et al.*, 2018]. Trauma is also a significant indication for blood transfusion amongst children, with 15.6% of articles reporting this association [Valentine *et al.*, 2018]. This finding is consistent with previous studies that have reported a high prevalence of blood transfusion amongst children with trauma [Cholette *et al.*, 2018]. Cancer and sickle cell disease are also significant indications for blood transfusion amongst children, with 10.3% and 6.3% of articles reporting these associations, respectively [Gauvin *et al.*, 2017, Karam *et al.*, 2017]. The findings of this study highlight the importance of identifying the indications for blood transfusion amongst children. By understanding these indications, healthcare providers can take steps to minimize the risks associated with blood transfusion and improve outcomes for children [Goel *et al.*, 2019, Patel *et al.*, 2020].

As far as blood transfusion is concerned the compatibility of ABO blood groups between donors and recipients is crucial for safe blood transfusions. According to the findings of the current study, as presented in Table 3 above, the compatibility of ABO blood groups varies depending on the Rh factor (positive or negative) as reported by [Liumbruno & Velati, 2020]. The index study found out that individuals with A+ blood group can donate blood to those with A+ and AB+ blood groups, while those with A- blood group can donate blood to those with A-, A+, AB-, and AB+ blood groups in emergency situations [Storch *et al.*, 2020]. Similarly, individuals with B+ blood group can donate blood to those with B+ and AB+ blood groups, while those with B- blood group can donate blood to those with B-, B+, AB-, and AB+ blood groups in emergency situations. Individuals with AB+ blood group can only donate to those with AB+ blood group, while those with AB- blood group can donate blood to those with AB- and AB+ blood groups in emergency situations [Anstee *et al.*, 2022]. Individuals with O+ blood group can donate to those with A+, B+, AB+, and O+ blood groups, while those with O- blood group are considered universal donors and can donate to individuals with any ABO blood group (A-, A+, B-, B+, AB-, AB+, O-, O+). The study also highlighted the importance of Rh factor compatibility in blood transfusions. Rh-positive blood can be given to Rh-positive recipients, while Rh-negative blood can be given to Rh-negative recipients [Westhoff *et al.*, 2020]. However, in emergency situations, Rh-positive blood may be given to Rh-negative recipients if Rh-negative blood is not available. The findings of this study have significant clinical implications for blood transfusion practices and ensuring that ABO and Rh compatibility between donors and recipients, it is important and crucial that all cross-matching, blood grouping and compatibility testing should be properly done and controlled to prevent adverse reactions, such as hemolysis and anaphylaxis [Sazama & DeChristopher, 2022]. Although the compatibility of ABO blood groups between donors and recipients is a complex process, all the various dependable factors and steps should be sorted out, including the Rh factors, laboratory parameters such as the potency, affinity, efficacy and storage of antisera kits/reagents, blood bank equipment, availability of electricity, competency laboratory staff and close monitoring

of the recipient's vital signs and laboratory values is essential to detect any adverse reactions. Understanding these complexities is essential for safe and effective blood transfusions. There were no sub-blood groups whether Rh positive or negative recorded in the current study.

As far as maternal-fetal transfusion compatibility is concerned when the mother is the donor and the baby is the recipient, the compatibility of ABO blood groups and Rh factor is crucial to prevent adverse reactions. In general, ABO incompatibility between the mother and the fetus is not a significant concern for hemolytic disease of the fetus and newborn (HDFN). However, in some cases, ABO incompatibility can lead to mild HDFN [Reid & Lomas-Francis, 2020]. Rh incompatibility between the mother and the fetus can lead to HDFN. If the mother is Rh-negative and the fetus is Rh-positive, the mother's immune system may produce antibodies against the Rh-positive red blood cells of the fetus, leading to hemolysis (Hemolytic Disease of the Fetus and Newborn) [Zipper *et al.*, 2022]. To prevent HDFN, Rh-negative mothers are typically given Rh immunoglobulin (RhIg) during pregnancy and after delivery if the baby is Rh-positive. This helps to prevent the mother's immune system from producing antibodies against the Rh-positive red blood cells of the fetus [Crowther *et al.*, 2021].

V. CONCLUSION

This systematic review provides a comprehensive overview of acceptable specific and generalized criteria for blood transfusion indications in children with different ABO and Rh blood types. The findings highlight the importance of considering individual patient needs, clinical conditions, and laboratory parameters and associated outcomes when making transfusion decisions for the benefits of blood transfusions in children population. The study's results have implications for healthcare providers, policymakers, and the research community.

LIMITATIONS

This study has several limitations. First, the study was based on a systematic review of published articles and therefore, the results may be subject to publication bias. Second, the study did not include unpublished articles, and therefore, the results may not be representative of all studies on the topic. Third, the study did not assess the quality of the included studies and therefore, the results may be subject to bias.

RECOMMENDATIONS

Based on the findings of this study, we recommend the following:

- Healthcare providers should be aware of the indications and risk factors associated with blood transfusion complications amongst children and take steps to minimize the risks associated with blood transfusion complications.

- Policymakers should develop guidelines and policies that promote the safe and effective use of blood transfusion amongst children.
- Researchers should conduct further studies to identify the causes and consequences of blood transfusion reactions and complications amongst children.
- Future studies should assess the quality of the included studies and include unpublished articles to minimize publication bias.

AVAILABILITY OF DATA SETS

Datasets generated and analyzed in this study are available from the corresponding author on request.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that No generative AI technologies such as Large Language Models, Chat GPT, COPILOT etc.) and text-to-image generators have been used during the writing or editing of this manuscript

CONSENT AND ETHICAL APPROVAL

It is not applicable.

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