OPTN

Briefing to the OPTN Board of Directors on

Human Leukocyte Antigen (HLA) Equivalency Tables Update 2020 (Including Expedited Pathway for Future Updates)

OPTN Histocompatibility Committee

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Human Leukocyte Antigen (HLA) Equivalency Tables Update 2020 (Including Expedited Pathway for Future Updates)

Affected Policies:	*4.9: HLA Antigen Values and Split Equivalences* *4.10: Reference Tables of HLA Antigen Values and Split Equivalences*
Sponsoring Committee:	*Histocompatibility*
Public Comment Period:	*January 22, 2020 – March 24, 2020*
Board of Directors Date:	*June 8, 2020*

Executive Summary

OPTN *Policy 4.9: HLA Antigen Values and Split Equivalences* requires the OPTN Histocompatibility Committee (Committee) to review HLA equivalency tables listed in OPTN *Policy 4.10: Reference Tables of HLA Antigen Values and Split Equivalences* on an annual basis and recommend any changes needed on or before June 1st of each year. The OPTN Board of Directors (Board) approved the most recent recommended table update in December 2017 with implementation following in December 2018. During their 2019 annual review, the Committee identified changes (additions and deletions) that needed to be made to better ensure safety and accuracy in matching donors with transplant candidates.

To improve the expediency of identifying and making routine HLA table changes, the Committee also proposes using an expedited policy making pathway outlined in OPTN *Bylaws Article XI, Section 11.8: Expedited Actions* for future updates.

Background

OPTN Policy 4.9: HLA Antigen Values and Split Equivalences requires the OPTN Histocompatibility Committee hereafter (The Committee) to review HLA equivalency tables listed in OPTN Policy 4.10: Reference Tables of HLA Antigen Values and Split Equivalences on an annual basis and recommend any changes needed on or before June 1st of each year. During the 2019 annual HLA equivalency tables review the committee identified changes to be made based on current nomenclature, clinical practice, and testing abilities. The OPTN Board of Directors approved the most recent recommended table update in December 2017.

Purpose

The Committee conducted their required annual review of the HLA equivalency tables and identified the following four areas of change:

1. Review and update the current HLA equivalency tables (Tables 4-2 through 4-15) to be more consistent with current nomenclature and account for changes in available testing reagents that may impact testing.
2. Refine OPTN *Policy 4: Histocompatibility, Table 4-14: HLA DPB1 Unacceptable Antigen Equivalences* due to its lengthy nature and, in its place, create an adapted table that would cover 99.9% of the relevant DPB1 antigens and correct current discrepancies.
3. Include an option for assigning unacceptable antigens (UA) for DPB1 using epitopes in policy. An epitope is a molecular region on the surface of an antigen capable of eliciting an immune response from B cells and of combining with the specific antibody produced by such a response. It incorporates the information about the conformation of transcribed proteins while HLA typing is the genetic sequencing of DNA encoding HLA gene.[1] The Committee recommends inclusion of this highly specified type of matching to keep with advancing technology/ terminology.
4. Shorten the length of time for routine table updates through inclusion of the Expedited Actions pathway outlined in OPTN *Bylaws Article XI, Section 11.8: Expedited Actions*.

The Committee submits the following proposal for the Board consideration under the authority of the National Organ Transplantation Act, which states, "The Organ Procurement and Transplantation Network shall… (A) establish… (ii) a national system… to match organs and individuals included in the list, especially individuals whose immune system makes it difficult for them to receive organs…"[2] The Committee also submits the following proposal for the Board consideration under the authority of the OPTN Final Rule, which states "The OPTN Board of Directors shall be responsible for developing…policies for the equitable allocation for cadaveric organs."[3]

Public Comment Sentiment and Themes

This proposal was released for public comment from January 22, 2020 to March 24, 2020. During that time, it received 33 individual comments. Figure 1 shows the overall sentiment by member type for the public comment proposal. It was strongly supported across all member types, with no votes in opposition. The strongest support for the proposal by member type was Histocompatibility labs.

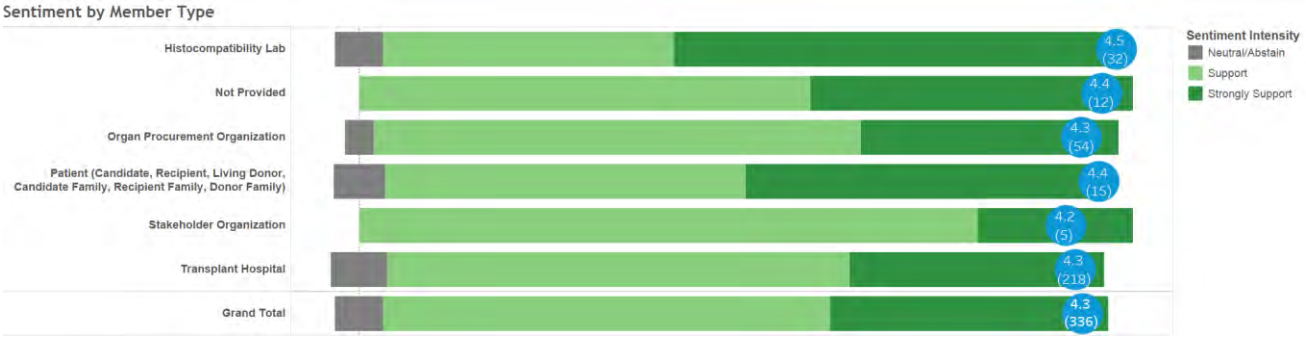
[1] Larkins, Nicholas G, Germaine Wong, Anne Taverniti, and Wai H Lim. 2019. "Epitope Matching in Kidney Transplantation: Recent Advances and Current Limitations." *Current Opinion in Organ Transplantation* 24 (4): 370–77. https://doi.org/10.1097/MOT.0000000000000657.

[2] 42 USC 274(b)(2)(A)(ii).

[3] CFR §121.8(a).

Histocompatibility labs scored 4.5/5 on the Likert sentiment scale, with 32 out of the total 336 participants.

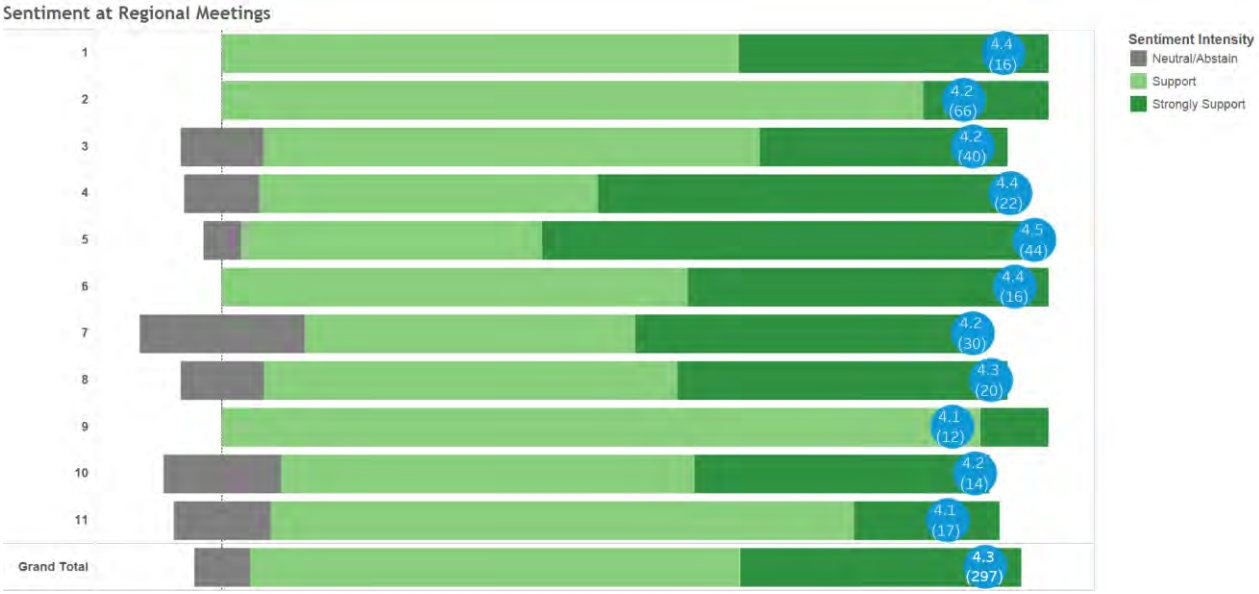
Figure 1: Sentiment by Member Type[4]



Regional Sentiment

This proposal was on the consent agenda in all 11 regions, and as such received no comments at the regional meetings. The overall sentiment for consent agenda items from OPTN regional meetings was supportive, with no votes in opposition. Regions 9, 10, and 11 were changed to virtual meetings due to the COVID-19 pandemic. Figure 2 shows a breakdown of sentiment by region at the regional meetings.

Figure 2: Sentiment by Region[5]



[4] Sentiment is reported by the participant using a 5-point Likert scale (1-5 representing Strongly Oppose to Strongly Support). Sentiment by member type includes all comments regardless of source (regional meeting, committee meeting, online, fax, etc.) The circles after each bar indicate the average sentiment score and the number of participants is in the parentheses.

[5] Sentiment is reported by the participant using a 5-point Likert scale (1-5 representing Strongly Oppose to Strongly Support). Sentiment for regional meetings only includes attendees at that regional meeting. Region 6 uses the average score for each institution. The circles after each bar indicate the average sentiment score and the number of participants is in the parentheses.

OPTN Committee Sentiment

The Histocompatibility Committee presented the proposal to two OPTN committees for consideration during the public comment period. The OPTN Operations and Safety Committee voted: 46% Strongly Support and 54% Support. The OPTN Kidney Transplantation Committee voted strongly in support, with 55% of members strongly in support and 45% of members in support. Neither committee gave additional input or comments for consideration.

Stakeholder Organization Sentiment

Four external stakeholder organizations commented on the proposal. These organizations were American Society for Histocompatibility and Immunogenetics (ASHI), American Nephrology Nurses Association (ANNA), American Society of Transplant Surgeons (ASTS), and American Society of Transplantation (AST). All organizations commented in support.

American Society for Histocompatibility and Immunogenetics (ASHI)

ASHI was identified as a major stakeholder early in the policy development process. ASHI is an international society that accredits histocompatibility labs. They commented in support of every aspect of the proposal. They also commented that they would recommend monitoring of the use of HLA epitope-based unacceptable antigen assignment for frequency of use and its effect on crossmatch outcomes.

Themes in Public Comment

Additional Alleles or Epitopes to Consider

Five commenters suggested additional alleles or epitopes for the Committee to consider adding to the tables. The Committee went through an extensive review process when deciding the current values, and had chosen the DPB1 epitopes for their immunological significance.[6] Since laboratories have not used epitopes for clinical applications before, the Committee wanted to start with a limited cohort and collect data on utilization before introducing a larger number of epitopes. The Committee also reviewed every proposed allele. DPB1*99:01 will be added to the proposal following public comment, but the Committee did not choose to add any of the other proposed alleles as there is no current evidence of their clinical significance in solid organ donation.

Alternative DPB1 Grouping

Three commenters suggested alternative DPB1 grouping structures. The Committee based the grouping structures on the most immunodominant epitopes on the DP molecules.[7] As the proposal contains the most clinically significant grouping structures to solid organ donation, the Committee felt that they should remain as proposed.

[6] Cano, Pedro, and Marcelo Fernandez-Vina. 2009. "Two Sequence Dimorphisms of DPB1 Define the Immunodominant Serologic Epitopes of HLA-DP." *Human Immunology* 70 (July): 836–43. https://doi.org/10.1016/j.humimm.2009.07.011.
[7] Id.

Addition of DPA1

Three commenters suggesting DPA1 to the equivalency tables update. Currently, HLA-DPA1 typing is not required for donors, and would require a change to OPTN *Policy 4.3.A: Deceased Donor HLA Typing*. The best utility of resources would be to include unacceptable antigens to the tables at the same time that DPA1 typing can be added to all deceased donors. This falls outside of the scope of this equivalency tables update, but the addition can be pursued as a separate policy action in the future.

P vs. G Grouping for Alleles

Four commenters suggested P grouping instead of G grouping for DPB1 alleles. This was addressed in the 2016 HLA Equivalency Tables review. In 2016 the Committee believed that using the P group would mean that laboratories would be required to rule out all null alleles. Since the G group includes the nulls, the Committee decided to keep the G group alleles in the equivalency table. The Committee discussed this again, and the comments offered during this round of public comment, but discussion resulted in the same conclusion.

Nomenclature

Three commenters suggested an alternative nomenclature be used. The Committee has researched the matter, and there is confusion in the field of histocompatibility as whether to use the term eplet or epitope when referring to immunogenic polymorphic amino acid residues appearing on multiple loci. The Committee believes that epitope more closely matches the proposed residues being used, and will keep the proposed term.

Proposal for Board Consideration

In 2019, a subcommittee comprised of histocompatibility experts was formed to conduct the table review. The subcommittee reviewed all existing tables and recommended deletions of values that are no longer appropriate, as well as necessary additions identified by updates in HLA nomenclature and HLA testing reagents. Proposed changes were also made to align the tables with the Immuno Polymorphism Database-International ImMunoGeneTics (IPD-IMGT) HLA Database project. The IPD-IMGT/HLA database is a repository for sequences of the human major histocompatibility complex (MHC). The database includes official sequences named by the World Health Organization (WHO) Nomenclature Committee for Factors of the HLA System and currently utilizes the 2010 naming convention for HLA alleles.[8] This database is updated several times each year. HLA value changes in this proposal use version 3.37.0 released in July 2019.[9]

Updates are proposed for tables presenting matching antigen equivalences for HLA B and DR (DRB1) loci. Other changes are offered for UA and donor equivalences for HLA B, C, DR, and DQB1 tables. The subcommittee proposed more significant revisions to several DPB1 UA equivalency table and the addition of a table to facilitate epitope-based assignment of DPB1 UAs and list all DPB1 alleles for use in programming. The full Committee agreed with these recommendations and voted to send the proposed changes to the Board for consideration.

[8] https://www.ebi.ac.uk/ipd/imgt/hla/

[9] https://www.ebi.ac.uk/ipd/imgt/hla/docs/version_r3370.html

DPB1 table Modifications

The subcommittee proposed changes to table structures for DPB1 values including:

1. Shortening the current Table 4-14: DPB1 HLA Unacceptable Antigen equivalence table
2. Adding an additional table for all DPB1 values that are able to be reported as candidate or donor HLA
3. Creating a table for epitope-based UA assignment for DPB1 loci

Shortening the current table for DPB1 HLA UA equivalences is proposed as the current table has over 660 values spanning over fifteen pages, with the vast majority of listed equivalences only equivalent to the value itself. The table in its current format is difficult to use and would continue to increase in length as new DPB1 alleles are identified. The subcommittee evaluated frequencies of reported DPB1 donor antigens and recommended a truncated table that would include 99.9% of DPB1 values reported in donor typing. Policy language has been updated to reflect that any DPB1 allele not represented in the UA equivalency Table 4-14 is only equivalent to its own value.

An additional table was constructed to account for all DPB1 alleles that may be reported. The Committee chose to include valid potential reportable DPB1 values up through 1036:01 (as of IMGT-HLA release 3.37). The formatting of the DPB1 table is updated for ease of use.

Epitope-based unacceptable antigen assignment for DPB1 loci

The proposed model of epitope-based assignment of unacceptable antigens would allow members to select a particular DPB1 epitope as unacceptable and UNet^{SM} would then eliminate all equivalent DPB1 antigens that possess the selected epitope based on donor DPB1 typing, rather than individually eliminate hundreds of antigens by hand. Epitope-based assignment of UA was previously proposed in the 2016 review of the HLA equivalency tables as an additional method to select UA based on common epitope reactivity. However, this was not pursued at the time due to time constraints, possible community pushback, and lack of literature regarding epitopes' assignment. With the greater recognition and acceptance for the use of epitopes in the histocompatibility field, the Committee feels that this is an opportune time to include this method of assigning UA. The introduction of epitope-based assignment of UA is focused on one locus (DPB1) at this time. The basis for assigning UA based on epitope reactivity already exists in current policy for assigning unacceptable HLA-B antigens based on association with the Bw4 or Bw6 epitopes.

Expedited Actions

Another aspect of this proposal is to change the process by which future updates to the HLA equivalency tables are developed and approved. In July 2015, the OPTN Board of Directors approved a change to the Bylaws to allow for Expedited Actions to approve non-controversial actions.[10] When developing this pathway, the Executive Committee specifically discussed its potential application to the HLA equivalency tables.

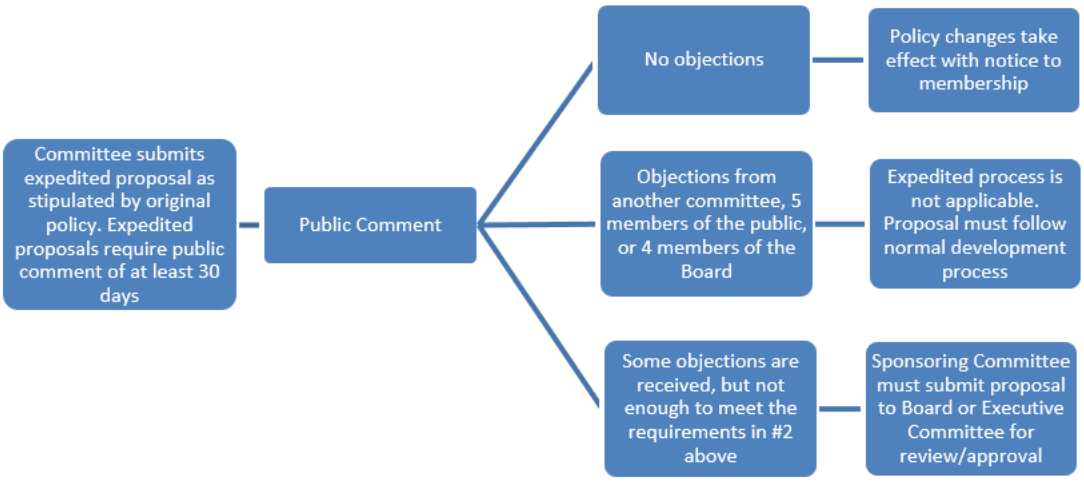
[10] Alcorn, James, "Changes to OPTN Bylaws and Policies from actions at June 2015 Board of Directors Meeting" (July 1, 2015), available at https://www.transplantpro.org/wp-content/uploads/sites/3/Policy_Notice_07-2015.pdf?a3c8d8. See "OPTN Policy Development Process Explanatory Document" for a description of the expedited pathway, available at: https://optn.transplant.hrsa.gov/media/3115/optn-policy-development-process-explanatory-document.pdf.

Utilizing the expedited pathway still requires public comment, although the public comment period can be shorter than typical public comment. Figure 3 below, provides an overview of this pathway, per OPTN *Bylaws Article XI, Section 11.8: Expedited Actions*. If approved, the pathway would allow the proposal to be approved and implemented faster than traditional OPTN policy development process as long as little opposition is raised during the public comment period. If concerns are raised, then the proposal will follow the regular OPTN policy development pathway. This current proposal itself will not follow the expedited pathway; instead, it is step one in identifying the HLA equivalency tables as eligible for the expedited pathway in the future. Identification of HLA equivalency tables as a policy item that can be amended potentially using the Expedited Action pathway must be approved by the Board before subsequent proposals could use this process.

Figure 3: Expedited Pathway

Step 1: Identify Policy as Eligible for Expedited Pathway

Step 2: Make Changes Using the Expedited pathways



The HLA equivalency tables have traditionally been non-controversial. In regional meetings, these proposals have typically been on consent agendas. Two of the last three equivalence table updates were on the non-discussion agendas for regional meetings. The 2013 update was a discussion agenda due to changes to OPTN *Bylaws: Appendix C* as part of that proposal, not due to the equivalence tables. The table changes were unanimously supported by the regions in 2013 as well. Every public comment has been supportive. All three of the last three table update proposals were placed on the consent agenda at Board meetings due to their non-controversial nature, and were all passed by the Board as well. Table 1, below, outlines the last three HLA reviews and shows that each has been on the consent agenda when passed by the Board. The most frequent stakeholders commenting on these proposals have been American Society for Histocompatibility and Immunogenetics (ASHI) and College of American

Pathologists (CAP). The Committee will continue to do outreach to key stakeholders for their input and comments.

Table 1: Summary of Previous HLA Table Review Proposals

Proposal Title	Regional Meeting Agendas	Board Agenda
Review of HLA Tables (2016)	Non-discussion	12/2016 - Consent
Update to the Human Leukocyte Antigens (HLA) Equivalency Tables (2015)	Non-discussion	12/2015 - Consent
Changes to the HLA Equivalency Tables (2013)	Discussion agenda	11/2013 - Consent

NOTA and Final Rule Analysis

The Committee submits the following proposal for the Board consideration under the authority of the National Organ Transplantation Act, which states, "The Organ Procurement and Transplantation Network shall… (A) establish… (ii) a national system… to match organs and individuals included in the list, especially individuals whose immune system makes it difficult for them to receive organs…"[11] The Committee also submits the following proposal for the Board consideration under the authority of the OPTN Final Rule, which states "The OPTN Board of Directors shall be responsible for developing…policies for the equitable allocation for cadaveric organs."[12]

The Final Rule requires that when developing policies for the equitable allocation of cadaveric organs, such policies must be developed "in accordance with §121.8," which requires that allocation policies "(1) Shall be based on sound medical judgment; (2) Shall seek to achieve the best use of donated organs; (3) Shall preserve the ability of a transplant program to decline an offer of an organ or not to use the organ for the potential recipient in accordance with §121.7(b)(4)(d) and (e); (4) Shall be specific for each organ type or combination of organ types to be transplanted into a transplant candidate; (5) Shall be designed to avoid wasting organs, to avoid futile transplants, to promote patient access to transplantation, and to promote the efficient management of organ placement;…(8) Shall not be based on the candidate's place of residence or place of listing, except to the extent required by paragraphs (a)(1)-(5) of this section." This proposal:

- **Is based on sound medical judgment**[13] because it is an evidenced-based change relying on the following evidence:
    - Proposed changes were made to align the tables with the Immuno Polymorphism Database-International ImMunoGeneTics (IPD-IMGT) HLA Database project. The IPD-IMGT/HLA database is a repository for sequences of the human major histocompatibility complex (MHC). This database is updated several times each year. HLA value changes in this proposal use version 3.37.0 released in July 2019.
- **Is designed to avoid futile transplants**[14]**:** This proposal should not result in transplanting patients that are unlikely to have good post-transplant outcomes.

[11] 42 USC 274(b)(2)(A)(ii).
[12] CFR §121.8(a).
[13] CFR §121.8(a)(1).
[14] Id.

    - Proposed changes help to increase accuracy of HLA matching, allowing centers to better avoid transplants into patients that would not have good post-transplant outcomes.
- **Is designed to…promote patient access to transplantation[15] by** giving similarly situated candidates equitable opportunities to receive an organ offer.
    - Proposed changes help to characterize sensitized patients as accurately as possible, helping allow proper access to donated organs.
- **Is not based on a candidate's place of residence or place of listing except to the extent required by other regulatory requirements.[16]**

Although the proposal outlined in this briefing paper addresses certain aspects of the Final Rule listed above, the Committee does not expect impacts on the following aspects of the Final Rule:

- **Seeks to achieve the best use of donated organs[17] by** ensuring organs are allocated and transplanted according to medical urgency.
- **Is designed to avoid wasting organs[18] by** decreasing the number of organs recovered but not transplanted
- **Promotes the efficient management of organ placement[19] by** taking into account factors including the costs and logistics of procuring and transplanting organs.

The OPTN Final Rule also requires the OPTN to consider **"whether to adopt transition procedures that would treat people on the waiting list and awaiting transplantation prior to the adoption or effective date of the revised policies no less favorably than they would have been treated under the previous policies."[20]** Upon consideration of whether there would be any populations treated less favorably, it was determined that the proposed changes will not affect any patient population more or less favorably when receiving organ offers. This is because the only changes to matching equivalences were made to keep the tables current with nomenclature, and will not alter the way in which matches are determined. Therefore, it is not recommended that the Board adopt any transition procedures for this proposal.

Alignment with OPTN Strategic Plan[21]

1. *Improve waitlisted patient, living donor, and transplant recipient outcomes:*
   The increased specificity with the addition of epitopes and other alleles will improve outcomes by providing members with more allele specific equivalences, which will improve organ survival, especially for sensitized candidates.

2. *Promote the efficient management of the OPTN:*
   Utilizing the expedited pathway for policy actions will promote efficient management by reducing the time and effort required for routine updates of the HLA equivalency tables.

[15] Id.
[16] CFR §121.8(a)(8).
[17] CFR §121.8(a)(2).
[18] CFR §121.8(a)(5).
[19] Id.
[20] 42 CFR §121.8(d).
[21] For more information on the goals of the OPTN Strategic Plan, visit https://optn.transplant.hrsa.gov/governance/strategic-plan/.

Implementation Considerations

Member and OPTN Operations

Operations affecting Histocompatibility Laboratories

Histocompatibility laboratories will need to be prepared to answer questions from transplant community members regarding value changes, including epitope-based UA reporting availability.

Lab informatics systems (LIS) will require updating to accommodate reporting of new values including DPB1 epitopes and update electronic data transfer programs for interfaces between LIS to UNet^{SM}. Histocompatibility laboratories will have the option to report UAs based on epitopes instead of individually, likely leading to less time-intensive clinical data entry after initial training and adjustment.

Operations affecting the OPTN

This proposal will require additional programming in UNet^{SM}. UNOS IT will need to add new antigens and equivalences and also remove some values in UNet^{SM}. IT will also need to program epitope level reporting. UNOS will distribute a Policy Notice to inform members of any policy changes resulting from this proposal upon the completion of the necessary programming changes, prior to implementation.

Operations affecting Organ Procurement Organizations

OPOs may need to evaluate their agreements with histocompatibility laboratories to accommodate any needed transactional changes related to the proposal changes.

For OPOs that use third party vendors to input HLA information into UNet^{SM}, their vendors will have to update their programs to reflect the changes in this proposal.

Operations affecting Transplant Hospitals

Transplant hospital staff may require training to understand epitope-based UAs. These will be reported in a consistent manner as UA determinations currently, and the burden of interpretation of results lies with histocompatibility labs, so this is expected to cause minimal impact.

Projected Fiscal Impact

Projected Impact on Histocompatibility Laboratories

Minimal costs for laboratory programming updates may be necessary, but implementation is possible as soon as laboratory updates are complete. Updates to the tables will lead to overall laboratory efficiency, reducing human error and staff time in virtual crossmatch review. It will provide greater efficiency in organ allocation decision making.

Projected Impact on the OPTN

Policy and Community Relations (PCR) hosted a subcommittee to develop proposed changes to the HLA equivalency tables. PCR staff worked with cross-department UNOS staff to prepare the proposal for public comment, and incorporate changes to the proposal based on the Committee's decisions following public comment.

A Medium IT implementation effort, estimated at 700 hours, includes the addition and removal of HLA equivalencies, as well as DPB1 epitope addition and testing. The effort will require an architectural change to DPB1 to accommodate the use of epitopes. Additionally, these changes will require significant resources by IT and Research in testing to ensure accuracy of HLA Equivalencies as errors may pose risk for patient safety.

Research and IT anticipate a low-complexity effort in routine monitoring. Member Quality does not anticipate any change to their current monitoring.

Projected Impact on Organ Procurement Organizations

This proposal is not anticipated to have any fiscal impact on Organ Procurement Organizations

Projected Impact on Transplant Hospitals

This proposal is not anticipated to have any fiscal impact on Transplant Hospitals.

Post-implementation Monitoring

Member Compliance

The Final Rule requires that allocation policies "include appropriate procedures to promote and review compliance including, to the extent appropriate, prospective and retrospective reviews of each transplant program's application of the policies to patients listed or proposed to be listed at the program."[22]

The proposed language will not change the current routine monitoring of OPTN members. Any data entered in UNet^{SM} may be reviewed by the OPTN, and members are required to provide documentation as requested.

Policy Evaluation

The Final Rule requires that allocation policies "be reviewed periodically and revised as appropriate." The Committee will evaluate changes in CPRA values due to revisions of UA equivalences immediately after the implementation compared to values immediately prior to the implementation.

The Committee's hypothesis is that more accurate typing and the ability to better report these results in UNet^{SM} along with the revised UA equivalency tables will result in improved allocation due to more efficient virtual crossmatching. The following questions, and any others subsequently requested by the Committee, will guide the evaluation of the proposal after implementation:

1. Are members utilizing the new DPB1 epitopes when selecting unacceptable antigens?
2. Are members reporting the new donor HLA and unacceptable antigen values added during the table revision?
3. Has the number of organ offers refused due to a positive cross match changed after implementation?

[22] CFR §121.8(a)(7).

4. Was there a change in CPRA values among kidney, kidney-pancreas, and pancreas registrations on the waiting list?

The following metrics, and any others subsequently requested by the Committee, will be evaluated as data become available to compare performance before and after the implementation of this policy:

1. Deceased donor HLA typing frequencies
2. Changes in HLA and unacceptable antigen frequencies of kidney, kidney-pancreas and pancreas registrations on the waiting list
3. The number and percentage of offers refused due to a positive crossmatch
4. Usage of DPB1 epitope-based assignment of UA
5. Change in CPRA values for kidney, kidney-pancreas and pancreas registrations on the day of implementation:
    - Distribution of the difference in pre and post-implementation CPRA
    - The number of registrations for which the change in post-implementation CPRA values resulted in a change in the number of allocation points received
    - The distribution of the change in the number of allocation points received by registration as a result of the change in post-implementation CPRA values

The Committee expects to see utilization of antigens added to the equivalency tables as well as the new DPB1 epitopes. They also expect minor changes in CPRA values for some registrations due to inclusion of additional alleles.

These metrics will be evaluated at approximately one and two years' post-implementation.

Conclusion

The proposal contains four major parts:

1. Updating the HLA Equivalency tables
2. Refining the OPTN DPB1 antigen list
3. Adding DPB1 epitope-based assignment of unacceptable antigens
4. Allowing for expedited policy actions for future routine table updates

Overall, sentiment from public comment was highly supportive across all regions and voter types. Most proposed changes during the public comment period were based on clinical preference and had already been evaluated by the Committee when developing the proposal. The proposal will proceed as originally written, except for the addition of DPB1*99:01 to the equivalencies for 55AAE and 84GGPM in Table 4-15. Language for use of the expedited pathway was slightly refined for clarity.

Policy Language

Proposed new language is underlined (example) and language that is proposed for removal is struck through (~~example~~). Heading numbers, table and figure captions, and cross-references affected by the numbering of these policies will be updated as necessary.

4.9 HLA Antigen Values and Split Equivalences

HLA matching of ~~A, B, DR locus~~ antigens is based on the antigens which are listed in Policy 4.10: Reference Tables of HLA Antigen Values and Split Equivalences. The Histocompatibility Committee must review and recommend any changes needed to the tables ~~on or before June 1 of each year~~ on an annual basis. Changes to the tables in Policy 4.10 are eligible for future expedited updates pursuant to OPTN Bylaw 11.8: *Expedited Actions*. For matching purposes, split antigens not on this list will be indicated on the waiting list as the parent antigens and will match only with the corresponding parent antigens.

4.10 Reference Tables of HLA Antigen Values and Split Equivalences

Tables 4-2, 4-3, and *4-4* show candidate-donor antigen equivalencies and whether they are mismatches. For each candidate antigen, the donor antigens that are not mismatched are listed below. All other combinations are considered mismatches.

Examples of how "Matching Antigen Equivalences" works:

- If the candidate types as B70: only donors that type as B70 are considered matched. Donors typed as B71 or B72 are considered mismatched.
- If the candidate types as B71: only donors that type as B71, B15:10, or B15:18 are considered matched. Donors typed as B70 are considered mismatched.

Table 4-3: HLA B Matching Antigen Equivalences

Candidate B-Locus Antigen	Equivalent Donor Antigens
5	5
7	7, 07:02, 07:03, 07:14
07:02	07:02, 7
07:03	07:03, 7
07:14	07:14, 7
8	8, 08:01, 08:02, 08:03, 08:04
08:01	08:01, 8
08:02	08:02, 8
08:03	08:03, 8
08:04	08:04, 8
12	12
13	13, 13:01, 13:02
13:01	13:01, 13
13:02	13:02, 13
14	14
14:01	14:01, 64
14:02	14:02, 65

Candidate B-Locus Antigen	Equivalent Donor Antigens
15	15
15:01	15:01, 62
15:02	15:02, 75
15:03	15:03, 72
15:04	15:04, 62
15:06	15:06, 62
15:07	15:07, 62
15:10	15:10, 71
15:11	15:11, 75
15:12	15:12, 76
15:13	15:13, 77
15:16	15:16, 63
15:17	15:17, 63
15:18	15:18, 71
15:20	15:20, 62
15:21	15:21, 75
15:24	15:24~~, 62~~
15:27	15:27, 62
16	16
17	17
18	18
21	21
22	22
27	27, 27:03, 27:04, 27:05, 27:06~~, 27:08~~
27:03	27:03, 27
27:04	27:04, 27
27:05	27:05, 27
27:06	27:06, 27
27:08	27:08
35	35, 35:01, 35:02, 35:03 35:08, 35:12
35:01	35:01, 35
35:02	35:02, 35
35:03	35:03, 35
35:08	35:08, 35
35:12	35:12, 35
37	37
38	38, 38:01, 38:02
38:01	38:01, 38
38:02	38:02, 38
39	39, 39:01, 39:02, 39:04, 39:05, 39:06, 39:13
39:01	39:01, 39
39:02	39:02, 39
39:04	39:04, 39
39:05	39:05, 39
39:06	39:06, 39

Candidate B-Locus Antigen	Equivalent Donor Antigens
39:13	39:13, 39
40	40
40:01	40:01, 60
40:02	40:02, 61
40:03	40:03, 61
40:04	40:04, 61
40:05	40:05, 50
40:06	40:06, 61
41	41, 41:01, 41:02
41:01	41:01, 41
41:02	41:02, 41
42	42, 42:01, 42:02
42:01	42:01, 42
42:02	42:02, 42
44	44, 44:02, 44:03
44:02	44:02, 44
44:03	44:03, 44
45	45, 50:02
46	46
47	47
48	48, 48:01, 48:02
48:01	48:01, 48
48:02	48:02, 48
49	49
50	50, 50:01, ~~50:02,~~ 40:05
50:01	50:01, 50
50:02	50:02, 45
51	51, 51:01, 51:02
51:01	51:01, 51
51:02	51:02, 51
52	52
53	53
54	54
55	55, 55:01, 55:02, 55:04
55:01	55:01, 55
55:02	55:02, 55
55:04	55:04, 55
56	56, 56:01, 56:03
56:01	56:01, 56
56:03	56:03, 56
57	57, 57:01, 57:03
57:01	57:01, 57
57:03	57:03, 57
58	58
59	59

Candidate B-Locus Antigen	Equivalent Donor Antigens
60	60, 40:01
61	61, 40:02, 40:03, 40:04, 40:06
62	62, 15:01, 15:04, 15:06, 15:07, 15:20, 15:27
63	63, 15:16, 15:17
64	64, 14:01
65	65, 14:02
67	67
70	70
71	71, 15:10, 15:18
72	72, 15:03
73	73
75	75, 15:02, 15:11, 15:21
76	76, 15:12
77	77, 15:13
78	78
81	81
82	82
83:01	83:01

Table 4-4: HLA DR Matching Antigen Equivalences

Candidate DR-Locus Antigen	Equivalent Donor Antigens
1	1, 01:01, 01:02
01:01	01:01, 1
01:02	01:02, 1
01:03	01:03, 103
2	2
3	3, 03:01, 03:02, 03:03
03:01	03:01, 17
03:02	03:02, 18
03:03	03:03, 18
4	4, 04:01, 04:02, 04:03, 04:04, 04:05, 04:06, 04:07, 04:10, 04:11
04:01	04:01, 4
04:02	04:02, 4
04:03	04:03, 4
04:04	04:04, 4
04:05	04:05, 4
04:06	04:06, 4
04:07	04:07, 4
04:10	04:10, 4
04:11	04:11, 4
5	5
6	6
7	7
8	8, 08:01, 08:02, 08:03, 08:07
08:01	08:01, 8

Candidate DR-Locus Antigen	Equivalent Donor Antigens
08:02	08:02, 8
08:03	08:03, 8
08:07	08:07, 8
9	9, 09:01, 09:02
09:01	09:01, 9
09:02	09:02, 9
10	10
11	11, 11:01,11:03, 11:04
11:01	11:01, 11
11:03	11:03, 11
11:04	11:04, 11
12	12, 12:01, 12:02
12:01	12:01, 12
12:02	12:02, 12
13	13, 13:01, 13:02, 13:03, 13:05
13:01	13:01, 13
13:02	13:02, 13
13:03	13:03, 13
13:05	13:05, 13
14	14, 14:01, 14:02, 14:03, 14:04, 14:05, 14:06, 14:54
14:01	14:01, 14, 14:54
14:02	14:02, 14
14:03	14:03, 14
14:04	14:04, 14
14:05	14:05, 14
14:06	14:06, 14
14:54	14:54, 14, 14:01
15	15, 15:01, 15:02, 15:03
15:01	15:01, 15
15:02	15:02, 15
15:03	15:03, 15
16	16, 16:01, 16:02
16:01	16:01, 16
16:02	16:02, 16
17	17, 03:01
18	18, 03:02, 03:03
103	103, 01:03

~~Tables 4-5, 4-6, 4-7, 4-8, 4-9, 4-10, 4-11, 4-12, 4-13, and 4-14 show candidate-donor unacceptable antigen combinations. For each candidate antigen, the donor antigens that are unacceptable are listed below. Table 4-15 shows additional unacceptable antigen equivalences to be used in the Calculated Panel Reactive Antibody (CPRA) only.~~

- Tables 4-5, 4-6, 4-7, 4-8, 4-9, 4-10, 4-11, 4-12, 4-13, and 4-14 show candidate-donor unacceptable antigen combinations. For each candidate antigen, the donor antigens that are unacceptable are listed below.
- Table 4-15 shows a candidate unacceptable epitopes for DPB1 and their corresponding donor HLA types.
- Table 4-16 shows the values that can be reported as valid DPB1 HLA typing.
- Table 4-17 shows additional unacceptable antigen equivalences to be used in the Calculated Panel Reactive Antibody (CPRA) only.

Examples of how "Unacceptable Antigen Equivalences" works:
If a candidate has B70 listed as an "unacceptable antigen", donors typed as B70, B71, B72, 15:03, 15:10, or 15:18 are considered unacceptable.

Table 4-6 HLA B Unacceptable Antigen Equivalences

Candidate Unacceptable B-Locus Antigen	Donor Equivalent Antigens
5	5, 51, 51:01, 51:02, 52
7	7, 07:02, 07:03, 07:14
07:02	07:02
07:03	07:03
07:14	07:14
8	8, 08:01, 08:02, 08:03, 08:04
08:01	08:01
08:02	08:02
08:03	08:03
08:04	08:04
12	12, 44, 44:02, 44:03, 45, 50:02
13	13, 13:01, 13:02
13:01	13:01
13:02	13:02
14	14, 64, 65, 14:01, 14:02
14:01	14:01, 64
14:02	14:02, 65
15	15, 62, 63, 70, 71, 72, 75, 76, 77, 15:01, 15:02, 15:03, 15:04, 15:06, 15:07, 15:10, 15:11, 15:12, 15:13, 15:16, 15:17, 15:18, 15:20, 15:21, 15:24, 15:27
15:01	15:01
15:02	15:02
15:03	15:03
15:04	15:04
15:06	15:06
15:07	15:07
15:10	15:10
15:11	15:11
15:12	15:12
15:13	15:13

Candidate Unacceptable B-Locus Antigen	Donor Equivalent Antigens
15:16	15:16
15:17	15:17
15:18	15:18
15:20	15:20
15:21	15:21
15:24	15:24
15:27	15:27
16	16, 38, 38:01, 38:02, 39, 39:01, 39:02, 39:04, 39:05, 39:06, 39:13
17	17, 57, 57:01, 57:03, 58
18	18
21	21, 49, 50, 40:05, 50:01
22	22, 54, 55, 55:01, 55:02, 55:04, 56, 56:01, 56:03
27	27, 27:03, 27:04, 27:05, 27:06~~, 27:08~~
27:03	27:03
27:04	27:04
27:05	27:05
27:06	27:06
27:08	27:08
35	35, 35:01, 35:02, 35:03, 35:08, 35:12
35:01	35:01
35:02	35:02
35:03	35:03
35:08	35:08
35:12	35:12
37	37
38	38, 38:01, 38:02
38:01	38:01
38:02	38:02
39	39, 39:01, 39:02, 39:04, 39:05, 39:06,39:13
39:01	39:01
39:02	39:02
39:04	39:04
39:05	39:05
39:06	39:06
39:13	39:13
40	40, 60, 61, 40:01, 40:02, 40:03, 40:04, 40:06
40:01	40:01, 60
40:02	40:02
40:03	40:03
40:04	40:04
40:05	40:05, 50
40:06	40:06
41	41, 41:01, 41:02
41:01	41:01

Candidate Unacceptable B-Locus Antigen	Donor Equivalent Antigens
41:02	41:02
42	42, 42:01, 42:02
42:01	42:01
42:02	42:02
44	44, 44:02, 44:03
44:02	44:02
44:03	44:03
45	45, 50:02
46	46
47	47
48	48, 48:01, 48:02
48:01	48:01
48:02	48:02
49	49
50	50, 40:05, 50:01~~, 50:02~~
50:01	50:01
50:02	50:02, 45
51	51, 51:01, 51:02
51:01	51:01
51:02	51:02
52	52
53	53
54	54
55	55, 55:01, 55:02, 55:04
55:01	55:01
55:02	55:02
55:04	55:04
56	56, 56:01, 56:03
56:01	56:01
56:03	56:03
57	57, 57:01, 57:03
57:01	57:01
57:03	57:03
58	58
59	59
60	60, 40:01
61	61, 40:02, 40:03, 40:04, 40:06
62	62, 15:01, 15:04, 15:06, 15:07, 15:20, 15:27
63	63, 15:16, 15:17
64	64, 14:01
65	65, 14:02
67	67
70	70, 71, 72, 15:03, 15:10, 15:18
71	71, 15:10, 15:18

Candidate Unacceptable B-Locus Antigen	Donor Equivalent Antigens
72	72, 15:03
73	73
75	75, 15:02, 15:11, 15:21
76	76, 15:12
77	77, 15:13
78	78
81	81
82	82
83:01	83:01
Bw4	Bw4, 08:02, 08:03, 5, 13, 13:01, 13:02, 15:13, 15:16, 15:17, 15:24,17, 27, 27:03, 27:04, 27:05, 27:06, 37, 38, 38:01, 38:02, 44, 44:02, 44:03, 47, 49, 51, 51:01, 51:02, 52, 53, 57, 57:01, 57:03, 58, 59, 63, 77
Bw6	Bw6, 7, 07:02, 07:03, 07:14, 8, 08:01, 08:04, 14, 14:01, 14:02,15:01, 15:02, 15:03, 15:04, 15:06, 15:07, 15:10, 15:11,15:12, 15:18, 15:20, 15:21, 15:27, 18, 22, 27:08, 35, 35:01, 35:02, 35:03, 35:08, 35:12, 39, 39:01, 39:02, 39:04, 39:05, 39:06, 39:13, 40, 40:01, 40:02, 40:03, 40:04, 40:05, 40:06, 41, 41:01, 41:02, 42, 42:01, 42:02, 45, 48, 48:01 48:02, 50, 50:01, 50:02, 54, 55, 55:01, 55:02, 55:04, 56, 56:01, 56:03, 60, 61, 62, 64, 65, 67, 70, 71, 72, 75, 76, 78, 81, 82

Table 4-7: HLA C Unacceptable Antigen Equivalences

Candidate Unacceptable C-Locus Antigen	Donor Equivalent Antigens
01	01, 01:02, 01:03
01:02	01:02
01:03	01:03
02	02, 02:02, 02:10
02:02	02:02
02:10	02:10
03	03, 03:02, 03:03, 03:04, 03:05, 03:06, 09, 10
03:02	03:02
03:03	03:03
03:04	03:04
03:05	03:05
03:06	03:06
04	04, 04:01, 04:03, 04:04, 04:07
04:01	04:01
04:03	04:03
04:04	04:04
04:07	04:07
05	05, 05:01
05:01	05:01

Candidate Unacceptable C-Locus Antigen	Donor Equivalent Antigens
06	06, 06:02
06:02	06:02
07	07, 07:01, 07:02, 07:04, 07:06, 07:18
07:01	07:01
07:02	07:02
07:04	07:04
07:06	07:06
07:18	07:18
08	08, 08:01, 08:02, 08:03, 08:04
08:01	08:01
08:02	08:02
08:03	08:03
08:04	08:04
09	09, 03:03
10	10, 03:02, 03:04, 03:06
12	12, 12:02, 12:03, 12:04
12:02	12:02
12:03	12:03
12:04	12:04
14	14, 14:02, 14:03
14:02	14:02
14:03	14:03
15	15, 15:02, 15:04, 15:05, 15:06, 15:09
15:02	15:02
15:04	15:04
15:05	15:05
15:06	15:06
15:09	15:09
16	16, 16:01, 16:02, 16:04
16:01	16:01
16:02	16:02
16:04	16:04
17	17, 17:01, 17:03
17:01	17:01
17:03	17:03
18	18, 18:01, 18:02
18:01	18:01
18:02	18:02

Table 4-8: HLA DR Unacceptable Antigen Equivalences

Candidate Unacceptable DR Locus Antigen	Donor Equivalent Antigens
1	1, 01:01, 01:02~~, 01:03~~
01:01	01:01

Candidate Unacceptable DR Locus Antigen	Donor Equivalent Antigens
01:02	01:02
01:03	01:03, 103
2	2, 15, 15:01, 15:02, 15:03, 16, 16:01, 16:02
3	3, 17, 18, 03:01, 03:02, 03:03
03:01	03:01, 17
03:02	03:02, 18
03:03	03:03, 18
4	4, 04:01, 04:02, 04:03, 04:04, 04:05, 04:06, 04:07, 04:10, 04:11
04:01	04:01
04:02	04:02
04:03	04:03
04:04	04:04
04:05	04:05
04:06	04:06
04:07	04:07
04:10	04:10
04:11	04:11
5	5, 11, 11:01, 11:04, 12, 12:01, 12:02
6	6, 13, 13:01, 13:02, 13:03, 13:05, 14, 14:01, 14:02, 14:03, 14:04, 14:05, 14:06, 14:54
7	7
8	8, 08:01, 08:02, 08:03, 08:07
08:01	08:01
08:02	08:02
08:03	08:03
08:07	08:07
9	9, 09:01, 09:02
09:01	09:01
09:02	09:02
10	10
11	11, 11:01, 11:03, 11:04
11:01	11:01
11:03	11:03
11:04	11:04
12	12, 12:01, 12:02
12:01	12:01
12:02	12:02
13	13, 13:01, 13:02,13:03, 13:05
13:01	13:01
13:02	13:02
13:03	13:03
13:05	13:05
14	14, 14:01, 14:02, 14:03, 14:04, 14:05, 14:06, 14:54
14:01	14:01, 14:54

Candidate Unacceptable DR Locus Antigen	Donor Equivalent Antigens
14:02	14:02
14:03	14:03
14:04	14:04
14:05	14:05
14:06	14:06
14:54	14:54, 14:01
15	15, 15:01, 15:02, 15:03
15:01	15:01
15:02	15:02
15:03	15:03
16	16, 16:01, 16:02
16:01	16:01
16:02	16:02
17	17, 03:01
18	18, 03:02, 03:03
103	103, 01:03

Table 4-13: HLA DQB1 Unacceptable Antigen Equivalences

Candidate Unacceptable DQB1 Locus Antigen	Donor Equivalent Antigens
~~1~~	~~1, 5, 6, 05:01, 05:02, 06:01, 06:02, 06:03, 06:04, 06:09~~
2	2, 02:01, 02:02
02:01	02:01
02:02	02:02
3	3, 7, 8, 9, 03:01, 03:02, 03:03, 03:19
03:01	03:01, 7
03:02	03:02, 8
03:03	03:03, 9
03:19	03:19, 7
4	4, 04:01, 04:02
04:01	04:01
04:02	04:02
5	5, 05:01, 05:02, 05:03
05:01	05:01
05:02	05:02
05:03	05:03
6	6, 06:01, 06:02, 06:03, 06:04, 06:09
06:01	06:01
06:02	06:02
06:03	06:03
06:04	06:04
06:09	06:09
7	7, 3, 03:01, 03:19
8	8, 3, 03:02

Candidate Unacceptable DQB1 Locus Antigen	Donor Equivalent Antigens
9	9, 3, 03:03

Table 4-14: HLA DPB1 Unacceptable Antigen Equivalences

Candidate Unacceptable DPB1 Locus Antigen	Donor Equivalent Antigen
01:01	01:01, 162:01, 417:01, 462:01, 616:01, 733:01, 807:01, 810:01, 853:01, 931:01, 953:01, 979:01, 998:01, 999:01, 1024:01
02:01	02:01, 141:01, 352:01, 414:01, 416:01, 461:01, 617:01, 640:01, 678:01, 723:01, 783:01, 799:01, 819:01, 845:01, 857:01, 861:01, 955:01, 967:01, 975:01, 1036:01
02:02	02:02, 547:01,721:01, 766:01
03:01	03:01, 104:01, 124:01, 351:01, 669:01, 675:01, 676:01, 704:01, 706:01, 728:01, 829:01, 855:01, 938:01, 946:01, 948:01, 952:01, 1000:01, 1014:01, 1021:01
04:01	04:01, 126:01, 350:01, 415:01, 459:01, 464:01, 534:01, 615:01, 618:01, 670:01, 699:01, 702:01, 755:01, 757:01, 765:01, 767:01, 784:01, 804:01, 813:01, 820:01, 824:01, 826:01, 849:01, 850:01, 859:01, 880:01, 882:01, 926:01, 932:01, 939:01, 978:01, 988:01, 989:01, 992:01, 997:01, 1001:01, 1002:01, 1003:01, 1004:01, 1010:01, 1011:01, 1023:01, 1033:01
04:02	04:02, 105:01, 463:01, 571:01, 647:01, 665:01, 701:01, 725:01, 726:01, 730:01, 731:01, 734:01, 735:01, 763:01, 809:01, 818:01, 823:01, 858:01 , 881:01, 927:01, 933:01, 954:01, 958:01, 981:01, 1005:01, 1013:01, 1020:01 ,1025:01, 1031:01, 1035:01
05:01	05:01, 135:01, 668:01, 729:01, 744:01, 764:01, 790:01, 847:01, 848:01, 851:01, 860:01, 923:01, 951:01, 1015:01, 1018:01
06:01	06:01,737:01, 906:01, 914:01, 1022:01
08:01	08:01
09:01	09:01, 797:01, 899:01
10:01	10:01, 650:01, 673:01, 902:01
11:01	11:01, 649:01, 654:01, 672:01, 707:01, 907:01, 937:01
13:01	13:01, 107:01, 133:01, 518:01, 519:01, 888:01, 924:01, 947:01, 996:01
14:01	14:01, 498:01, 572:01, 651:01, 671:01, 705:01, 834:01, 854:01, 949:01
15:01	15:01, 585:01, 896:01, 910:01
16:01	16:01, 652:01, 653:01, 864:01, 886:01, 940:01, 968:01
17:01	17:01, 131:01, 168:01, 460:01, 846:01, 956:01, 1032:01
18:01	18:01, 897:01, 942:01

Candidate Unacceptable DPB1 Locus Antigen	Donor Equivalent Antigen
19:01	19:01, 106:01, 533:01, 535:01, 785:01, 965:01
20:01	20:01, 905:01
21:01	21:01, 1019:01
22:01	22:01, 1026:01
23:01	23:01, 138:01
24:01	24:01
25:01	25:01
26:01	26:01
27:01	27:01
28:01	28:01, 296:01
29:01	29:01, 909:01
30:01	30:01
31:01	31:01, 945:01
~~32:01~~	~~32:01~~
~~33:01~~	~~33:01~~
34:01	34:01, 835:01, 913:01
35:01	35:01
~~36:01~~	~~36:01~~
~~37:01~~	~~37:01~~
~~38:01~~	~~38:01~~
39:01	39:01, 584:01
40:01	40:01, 745:01
~~41:01~~	~~41:01~~
~~44:01~~	~~44:01~~
45:01	45:01, 832:01
~~46:01~~	~~46:01~~
~~47:01~~	~~47:01~~
~~48:01~~	~~48:01~~
~~49:01~~	~~49:01~~
~~50:01~~	~~50:01~~
51:01	51:01, 736:01
~~52:01~~	~~52:01~~
~~53:01~~	~~53:01~~
~~54:01~~	~~54:01~~

Candidate Unacceptable DPB1 Locus Antigen	Donor Equivalent Antigen
~~55:01~~	~~55:01~~
~~56:01~~	~~56:01~~
57:01	57:01, 648:01
~~58:01~~	~~58:01~~
59:01	59:01,782:01
~~60:01~~	~~60:01~~
~~62:01~~	~~62:01~~
~~63:01~~	~~63:01~~
~~65:01~~	~~65:01~~
~~66:01~~	~~66:01~~
~~67:01~~	~~67:01~~
~~68:01~~	~~68:01~~
~~69:01~~	~~69:01~~
~~70:01~~	~~70:01~~
~~71:01~~	~~71:01~~
~~72:01~~	~~72:01~~
~~73:01~~	~~73:01~~
~~74:01~~	~~74:01~~
~~75:01~~	~~75:01~~
~~76:01~~	~~76:01~~
~~77:01~~	~~77:01~~
~~78:01~~	~~78:01~~
~~79:01~~	~~79:01~~
80:01	80:01, 762:01
~~81:01~~	~~81:01~~
~~82:01~~	~~82:01~~
~~83:01~~	~~83:01~~
~~84:01~~	~~84:01~~
85:01	85:01, 713:01, 901:01, 1034:01
~~86:01~~	~~86:01~~
~~87:01~~	~~87:01~~
~~88:01~~	~~88:01~~
~~89:01~~	~~89:01~~
90:01	90:01, 1012:01

Candidate Unacceptable DPB1 Locus Antigen	Donor Equivalent Antigen
~~91:01~~	~~91:01~~
~~92:01~~	~~92:01~~
~~93:01~~	~~93:01~~
~~94:01~~	~~94:01~~
~~95:01~~	~~95:01~~
~~96:01~~	~~96:01~~
~~97:01~~	~~97:01~~
~~98:01~~	~~98:01~~
~~99:01~~	~~99:01~~
~~100:01~~	~~100:01~~
~~101:01~~	~~101:01~~
~~102:01~~	~~102:01~~
~~103:01~~	~~103:01~~
104:01	104:01
105:01	105:01
106:01	106:01
107:01	107:01
~~108:01~~	~~108:01~~
~~109:01~~	~~109:01~~
~~110:01~~	~~110:01~~
~~111:01~~	~~111:01~~
~~112:01~~	~~112:01~~
~~113:01~~	~~113:01~~
~~114:01~~	~~114:01~~
~~115:01~~	~~115:01~~
~~116:01~~	~~116:01~~
~~117:01~~	~~117:01~~
~~118:01~~	~~118:01~~
~~119:01~~	~~119:01~~
~~121:01~~	~~121:01~~
~~122:01~~	~~122:01~~
~~123:01~~	~~123:01~~
124:01	124:01
~~125:01~~	~~125:01~~

Candidate Unacceptable DPB1 Locus Antigen	Donor Equivalent Antigen
126:01	126:01
~~127:01~~	~~127:01~~
~~128:01~~	~~128:01~~
~~129:01~~	~~129:01~~
~~130:01~~	~~130:01~~
131:01	131:01
132:01	132:01, 1027:01
~~133:01~~	~~133:01~~
~~134:01~~	~~134:01~~
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Candidate Unacceptable DPB1 Locus Antigen	Donor Equivalent Antigen
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Candidate Unacceptable DPB1 Locus Antigen	Donor Equivalent Antigen
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Candidate Unacceptable DPB1 Locus Antigen	Donor Equivalent Antigen
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Candidate Unacceptable DPB1 Locus Antigen	Donor Equivalent Antigen
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Candidate Unacceptable DPB1 Locus Antigen	Donor Equivalent Antigen
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Candidate Unacceptable DPB1 Locus Antigen	Donor Equivalent Antigen
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Table 4-15: Epitope based Unacceptable Antigen Assignment for DPB1

Candidate Unacceptable Epitope	Donor Equivalent Antigens								
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Candidate Unacceptable Epitope	Donor Equivalent Antigens								
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	682:01	683:01	686:01	687:01	694:01	695:01	699:01	702:01	703:01
	707:01	708:01	709:01	713:01	716:01	722:01	733:01	739:01	742:01
	745:01	747:01	749:01	750:01	753:01	755:01	757:01	758:01	761:01
	765:01	767:01	768:01	769:01	772:01	773:01	784:01	787:01	788:01
	789:01	795:01	803:01	804:01	806:01	807:01	808:01	810:01	811:01
	812:01	813:01	814:01	820:01	822:01	824:01	826:01	828:01	830:01
	835:01	837:01	840:01	842:01	849:01	850:01	852:01	853:01	856:01
	859:01	879:01	880:01	882:01	888:01	893:01	895:01	896:01	901:01
	904:01	907:01	908:01	910:01	912:01	913:01	915:01	916:01	921:01
	922:01	924:01	926:01	930:01	931:01	932:01	934:01	937:01	945:01
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	1001:01	1002:01	1003:01	1004:01	1010:01	1011:01	1012:01	1016:01	1023:01
	1024:01	1033:01	1034:01						
55DED	03:01	06:01	09:01	14:01	17:01	20:01	29:01	35:01	44:01
	46:01	50:01	57:01	69:01	70:01	76:01	78:01	80:01	86:01
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	130:01	131:01	132:01	152:01	156:01	157:01	164:01	166:01	168:01
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	235:01	241:01	242:01	243:01	245:01	248:01	249:01	251:01	259:01
	266:01	270:01	287:01	288:01	289:01	292:01	293:01	329:01	332:01
	343:01	351:01	355:01	361:01	363:01	379:01	383:01	384:01	385:01
	386:01	391:01	394:01	404:01	405:01	407:01	409:01	413:01	439:01
	442:01	445:01	446:01	447:01	460:01	472:01	484:01	491:01	492:01
	498:01	504:01	505:01	506:01	508:01	509:01	530:01	536:01	540:01
	541:01	545:01	546:01	548:01	555:01	566:01	567:01	568:01	572:01
	581:01	601:01	610:01	613:01	620:01	621:01	629:01	630:01	645:01
	648:01	651:01	662:01	664:01	669:01	671:01	675:01	676:01	684:01
	688:01	689:01	698:01	704:01	705:01	706:01	714:01	719:01	727:01
	728:01	737:01	760:01	762:01	797:01	801:01	815:01	829:01	833:01
	834:01	839:01	846:01	854:01	855:01	883:01	899:01	905:01	906:01
	909:01	914:01	920:01	935:01	938:01	944:01	946:01	948:01	949:01
	952:01	956:01	970:01	977:01	983:01	987:01	990:01	994:01	1000:01
	1009:01	1014:01	1017:01	1021:01	1022:01	1027:01	1030:01	1032:01	
	02:01	04:02	08:01	10:01	16:01	18:01	25:01	28:01	37:01

Candidate Unacceptable Epitope	Donor Equivalent Antigens								
55DEE	41:01	45:01	48:01	49:01	51:01	53:01	59:01	60:01	68:01
	73:01	75:01	77:01	79:01	81:01	82:01	83:01	93:01	94:01
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	137:01	141:01	143:01	144:01	145:01	146:01	151:01	153:01	155:01
	163:01	165:01	167:01	172:01	183:01	184:01	185:01	186:01	187:01
	188:01	189:01	191:01	196:01	198:01	200:01	204:01	210:01	211:01
	217:01	219:01	229:01	236:01	237:01	238:01	239:01	252:01	256:01
	257:01	258:01	260:01	261:01	263:01	265:01	269:01	271:01	273:01
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	430:01	431:01	432:01	433:01	441:01	443:01	444:01	448:01	452:01
	457:01	461:01	463:01	466:01	467:01	469:01	470:01	477:01	488:01
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	557:01	571:01	574:01	577:01	579:01	582:01	586:01	594:01	595:01
	596:01	602:01	603:01	604:01	606:01	608:01	617:01	622:01	624:01
	627:01	628:01	633:01	637:01	639:01	640:01	641:01	646:01	647:01
	650:01	652:01	653:01	655:01	656:01	659:01	660:01	663:01	665:01
	673:01	674:01	678:01	680:01	681:01	685:01	690:01	692:01	701:01
	711:01	723:01	725:01	726:01	730:01	731:01	734:01	735:01	736:01
	740:01	741:01	751:01	752:01	759:01	763:01	770:01	771:01	774:01
	775:01	776:01	780:01	781:01	782:01	783:01	791:01	799:01	805:01
	809:01	816:01	817:01	818:01	819:01	823:01	827:01	832:01	836:01
	841:01	843:01	845:01	857:01	858:01	861:01	863:01	864:01	881:01
	884:01	885:01	886:01	887:01	889:01	890:01	891:01	892:01	897:01
	898:01	900:01	902:01	903:01	918:01	927:01	933:01	936:01	940:01
	942:01	943:01	954:01	955:01	958:01	963:01	964:01	967:01	968:01
	973:01	975:01	981:01	1005:01	1006:01	1007:01	1013:01	1020:01	1025:01
	1028:01	1031:01	1035:01	1036:01					
55EAE	02:02	05:01	19:01	21:01	22:01	24:01	30:01	36:01	38:01
	47:01	54:01	97:01	100:01	101:01	106:01	114:01	135:01	139:01
	140:01	170:01	171:01	223:01	226:01	233:01	284:01	291:01	300:01
	301:01	302:01	317:01	330:01	331:01	337:01	358:01	390:01	395:01
	400:01	406:01	408:01	473:01	478:01	495:01	496:01	527:01	533:01
	535:01	547:01	550:01	558:01	560:01	573:01	587:01	588:01	589:01
	590:01	611:01	619:01	638:01	668:01	697:01	715:01	717:01	718:01
	720:01	721:01	729:01	744:01	746:01	764:01	766:01	778:01	779:01
	785:01	790:01	798:01	802:01	847:01	848:01	851:01	860:01	923:01

Candidate Unacceptable Epitope	Donor Equivalent Antigens								
	928:01	929:01	951:01	961:01	962:01	965:01	971:01	980:01	982:01
	1008:01	1015:01	1018:01	1019:01	1026:01				
84DEAV	01:01	03:01	05:01	06:01	08:01	09:01	10:01	11:01	13:01
	14:01	16:01	17:01	19:01	20:01	21:01	22:01	25:01	26:01
	27:01	29:01	30:01	31:01	35:01	36:01	37:01	38:01	44:01
	45:01	50:01	52:01	54:01	55:01	56:01	57:01	58:01	63:01
	65:01	67:01	68:01	69:01	70:01	76:01	78:01	79:01	84:01
	85:01	87:01	88:01	89:01	90:01	91:01	92:01	93:01	97:01
	98:01	102:01	103:01	104:01	106:01	107:01	110:01	111:01	114:01
	118:01	122:01	124:01	125:01	127:01	130:01	131:01	132:01	133:01
	135:01	136:01	137:01	140:01	142:01	147:01	150:01	152:01	156:01
	157:01	162:01	165:01	166:01	167:01	168:01	170:01	171:01	173:01
	182:01	184:01	197:01	201:01	202:01	203:01	204:01	205:01	206:01
	207:01	208:01	209:01	220:01	221:01	222:01	223:01	226:01	234:01
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	277:01	284:01	285:01	287:01	288:01	289:01	291:01	293:01	295:01
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	389:01	390:01	391:01	393:01	394:01	395:01	398:01	400:01	404:01
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	483:01	490:01	491:01	492:01	495:01	498:01	503:01	504:01	505:01
	506:01	509:01	514:01	515:01	516:01	517:01	518:01	519:01	527:01
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	545:01	548:01	550:01	552:01	558:01	560:01	562:01	563:01	564:01
	565:01	566:01	567:01	568:01	572:01	573:01	587:01	588:01	597:01
	599:01	600:01	608:01	609:01	610:01	611:01	612:01	613:01	616:01
	619:01	621:01	623:01	629:01	630:01	631:01	632:01	633:01	634:01
	635:01	636:01	638:01	645:01	648:01	649:01	650:01	651:01	652:01
	653:01	654:01	662:01	664:01	667:01	668:01	669:01	671:01	672:01
	673:01	675:01	676:01	684:01	688:01	689:01	698:01	703:01	704:01
	705:01	706:01	707:01	708:01	709:01	710:01	711:01	713:01	714:01
	715:01	716:01	717:01	718:01	720:01	727:01	728:01	729:01	733:01
	737:01	744:01	746:01	749:01	760:01	764:01	778:01	785:01	789:01
	790:01	791:01	797:01	798:01	801:01	802:01	807:01	810:01	815:01
	822:01	825:01	829:01	832:01	833:01	834:01	839:01	846:01	847:01
	848:01	851:01	853:01	854:01	855:01	856:01	860:01	864:01	879:01

Candidate Unacceptable Epitope	Donor Equivalent Antigens								
	883:01	886:01	888:01	891:01	892:01	893:01	898:01	899:01	901:01
	902:01	904:01	905:01	906:01	907:01	908:01	909:01	912:01	914:01
	920:01	922:01	923:01	924:01	929:01	930:01	931:01	935:01	937:01
	938:01	940:01	944:01	945:01	946:01	947:01	948:01	949:01	951:01
	952:01	953:01	956:01	965:01	968:01	969:01	970:01	971:01	976:01
	977:01	979:01	980:01	982:01	983:01	990:01	991:01	994:01	996:01
	998:01	999:01	1000:01	1006:01	1007:01	1008:01	1009:01	1012:01	1014:01
	1015:01	1017:01	1018:01	1019:01	1021:01	1022:01	1024:01	1026:01	1027:01
	1030:01	1032:01	1034:01						
84GGPM	02:01	02:02	04:01	04:02	23:01	24:01	32:01	33:01	39:01
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	71:01	72:01	73:01	75:01	77:01	80:01	81:01	82:01	83:01
	86:01	94:01	95:01	96:01	99:01	100:01	101:01	105:01	108:01
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	128:01	129:01	134:01	138:01	141:01	143:01	144:01	145:01	146:01
	148:01	149:01	151:01	153:01	155:01	158:01	163:01	164:01	169:01
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	186:01	187:01	188:01	189:01	190:01	191:01	192:01	193:01	194:01
	195:01	196:01	199:01	200:01	210:01	211:01	212:01	213:01	214:01
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	549:01	553:01	554:01	555:01	556:01	557:01	559:01	561:01	569:01
	571:01	574:01	575:01	576:01	577:01	578:01	579:01	581:01	582:01
	583:01	584:01	586:01	591:01	593:01	594:01	595:01	596:01	601:01
	602:01	603:01	604:01	605:01	606:01	607:01	614:01	615:01	617:01

Candidate Unacceptable Epitope	Donor Equivalent Antigens								
	618:01	620:01	622:01	624:01	625:01	626:01	627:01	628:01	637:01
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	658:01	659:01	660:01	663:01	665:01	666:01	670:01	674:01	677:01
	678:01	679:01	680:01	681:01	682:01	683:01	685:01	686:01	687:01
	690:01	692:01	694:01	699:01	701:01	702:01	721:01	722:01	723:01
	725:01	726:01	730:01	731:01	734:01	735:01	736:01	739:01	741:01
	742:01	747:01	750:01	751:01	753:01	755:01	757:01	758:01	759:01
	761:01	762:01	763:01	765:01	766:01	767:01	769:01	770:01	771:01
	772:01	773:01	774:01	775:01	776:01	779:01	780:01	781:01	782:01
	783:01	784:01	787:01	788:01	795:01	796:01	799:01	803:01	804:01
	805:01	806:01	808:01	809:01	811:01	812:01	813:01	814:01	816:01
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	882:01	884:01	885:01	887:01	889:01	890:01	895:01	915:01	916:01
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	1035:01	1036:01							
84VGPM	15:01	18:01	28:01	34:01	40:01	53:01	62:01	74:01	139:01
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	471:01	482:01	484:01	493:01	499:01	512:01	526:01	580:01	585:01
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	903:01	910:01	913:01	918:01	942:01				

Table 4-16: Reportable OPTN DPB1 HLA Allele Values

01:01	02:01	02:02	03:01	04:01	04:02	05:01	06:01	08:01	09:01
10:01	11:01	13:01	14:01	15:01	16:01	17:01	18:01	19:01	20:01
21:01	22:01	23:01	24:01	25:01	26:01	27:01	28:01	29:01	30:01
31:01	32:01	33:01	34:01	35:01	36:01	37:01	38:01	39:01	40:01
41:01	44:01	45:01	46:01	47:01	48:01	49:01	50:01	51:01	52:01
53:01	54:01	55:01	56:01	57:01	58:01	59:01	60:01	62:01	63:01
65:01	66:01	67:01	68:01	69:01	70:01	71:01	72:01	73:01	74:01
75:01	76:01	77:01	78:01	79:01	80:01	81:01	82:01	83:01	84:01
85:01	86:01	87:01	88:01	89:01	90:01	91:01	92:01	93:01	94:01
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105:01	106:01	107:01	108:01	109:01	110:01	111:01	112:01	113:01	114:01

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169:01	170:01	171:01	172:01	173:01	174:01	175:01	176:01	177:01	178:01
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1026:01	1027:01	1028:01	1030:01	1031:01	1032:01	1033:01	1034:01	1035:01	1036:01

Table 4-~~15~~17: Additional Unacceptable Antigen Equivalences to be used in the Calculated Panel Reactive Antibody (CPRA) Only

Locus	Patient Unacceptable Antigen	Unacceptable DR antigen equivalences used for CPRA calculation
DR51	51	2, 15, 16
DR52	52	3, 5, 6, 11, 12, 13, 14, 17, 18
DR53	53	4, 7, 9