PRE-TRANSPLANT IMMUNIZATION GUIDELINES

SOLID ORGAN TRANSPLANT

December 2022

SickKids®

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1.0 INTRODUCTION

PRE-TRANSPLANT IMMUNIZATION GUIDELINES:

The following tables are suggested immunization schedules for solid organ transplant candidates. They are meant as a guide only and may not be applicable to all patients. Please consult Infectious Diseases as appropriate for patient specific issues. Vaccines listed are those that are licensed for use in children <18 yrs of age. Please consult your local pharmacy for current cost of vaccines that are not covered by the Ontario Ministry of Health and Long Term Care (MOHLTC).

PRE-TRANSPLANT CONSIDERATIONS:

- Accelerated regimen schedules may be possible for some vaccines to facilitate optimal dosing and response with limited time prior to transplant. Refer to tables for the minimum age to receive each vaccine and interval recommended for accelerated scheduling.
- Defer transplant for 2 wks (if possible) following administration of INACTIVE vaccines to ensure adequate vaccine response.
- LIVE vaccines should be administered PRIOR to transplant when possible. Ideally transplant should not occur until at least 4 wks following live vaccine administration.

SIBLINGS AND OTHER FAMILY MEMBERS:

All siblings should be vaccinated per routine guidelines. It is also safe for siblings of solid organ transplant candidates to receive LIVE vaccines.

TRAVEL VACCINES:

Prior to travel, all transplant candidates should consult Infectious Diseases/Travel Clinic for recommended vaccinations. Travel Clinic consultations are not covered by the Ontario Ministry of Health and Long Term Care. Most travel vaccines are also not covered. Families will need to budget for the cost of consultation and vaccination. Some vaccines need to be administered several wks prior to travel in order to provide adequate protection. Families will need to plan consultations well ahead of their travel date.

2.0 PRE-TRANSPLANT: INACTIVE VACCINES

2.1 INACTIVE VACCINES: DIPHTHERIA, PERTUSSIS, TETANUS, POLIO AND HAEMOPHILUS INFLUENZA B – PRE-TRANSPLANT GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	ROUTINE SCHEDULE (ONTARIO)	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL BETWEEN DOSES	NUMBER OF DOSES REQUIRED	RECOMMEND PRE-TRANSPLANT	SEROLOGY PRE/POST VACCINATION	COVERAGE IN ONTARIO
DTaP-IPV-Hib Pediacel®/Pentacel® Infanrix® IPV/Hib	2, 4, 6 and 18 mths	6 wks[1,6]	**Doses 1, 2, 3** 4 wks **Dose 3 to 4** 6 mths but 4th dose must be given at or after 12 mths of age[1, 2, 4, 6, 9]	As per routine schedule	**YES** In addition: Transplant candidates ≥5 yrs of age should receive one dose of Hib vaccine regardless of prior Hib vaccination history, at least 1 yr after any previous dose[1, 6] Defer transplant for 2 wks following vaccine administration (if possible) to ensure adequate response	NOT done routinely	Covered by MOHLTC
Tdap-IPV Adacel® Polio Boostrix® Polio	4-6 yrs x1 dose	4 yrs[1, 6, 14, 15]	N/A				
Tdap Adacel® Boostrix®	14 years: 1 dose + booster in 10 yrs	7 yrs[6, 13, 14]	N/A				

NOTES:

- D=diphtheria toxoid high dose; d=diphtheria toxoid low dose; ap or aP=acellular pertussis; T=tetanus toxoid; IPV or Polio=inactivated polio; Hib=haemophilus influenza type b; HB=hepatitis B.
- DTap-HB-IPV-Hib: Infanrix-hexa® is not part of the Ontario routine immunization schedule and is NOT covered by MOHLTC.
- Act-HIB® and Hiberix® are single entity haemophilus influenza b vaccines licenced for use in patients 2 mths and older.

CONCOMITANT ADMINISTRATION OF VACCINES LISTED IN THIS TABLE:

- The National Advisory Committee on Immunization (NACI) states that administering the most widely used live and inactivated vaccines during the same patient visit has produced seroconversion rates and rates of adverse reactions similar to those observed when the vaccines are administered separately.[1]
- NACI recommends that vaccines administered simultaneously should be given using separate syringes at separate sites.[1]
- DTaP-IPV-Hib (Pediacel®) can be given at the same time as other routine vaccinations such as meningococcal C conjugate and hepatitis B.[9]

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2.2 INACTIVE VACCINES: MENINGOCOCCAL – PRE-TRANSPLANT GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	ROUTINE SCHEDULE (ONTARIO)	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL BETWEEN DOSES	NUMBER OF DOSES REQUIRED	RECOMMEND PRE-TRANSPLANT	SEROLOGY PRE/POST VACCINATION	COVERAGE IN ONTARIO
Meningococcal quadrivalent ACW-135Y conjugate vaccine (Men-C-ACWY) Menactra® Menveo® Nimenrix®	Grade 7 **OR** **HIGH RISK*** (≥9 mths)	**Nimenrix®** 6 wks[1, 7] **Menveo®** 2 mths[9, 15] **Menactra®** 9 mths[4, 8, 15]	**Nimenrix®** 2 mths[17] **Menveo®** 2 mths[9] **Menactra®** 3 mths[8, 15] Accelerated Men-C-ACWY schedule: ≥ 12 mths: 4 wks[1]	**Men-C-ACWY**[Ψ] **2 -11 mths:** 2 or 3 doses, 8 wks apart, then booster between 12-23 mths, 8 wks from previous dose[1, 2] **12-23 mths:** 2 doses, 8 weeks apart[1] **≥24 mths:** 2 doses, 8 weeks apart[1]	**YES** Transplant candidates are at **HIGH RISK*** of invasive meningococcal disease (IMD) due to impending immunouppression and should receive Men-C-ACWY vaccine** Routine Meningococcal Conjugate vaccine does not need to be administered in addtion to the quadrivalent vaccine[1] Defer transplant for 2 wks following administration to ensure adequate response	NOT done routinely	Covered under MOHLTC school program (grade 7)[2] **OR** **HIGH RISK*** (≥9 mths)[2]
Serogroup B Meningococcal Vaccine 4CMenB Bexsero® MenB-fHBP Trumenba® (NOT interchangeable)	For **HIGH RISK*** only (2 mths-17 yrs)[2]	**4CMenB** **Bexsero®** 2 mths[12] **MenB-fHBP** **Trumenba®** 10 yrs[21]	**Bexsero®[12]** **2-5 mths**: 1 mth **6-23 mths**: 2 mths **≥2 yrs**: 1 mth **Trumenba®[21]** **HIGH RISK***: **Dose 1 and 2**: 1 mth **Dose 2 and 3**: 4 mths	**Bexsero®** **2-5 mths**[12]: 3 doses, 1 mth apart then booster at 12-23 mths **AND** 6 mths after 3rd dose **6-11 mths**[12]: 2 doses, 2 mths apart then booster at 12-23 mths **AND** 2 mths after 2nd dose **12-23 mths**[12]: 2 doses, 2 mths apart then booster 12-23 mths after dose 2 **≥2 yrs**[12]: 2 doses, 1 mth apart. Consider booster if continued risk of IMD **Trumenba[21]** **HIGH RISK* ≥10 yrs of age**: 3 doses; 1 mth interval between 1st and 2nd dose, then 4 mth interval between 2nd and 3rd dose	**YES** Transplant candidates are at **HIGH RISK*** of invasive meningococcal disease (IMD) due to impending immune- suppression and should receive MenB-vaccine** Defer transplant for 2 wks following administration to ensure adequate response		Covered by MOHLTC for **HIGH RISK*** ONLY[2]

***HIGH RISK FOR INVASIVE MENINGOCOCCAL DISEASE (IMD) INCLUDE:**

1. Functional/anatomic asplenia or sickle cell disease[1, 2]
2. Complement, properdin, factor D or combined T and B cell deficiencies[1, 2]
3. Cochlear implants (pre/post implant)[2]
4. HIV+[1, 2]
5. Acquired complement deficiencies due to receipt of the terminal complement inhibitor eculizumab (Soliris™)[1, 2]
6. Increased risk of exposure: travelers where meningococcal vaccine is recommended (meningitis belt of Sub-Saharan Africa) or required (Hajj, Mecca)[1]

** Expert opinion

[Ψ]Nimenrix® is funded by MOHLTC (June 2022). At the time of TRMC guideline update, NACI was reviewing its recommendations in view of Nimenrix® receiving approval for use in infants as young as 6 wks of age. (Previously Menveo® (Men-C-ACWY-CRM) was the vaccine of choice for children <2 yrs of age per NACI and CPS).

Provincial recommendations may vary based on available vaccine products. Choice of vaccine and recommended schedules vary with age[1]

CONTRAINDICATIONS:

In persons with history of anaphylaxis after a previous dose of the vaccine and in patients with proven hypersensitivity/ anaphylaxis to any component of the vaccine or its container.[1]

CONCOMITANT ADMINISTRATION OF VACCINES LISTED IN THIS TABLE:

- The National Advisory Commmitee on immunization (NACI) states that administering the most widely used live and inactivated vaccines during the same patient visit has produced seroconversion rates and rates of adverse reactions similar to those observed when the vaccines are administered separately.[1]
- NACI recommends that vaccines administered simultaneously should be given using separate syringes at separate sites.[1]
- Men-C-C products, Menactra® and Bexsero® can be given with other routine childhood immunizations, in a different injection site with a separate needle and syringe[1]. Per NACI, Menveo® administration at the same time as Pneu-C-13 requires further study.[1] However, the Menveo® product monograph indicates concomitant administration with other routine childhood immunizations is appropriate (separate injection site and syringe).[9]
- Co-administration of Men-C-ACYW-CRM (Menveo) and Tdap may result in a lower immune response to the pertussis antigens than when Tdap vaccine is given alone; however, the clinical significance of this is unknown.[1]
- Tdap vaccine given one mth after Men-C-ACYW-CRM induces the strongest immunologic response to pertussis antigens.[1]

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2.3 INACTIVE VACCINES: PNEUMOCOCCAL – PRE-TRANSPLANT GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	ROUTINE SCHEDULE (ONTARIO)	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL BETWEEN DOSES	NUMBER OF DOSES REQUIRED	RECOMMEND PRE-TRANSPLANT	SEROLOGY PRE/POST VACCINATION	COVERAGE IN ONTARIO
Pneumococcal Conjugate Vaccine (Pneu-C) Prevnar® 20 (Pneu-C-20) Vaxneuvance® (Pneu-C-15) Prevnar® 13 (Pneu-C-13) Synflorix® (Pneu-C-10) Dose = 0.5 mL	**HIGH RISK* (2 mths - < 18 yrs)**[1,2] Pneu-C-20 at 2,4, 6 and 12-15 months[1] **LOW RISK** Pneu-C 15 at 2,4 and 12 months of age[2]	Pneu-C-20 (Prevnar®20): 6 wks[1, 2, 4]	Pneu-C-20 (Prevnar®20): 8 weeks[1, 2]	**Pneu-C-20 (Prevnar®20):** **Previously *unimmunized*:** **2 to < 7 mths**: 4 doses (2, 4, 6 & 12-15 mths) **7 to < 12 mths:** 3 doses (2 doses, 8** weeks apart followed by 3rd dose at 12-15 months, at least 8 weeks after 2nd dose) **12 to < 24 mths**: 2 doses, 8 weeks apart **2 yrs to <18 yrs**: 1 dose Patients with previous pneumococcal conjugate vaccine history: Follow NACI[1] schedule for **HIGH RISK*** (see table next page)	**YES** Transplant candidates are considered to be at high risk due to chronic end-organ disease[1,2] and due to impending immunesuppression[¥] If possible, administer vaccine at least 2 wks prior to transplant to ensure adequate immune responses Infants who have started series with either Pneu-C-13 or Pneu-C-15 should receive Pneu-C-20 to complete their vaccination series[1]	NOT done routinely	**Pneu-C-20** Covered by MOHLTC ONLY for children with **HIGH RISK*** of invasive pneumo-coccal disease (IPD) **Pneu-C-15** Covered by MOHLTC for children with **LOW RISK** of invasive pneumo-coccal disease (IPD)
Pneumococcal Polysaccharide Vaccine (Pneu-P) Pneumovax® 23 (Pneu-P-23)	Children who have completed a vaccine series appropriate for age that includes at least one dose of Pneu-C-20 do not require additional doses of Pneu-P-23[1,2] If Pneu-P-23 dose has been given, it is recommended to wait 1 year before immunizing the child with Pneu-C-20[1,2]. In cases where a patient's risk profile has changed and a dose of Pneu-C-20 may be considered within 1 year of receipt of Pneu-P-23, please consult Infectious Diseases.[¥]						

NOTES:

*Children at increased risk of IPD *include* those who: have chronic medical conditions (example: heart, kidney, liver or lung disease), have sickle cell disease/sickle cell hemoglobinopathies, have other types of functional or anatomic asplenia, have HIV infection, are immunocompromised (eg. primary immunodeficiencies, malignancies, immunosuppressive therapy, use of long-term systemic corticosteroids, nephrotic syndrome), have chronic medical conditions (e.g. diabetes mellitus, neurologic conditions impairing clearance of oral secretions or chronic CSF leak) and children with cochlear implants/receiving cochlear implants.[1] Children living in residential care are also at increased risk of IPD[1,2]

**In cases where significant acceleration is required (e.g. if transplantation is imminent), a minimum of 4 weeks between the first two doses of Pneu-C-20 may be considered as per the manufacturer[4]. Please consult Infectious Diseases.

[¥]Expert Opinion

CONTRAINDICATIONS:

Prevnar®13, Prevnar®20, Vaxneuvance®: Hypersensitivity to any component of the vaccine, including diphtheria toxoid[4, 5, 10]

CONCOMITANT ADMINISTRATION OF VACCINES LISTED IN THIS TABLE:

- The National Advisory Committee on Immunization (NACI) states that administering the most widely used live and inactivated vaccines during the same patient visit has produced seroconversion rates and rates of adverse reactions similar to those observed when the vaccines are administered separately.[1]
- NACI recommends that vaccines administered simultaneously should be given using separate syringes at separate sites.[1]
- Infants and Children 6 Weeks to 5 years of age: PREVNAR® 20 can be administered concomitantly with any of the following vaccine antigens, either as monovalent or combination vaccines: diphtheria, tetanus, acellular pertussis, Haemophilus influenzae type b, inactivated poliomyelitis, hepatitis B, measles, mumps, rubella (MMR) and varicella vaccines.[4] The vaccine has been safely administered with influenza, rotavirus vaccine and COVID-19 mRNA vaccine.[4] There are no data on the concomitant administration of PREVNAR 20 with other vaccines.[4]

TABLE 1: RECOMMENDED SCHEDULES FOR PNEU-C-20 VACCINE FOR CHILDREN 2 MONTHS TO LESS THAN 18 YEARS OF AGE WITH IPD RISK FACTORS[1]		
AGE AT INITIATION OF PNEU-C-20 VACCINE SERIES	**NUMBER OF PREVIOUSLY RECEIVED PNEUMOCOCCAL CONJUGATE VACCINES**	**RECOMMENDED SCHEDULE FOR PNEU-C-20**
2 to less than 7 months	0 doses	3 doses** + 1 dose at 12-15 months of age
	1 dose	2 doses** + 1 dose at 12-15 months of age
	2 doses	1 dose + 1 dose at 12-15 months of age
7 to less than 12 months	0 doses	2 doses** + 1 dose at 12-15 months of age
	1 dose	1 dose + 1 dose at 12-15 months of age
	2 doses	1 dose at 12-15 months of age
12 to less than 24 months	0 doses	2 doses, 8 weeks apart
	1 dose at less than 12 months of age	
	2 or more doses at less than 12 months of age	1 dose
	0 or 1 dose at less than 12 months of age **AND** 1 dose at 12 months of age or older	
24 to less than 60 months (5 years)	0 doses of Pneu-C-20	1 dose
5 years to less than 18 years	0 doses of Pneu-C-20	1 dose

Adapted from Canadian Immunization Guide: Pneumococcal Vaccines[1] Table 4

**8 wks minimum interval between doses; 4 wks minimum interval recommended by vaccine manufacturer for accelerated course

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2.4 INACTIVE VACCINES: HEPATITIS A – PRE-TRANSPLANT GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	ROUTINE SCHEDULE (ONTARIO)	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL BETWEEN DOSES	NUMBER OF DOSES REQUIRED	RECOMMEND PRE-TRANSPLANT	SEROLOGY PRE/POST VACCINATION	COVERAGE IN ONTARIO
Hepatitis A Avaxim® Avaxim Ped® Havrix® Havrix Jr® Vaqta® Vaqta Ped® (Can be used interchangeably)	None	6 mths[1]	**Monovalent vaccines** 6 mths[1]	2 doses See table 1 for schedule	Recommended for liver transplant candidates, and for other organ candidates meeting **HIGH RISK*** criteria[1] Hepatitis A vaccine may be given either as a monovalent product or in combination with hepatitis B; dosing is different NACI does not recommend the use of Twinrix® or Twinrix® Junior in functionally immunosuppressed or hyporesponsive patients (example ESRD dialysis patients)[1] Defer transplant for 2 wks following vaccine administration to ensure adequate response[1]	NO**	Covered by ON MOHLTC **only** for patients >1 yr old with chronic liver disease
Combination Hep A/B Vaccines Twinrix® Twinrix® Junior		1 yr[11]	**Twinrix®** 6 mths **Twinrix® Junior** 1 mth between first and second dose; 6 mths between first and third dose	See table 2 for schedule			

***HIGH RISK** includes persons travelling to endemic countries, individuals living in communities at risk of hepatitis A (HA) outbreaks or in which HA is endemic[1]

**High response rate to immunization makes routine post immunization serologic testing unnecessary in healthy populations. Commercial assay kits are not universally reliable for detecting vaccine-induced antibody[1,2]

TABLE 1: CANADIAN IMMUNIZATION GUIDE (NACI)- HEPATITIS A DOSING RECOMMENDATIONS FOR MONOVALENT HEPATITIS A VACCINES[1]

VACCINE	ANTIGEN*	VOLUME	SCHEDULE (BOOSTER)	AGE†
Avaxim®	160 antigen units HAV	0.5 mL	0, (6-36) mths	12 yrs and older
Avaxim Ped®	80 antigen units HAV	0.5 mL	0, (6-36) mths	6 mths-<16 yrs
Havrix®	1440 ELISA units HAV	1 mL	0, (6-12) mths‡	19 yrs and older
Havrix Jr®	720 ELISA units HAV	0.5 mL	0, (6-12) mths	6 mths-<19 yrs
Vaqta®	50 units HAV	1 mL	0, (6-18) mths	18 yrs and older
Vaqta Ped®	25 units HAV	0.5 ml	0, (6-18) mths	6 mths-<18 yrs

*There is no international standard for HAV measurement. Each manufacturer uses its own units of measurement.

†Ages for which the vaccine is approved

‡Studies have shown that 720 ELISA units provides an effective booster dose in those over 19 yrs of age

NOTE:

- Comparable to the results reported in clinical trials of children more than 12 mths, all reviewed studies have consistently shown that vaccination of infants 6-12 mths with inactivated HA vaccines is immunogenic and safe.
- Product monographs for Avaxim Ped, Havrix Jr and Vaqta Ped indicate 12 mths as the lower age limit.

TABLE 2: TWINRIX® AND TWINRIX® JR DOSING SCHEDULE[1]

AGE	TWINRIX®			TWINRIX JR®		
	ANTIGEN*	mL	SCHEDULE (MTHS)	ANTIGEN*	mL	SCHEDULE (MTHS)
1 yr-<16 yrs	720 ELISA units	1	0, 6-12	360 ELISA units	0.5	0, 1, 6
16-<19 yrs	-	-	-	360 ELISA units	0.5	0, 1, 6

CONTRAINDICATIONS:

- In persons with a history of anaphylaxis after previous administration of a HA-containing vaccine and in persons with proven immediate or anaphylactic hypersensitivity to any component of the product or its container.[11] TWINRIX® and TWINRIX® Junior: latex in plunger stopper of pre-filled syringe, neomycin, yeast[11]

CONCOMITANT ADMINISTRATION OF VACCINES LISTED IN THIS TABLE:

- The National Advisory Committee on Immunization (NACI) states that administering the most widely used live and inactivated vaccines during the same patient visit has produced seroconversion rates and rates of adverse reactions similar to those observed when the vaccines are administered separately.[1]
- NACI recommends that vaccines administered simultaneously should be given using separate syringes at separate sites.[1]
- Since HAVRIX® is an inactivated vaccine, its concomitant use with other inactivated vaccines is unlikely to result in interference with immune responses. When concomitant administration of other vaccines is considered necessary, the vaccines must be given with different syringes and at different injection sites.[10]

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2.5 INACTIVE VACCINES: HEPATITIS B – PRE-TRANSPLANT GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	ROUTINE SCHEDULE (ONTARIO)	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL BETWEEN DOSES	NUMBER OF DOSES REQUIRED	RECOMMEND PRE-TRANSPLANT	SEROLOGY PRE/POST VACCINATION	COVERAGE IN ONTARIO
Hepatitis B Engerix® B **OR** Recombivax HB® (Can be used interchangeably)	Grade 7 (12 yrs) 2 doses (0, 6 mths)	Newborn[1]	Varied accelerated schedules available **ACCELERATED SCHEDULES** **4 dose** 0, 7, 21-28 days, and booster at 6-12 mths **3 dose** 0, 1, >2 mths[2]	**3 dose schedule preferred** 0, 1, 6 mths[1]	**YES** *See tables 1 and 2 below for dosing If functionally immunosuppressed or hyporesponsive, consider **double the microgram dose for age** and use 3 or 4 dose schedule (example chronic renal failure, dialysis, congenital immunodeficiency, patients receiving immunosuppressive therapy)[1] NACI does not recommend the use of Twinrix® or Twinrix® Junior or Infanrix Hexa® in functionally immunosuppressed or hyporesponsive patients (example chronic renal failure, dialysis patients)[1] Defer transplant for 2 wks following vaccine administration to ensure adequate response[1]	**YES** 6-8 wks¥ (range 1-6 mths[1]) post series Annually post series to assess ongoing immunity If suboptimal response (titre <10 mIU/mL) repeat 3 dose series (higher dose if req'd) If non-responsive with repeat series, consult ID	Monovalent vaccines covered by ON MOHLTC school program (grade 7): 2 doses only Covered <7 yrs age immigrated from countries of high prevalence or exposed to hepatitis B **Doses 2 and 3 covered for patients[2]:** -on dialysis or receiving frequent blood products -listed for transplant 3 doses covered for patients with chronic liver disease[2]
Combination Hepatitis B Vaccines: Hepatitis A +B: Twinrix® Twinrix® Junior DTaP-HB-IPV-Hib INFANRIX Hexa™		1 yr[11] **NACI:** 6 mths[1] for urgent cases	See Table 3 for Twinrix® and Twinrix® Junior intervals	See Table 3 for Twinrix® and Twinrix® Junior dosing			

TABLE 1: CANADIAN IMMUNIZATION GUIDE (NACI) – HEPATITIS B STANDARD DOSING RECOMMENDATIONS1 FOR PAEDIATIC PATIENTS (3 OR 4 DOSE SCHEDULE ONLY):

RECIPIENTS	RECOMBIVAX HB®			ENGERIX® B		
	µg	mL	SCHEDULE (MTHS)	µg	mL	SCHEDULE (MTHS)
Infants (regardless of mothers' HBV status)	5	0.5	0, 1, 6**	10	0.5	0, 1, 6 **OR** 0, 1, 2, 12
12 mths-19 yrs	5	0.5	0, 1, 6**	10	0.5	0, 1, 6 **OR** 0, 1, 2, 12

*Thimerosal preservative-free preparation is recommended

**Although higher dose with a schedule of 0, 1 and >2 mths is approved, the preferred schedule is 0, 1, and 6 mths

¥Expert opinion

TABLE 2: HEPATITIS B-REVISED DOSING GUIDELINES FOR FUNCTIONALLY IMMUNOSUPPRESSED OR HYPORESPONSIVE PATIENTS (ADAPTED FROM CANADIAN IMMUNIZATION GUIDE-NACI)
NOTE: DOSES LISTED ARE DOUBLE THE ROUTINE AGE RECOMMENDED DOSE

RECIPIENTS	RECOMBIVAX HB®			ENGERIX® B		
	µg	mL	SCHEDULE (MTHS)	µg	mL	SCHEDULE (MTHS)
Infants (regardless of mothers' HBV status)	10	1	0, 1, 6**	20	1	0, 1, 6 **OR** 0, 1, 2, 12
12 mths-<16 yrs	10	1	0, 1, 6** **OR** 0, 1, 2, 12 for dialysis, chronic renal failure, and some immunocompromised individuals	20	1	0, 1, 6 **OR** 0, 1, 2, 12
16-<20 yrs	10	1	0, 1, 6** **OR** 0, 1, 2, 12 for dialysis, chronic renal failure, and some immunocompromised individuals	40	2	0, 1, 2, 6[1] particularly for ESRD/dialysis patient

*Thimerosal preservative-free preparation recommended;

**Although higher dose with a schedule of 0, 1 and >2 mths is approved, the preferred schedule is 0, 1, and 6 mths

TABLE 3: TWINRIX® AND TWINRIX JR® DOSING SCHEDULE[11]						
AGE	TWINRIX®			TWINRIX JR®		
	µg	mL	SCHEDULE (MTHS)	µg	mL	SCHEDULE (MTHS)
1 yr-<16 yrs	20	1	0, 6-12	10	0.5	0, 1, 6
16-<19 yrs	-	-	-	10	0.5	0, 1, 6

There are no data to support the use of Twinrix® and Twinrix® Jr on an accelerated schedule in children[11]

CONCOMITANT ADMINISTRATION OF VACCINES LISTED IN THIS TABLE:

- The National Advisory Committee on Immunization (NACI) states that administering the most widely used live and inactivated vaccines during the same patient visit has produced seroconversion rates and rates of adverse reactions similar to those observed when the vaccines are administered separately.[1]
- NACI recommends that vaccines administered simultaneously should be given using separate syringes at separate sites.[1]
- According to the National Advisory Committee on Immunization (NACI), RECOMBIVAX HB® (hepatitis B vaccine [recombinant]) may be administered simultaneously with other vaccines at different sites. A separate needle and syringe should be used for each vaccine.[14]

CONTRAINDICATIONS:

- In persons with a history of anaphylaxis after previous administration of a HB-containing vaccine and in persons with proven immediate or anaphylactic hypersensitivity to any component of the product or its container.[11]
- TWINRIX® and TWINRIX® Junior: latex in plunger stopper of pre-filled syringe, neomycin, yeast.[11]

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2.6 INACTIVE VACCINES: HUMAN PAPILLOMA VIRUS – PRE-TRANSPLANT GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	ROUTINE SCHEDULE (ONTARIO)	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL BETWEEN DOSES	NUMBER OF DOSES REQUIRED	RECOMMEND PRE-TRANSPLANT	SEROLOGY PRE/POST VACCINATION	COVERAGE IN ONTARIO
Human Papilloma Virus Gardasil® 9 (9-valent HPV 9 type 6, 11, 16, 18, 31, 33, 45, 52, 58) Cervarix® (Bivalent HPV 2 type 16, 18)	Grade 7 females and males	9 yrs[1, 2] **Gardasil® 9** Approved in both females and in males between 9 and 45 yrs[3] **Cervarix®** Approved in females between 9 and 45 yrs[1, 6]	**3 dose series** 4 wks between first and second dose[1, 2, 3] 12 wks between second and third dose[1, 2, 3] Third dose at least 24 wks after first dose[1, 2, 3] **2 dose series** 5 mths between first and second dose[3]	**Gardasil® 9** **3 doses**: 0, 2 and 6 mths[1, 2, 3] Immunocompetent patients 9-<15 yrs of age at time of first injection may receive HPV vaccine on a 2 dose schedule (0 and 6 mths)[1] If schedule interrupted, series does not need to be restarted[5], however ideally all 3 doses should be completed within a 1 yr period[3]	**YES** Recommend if patient >9 yrs of age and is a transplant candidate[1, 4, 5, 9]	NO	**Gardasil® 9** Covered under ON MOHLTC school program (grade 7-12) for immunocompromised: 3 doses **Cervarix®** Not covered in Ontario

NOTES:

- Dose 0.5 mL IM
- Higher incidence of fainting in younger individuals; observe patients for full 15 minutes post dose.

CONCOMITANT ADMINISTRATION OF VACCINES LISTED IN THIS TABLE:

- The National Advisory Committee on Immunization (NACI) states that administering the most widely used live and inactivated vaccines during the same patient visit has produced seroconversion rates and rates of adverse reactions similar to those observed when the vaccines are administered separately.[1]
- NACI recommends that vaccines administered simultaneously should be given using separate syringes at separate sites.[1]
- GARDASIL® 9 may be administered concomitantly (at a separate injection site) with Menactra* [Meningococcal (Groups A, C, Y and W-135) Polysaccharide Diphtheria Toxoid Conjugate Vaccine] and Adacel* [Tetanus Toxoid, Reduced Diphtheria Toxoid and Acellular Pertussis Vaccine Adsorbed (Tdap)], and Poliomyelitis (inactivated) Vaccine.[3]

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3.0 PRE-TRANSPLANT: LIVE VACCINES

3.1 LIVE VACCINES: MEASLES, MUMPS, RUBELLA – PRE-TRANSPLANT GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	ROUTINE SCHEDULE (ONTARIO)	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL BETWEEN DOSES	NUMBER OF DOSES REQUIRED	RECOMMEND PRE-TRANSPLANT	SEROLOGY PRE/POST VACCINATION	COVERAGE IN ONTARIO
Priorix® (MMR) MMR-II® (MMR)	MMR at 12 mths	6 mths[4]	4 wks-6 wks[4, 5, 6, 7, 9, 10] in consultation with Infectious Diseases	**2 doses recommended** Initial dose as MMR; second dose in combination with varicella (MMRV)[2] If first dose given <12 mths, 2 additional doses of measles-containing vaccine are required after the child is >12 mths old (and at least 4 wks after previous dose) to ensure long lasting immunity[4, 10]	**YES** Ideally defer transplant for 4 wks following vaccine administration[1, 6]	May be done prior to vaccination Post-serology NOT routinely recommended[4] Consider post serology if first dose <12 mths or if functionally immunosuppressed[4, 5]	Covered by MOHLTC
Priorix-Tetra® (MMR-V) ProQuad® (MMR-V)[3]	MMRV at 4-6 yrs[2]	**Priorix-Tetra®** 9 mths[8] **ProQuad®** 12 mths[3]	4 wks[3, 4, 8, 16] In consultation with Infectious Diseases				

NOTES:

- Upper limit for MMR-V products is 12 yrs of age.
- Use of immune globulin or other antibody-containing blood products: Delay immunization for 3 to 11 mths depending on the product to avoid vaccine failure secondary to passively acquired varicella/measles antibodies [https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-1-key-immunization-information/page-11-blood-products-human-immune-globulin-timing-immunization.html].
- Blood products of human origin contain significant amounts of antibodies to infectious agents such as measles virus and varicella zoster virus (VZV). Administration of IVIG preparations can interfere with the immune responses to live virus vaccines given concomitantly with or shortly before or after the vaccine. The duration of interference with the immune response to the vaccine is related to the amount of antibody in the Ig preparation.[4, 16]
- If the interval between administration of any of these vaccines and subsequent administration of an IVIG preparation is less that the recommended intervals, immunization should be repeated at 3 mths or longer, unless serologic test indicates that the antibodies were produced.[4.16] [https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-1-key-immunization-information/page-11-blood-products-human-immune-globulin-timing-immunization.html].
- Egg allergy is NOT a contraindication to MMR or MMRV vaccine-trace amount of egg protein appears insufficient to elicit a hypersensitivity reaction in egg allergic individuals.[4]

CONCOMITANT ADMINISTRATION OF VACCINES LISTED IN THIS TABLE:

- Measles, mumps and rubella vaccine may be given at the same time as the inactivated polio vaccine (IPV), diphtheria, tetanus and pertussis vaccines (DTPw/DTPa) and Haemophilus influenzae type b (Hib) as well as hepatitis A and B, meningococcal B, meningococccal C conjugate, meningococcal polysaccharide groups Ac, C, W- 135 and Y conjugate and pneumococcal polysaccharide vaccines if they are administered at separate injection sites.[4, 8, 9, 10]
- Per NACI, a minimum interval of 4 wks between 2 varicella-containing vaccines is acceptable under exceptional circumstances.With resepct to other live vaccinations: NACI recommends that if the live vaccines were not given concomitantly, a minimum interval of 4 wks interval should be observed between admnistration of other live vaccines.[4]

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3.2 LIVE VACCINES: VARICELLA – PRE-TRANSPLANT GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	ROUTINE SCHEDULE (ONTARIO)	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL BETWEEN DOSES	NUMBER OF DOSES REQUIRED	RECOMMEND PRE-TRANSPLANT	SEROLOGY PRE/POST VACCINATION	COVERAGE IN ONTARIO
Varivax® III (Varicella only) Varilrix® (Varicella only)	Varicella at 15 mths[15]	12* mths (varicella alone)	**Varivax®** 4 wks[8, 10, 12, 13, 25] **Varilix®** 6 wks[26]	**2 doses recommended** Initial dose as varicella vaccine; second dose in combination with MMR (MMR-V)	**YES** Ideally defer transplant for 4 wks following vaccine administration[1, 10]	**YES** Check serology minimum 4-6 wks[8, 11] following last dose	Covered under MOHLTC
Priorix-Tetra® (MMR-V) ProQuad® (MMR-V)	MMR-V at 4-6 yrs[15]	**Priorix-Tetra®** 9 mths[3] **ProQuad®** 12 mths[2]	4 wks[2, 10, 14, 16, 17]				

NOTES:

- *Varicella vaccine may be given at 9 mths[3, 8, 11, 12, 26] in consultation with Infectious Diseases.
- Upper limit for MMR-V products is 12 yrs of age.
- Use of immune globulin or other antibody-containing blood products: Delay immunization for 3 to 11 mths depending on the product to avoid vaccine failure secondary to passively acquired varicella/measles antibodies.[14] https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-1-key-immunization-information/page-11-blood-products-human-immune-globulin-timing-immunization.html
- Blood products of human origin contain significant amounts of antibodies to infectious agents such as measles virus and varicella zoster virus (VZV). Administration of IVIG preparations can interfere with the immune responses to live virus vaccines given concomitantly with or shortly before or after the vaccine. The duration of interference with the immune response to the vaccine is related to the amount of antibody in the Ig preparation.[13, 14]
- If the interval between administration of any of these vaccines and subsequent administration of an IVIG preparation is less that the recommended intervals, immunization should be repeated at 3 mths or longer, unless serologic test indicates that the antibodies were produced.[13, 14] https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-1-key-immunization-information/page-11-blood-products-human-immune-globulin-timing-immunization.html
- Refer to product monographs for information regarding potential allergens such as neomycin, gelatin and egg protein.
- Contraindicated in patients with history of anaphylaxis after previous administration of the vaccine or with proven immediate/anaphylactic hypersensitivity to any component of the product.
- Egg allergy is NOT a contraindication to MMR-V vaccine-trace amount of egg protein appears insufficient to elicit a hypersensitivity reaction in egg allergic individuals.[14]
- Close contacts should be vaccinated against varicella if they do not have a previous history of chicken pox. Isolate contacts from the transplant recipient if they develop a varicella-like rash (>50 lesions).[7, 27]

CONCOMITANT ADMINISTRATION OF VACCINES LISTED IN THIS TABLE:

- Varicella vaccine can be administered concomitantly with diphtheria and tetanus toxoids and pertussis vaccine adsorbed (DTaP) and Haemophilus b (Hib) conjugate vaccine.
- MMR vaccine can be administered concomitantly with diphtheria and tetanus toxoids and pertussis vaccine adsorbed, Haemophilus b conjugate vaccine and inactivated polio (IPV) vaccine if given at separate sites.[4, 9, 10]
- MMR-V vaccines: Priorix Tetra® can be given at the same time as DTaP, Hib and IP vaccines if administered at separate sites.3 ProQuad® can be given at the same time as Hib, Hepatitis B, Hepatitis Aand pneumococcal vaccines if given at separate sites. There is insufficient evidence with DTaP and no data with IP vaccine.[2]
- Per NACI, a minimum interval of 4 wks between 2 varicella-containing vaccines is acceptable under exceptional circumstances.With resepct to other live vaccinations: NACI recommends that if the live vaccines were not given concomitantly, a minimum interval of 4 wks interval should be observed between admnistration of other live vaccines.[14]

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3.3 LIVE VACCINES: ROTAVIRUS – PRE-TRANSPLANT GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	ROUTINE SCHEDULE (ONTARIO)	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL BETWEEN DOSES	NUMBER OF DOSES REQUIRED	RECOMMEND PRE-TRANSPLANT	SEROLOGY PRE/POST VACCINATION	COVERAGE IN ONTARIO
Rotavirus oral vaccine Rotarix® RotaTeq® (Not interchangeable)	**Rotarix®** 2 and 4 mths[1, 2, 4] **RotaTeq®** 2, 4, 6 mths[1, 2, 5]	6 wks[2, 4, 5]	4 wks[2, 4, 5]	**Rotarix®** **2 doses**[2] All doses completed by <25 wks of age[1, 2, 4] **RotaTeq®** **3 doses** All doses completed by <32 wks of age[1, 2, 5]	**YES** As per suggested schedule if no contraindication Ideally defer transplant for 4 wks following vaccine administration[1, 6]	NO	**Rotarix®** Covered by MOHLTC for infants: 6-25 wks of age

NOTES:

- Contraindicated with history of intussusceptions[4, 5], severe combined immunodeficiency disorder (SCID).[2, 4, 5]
- Infants with moderate to severe gastroenteritis should have rotavirus vaccine deferred until clinical condition improves, unless deferral will result in first dose being given >15 wks.[2] If an incomplete dose is administered for any reason (for example, infant spits or regurgitates the vaccine) a replacement dose should NOT be administered.[2]
- Live virus sheds in stool; care with diaper changes.[4, 5]
- Typically NOT be given in hospital due to risk of transmission.
- Siblings may receive vaccine however careful handwashing recommended. Older transplant recipients should not change/handle their vaccinated sibling's diapers for 10 days following vaccine dose.[2]

CONCOMITANT ADMINISTRATION OF VACCINES LISTED IN THIS TABLE:

- Rotavirus oral vaccines may be given at the same time as other routine vaccinations (diphtheria, tetanus, pertussis, Haemophilus influenzae type b, inactivated polio, hepatitis B, pneumococcal vaccines as well as meningococcal serogroup C conjugate vaccine).[4,5]

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4.0 PRE-TRANSPLANT: INFLUENZA VACCINES

4.0 INFLUENZA VACCINES: PRE-TRANSPLANT GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	ROUTINE SCHEDULE (ONTARIO)	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL BETWEEN DOSES	NUMBER OF DOSES REQUIRED	RECOMMEND PRE-TRANSPLANT	SEROLOGY PRE/POST VACCINATION	COVERAGE IN ONTARIO
Influenza Vaccine availability may vary annually Quadrivalent Inactivated: Flulaval® Tetra Fluzone® Quad Flucelvax® Quad Influvac® Tetra Afluria® Tetra (age ≥5 yrs) Trivalent Inactivated, Adjuvanted: Fluad Pediatric™ (age 6-23 mths)	Yearly	6 mths[1]	Annual	**6 mths-<9 yrs, no previous influenza vaccination:** 2 doses, 4 wks apart[1, 2, 5] **6 mths-<9 yrs, previous influenza vaccination:** 1 dose[1] **≥9 yrs:** 1 dose[1]	**YES** Quadrivalent vaccine preferred for paediatric patients	NO	Covered by MOHLTC for all patients at risk
Live-attenuated Influenza Vaccine (LAIV) quadrivalent: FluMist®	Yearly	2 yrs[1]	Annual	**2 to < 9 yrs, no prior influenza vaccination:** 2 doses, 4 wks apart[1, 2, 3, 6] **2 to < 9 yrs, previous influenza vaccination:** 1 dose[1] **≥9 yrs:**1 dose[1]	Reserve FluMist® for needle averse patients; less data regarding efficacy in the CKD population Recommendations may vary across international jurisdictions. Defer transplant for 2 wks following vaccine administration to ensure adequate response[9, 10]		

NOTES:

- If a quadrivalent vaccine is not available, any of the available trivalent vaccines licensed for the pertinent age group should be used.[1]

CONCOMITANT ADMINISTRATION OF VACCINES LISTED IN THIS TABLE:

- The National Advisory Committee on Immunization (NACI) states that administering the most widely used live and inactivated vaccines during the same patient visit has produced seroconversion rates and rates of adverse reactions similar to those observed when the vaccines are administered separately.[1]
- NACI recommends that vaccines administered simultaneously should be given using separate syringes at separate sites.[1]
- As a precaution, siblings who have been vaccinated with LAIV should avoid contact with recently transplanted patients who are still in hospital for one wk following LAIV dose.[9, 27, 31]

CONTRAINDICATIONS:

- Persons who have developed an anaphylactic reaction to a previous dose of influenza vaccine or any of its components (with the exception of egg*), have developed Guillain-Barre Syndrome (GBS) within 6 wks of influenza vaccination.[1]
- *Egg allergic individuals can be vaccinated with influenza vaccine with inactivated TIV and QIV or LAIV without an influenza skin test and with the full dose of the vaccine.[1] There is low risk of adverse reaction to trace amounts of ovalbumin exist in the current influenza vaccines.[1]
- Consult individual product monographs for specific warnings in this regard.

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5.0 PRE-TRANSPLANT: TRAVEL VACCINES

5.1 ENTEROTOXIGENIC E COLI – PRE-TRANSPLANT TRAVEL GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL PRIOR TO TRAVEL	NUMBER OF DOSES REQUIRED	MINIMUM INTERVAL BETWEEN DOSES	INDICATION PRE-TRANSPLANT	SEROLOGY REQUIRED PRE/POST VACCINATION	COVERAGE IN ONTARIO
Enterotoxigenic E coli Dukoral® (Oral, inactivated)	2 yrs[1]	2 wks[1]	**Primary immunization** **2 doses*** 1st dose 2 wks before departure; 2nd dose 1 wk following first dose and at least 1 wk before departure **Booster** Every 3 mths if in area of ongoing risk[2]. If more than 5 yrs have passed since primary immunization or last booster dose, repeat primary series.[2]	1 wk[1, 2]	**YES** If indicated[2]	NO	Not routinely covered by ON-MOHLTC

NOTES:

*If 6 wks elapses between doses patient will need to repeat the primary series.

Dukoral dose is prepared differently for younger children. See below:

- Open the white sachet of powder and pour into 150 ml (5 oz) of cool water.
- Stir gently with spoon to dissolve.
- Do not use any other liquid.
- For children aged 2–6 yrs, pour away half of the powder/water mixture before adding the vaccine component.[1]

REFERENCES:

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5.2 HEPATITIS A – PRE-TRANSPLANT TRAVEL GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL PRIOR TO TRAVEL	NUMBER OF DOSES REQUIRED	MINIMUM INTERVAL BETWEEN DOSES	INDICATION PRE-TRANSPLANT	SEROLOGY REQUIRED PRE/POST VACCINATION	COVERAGE IN ONTARIO
Hepatitis A AVAXIM® AVAXIM® PED HAVRIX® HAVRIX® JR VAQTA® VAQTA® PED (Interchangeable) *IM inj*	6 mths[2]	2-4 wks Vaccination up until the day of travel may still provide some protection[2]	**2 doses** (Refer to dosing table below)	6 mths	**YES** If indicated Recommended for ALL transplant candidates	NO	Not covered routinely by ON MOHLTC except for **HIGH RISK*** individuals
Combination Hepatitis A Vaccines Hep A + Hep B Twinrix® Twinrix® Junior	12 mths[12]		**Twinrix®** **2 doses** **Twinrix® Junior** **3 doses**	**Twinrix®** 6 mths **Twinrix® Jr** 1 mth between 1st and 2nd dose; 6 mths between 1st and 3rd dose	**YES*** *NACI does not recommend the use of Twinrix® and Twinrix® Jr in patients who are functionally immunosuppressed or hyporesponsive (e.g. ESRD dialysis patients)[2]		Not covered routinely by ON MOHLTC

TABLE 1: CANADIAN IMMUNIZATION GUIDE (NACI)- HEPATITIS A DOSING RECOMMENDATIONS FOR MONOVALENT HEPATITIS A VACCINES[1]

VACCINE	ANTIGEN*	VOLUME	SCHEDULE (BOOSTER)	AGE[t]
Avaxim®	160 antigen units HAV	0.5 mL	0, (6-36) mths	12 yrs and older
Avaxim Ped®	80 antigen units HAV	0.5 mL	0, (6-36) mths	6 mths-<16 yrs
Havrix®	1440 ELISA units HAV	1 mL	0, (6-12) mths[‡]	19 yrs and older
Havrix Jr®	720 ELISA units HAV	0.5 mL	0, (6-12) mths	6 mths-<19 yrs
Vaqta®	50 units HAV	1 mL	0, (6-18) mths	18 yrs and older
Vaqta Ped®	25 units HAV	0.5 ml	0, (6-18) mths	6 mths-<18 yrs

*There is no international standard for HAV measurement. Each manufacturer uses its own units of measurement.

[t] Ages for which the vaccine is approved.

[‡] Studies have shown that 720 ELISA units provides an effective booster dose in those over 19 yrs of age.

NOTE:

- Comparable to the results reported in clinical trials of children more than 12 mths, all reviewed studies have consistently shown that vaccination of infants 6-12 mths with inactivated HA vaccines is immunogenic and safe.
- The manufacturer of Twinrix and Twinrix Jr has not authorized use of the combination products in children <1 yr of age.
- ***HIGH RISK** includes patients with chronic liver disease, patients awaiting liver transplants, and individuals living in communities at risk of hepatitis A (HA) outbreaks or in which HA is endemic[2]

REFERENCES:

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5.3 HEPATITIS B – PRE-TRANSPLANT TRAVEL GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL PRIOR TO TRAVEL	NUMBER OF DOSES REQUIRED	MINIMUM INTERVAL BETWEEN DOSES	INDICATION PRE-TRANSPLANT	SEROLOGY REQUIRED PRE/POST VACCINATION	COVERAGE IN ONTARIO
Hepatitis B RECOMBIVAX HB® **OR** ENGERIX® B (Interchangeable) *IM inj* For routine schedule refer to Publicly Funded Immunization Schedules for Ontario	Newborn[2]	Accelerated schedule available given on Days 0, 7, 21 with booster at 6-12 mths (upon return from travel)[¥, 10]	**3 dose schedule preferred** (0, 1 and 6 mths) if travel not imminent[2] (Various dosing schedules available, refer to dosing tables below)	7 days after first dose, 14 days after second dose[2, 10]	**YES** If indicated If functionally immunosuppressed (asplenic, hypersplenic), receiving immunosuppressant for underlying condition or hyporesponsive (e.g. ESRD dialysis) consider **double the microgram dose for age**; use 3 or 4 dose schedule.[2] Defer transplant for 2 wks following vaccine administration to ensure adequate response.	**YES** 6-8 wks post series[¥] (range 1-6 mths)[2] Repeat series if antibody response is suboptimal (< 10 IU/L) (If higher dose used initially, ensure higher dose used for repeat[2]) If non-responsive to repeat series, consult ID	Not covered routinely by ON MOHLTC except for **HIGH RISK*** individuals
Combination Hepatitis A+B Twinrix® Twinrix® Junior *IM*	12 mth[12]	If departing in <21 days and needing both HA & HB vaccines, use monovalent vaccines and complete the series after travel[2]	**Twinrix®** **2 doses** **Twinrix® Junior** **3 doses**	**Twinrix®** 6 mths[12] **Twinrix® Junior** 1 mth between 1st and 2nd dose[12] 6 mths between 1st and 3rd dose[12]	NACI does not recommend the use of Twinrix® or Twinrix® Jr in immunosuppressed or hyporesponsive (e.g ESRD dialysis) patients[2]		

[¥] Expert Opinon

TABLE 1: CANADIAN IMMUNIZATION GUIDE (NACI)- HEPATITIS B STANDARD DOSING RECOMMENDATIONS1 FOR PAEDIATIC PATIENTS (3 OR 4 DOSE SCHEDULE ONLY):

RECIPIENTS	RECOMBIVAX HB®			ENGERIX® B		
	µg	mL	SCHEDULE (MTHS)	µg	mL	SCHEDULE (MTHS)
Infants (regardless of mothers' HBV status)	5	0.5	0, 1, 6**	10	0.5	0, 1, 6 **OR** 0, 1, 2, 12
12 mths-19 yrs	5	0.5	0, 1, 6**	10	0.5	0, 1, 6 **OR** 0, 1, 2, 12

*Thimerosal preservative-free preparation is recommended.

**Although a schedule of 0, 1 and >2 mths is approved, the preferred schedule is 0, 1, and 6.

TABLE 2: HEPATITIS B-REVISED DOSING GUIDELINES FOR TRANSPLANT (ADAPTED FROM CANADIAN IMMUNIZATION GUIDE-NACI) NOTE: DOSES LISTED ARE DOUBLE THE ROUTINE AGE RECOMMENDED DOSE

RECIPIENTS	RECOMBIVAX HB®			ENGERIX® B		
	µg	mL	SCHEDULE (MTHS)	µg	mL	SCHEDULE (MTHS)
Infants (regardless of mothers' HBV status)	10	1	0, 1, 6**	20	1	0, 1, 6 **OR** 0, 1, 2, 12
12 mths-19 yrs	10	1	0, 1, 6** **OR** 0, 1, 2, 12 for dialysis, chronic renal failure, and some immuno-compromised individuals	20	1	0, 1, 6 **OR** 0, 1, 2, 12
16 to <20 yrs	10	1	0, 1, 6** OR 0, 1, 2, 12 for dialysis, chronic renal failure, and some immuno-compromised individuals	40	2	0, 1, 2, 6 (CIG) particularly for ESRD/ dialysis patient

*Thimerosal preservative-free preparation recommended;

**Although schedule of 0, 1 and >2 mths is approved, the preferred schedule is 0, 1, and 6.

TABLE 3: TWINRIX® AND TWINRIX JR® DOSING SCHEDULE[11]						
AGE	TWINRIX®			TWINRIX® JR		
	µg	mL	SCHEDULE (MTHS)	µg	mL	SCHEDULE (MTHS)
1 yr- <16 yrs	20	1	0, 6-12	10	0.5	0, 1, 6
16- <19 yrs	–	–	–	10	0.5	0, 1, 6

There are no data to support the use of Twinrix® and Twinrix® Jr on an accelerated schedule in children.[11]

The manufacturer of Twinrix and Twinrix Jr has not authorized use of the combination products in children <1 yr of age.

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5.4 JAPANESE ENCEPHALITIS – PRE-TRANSPLANT TRAVEL GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL PRIOR TO TRAVEL	NUMBER OF DOSES REQUIRED	MINIMUM INTERVAL BETWEEN DOSES	INDICATION PRE-TRANSPLANT	SEROLOGY REQUIRED PRE/POST VACCINATION	COVERAGE IN ONTARIO
Japanese encephalitis IXIARO® (Inactivated) *IM inj*	2 mths[3, 4, 7]	Consult travel clinic	**2 doses**[3, 7] Children younger than 3 yrs of age receive half of the adult dose[7] If primary series was administered ≥1 yr ago, a booster dose should be given prior to potential re-exposure or if there is a continued risk for JEV infection[2, 7]	28 days	**YES** If indicated[1, 4]	NO	Not covered routinely by ON-MOHLTC

NOTES:

Children receive 2 doses, 28 days apart[7]:

- 2 mths-<3 yrs of age: 0.25 mL per single dose.
- Refer to product monograph for Special Handling Instructions for preparing a 0.25 mL dose.
- 3 yrs-<18 yrs of age: 0.5 mL per single dose.

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5.5 RABIES – PRE-TRANSPLANT TRAVEL GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL PRIOR TO EXPOSURE OR TRAVEL	NUMBER OF DOSES REQUIRED	MINIMUM INTERVAL BETWEEN DOSES	INDICATION PRE-TRANSPLANT	SEROLOGY REQUIRED PRE/POST VACCINATION	COVERAGE IN ONTARIO
Rabies IMOVAX® RabAvert® (inactivated vaccine) (Can be used interchangeably) *IM* 1 mL	Newborn[1]	7 days	**Pre-Exposure Prophylaxis** **3 doses** Day 0, 7 and between day 21 to 28[2] **Post-Exposure prophylaxis** Day 0, 3, 7 and 14 (immunocompromised patients should receive 5th dose on Day 28)[2, 3, 8]	Interval varies depending on prescribed prophylaxis	**Pre-Exposure** No; unless immunocompromised and expecting intense animal exposure or who will be distant from medical care **Post-Exposure Prophylaxis** Yes, if indicated[2]	**Pre Exposure** NO **Post Exposure** Consider serology 7 to 14 days post-completion of series[2, 3] If titre <0.5 re-vaccinate with 2nd series	Pre-exposure prophylaxis is not routinely covered by ON MOHLTC Post-exposure immunization is covered by OHIP for exposures in Ontario
Rabies Pasteurized immune globulin IMOGAM® (rabies immune globulin)			Recommended dose of RabIg: 20 IU/kg body weight for all age groups[2] Given on Day 0[2]	N/A			

Whenever possible, the complete complement of vaccines should be administered before transplantation. Vaccines noted to be safe for administration after transplantation may not be sufficiently immunogenic after transplantation.[2]

Persons with egg allergies are not necessarily at increased risk of a hypersensitivity reaction to RabAvert®. However, for pre-exposure vaccination, an alternative vaccine, Imovax®, should be used in patients with a history of hypersensitivity reactions to egg or egg products. If an alternative vaccine is not available, post-exposure prophylaxis using RabAvert should be administered with strict medical monitoring. Facilities for emergency treatment of anaphylactic reactions should be available.[2]

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5.6 TYPHOID (SALMONELLA TYPHI) – PRE-TRANSPLANT TRAVEL GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL PRIOR TO TRAVEL	NUMBER OF DOSES REQUIRED	MINIMUM INTERVAL BETWEEN DOSES	INDICATION PRE-TRANSPLANT	SEROLOGY REQUIRED PRE/POST VACCINATION	COVERAGE IN ONTARIO
Salmonella Typhi (parenteral inactivated) TYPHIM Vi® *IM*	2 yrs[1, 2]	14 days prior to travel[1, 2]	**1 dose**	N/A	**YES** If indicated[2, 3] Immunosuppressed transplant candidates should only receive inactivated vaccine Re-immunize by IM route every 3 yrs if ongoing risk[1, 2, 3] Re-immunization by PO route every 7 yrs if ongoing risk[2, 8]	Not required[2]	Not covered routinely by ON MOHLTC
Oral, LIVE attenuated Vivotif®	5 yrs[8]	7 days following last dose of capsules	4 enteric-coated capsules* taken on alternate days (7-day course)[8]				Not covered routinely by ON MOHLTC

Whenever possible, the complete complement of vaccines should be administered before transplantation. Vaccines noted to be safe for administration after transplantation may not be sufficiently immunogenic after transplantation.

*Vivotif capsules MUST be swallowed whole, 1 hour before or 2 hours after a meal.[8]

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5.7 YELLOW FEVER – PRE-TRANSPLANT TRAVEL GUIDELINES

NAME OF VACCINE PRODUCTS AVAILABLE IN CANADA	MINIMUM AGE FOR 1ST DOSE	MINIMUM INTERVAL PRIOR TO TRAVEL	NUMBER OF DOSES REQUIRED	MINIMUM INTERVAL BETWEEN DOSES	INDICATION PRE-TRANSPLANT	SEROLOGY REQUIRED PRE/POST VACCINATION	COVERAGE IN ONTARIO
Yellow Fever YF-VAX® (LIVE attenuated) *SC inj*	9* mths[1, 9]	10 days[2, 9] (Neutralizing antibodies develop 10 days after vaccination in 80% of immunized persons[2])	**1 dose**[1, 2, 9] Booster only required every 10 yrs[1, 2] if patient meets certain criteria	N/A	**YES** If indicated based on travel destination[1] In general, not recommended for transplant candidates who are receiving immunosuppressive medications[2]	For patients who become immunocompromised following immunization, serologic testing should be considered two to five yrs post-immunization[2]	Not routinely covered by MOHLTC

Whenever possible, the complete complement of vaccines should be administered before transplantation.[2]

*If travel is unavoidable, the decision to vaccinate infant between 6 to <9 mths needs to balance the risk of YF exposure with the risks of vaccination (increased risk of encephalitis) in this age group.[2]

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