OPTN | UNOS

## Public Comment Proposal

# Guidance for ABO Subtyping Organ Donors for Blood Groups A and AB

*OPTN/UNOS Operations and Safety Committee*

*Prepared by: Susan Tlusty*
*UNOS Policy Department*

## Contents

# Guidance for ABO Subtyping Organ Donors for Blood Groups A and AB

*Affected Policies:* *N/A*
*Sponsoring Committee:* *Operations and Safety*
*Public Comment Period:* *January 22, 2018 –March 23, 2018*

## Executive Summary

The OPTN/UNOS Operations and Safety Committee (the Committee) has updated the Guidance for ABO Subtyping Organ Donors for Blood Groups A and AB, originally developed by the Committee and approved by the OPTN/UNOS Board of Directors in June 2011.

Since the original publication, the Committee sponsored major revisions to ABO policies that were approved by the OPTN/UNOS Board of Directors and implemented in June 2016. During that process, the Committee identified the need to revise the subtyping guidance, as many questions emerged related to subtyping. Questions and identified issues include lab result nomenclature, results interpretation, and incomplete knowledge of policy requirements.

In addition, the revised Kidney Allocation System (KAS) went into effect in December 2014. It eliminated variances (including subtyping variances). KAS put use of subtyped deceased donors into policy to help promote greater access to kidneys for blood type B candidates. Allocation of kidneys using subtyped donors has increased. Pre-KAS there were 19 transplants (0.2% of all kidney transplants) using subtyped donors for blood type B candidates. Post-KAS (year 2) that number had risen to 168 (1.4% of all kidney transplants).

The revised guidance document is also part of efforts to assist members with subtyping. Nearly a quarter of OPOs had a subtyping issue cited on their last site survey. Instructional Innovations developed a subtyping e-learning module in response to these concerns. The guidance document is cited as a resource. It needs to be updated to complement the efforts aimed at improving compliant subtyping practices and reporting.

Changes made to the guidance document include:

- Updated OPTN Policy references
- Amended information about special considerations such as neonates
- Updated additional complementary resources
- Revised structure and addition of key points
- Modified language to read more as a plain language document

## Is the sponsoring Committee requesting specific feedback or input about this resource?

The Committee changed the section that covers special considerations in subtyping including neonates and history of red blood cell transfusion. The Committee seeks feedback whether this guidance is sufficient or if more detail or policy is desired.

The Committee also wants to know if there are related concerns not addressed in the guidance.

# What problem will this resource address?

Guidance for ABO Subtyping Organ Donors for Blood Groups A and AB was developed and approved by the Board of Directors in June 2011. Since the original publication, the Committee sponsored major revisions to ABO policies that were approved by the OPTN/UNOS Board of Directors and implemented in June 2016. During that process, the Committee identified the need to revise the subtyping guidance, as many questions emerged related to subtyping. Questions and identified issues include lab result nomenclature, results interpretation, and incomplete knowledge of policy requirements.

In addition, the revised Kidney Allocation System (KAS) went into effect in December 2014. It eliminated variances (including subtyping variances). KAS put use of subtyped deceased donors into policy to help promote greater access to kidneys for blood type B candidates. Allocation of kidneys using subtyped donors has increased. Pre-KAS there were 19 transplants (0.2% of all kidney transplants) using subtyped donors for blood type B candidates. Post-KAS (year 2) that number had risen to 168 (1.4% of all kidney transplants).

The guidance document is still a valuable and requested resource. Members and UNOS staff identify subtyping issues. These issues include lab result nomenclature, results interpretation, and incomplete knowledge of policy requirements. Nearly a quarter of OPOs had a subtyping issue cited on their last site survey. Instructional Innovations developed a subtyping e-learning module in response to these concerns and the guidance document is cited as a resource in the module. It needs to be updated to support efforts to promote compliant subtyping practices and reporting.

The revisions also address questions that have recently been asked regarding other special circumstances such as subtyping neonates.

# Why should you support this resource?

This resource is being revised to address identified transplant community needs. It needs to be updated to remain relevant to the community. It was developed in consultation with relevant subject matter experts, stakeholders, and internal staff. It is a free resource available along with others to assist members with subtyping education and practices. The revised guidance is one tool that can assist with answering questions, reducing confusion, and promoting effective practices regarding subtyping requirements. The revised guidance also supports other efforts to increase subtyping and availability of organs to candidates with traditionally less access due to blood types. This resource augments other policy initiatives and resources such as ABO policy modifications, KAS, UNOSConnect e-learning modules, and the most recently approved Guidance for Transplant Program Participation in the Transplantation of Non-A1/Non-A1B (A2/A2B) Donor Kidneys into Blood Group B Candidates.

## How was this resource developed?

In 2008, a kidney donated from a living donor, whose ABO subtyping completed prior to the donation was reported as non-$A_1$ (e.g. $A_2$), was transplanted into a blood type O recipient resulting in immediate graft rejection and organ failure. Repeat subtype testing of the donor indicated the actual subtype to be $A_1$. In response to this event, the Membership and Professional Standards Committee (MPSC) requested that the Operations and Safety Committee (OSC) examine current OPTN policies to evaluate whether they are adequate to ensure that subtyping of both deceased and living donors is accurately determined and verified.

In April 2010, after data review and discussion, the OSC requested that a group of experts in the field of ABO typing and subtyping be formed to assist the committee in its task. The ABO Subtyping Work Group was created and included representation from American Association of Blood Banks (AABB), a histocompatibility laboratory supervisor, a blood bank medical director, the OPTN/UNOS Histocompatibility Committee, representatives from OSC, and other transplant center and OPO personnel familiar with processes related to allocation of organs based on ABO subtyping. The OSC requested the work group to assist the committee with understanding the current practice of laboratories performing subtype testing and centers requesting completion of such tests. They were also asked to assist in

proposing requirements that would be consistent with current laboratory and transplant community practice for ABO subtype testing.

This group developed the guidance as part of their overall work on subtyping issues to address community education needs. Their work also resulted in a policy proposal approved by the OPTN/UNOS Board of Directors in November 2011. Policy changes were made to require two separate specimens and tests for subtyping as well as requiring two-person verification of results prior to reporting results to the OPTN Contractor.

The revised guidance was developed by a work group including members of the Operations and Safety Committee. The revision efforts also included three additional subject matter experts: two members who have served on the Histocompatibility Committee and are currently lab directors, as well as one member who is a blood bank expert. The work group met monthly to review the current guidance, research content, discuss current issues, and review new developments in the field.

Support staff to the Operations and Safety Committee contributed to the review. Member Quality staff provided updated feedback on issues that they might still uncover during site surveys such as the need to emphasize that two out of three subtyping results cannot be reported or used for allocation. All tests must indicate the same result in order for use in allocation; otherwise, the donor must be allocated on primary blood type. Other internal support staff reviewed the document and made suggestions to incorporate more plain language.

The workgroup solicited pre-public comment feedback from the Minority Affairs, Kidney, and Organ Procurement Organization (OPO) Committees. The Kidney Committee provided suggestions to improve readability and organization. As a result, the key points are listed at the beginning of the document for those that might not read the entire guidance. The guidance was presented to the Minority Affairs Committee. No suggestions were made at their monthly call. OPO leadership received an advance copy but did not have pre-public comment feedback. The Operations and Safety Committee will continue to consult with these stakeholders during the public comment process as needed. A revised document was developed and submitted for full Committee consideration. The Operations and Safety Committee voted at their November 2017 monthly conference call to send the revised guidance document for January 2018 public comment consideration.

## How well does this resource address the problem statement?

This resource addresses the issues identified in the problem statement by doing the following:

1. Updated OPTN Policy references

   The revised guidance removes language on kidney variance policy that is no longer in effect following the implementation of the new KAS. It also references organ-specific policies (e.g. kidney, kidney-paired donation, and liver). It also cites specific requirements from revised ABO policies that were amended for clarity.

2. Amended information about special considerations such as neonates

   Questions have arisen about special yet rare circumstances. For example, members have asked how far back in time does the rule apply requiring a pre-red blood cell transfusion specimen. The Committee has discussed this question but has decided not to specify a timeline in policy or guidance but the guidance offers information on the red blood cell life cycle. It also raises other considerations such as subtyping in neonates. Neonates do not immediately express red blood cell antigens. Members are encouraged to develop relationships and consult with their blood bank. When there is concern that subtyping cannot be accurately conducted, then the reasons must be documented and allocation based on primary blood type. Other issues known from site surveys are highlighted such as not using two out of three results to determine subtype.

3. Updated additional complementary resources

In 2011, this guidance was the sole OPTN resource. Since then, two UNOSConnect modules that include significant interactive content on subtyping requirements have been developed and released. These are referenced as well as the recently approved guidance for transplant programs on managing the candidate side of titer monitoring.

4. Revised structure and addition of key points

   The guidance has been reformatted to put the most important information first and move the more technical information towards the back. All key points are put in a summary statement up front. This is done to capture those who may have limited time or ability to read the entire document.

5. Modified language to read more as a plain language document

   Concerns were expressed that of the information might be more technical than helpful to assist one of the intended audiences of front line OPO staff. Efforts were put in to make the language simpler. Both work group members as well as communication and policy staff reviewed and revised the content to incorporate plain language wherever possible.

The updates, additional guidance, plain language, and reformatting should benefit the transplant community and help increase compliance with subtyping policies as well as promote effective practices. This resource, along with others discussed, should help answer community questions and ultimately help promote application of allocation subtyping policies that aim to increase organ access for certain blood type candidates.

# Which populations are impacted by this resource?

This guidance document augments existing efforts to promote sound subtyping practices that can widen organ offer access to some blood type B and blood type O candidates.

# How does this resource impact the OPTN Strategic Plan?

1. *Increase the number of transplants*: There is no impact to this goal.
2. *Improve equity in access to transplants*: There is no impact to this goal.
3. *Improve waitlisted patient, living donor, and transplant recipient outcomes*: There is no impact to this goal.
4. *Promote living donor and transplant recipient safety*: This guidance document originally developed and published in 2011 helps the transplant community understand the fundamentals of subtyping practices and terminology. The revisions will improve the transplant community's abilities to understand the importance of subtyping and to avoid incorrect results reporting.
5. *Promote the efficient management of the OPTN*: The revised guidance could help decrease questions and therefore decrease member and staff efforts involved in answering questions.

# How will the OPTN implement this resource?

This proposal will not require programming in UNet$^{SM}$.

Instructional Innovations will monitor this proposal for educational needs. The impact to members suggests that an educational offering may not be necessary.

Updated guidance will be posted on the OPTN website.

# How will members implement this resource?

The overall fiscal impact will be minimal to all member types as this is a guidance document that might be used for staff training.

### Transplant Hospitals

The fiscal impact to transplant hospitals will be minimal. They might use the updated tool as part of staff training.

### OPOs

The fiscal impact to OPOs will be minimal. They might use the updated tool as part of staff training.

### Histocompatibility Laboratories

The fiscal impact to histocompatibility laboratories will be minimal. They might use the updated tool as part of staff training.

## Will this resource require members to submit additional data?

No, this proposal is a guidance document and does not require additional data collection.

## How will members be evaluated for compliance with this resource?

This proposal is a guidance document does not require evaluation for compliance.

## How will the sponsoring Committee evaluate whether this resource was successful post implementation?

Although the Committee will not formally monitor this guidance document, support staff will be queried regarding the frequency and type of observed subtyping questions and issues among members. Staff will also review data from the subtyping course available on UNOS Connect as well as monitor website hits accessing the guidance. This will help determine whether the existing resources are being used, whether they are helpful, or whether additional steps need to be taken to assist with subtyping requirements and promotion of increasing access to disadvantaged blood type candidates.

# Guidance DocumentGuidance Document

All the language in the guidance document below is proposed new language; underlines have been omitted for easier reading.

## Guidance for ABO Subtyping Organ Donors for Blood Groups A and AB

## Table of Contents

# Summary

## Key Points

- Persons who are in blood groups A and AB (meaning that their primary blood type is A or AB, respectively) can be further tested to determine a more specific subtype (also known as a subtype).
- Subtypes for blood type A include $A_1$, $A_2$, $A_x$, $A_{int}$ and others, but the most common is $A_1$.
- If the donor is **not** subtype $A_1$, it means they have less A antigen on their red blood cells (RBCs) and organs, which allows them to donate to recipients outside of their primary blood type.
- OPTN policies refer to all subtypes that are not $A_1$ as non-$A_1$. Therefore, a donor who is primary blood type A and subtyping results show that the donor does not have the $A_1$ subtype is referred to as having blood type A, non-$A_1$.
- Perform subgroup typing before the donor receives RBC products or transfusions.
- ***Any*** blood transfusion can affect the accuracy of the results despite the donor's hemodilution status.
- OPOs and transplant hospitals should consult with their blood banks to consider special issues (such as RBC transfusion and neonates) and follow their recommendations.
- It is never acceptable to use two out of three results for a subtype determination. If there are any discrepant results, then only primary type can be used for allocation.
- There are no standards for how laboratories should report ABO subtypes. The International Society for Blood Transfusion Committee on Terminology for Red Cell Surface Antigens has created a standardized numerical format for reporting red cell subtypes, but this is not suitable for everyday communication. Popular terminology often uses terms: $A_1$, $A_2$, $A_1B$, and $A_2B$. OPTN policies use the term non-$A_1$ for any subtype that is not $A_1$.
- You must not use subtype results for organ allocation when:
    - The results do not match or indicate the same result. It is never acceptable to use two out of three results. If one result is different, then only primary type must be reported and used for allocation.
    - Pre-RBC transfusion specimens are not available for initial and/or confirmatory testing of subtyping.
    - Testing determines the presence or absence of the $A_1$ antigen only. It does not determine the actual sub-group. Typing is either positive for $A_1$ or negative for $A_1$ – hence the subgroup labeled A, non-$A_1$.
- Patients should not be labeled $A_2$- absence of $A_1$ as it does not equal $A_2$ due to the existence of multiple subgroups.

# What is required by OPTN Policy?

The OPTN has several policies that allow the transplantation of donors who have a non-$A_1$ subtype into blood type B candidates. These policies include:

- *Policy 9.7.B: Points Assigned by Blood Type*
- *Policy 8.5.D: Allocation of Kidneys by Blood Type*
- *Policy 13.7: OPTN KPD Screening Criteria*

## Requirements for Blood Type Determination

Clinical policies and information about how to perform these transplants are determined by the transplant program. When these types of transplants are planned, the OPTN has policies about how to determine a subtype for a deceased donor (*Policy 2.6.B: Deceased Donor Blood Subtype Determination*) or a living donor (*Policy 14.5.B: Living Donor Blood Subtype Determination*). OPTN policies mandate that all deceased and living donors, as well as candidates, be blood typed on two separate occasions, and these rules apply to subtyping as well. By definition, this means the blood must:

1. Be drawn on two separate occasions
2. Have different collection times
3. Be submitted as separate samples
4. Have results indicating the same blood type

## Requirements for Blood Subtype Determination

If testing determines that a deceased donor's primary blood type is A, then you must also subtype that donor. The only exception to this rule is when no blood samples are available before the donor is given red blood cell (RBC) products. Subtyping is optional for living donors and blood type AB deceased donors. If the donor is found to be blood type A, non-$A_1$ a second subtype must be drawn (different draw time, different draw occasion) for confirmation. It is important to note that:

*All subtyping for deceased or living donors must be completed before the donor receives any red blood cell transfusions.*

# What is a Subtype?

We are all familiar with the blood types (also called blood groups) A, B, O and AB.

Enzymes that add sugars to form either the group A or the group B antigens determine the blood type. Individuals who are blood type O lack the enzyme to add those sugars and have an H precursor substance that gives them their O blood type. You can find blood group antigens on many cells, including RBCs and cells inside blood vessels of all vascular organs that are routinely transplanted. The reason these blood group antigens are clinically important in transplantation and blood transfusion is that individuals have naturally occurring antibodies to blood group antigens they do not have. Those antibodies are termed isoagglutinins. Isoagglutinins are antibodies that can react with the blood group antigens on the cells of the organ being transplanted. For instance, blood type O individuals have A and B isoagglutinins, blood type B individuals have A, blood type A individuals have B, and blood type AB individuals have no isoagglutinins.

When an incompatible transplantation takes place, such as transplanting a blood type B organ into a blood type O individual, that organ would likely be rejected immediately. The rejection occurs because the B isoagglutinins in the blood type O patient react with the B antigens on the vessels of the transplanted organ.

Eighty percent of blood group A and AB persons are subtype $A_1$ and $A_1B$, respectively. The other 20% of these blood groups are subtype A- non-$A_1$. Most often the subtype is $A_2$ (or $A_2B$), but occasionally it may be a more rare subtype like $A_3$, $A_{int}$, etc. Blood group A, non-$A_1$ individuals express only about 20% of the normal level of group A antigen on their RBCs and organs. $A_1$ subtyping is not routinely performed in compatibility testing; however, some patients and donors may be identified as A, non-$A_1$ or AB, non-$A_1B$

in the course of routine blood bank typing because they have anti-$A_1$ antibody in their plasma (1-8% of group, non-$A_1$, 25% of group "AB, non-$A_1$B" persons[1].

## Key Points:

- Persons who are in blood groups A and AB (meaning that their primary blood type is A or AB, respectively) can be further tested to determine a more specific subtype (also known as a subtype).
- Subtypes (or subtypes) for blood type A include $A_1$, $A_2$, $A_x$, $A_{int}$ and others, but the most common is $A_1$.
- If the donor is **not** subtype $A_1$, it means they have less A antigen on their RBCs and organs, which allows them to donate to recipients outside of their primary blood type.
- OPTN policies refer to all subtypes that are not $A_1$ as non-$A_1$. Therefore, a donor who is primary blood type A and subtyping results show that the donor does not have the $A_1$ subtype is referred to as having blood type A, non-$A_1$.

# Why does it matter?

An ABO subgroup ($A_1$ vs. A, non-$A_1$) allows organs to be allocated to additional recipients for both deceased and living donor transplants. A person who is primary blood type A normally could not donate their organ to a candidate who is blood type B. If the person who is blood type A also has a non-A[1] subtype, then they could possibly donate a kidney to a person who is primary blood type B (or O) depending on other factors.

## When should we use and not use subtyping results for allocation?

Subtyping results can only be used when both samples were obtained before any RBC transfusions, and subtype testing results (both initial and confirmatory) are clear, valid, and match each other. You must not use subtype testing if you question the validity or interrelation of the ABO subgroup testing results or if pre-transfusion specimens are not available for both initial and confirmatory subtyping testing. In these situations, the safest approach is to allocate the organs based on the donor's primary blood type only. It is against OPTN policy to use two out of three results if even one of the results does not indicate the same subtype.

## What can interfere with test results?

If a donor recently received an RBC transfusion, the $A_1$ subtyping result may be inaccurate and therefore you should obtain all subtyping samples before RBC transfusions occur. Plasma and platelet transfusions do not affect RBC typing results.

For example, if you gave an organ donor an emergency blood group O RBC transfusion before you collected the subtyping specimen, then the $A_1$ typing could be inaccurate. Experiments with *in-vitro* mixtures of blood group O and $A_1$ RBCs suggest that $A_1$ typing could become falsely negative if more than 75% of the RBCs are group O[2]. Since it is difficult to estimate precisely how many units of group O RBCs need to be given to effect the efficacy of the test (as this depends on the patient's size, amount and rate of blood loss, timing of the transfusions and intravascular volume status) you must obtain all samples before RBC transfusion.

In the event that the potential donor received a RBC transfusion in the past (as opposed to the current hospitalization), then OPOs and transplant hospitals must determine the time, if any, since transfusion that they consider safe to perform subgroup testing. Currently no data identifies how many group A RBC transfusions it may take to change the subtyping result from non-$A_1$ ($A_1$ negative) to $A_1$. Transfused RBCs have a half-life of 30 days and the "youngest" RBCs in the blood bag would circulate for up to 120 days.

[1] John Roback et al., eds., AABB Technical Manual 17th edition (Bethesda, MD: AABB, 2008).
[2] Glenn Ramsey et al., "Abstract Presentations from the AABB Annual Meeting and CTTXPO, Baltimore, MD, October 9-12, 2010," Transfusion 50 (2010): 168A.

## Infants and Neonates

Neonates and infants do not fully express their ABO antigens. Manufacturers of anti-$A_1$ lectin also have varying warnings in their package inserts such as "results should be interpreted with caution in infants less than one year of age." Umbilical cord blood is another consideration for neonates and it is generally recommended that you not use cord blood cells to determine primary ABO or subtype. OPO and transplant programs should consult with their blood banks to consider this issue and adjust practices accordingly.

## Key Points:

- Perform subgroup typing before the donor receives RBC products or transfusions.
- ***Any*** blood transfusion can affect the accuracy of the results despite the donor's hemodilution status.
- OPOs and transplant hospitals should consult with their blood banks to consider special issues (such as RBC transfusion and neonates) and follow their recommendations.
- It is never acceptable to use two out of three results for a subtype determination. If there are any discrepant results, then only primary type can be used for allocation.

# What do the results say?

The wide range of terminologies used by blood banks and manufacturers to describe subtyping results is confusing. It is particularly confusing when transplant programs or OPOs need to identify the accurate subtyping for transplant compatibility. As we mentioned earlier, the actual subtype test looks for whether a blood group A or AB donor's RBCs react with anti-$A_1$ lectin. The following tables provide subtype terminology used by the OPTN, along with synonymous terms that you may also see on typing results.

**Blood Group A Subtype Reporting Terminology:**

| **OPTN** | $A_1$ | A, non-$A_1$ |
|---|---|---|
| **Other terms used** | $A_1$ positive | $A_1$ negative |
| | $A_1$ reactive | Non $A_1$ |
| | - | $A_2$ |

**Blood Group AB Subtype Reporting Terminology:**

| **OPTN** | $A_1B$ | AB- non-$A_1B$ |
|---|---|---|
| **Other terms used** | AB-$A_1$ positive | AB- $A_1$ negative |
| | AB-$A_1$ reactive | AB- $A_1$ non-reactive |
| | | $A_2B$ |

## Key Points:

- There are no standards for how laboratories should report ABO subtypes. The International Society for Blood Transfusion Committee on Terminology for Red Cell Surface Antigens has created a standardized numerical format for reporting red cell subtypes, but this is not suitable for everyday communication. Popular terminology often uses terms: $A_1$, $A_2$, $A_1B$, and $A_2B$. OPTN policies use the term non-$A_1$ for any subtype that is not $A_1$.
- You must not use subtype results for organ allocation when:

1. The results do not match or indicate the same result. It is never acceptable to use two out of three results. If one result is different, then only primary type must be reported and used for allocation.
2. Pre-RBC transfusion specimens are not available for initial and/or confirmatory testing of subtyping.

# Common issues in subtype reporting:

- Unclear or discordant subtyping results.
- You do not know the time of the last transfusion.

## What should I do when I am not sure how to report results?

A patient's age, transfusion status, and testing methods of the laboratory can all affect the efficacy of the test. If you have questions about how to interpret subtyping results or whether testing was performed accurately, your safest approach is to report and allocate the organs based on the donor's primary blood type and not to consider subtyping. For all blood type A donors, the host OPO must document either that subtyping was completed or the reason it could not be completed.

## More technical information about subtyping

Determination of a donor's $A_1$ RBC subtype is performed with Anti-$A_1$ lectin, an FDA- approved test reagent. Lectins are non-antibody proteins, which bind with high specificity to a particular carbohydrate structure. Anti-$A_1$ lectin is extracted from the lentil-like seeds of the plant Dolichus biflorus (horse gram). Anti-$A_1$ lectin binds to the $A_1$ carbohydrate and agglutinates $A_1$ or $A_1B$ RBCs in a suspension. When group A or AB RBCs are not agglutinated by anti-$A_1$ lectin, the RBCs are negative for $A_1$.

Strictly speaking, there is no (non-DNA) test for the $A_2$ antigen— only a test for whether the $A_1$ antigen is present or not. Therefore, when a blood group A donor does not test positive for $A_1$ it is called an A, non-$A_1$. Other group A variants exist. One group A variant called $A_{int}$ (intermediate) is partway between $A_1$ and $A_2$ in strength and can give weak reactions in $A_1$ typing. $A_{int}$ is found most often in blood group A African-Americans (5-8%). All of the other group A variants, such as $A_3$, $A_{end}$, and $A_x$, are rarely seen (<1:1000 group A persons) and are much weaker in expression overall than group A-non-$A_1$, and therefore presumably would be equivalent to $A_2$ for organ-transplant purposes. Laboratories using anti-$A_1$ lectin should follow the manufacturer's directions carefully.

From the perspective of transplant safety when using A, non-$A_1$ organs, any RBC reaction with anti-$A_1$ lectin, when performed according to the manufacturer's directions, should be regarded as $A_1$-reactive by the transplant program, unless proven otherwise.

## Key Points:

- Testing determines the presence or absence of the $A_1$ antigen only. It does not determine the actual sub-group. Typing is either positive for $A_1$ or negative for $A_1$ – hence the subgroup labeled A, non-$A_1$.
- Patients should not be labeled $A_2$- absence of $A_1$ as it does not equal $A_2$ due to the existence of multiple subgroups.

# Who can help?

Your local blood bank is a great resource. OPOs and transplant programs should establish a relationship with them as they can advise on protocol development and answer questions. Other national groups such as the American Association of Blood Banks (AABB) (http://www.aabb.org/Pages/default.aspx) have additional resources.

# Resources to learn more

- UNOS Connect, the location for all your transplant education materials, is available at: https://unosconnect.unos.org/

Two courses are available on UNOS Connect that relate to subtyping:

1. ABO Subtyping (SFT 116)
2. ABO Typing and Subtyping (SYS104)

- OPTN/UNOS "Guidance for Transplant Program Participation in the Transplantation of Non-A1/Non-A1B (A2/A2B) Donor Kidneys into Blood Group B Candidates" is available at: https://optn.transplant.hrsa.gov/resources/guidance/
- You can also find resources organized by specific organ types:
  - Kidney and pancreas
  - Liver and intestine
  - Heart and lung
  - Vascularized composite allograft

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