Vaccinations in Patients with LAM

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Patients with LAM should maintain appropriate vaccinations. Live vaccines should be avoided in patients taking immunosuppressive agents, so vaccination recommendations below differ between LAM patients who are on mTOR inhibitors such as sirolimus and those who are not.

For LAM patients who are NOT taking mTOR inhibitors, we recommend:

1. Annual influenza vaccination with the inactivated vaccine. Patients with severe egg allergies can receive egg-free alternatives. Flumist (live attenuated influenza vaccine) is not recommended in LAM patients, because diffuse lung disease is a relative contraindication.
2. Vaccination against pneumococcus:
    a. For patients who have not received any pneumococcal vaccine: All patients should receive pneumococcal conjugate vaccine-20 (PCV20 or Prevnar 20) as a single dose, or one dose of PCV15 followed one year later by pneumococcal polysaccharide vaccine (PPSV23 or Pneumovax).
    b. For patients who have previously received pneumococcal vaccination, the following approach can be utilized:
        - Patients who have previously received PPSV23, one dose of PCV15 or PCV20 at least one year after receiving PPSV23
        - Patients who have previously received PCV13 should receive PCV20 or PPSV23 at least one year after receiving PCV13.
        - Patients who have previously received both PCV13 and PPSV23, should receive PCV20 or PPSV23 at least five years after their last pneumococcal vaccination dose.
3. Shingles (H. Zoster) vaccination:
    a. Shingles (H. Zoster) vaccination with recombinant zoster vaccine (RZV aka Shingrix) is preferred over the live attenuated zoster vaccine (ZLV).
    b. RZV is recommended for all LAM patients over the age of 50 years.
    c. Requires a 2 dose administration series at zero, and 2-6 months
4. Hepatitis (A and B) vaccines: recommended for all patients.
5. Tetanus vaccine: recommended for all patients.
6. COVID-19 vaccination as per the latest FDA guidance.

Table 1 summarizing recommendations for LAM patients NOT on mTOR inhibitors

Vaccine	Type	Recommended for LAM patients	Who should receive the vaccine?	Series
Hepatitis A	Inactivated	YES	Negative antibody to hepatitis A (Anti-HAV)	2 doses (Months 0 and 6)
Hepatitis B	Inactivated	YES	Negative for BOTH surface antibody (HepBsAb) and surface antigen (HepBsAg)	3 doses (Months 0, 1, 6)
Influenza	Inactivated	YES	All patients	1 dose annually

	Live Attenuated	**NO**	**NO**	**NO**
Pneumococcal, 20 valent protein conjugate vaccine (PCV20 or Prevnar 20)	Inactivated	YES	All patients	1 dose in lifetime; no other pneumococcal vaccine required if given first. In patients who have received PPSV23 prior, PCV20 can be given one year later
Pneumococcal, 15 valent protein conjugate vaccine (PCV15)	Inactivated	YES	All patients	1 dose in lifetime; ideally given before PPSV23 and to be followed by PPSV23 at least one year after. In patients who have received PPSV23 prior, PCV15 can be given one year later
Pneumococcal, 23 valent polysaccharide vaccine (Pneumovax 23©)	Inactivated	YES	All patients	Not needed if patient receives PCV20, otherwise 1 dose given at least a year after PCV15. Can be repeated 5 years later in patients who have received PCV13 and PPSV23 and PCV20 is not available.
Tetanus, diphtheria (TD); Tetanus, diptheria, and pertussis (Tdap)	Inactivated	YES	**TD:** all patients **Tdap**: if > 19 years and haven't previously received	Tdap: 1 dose in lifetime if not given pre-treatment TD: 1 dose every 5-10 yrs
Shingrix (zoster vaccine recombinant, adjuvanted)	Inactivated	YES	In patient ≥50 years of age	SHINGRIX is given as a 2-dose series, with the second shot administered 2 to 6 months after the first shot

In special circumstances such as travel to areas of endemicity; other vaccines may be considered where applicable.

Vaccine	**Type**	**Recommendations for LAM patients**	**Who should receive the vaccine?**	**Series**
Polio, inactivated	Inactivated	YES	All patients not previously vaccinated and traveling to high risk areas	3 doses (Months 0, 1, 6)
Human Papilloma Virus (HPV)	Inactivated	Unknown/YES	Females and males 9 to 26 years of age. Optimally given pre treatment	3 doses (Months 0, 2, 6)
Neisseria meningitis	Inactivated	YES	All patients 11-18 years, asplenic patients,	1 dose

			college students, military	
Haemophilus influenzae	Inactivated	YES	Asplenic patients	3 doses
Rabies	Inactivated	Not routinely given	Recommended for exposures or potential exposures	IM x 5 doses (Days 0, 3, 7, 14, 28)
Measles, mumps, rubella (MMR)	Live Attenuated	YES (no less than 4 wks prior to mTOR treatment)	Pts with no evidence of past infection or documentation of vaccination	2 doses
BCG	Live Attenuated	NO	NO	NO
Rotavirus	Live Attenuated	NO	NO	NO

For LAM patients who <u>ARE</u> taking mTOR inhibitors, we recommend:

1. Annual influenza vaccination with the inactivated vaccine. Flumist (live attenuated influenza vaccine) is not recommended in patients with LAM.
2. Vaccination against pneumococcus:
    a. For patients who have not received any pneumococcal vaccine: All patients should receive pneumococcal conjugate vaccine-20 (PCV20 or Prevnar 20) as a single dose, or one dose of PCV15 followed one year later by pneumococcal polysaccharide vaccine (PPSV23 or Pneumovax).
    b. For patients who have previously received pneumococcal vaccination, the following approach can be utilized:
        - Patients who have previously received PPSV23, one dose of PCV15 or PCV20 at least one year after receiving PPSV23
        - Patients who have previously received PCV13 should receive PCV20 or PPSV23 at least one year after receiving PCV13.
        - Patients who have previously received both PCV13 and PPSV23, should receive PCV20 or PPSV23 at least five years after their last pneumococcal vaccination dose.
3. Shingles (H. Zoster) vaccination with recombinant zoster vaccine (RZV) should be given to all LAM patients who are either currently taking, or about to start taking mTOR inhibitors, regardless of age. Live attenuated Shingles vaccine should be avoided in patients taking mTOR inhibitors.
4. Hepatitis (A and B) vaccines: recommended for all patients.
5. Tetanus vaccine: recommended for all patients.
6. COVID-19 vaccination as per the latest FDA guidance.
7. Avoid other live virus vaccines:
    a. Measles, mumps, rubella
    b. Oral polio
    c. Smallpox
    d. Rotavirus
    e. Yellow fever
    f. Rabies

<u>Table 2 summarizing recommendations for patient on mTOR inhibitors</u>

Vaccine	Type	Recommendations for LAM patients?	Who should receive the vaccine?	Series

Hepatitis A	Inactivated	YES	Negative antibody to hepatitis A (Anti-HAV)	2 doses (Months 0 and 6)
Hepatitis B	Inactivated	YES	Negative for BOTH surface antibody (HepBsAb) and surface antigen (HepBsAg)	3 doses (Months 0, 1, 6)
Influenza	Inactivated	YES	All patients	1 dose annually
	Live Attenuated	NO	NO	NO
Pneumococcal, 20 valent protein conjugate vaccine (PCV20 or Prevnar 20)	Inactivated	YES	All patients	1 dose in lifetime; no other pneumococcal vaccine required if given first. In patients who have received PPSV23 prior, PCV20 can be given one year later
Pneumococcal, 15 valent protein conjugate vaccine (PCV15)	Inactivated	YES	All patients	1 dose in lifetime; ideally given before PPSV23 and to be followed by PPSV23 at least one year after. In patients who have received PPSV23 prior, PCV15 can be given one year later
Pneumococcal, 23 valent polysaccharide vaccine (Pneumovax 23©)	Inactivated	YES	All patients	Not needed if patient receives PCV20, otherwise 1 dose given at least a year after PCV15. Can be repeated 5 years later in patients who have received PCV13 and PPSV23 and PCV20 is not available.
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Shingrix (zoster vaccine recombinant, adjuvanted)	Inactivated	YES	All patients who are either currently taking or about to start mTOR inhibitors	SHINGRIX is given as a 2-dose series, with the second shot administered 2 to 6 months after the first shot

In special circumstances such as travel to areas of endemicity; other vaccines may be considered where applicable.

Vaccine	Type	Recommended for LAM patients?	Who should receive the vaccine?	Series
Polio, inactivated	Inactivated	YES	All patients not previously vaccinated and traveling to high risk areas	3 doses (Months 0, 1, 6)
Human Papilloma Virus (HPV)	Inactivated	Unknown/YES	Females and males 9 to 26 years of age. Optimally given pre treatment	3 doses (Months 0, 2, 6)
Neisseria meningitis	Inactivated	YES	All patients 11-18 years, asplenic patients, college students, military	1 dose
Haemophilus influenzae	Inactivated	YES	Asplenic patients	3 doses
Rabies	Inactivated	Not routinely given	Recommended for exposures or potential exposures	IM x 5 doses (Days 0, 3, 7, 14, 28)
Measles, mumps, rubella (MMR)	Live Attenuated	NO	NO	NO
BCG	Live Attenuated	NO	NO	NO
Rotavirus	Live Attenuated	NO	NO	NO

General comments

Inactivated or recombinant flu vaccines (i.e. the injectable types of flu vaccine that your physician will offer to you) should not be used in anyone with prior severe allergy without consulting an allergist and should be used with caution in: patients with moderate or severe acute illness with or without fever, a history of Guillain-Barré syndrome within 6 weeks of previous influenza vaccination, or people with egg allergy (hives only allergy can be mitigated with additional safety measures).

Minor illnesses (such as diarrhea, mild upper respiratory infection with or without low-grade fever, other low-grade febrile illness) are not contraindications to vaccination. Adults with egg allergy of any severity can receive inactivated vaccines with the same indications as those without egg allergy since the new preparations contain much smaller quantities of egg products.

Contraindications to Pneumovax and Prevnar include severe prior allergic reaction and moderate or severe acute illness. Patients with a documented true allergic reaction (rather than a history of egg allergy) to Prevnar or Pneumovax should seek the advice of an allergist.

Although inactivated and recombinant flu and pneumococcal vaccinations can result in soreness and low-grade fever and muscle aches, they cannot produce flu or pneumonia.