Guidelines for Vaccination of Adult Solid Organ Transplant Candidates and Recipients

A. General considerations regarding vaccination

1. Adult solid organ transplant (SOT) candidates and recipients should receive all vaccines indicated based on their ages, medical conditions, and other factors that apply to non-SOT candidates or recipients (see http://www.cdc.gov/vaccines/schedules/hcp/adult.html, Appendix A, and Appendix B) except for the below-listed exceptions or additions.
    - All SOT candidates and recipients should be vaccinated against pneumococcus with PCV13 and PPSV23.
    - All SOT candidates and recipients should receive a HepB vaccine series with post-vaccination titers unless they have a documented anti-HBs titer of ≥ 10 mIU/mL after a properly-timed HepB series or unless they have known hepatitis B virus infection.
    - All SOT candidates and recipients should receive a HepA vaccine series unless previously administered or unless they have a positive hepatitis A virus immunoglobulin G assay.
    - Live-attenuated vaccines[1] should not be administered to SOT recipients, SOT candidates on immunosuppression, or SOT candidates who may undergo SOT within 4 weeks. The timing of inactivated, subunit, or toxoid vaccines is discussed below.

Vaccine	Notes
Influenza	Can be given pre- and/or post-SOT (see Appendix C)
Tdap or Td	Can be given pre- and/or post-SOT
MMR	Live-attenuated vaccine to be given pre-SOT only; generally those born before 1957 (among others) are considered immune
VAR	Live-attenuated vaccine to be given pre-SOT only; generally those born in the U.S. before 1980 (among others) are considered immune
RZV	Only indicated for those ≥ 60 years old; has not been well-studied in SOT recipients and is not routinely recommended after SOT though is likely safe
HPV	Can be given pre- and/or post-SOT for patients age 26 or younger
PCV13 or PPSV23	Can be given pre- and/or post-SOT (see Appendix D)
HepA, HepB, or HepA-HepB	Can be given pre- and/or post-SOT
MenACWY or MenB	Can be given pre- and/or post-SOT; only if asplenia or complement deficiencies
Hib	Can be given pre- or post-SOT; only if asplenia or complement deficiencies

2. Individual SOT programs may adopt modified versions of these vaccine guidelines based on medical or programmatic considerations, in which case these modifications should be reflected in their respective SOT protocols.

3. Primary care providers and other specialists, including SOT providers, should be encouraged to vaccinate SOT candidates and recipients.

[1] Live-attenuated vaccines include MMR, VAR, ZVL, LAIV, oral typhoid vaccine (Vivotif), and yellow fever vaccine (YF, YF-Vax). Other live-attenuated vaccines available in the United States but uncommonly used in adults include the combined MMR and VAR vaccine (MMRV, ProQuad), adenovirus vaccine, rotavirus vaccine (RV1, Rotarix; RV5, RotaTeq), smallpox vaccine (ACAM2000), and tuberculosis vaccine (BCG).

B. Timing of vaccination

1. Ideally, vaccinations should be given as early before SOT as possible when the patient is first being evaluated for SOT candidacy.

2. Inactivated, subunit, or toxoid vaccines should ideally be given 2 weeks or more prior to immunosuppression or SOT to achieve maximum immunogenicity.

3. To maximize immunogenicity and effectiveness, inactivated, subunit, or toxoid vaccines should preferentially be given starting at 6 months post-SOT, though they can be given as early as 2 months based on patient-specific risk factors. Influenza vaccination can begin as early as 1 month after SOT if there is significant local influenza activity. Similarly, to maximize vaccine effectiveness, vaccination should ideally be delayed during other periods of intensified immunosuppression.

C. Unique medical and other risk factors

1. Vaccinations should ideally be given 2 weeks or more prior to splenectomy, eculizumab administration, or other iatrogenic procedures resulting in asplenia or complement component deficiencies. See SHC Functional or Anatomical Asplenia Vaccine Guide for further details involving both vaccinations and other considerations in caring for these patients.

2. Given the risk of meningococcal infection with eculizumab use, even when vaccination is appropriately provided, patients should generally be prescribed penicillin V potassium 500 mg by mouth twice daily for the duration of eculizumab treatment and for 4 weeks after treatment finishes. Patients who report penicillin allergy should be prescribed azithromycin 250 mg by mouth daily and referred to the allergy division for consideration of skin testing, drug challenge, or desensitization.

3. Patients with complex medical conditions not discussed in these recommendations and those with unique risk factors associated with travel or occupation (including contact with animals or work with pathogens) should be referred to the infectious diseases clinic to determine optimal immunization strategies.

D. Vaccination of family members and household contacts of SOT candidates and recipients

1. To protect immunocompromised patients from transmissible diseases, immunocompetent family members and household contacts should be encouraged to receive all age-appropriate vaccinations, particularly an annual influenza vaccine and live-attenuated vaccines such as MMR and VAR, with these exceptions or additions:
    - LAIV: Household contacts of SOT candidates and recipients should avoid LAIV or, if obtained, avoid contact with the immunocompromised patient for 7 days after vaccination.
    - Rotavirus: SOT candidates and recipients should avoid handling diapers of infants who have been vaccinated with rotavirus vaccine for 4 weeks after vaccination.
    - VAR/ZVL: Uncommonly, VAR or ZVL recipients can develop a localized or generalized varicella-like rash within 1 month after vaccination. Non-immune SOT candidates and recipients should avoid contact with these persons until skin lesions clear. Except in those rare individuals who develop a varicella-like rash, recipients of VAR or ZVL vaccines are not capable of transmitting varicella zoster virus (VZV) and can interact with SOT candidates and recipients without restriction. This issue is not relevant with RZV or when the SOT candidate or recipient is already immune to VZV.

APPENDIX A: Vaccine abbreviations and example trade names

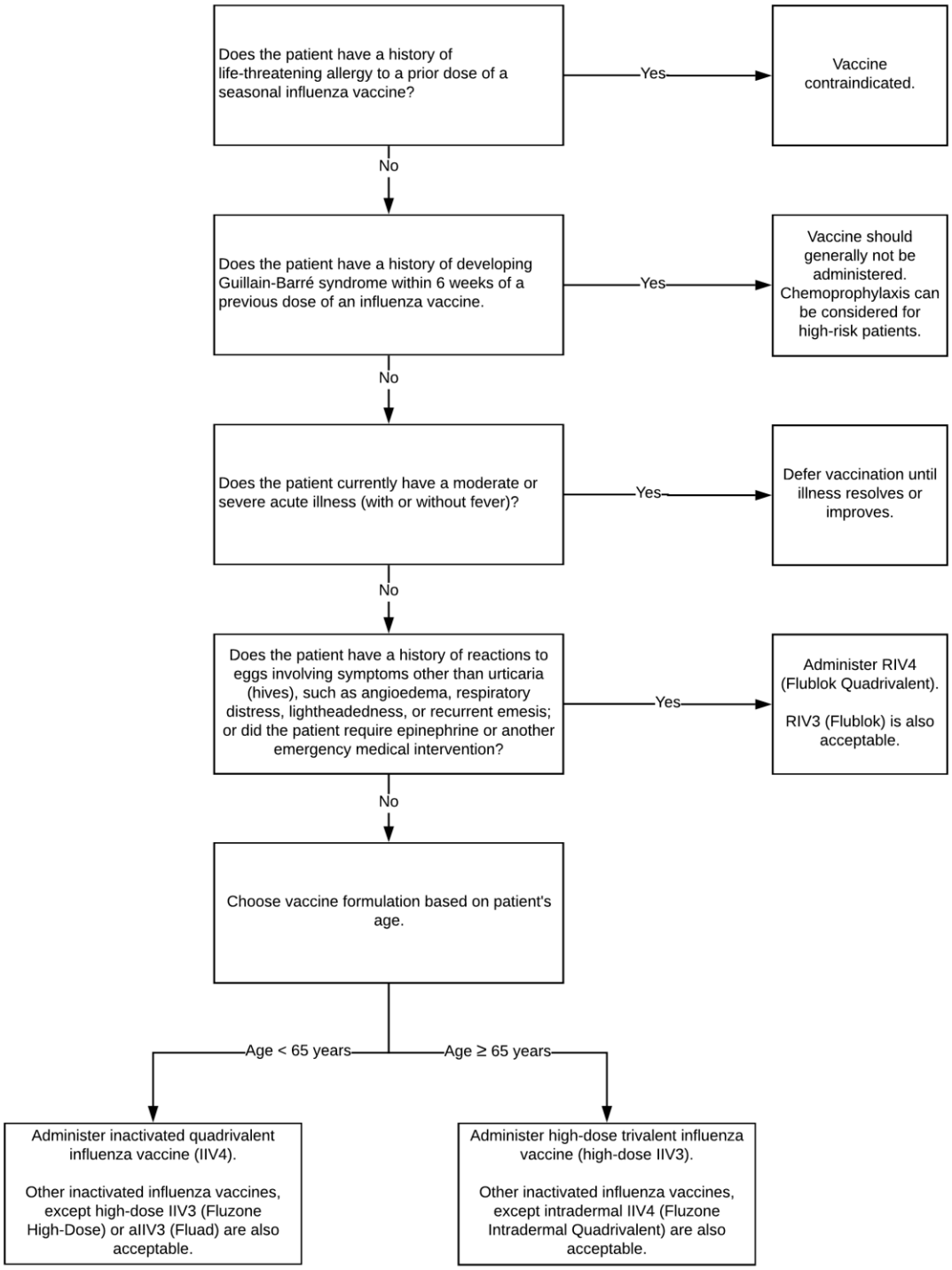
Abbreviation	Name	Example trade names
Influenza vaccines		
IIV3, standard dose	Trivalent inactivated influenza vaccine, standard dose	Afluria, Fluvirin
IIV3, high dose	Trivalent inactivated influenza vaccine, high dose	Fluzone High-Dose
aIIV3	Trivalent inactivated influenza vaccine, adjuvant-containing	Fluad
RIV3	Trivalent inactivated influenza vaccine, recombinant	Flublok
RIV4	Quadrivalent inactivated influenza vaccine, recombinant	Flublok Quadrivalent
IIV4	Quadrivalent inactivated influenza vaccine	FluLaval Quadrivalent, Fluzone Quadrivalent, Fluarix Quadrivalent, Fluzone Intradermal Quadrivalent, Afluria Quadrivalent
ccIIV4	Quadrivalent inactivated influenza vaccine, cell-culture-based	Flucelvax Quadrivalent
LAIV4	Live attenuated quadrivalent influenza vaccine	FluMist Quadrivalent
Other vaccines		
PCV13	Pneumococcal conjugate vaccine (13-valent)	Prevnar 13
PPSV23	Pneumococcal polysaccharide vaccine (23-valent)	Pneumovax 23
MenACWY	Meningococcal (Quadrivalent) Conjugate	Menveo, Menactra
MenB	Serogroup B meningococcal vaccines	Bexsero (MenB-4C), Trumenba (MenB-FHbp)
Hib	Haemophilus influenzae type b conjugate vaccine	ActHIB, Hiberix, PedvaxHIB
DTaP	Diphtheria and tetanus toxoids and acellular pertussis vaccine	Infanrix, Daptacel
Td	Tetanus and reduced diphtheria toxoids	*Generic*
Tdap	Tetanus and reduced diphtheria toxoid, and acellular pertussis vaccine	Boostrix, Adacel
HepA	Hepatitis A vaccine	Havrix, Vaqta
HepB-alum	Hepatitis B vaccine, alum adjuvant	Engerix-B, Recombivax HB
HepB-CpG	Hepatitis B vaccine, CpG 1018 adjuvant	Heplisav-B
HepA-HepB	Hepatitis A and hepatitis B vaccine	Twinrix
IPV	Inactivated poliovirus vaccine	Ipol
9vHPV	Human papillomavirus vaccine (nonavalent)	Gardasil 9
MMR	Measles, mumps, and rubella vaccine	M-M-R II
VAR	Varicella vaccine	Varivax
ZVL	Zoster vaccine live	Zostavax
RZV	Recombinant zoster vaccine	Shingrix

Vaccines in red are on formulary at Stanford Health Care (SHC)

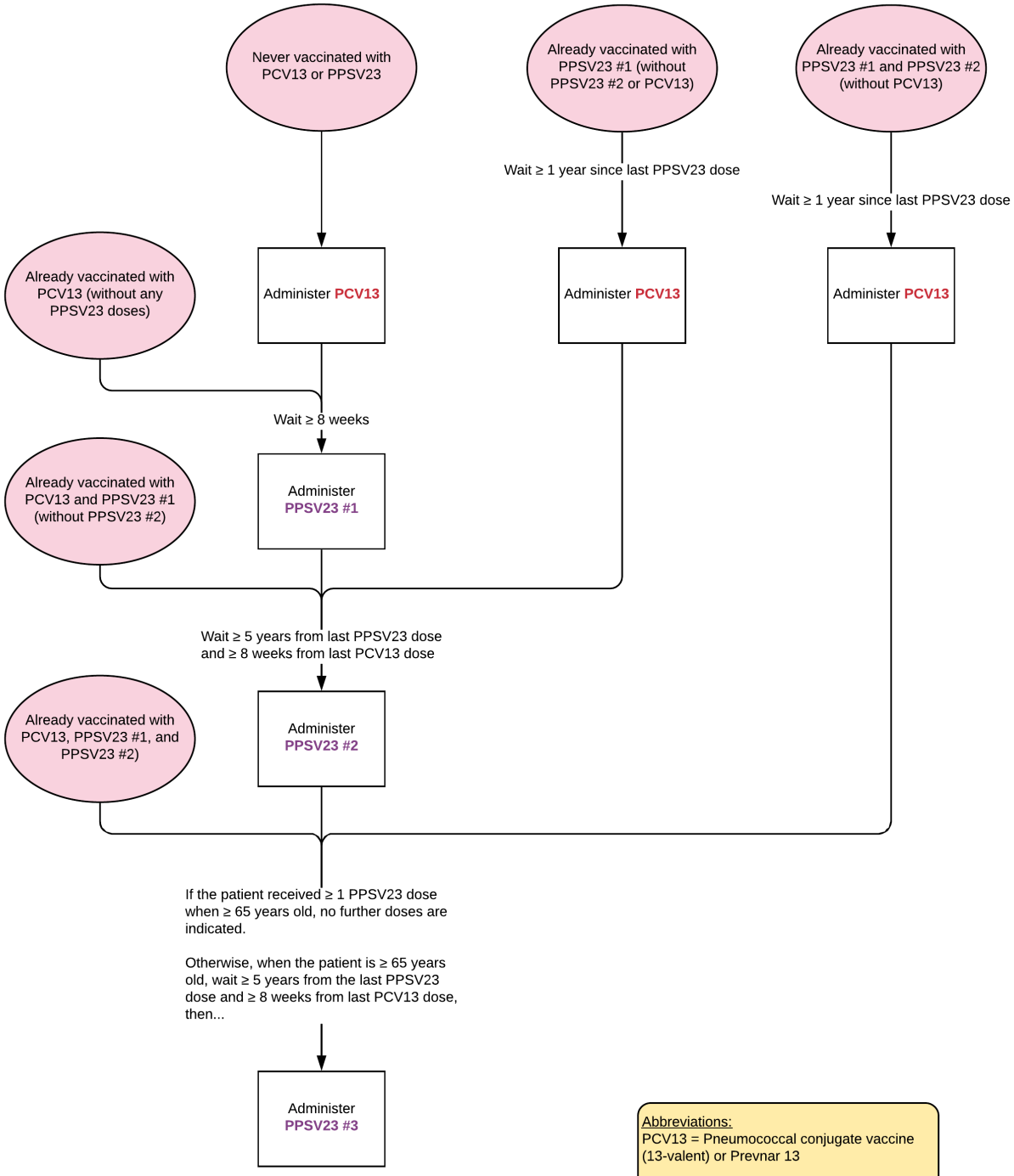
APPENDIX B: Vaccine administration, scheduling, and other details

1. See http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/genrec.pdf and http://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/downloads/general-recs.pdf for more information than is contained in this document.
2. Vaccines have minimum intervals between doses (which can be found at http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/appendices/a/age-interval-table.pdf) but no maximum intervals. There is no need to restart a series due to delayed administration of a vaccine in a series.
3. Live-attenuate vaccines (MMR, and VAR) can be given the same day but if not given the same day, they should be separated by at least 4 weeks.
4. Multiple vaccines can be given at the same visit, with 2 exceptions:
    a. PCV13 and PPSV23 should not be given together and need to be spaced apart.
    b. PCV13 and Menactra (not on formulary at Stanford Health Care) should not be given together. Menveo (on formulary at Stanford Health Care) can be given at the same visit as PCV13.
5. Vaccine contraindications and precautions are too extensive to list separately, but can be found at http://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/contraindications.html.
6. Vaccines supplied in vials or syringes containing latex can be found at http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/appendices/B/latex-table.pdf.
7. Administration of blood products and immunoglobulins can reduce the effectiveness of MMR and VAR. Specific recommendations on this topic can be found in Table 2-04 of http://wwwnc.cdc.gov/travel/yellowbook/2018/the-pre-travel-consultation/general-recommendations-for-vaccination-immunoprophylaxis.
8. In general, patient self-reporting of vaccination history should not be accepted as valid. If documentation of a vaccine is not available, the individual should be assumed to be unvaccinated for that dose. (An exception is that patient self-report can be accepted as valid for influenza and pneumococcal polysaccharide vaccines).

APPENDIX C: Influenza vaccination for SOT candidates and recipients



APPENDIX D: Pneumococcal vaccination for SOT candidates and recipients



Abbreviations:
PCV13 = Pneumococcal conjugate vaccine (13-valent) or Prevnar 13

PPSV23 = Pneumococcal polysaccharide vaccine (23-valent) or Pneumovax 23

Everyone ≥ 65 years old should have received:
PCV13: once
PSV23: 2-3 doses, including ≥ 1 dose ≥ 65 years old

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3. Kim DK, Riley LE, Hunter P. Advisory Committee on Immunization Practices Recommended Immunization Schedule for Adults Aged 19 Years or Older - United States, 2018. MMWR Morb Mortal Wkly Rep. 2018;67(5):158-160.
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B. DOCUMENT INFORMATION

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    - Stanford Health Care Vaccination Subcommittee
3. Reviews/Revisions
    - David Epstein, MD 08/2018
4. Approvals
    - Stanford Health Care Vaccination Subcommittee 11/2018