Immunization against vaccine-preventable diseases is one of the most beneficial public health measures available. However, utilization rates among adults remain low, well below target levels (see Table 1). Immunization by vaccination is a topic that has traditionally been within the bailiwick of pediatricians. Nonetheless, adolescents and adults cannot be thought of and treated simply as big children. Barriers to adult immunization are high and involve a number of financial, informational, and operational obstacles. Nevertheless, vaccination provides the longest lasting and most effective protection against disease at any age. A number of childhood immunizations, moreover, do not provide lifelong immunity against some diseases, including tetanus, diphtheria, and pertussis (whooping cough). Adults may require booster shots to maintain immunity, and adults who were not adequately immunized as children may be at risk of infection from other vaccine-preventable diseases and may also infect others. Adults who contract measles, mumps, or pertussis may infect infants who may not be fully immunized. Adults and adolescents, unlike young children, are at risk for vaccine-preventable diseases, such as genital warts, hepatitis B virus, and herpes zoster (HZ). Some immunizations are required seasonally, especially influenza vaccination, in order to prevent what can be a very serious illness for individuals over 65-years-of-age, infants, and children or adults with underlying chronic conditions. Individuals who do not get immunized are at risk of influenza infection and can also infect others. Individuals who travel abroad may also require immunizations. Diseases rarely found in Canada may be common in other parts of the world. Immunizations offer the most effective protection against diseases, such as hepatitis A, measles, polio, and yellow fever.

Tetanus, Diphtheria, Pertussis

Although unrelated, these three bacterial diseases are usually discussed together, as all can be prevented by the same combination vaccine, Tdap. Tetanus or lockjaw is an acute, often fatal, illness caused by a toxin produced by the bacterium Clostridium tetani. Diphtheria is another acute, toxin-mediated illness provoked by the microbe Corynebacterium diphtheriae. The third disease covered by the Tdap vaccine is pertussis, an infection caused by the bacterium Bordetella pertussis. Pertussis is highly communicable, with secondary attack rates of 80%; it is most severe in younger adults and
children. The most common complication of pertussis, and the leading cause of death, is secondary pneumonia. The incidence of tetanus and diphtheria in Canada is very low due to the availability of effective vaccines. Since 2000, approximately four cases of tetanus have been reported yearly, most of which followed acute injury or wounds. For diphtheria, the corresponding average incidence was 310 cases per year. An increase in incidence was observed in adolescents and adults due to low vaccine effectiveness in the population cohort that was immunized with the vaccine available between 1980 and 1997. The incidence of pertussis has decreased in the 15- to 19-year age group from 18.7 cases per 100,000 in 2003 to 2.8 cases per 100,000 in 2009.

Varicella, HZ

In the prevaccine era, it is estimated that there were approximately 350,000 varicella cases and 1,500 to 2,000 varicella-related hospitalizations each year in Canada. Following introduction of publicly funded varicella vaccination in Ontario, varicella-related hospitalizations, emergency department use, and visits to physicians’ offices decreased by 53%, 43%, and 45%, respectively. Varicella in adults tends to be more severe than varicella in children. The rate of breakthrough varicella disease following one dose of varicella vaccine has been estimated at 7.2% over a 10-year follow-up period. American data estimate the overall effectiveness of a single dose vaccination program to be between 70% and 90% in preventing varicella disease of any severity and 95% in protecting against severe varicella for at least 7 to 10 years after immunization.

In recent studies, the lifetime risk of HZ has been estimated to be as high as 30% in the general population. In Canada, it is estimated that, each year, there are 130,000 new cases of HZ, 17,000 cases of postherpetic neuralgias (PHN), and 20 HZ-related deaths, which result in 252,000 physician consultations and 2,000 hospitalizations. The incidence of HZ and PHN, as well as the duration and severity of HZ were significantly reduced in vaccine recipients in large clinical trials of people 60-years-of-age and older. Overall vaccine efficacy was 51.3% for HZ incidence and 66.5% for PHN.

Human Papilloma Virus (HPV)

The HPV vaccine is highly effective in preventing persistent infection and cervical cancer caused by HPV types 6, 11, 16, 18. In women 16- to 26-years-of-age, the efficacy of quadrivalent human papilloma virus vaccine (HPV4) against HPV types 16- and 18, which are related to cervical disease, is nearly 100%; efficacy against external genital lesions related to HPV.
types 6, 11, 16, or 18, including genital warts, is 95% to 99%. In men 16- to 26-years-of-age, HPV4 vaccine efficacy against the HPV types related to external genital lesions is 84% to 100%. Among HPV naïve women between 15- and 26-years-of-age, vaccination with HPV4 resulted in an overall reduction in abnormal PAP smears of 17.5% and a 42.3% reduction in the requirement for cervical definitive therapy.2

Pneumococcal Disease

The 23-valent pneumococcal polysaccharide vaccine (Pneu-P-23) leads to a persistent functional antibody response in adults and protects against invasive pneumococcal disease, such as bacteremia and meningitis, but only inconclusive evidence exists regarding its efficacy against pneumonia.3 The 13 valent conjugate pneumococcal vaccine (Pneu-C-13) was developed for greater immunogenicity for children under two-years-of-age, a booster effect upon reimmunization as well as possible eradication of the carrier state and noninvasive disease. The Pneu-C-13 vaccine has proven useful in children, but no evidence has yet been presented of superiority to Pneu-P-23 in adults. Pneu-C-13 and Pneu-P-23 in sequence have neither apparent benefit nor contraindication in healthy adults, but they are recommended by some authorities for immunocompromised adults.

Summary

Adults should receive the influenza vaccine once annually and the Td every 10 years. The elderly who are in contact with children should receive Tdap instead of Td every 10 years. If no history of immunization or negative laboratory tests for immunity are available, every adult should receive a single course of immunization for varicella, HPV (in young adulthood), MMR, as well

### Table 2: Recommended Adult Immunization Schedule by Vaccine and Age Group

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Age Group</th>
<th>19-21</th>
<th>22-26</th>
<th>27-49</th>
<th>50-59</th>
<th>60-64</th>
<th>65 or &gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenza</td>
<td></td>
<td>1 dose annually</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tetanus, diphtheria, (+/-) pertussis (Td/Tdap)</td>
<td>1 time dose of Tdap; then boost with Td every 10 years&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Td/Tdap&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Varicella</td>
<td></td>
<td>2 doses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human papilloma virus (HPV) Female</td>
<td></td>
<td>3 doses</td>
<td></td>
<td></td>
<td>No recommendation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human papilloma virus (HPV) Male</td>
<td></td>
<td>3 doses&lt;sup&gt;c&lt;/sup&gt;</td>
<td>No recommendation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zoster</td>
<td></td>
<td>No recommendation</td>
<td>1 dose</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measles, mumps, rubella (MMR)</td>
<td></td>
<td>1 or 2 doses</td>
<td>1 dose&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumococcal (polysaccharide)</td>
<td></td>
<td>1 or 2 doses&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1 dose</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meningococcal</td>
<td></td>
<td>1 or more doses&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepatitis A</td>
<td></td>
<td>2 doses&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepatitis B</td>
<td></td>
<td>3 doses&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

<sup>a</sup> For all persons who meet the age requirements and who lack documentation of vaccination or have no evidence of previous infection.

<sup>b</sup> Tdap recommended for ≥ 65 if contact with < 12-month-old child. Either Td or Tdap can be used if no infant contact.

<sup>c</sup> Three doses recommended for males age 19 to 21. Three doses recommended for males age 22 to 26 if they have never received HPV vaccine and some other risk factor is present (e.g., on the basis of medical, occupational, lifestyle, or other indications).

<sup>d</sup> Recommended if some other risk factor is present (e.g., on the basis of medical, occupational, lifestyle, or other indications). Under the age of 65, pneumococcal vaccine is given only when risk factors are present. In such patients some authorities recommend 2 doses: a dose of Pneu-C-13 followed in eight weeks by a dose of Pneu-P-23.
as pneumococcal disease, and zoster when over the age of 65. Immunocompromised individuals, as well as individuals with travel, occupational, lifestyle, medical, or other problematic exposures, need specialized attention, which is beyond the scope of the current publication (see Table 3).

**Questions and Answers**

1) Does the pneumococcal vaccine require booster doses in adults?

No. Over the age of 65, only a single dose is given to healthy adults. Under the age of 65, pneumococcal vaccines are given only when risk factors are present. In such patients, some authorities recommend two doses: a dose of Pneu-C-13 followed in eight weeks by a dose of Pneu-P-23.

2) How do travellers get specialized vaccines, (*i.e.* yellow, fever, cholera, typhoid, *etc.*)?

There is no single schedule for the administration of immunization to travellers. Each schedule must be personalized according to the traveller’s age, immunization history, existing medical conditions, countries to be visited, the duration and nature of travel, the legal requirements for entry into countries being visited, and the amount of time available before

### Table 3: Additional Indications for Adult Immunization

<table>
<thead>
<tr>
<th>Asplenia/functional asplenia:</th>
<th>Situational/occupational exposure:</th>
<th>Travel–related exposure:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meningococcal conjugate vaccine</td>
<td>Meningococcal conjugate vaccine</td>
<td>Meningococcal conjugate vaccine</td>
</tr>
<tr>
<td><em>Haemophilus influenzae</em> type b (Hib) conjugate vaccine</td>
<td>Hepatitis A vaccine (HAV)/hepatitis B vaccine</td>
<td>HAV vaccine</td>
</tr>
<tr>
<td>Rabies vaccine</td>
<td>Rabies vaccine</td>
<td>Cholera vaccine</td>
</tr>
<tr>
<td>Bacille Calmette-Guérin vaccine</td>
<td>Vaccinia (smallpox) vaccine</td>
<td>Japanese encephalitis vaccine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poliovirus vaccine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Typhoid vaccine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yellow fever vaccine</td>
</tr>
</tbody>
</table>

### Back to the Refugees

The following immunizations were recommended for these three women. Inactivated poliovirus vaccine (IPV) and HAV are recommended because of the possibility of return to Nigeria, which has significant rates of both endemic HAV and polio.

**17-year-old**
- TdaP x 1
- Td x 2
- Varicella x 2 (if negative history)
- MMR x 1
- Polio (IPV) x 3
- HAV x 2
- HBV x 3 (if indicated by lifestyle)

**38-year-old**
- TdaP x 1
- Td x 2
- Varicella x 2 (if negative history)
- MMR x 1
- Polio (IPV) x 3
- HAV x 2
- HBV x 3 (if indicated by lifestyle or occupation)

**76-year-old**
- TdaP x 1
- Td x 2
- Varicella x 2 (if negative history)
- MMR x 1
- Polio (IPV) x 3
- HAV x 2
- HBV x 3 (if indicated by lifestyle or occupation)
- Zoster x 1 (if positive history)
- MMR x 1
- Pneumococcal x1
Vaccine utilization rates among adults remain low; in fact, they are well below target levels. Adults may require booster shots to maintain immunity. Adults who were not adequately immunized as children may be at risk of infection from other vaccine preventable diseases and may also infect others. Adults who contract measles, mumps, or pertussis may infect infants who may not yet be fully immunized. Adults and adolescents, unlike young children, are at risk for vaccine-preventable diseases, such as genital warts, hepatitis B virus, and HZ.

Take-home Message

Vaccine utilization rates among adults remain low; in fact, they are well below target levels. Adults may require booster shots to maintain immunity. Adults who were not adequately immunized as children may be at risk of infection from other vaccine preventable diseases and may also infect others. Adults who contract measles, mumps, or pertussis may infect infants who may not yet be fully immunized. Adults and adolescents, unlike young children, are at risk for vaccine-preventable diseases, such as genital warts, hepatitis B virus, and HZ.

3) How should immunocompromised individuals be vaccinated?

There is potential for serious illness and death in the underimmunization of immunocompromised people. However, the inappropriate use of live vaccines can cause serious adverse events in some immunocompromised hosts as a result of uncontrolled replication of the virus or bacterium. The decision to recommend for or against any particular vaccine will depend upon a careful, case-by-case analysis of the risks and benefits. Details can be found in the Canadian Immunization Guide.

Resources

References

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