Prevalence and Risk of Blood-borne Pathogens in the Canadian Blood Supply

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Medical Director, Medical Microbiology, Canadian Blood Services
September 26, 2015
“It usually takes me two or three days to prepare an impromptu speech.”
— Mark Twain
Outline

• Current prevalence of ‘classical’ transfusion transmissible infections in CBS blood donors.
• ‘New’ Infectious diseases – 1999 to 2010
• Emerging, re-emerging Infectious Diseases
• How we prepare for and manage new risks.
• New paradigms for risk management

Confirmed TD (viruses and syphilis) Positive Allogeneic Donors 2002 – 2014

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>HBV</td>
<td>93</td>
<td>95</td>
<td>77</td>
<td>66</td>
<td>72</td>
<td>78</td>
<td>84</td>
<td>61</td>
<td>77</td>
<td>69</td>
<td>73</td>
<td>60</td>
<td>54</td>
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<tr>
<td>HCV</td>
<td>94</td>
<td>81</td>
<td>82</td>
<td>73</td>
<td>77</td>
<td>82</td>
<td>74</td>
<td>65</td>
<td>57</td>
<td>64</td>
<td>51</td>
<td>50</td>
<td>56</td>
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<td>HIV</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>2</td>
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<td>HTLVI/II</td>
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<td>13</td>
<td>12</td>
<td>13</td>
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<td>11</td>
<td>9</td>
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<td>10</td>
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<tr>
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<td>54</td>
<td>55</td>
<td>38</td>
<td>28</td>
<td>39</td>
<td>27</td>
<td>33</td>
<td>29</td>
<td>30</td>
<td>47</td>
<td>29</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>WNV</td>
<td>-</td>
<td>14</td>
<td>0</td>
<td>13</td>
<td>8</td>
<td>66</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>20</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

24 Chagas confirmed positive donors from May 2010 – Dec. 2014
### Estimated residual risk in Canada using incidence rates from observed donor seroconversions 2006-2009*

<table>
<thead>
<tr>
<th>Virus</th>
<th>Window period in days (95% CI)</th>
<th>Incidence rate from repeat donors (per 100,000 person years)</th>
<th>Residual Risk for all donors per million donations (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV</td>
<td>9.5 (8.2-10.8)</td>
<td>0.40</td>
<td>1:8</td>
</tr>
<tr>
<td>HCV</td>
<td>8.0 (6.8-9.2)</td>
<td>0.56</td>
<td>1:6.7</td>
</tr>
<tr>
<td>HBV</td>
<td>38.3 (33-43.7)</td>
<td>0.48</td>
<td>1:1.7</td>
</tr>
</tbody>
</table>


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**Wine Pairing in the Stone Age**

"Simple rule of thumb; if it tries to eat us, serve with red. If it runs away from us, serve with white."

Do not use without permission from Dr. M. Fearon
New Testing Paradigms

• **West Nile virus** (Universal donor testing 2003)
  – Seasonal WNV testing (June 2015)
    – *All donors tested from June 1 to November 30*
    – *Only donors with travel outside Canada tested Dec. 1 – May 31*

• **Chagas Disease** (*Trypanosoma cruzi*) (May 2010)
  – Test donors at risk only:
    – *Born or lived in an endemic country (South America, Central America, Mexico)*
    – *Mother or maternal grandmother born or lived in an endemic country*
Infectious Disease Outbreaks that impact Security of Supply

• Sars, Pandemic Influenza
  – Contingency planning for:
    – *Shortage of staff, and donors due to illness*
    – *Shortage of critical supplies*
    – *Staff and donor education*
    – *Infection control procedures in clinic*
    – *Donor deferral criteria*

“Clearly there has been a lack of imagination about how much can go wrong.”

Rachel Maddow
Emerging Infectious Disease Risks

*Babesiosis*

- Babesiosis is caused by a protozoan parasite (*Babesia microti, duncani*) spread by infected ticks.
- Most infections asymptomatic or unrecognized
- Incubation 1-6wks. (9 post transfusion)
  - Flu like symptoms
  - Severe: hemolytic anemia, thrombocytopenia, renal failure, ARDS
- Overall mortality ~5% (higher if at-risk)
  - i.e. immunocompromised,
  - asplenics,
  - Transfusion – transmitted cases 160 reported cases from 1979 – 2009 in the U.S., one case reported in Canada.

- Majority of U.S. Cases reported in:
  - Connecticut
  - Massachusetts
  - Rhode Is.
  - New York State
  - New Jersey
  - Wisconsin

1,762 reported cases of babesiosis by county of residence (27 states) 2013. CDC January 2015
Hepatitis E

- Common viral hepatitis clinically similar to hepatitis A
- Genotypes 1 and 2 common in developing countries, generally transmitted via contaminated water.
- Travel is not the only risk factor. Endemic cases (genotypes 3 and 4) occur in developed countries.
- Contact with pigs, raw pork a risk factor?
- Prevalence in Canada is unknown.
- No cases of transfusion transmission reported in North America but cases have been reported in endemic countries and recently in the U.K.

Dengue

- Two viruses common in the tropics.
- Spread by mosquitoes (Aedes aegypti, Aedes albopictus).
- Similar acute illness – fever, rash, muscle and joint pain. Similar incubation 3-7 days.
- Dengue (‘breakbones fever’) is currently more widespread.
- Chikungunya (‘that which bends up’) just arrived in the Caribbean in 2013.
- A few clusters of transfusion transmitted dengue reported.
- No cases of TT chikungunya reported to date.
- Current malaria travel deferral covers many but not all affected areas.
‘In preparing for battle, I have always found that plans are useless but planning is indispensable.’

Dwight D. Eisenhower

Preparing for Emerging Infectious Disease Risks

- **Surveillance**
  - PHAC, WHO, CDC, ProMED mail
  - Collaboration with public health:
    - *Diagnostic testing data from National Microbiology Laboratory and provincial Public Health Laboratories*
    - Collaboration with Veterinarians, Etymologists, Ornithologists
    - *Animal, Bird, Tick and Mosquito surveillance data*

- **Seroprevalence studies** on our donors

- **Donor surveys** – risk behaviours, travel

- **Risk based decision making** (Alliance of Blood Operators)
Centers for Disease Control and Prevention

Canadian Data

Public Health Agency of Canada (National Microbiology Lab)

520 confirmed Chikungunya antibody Positive patients Jan.1 2014 - July 1, 2015 (25% (112) are PCR positive)

Travel documented for only 1/3 of cases, but of those, 90% travelled to the Caribbean.

ProMED mail

EBOLA UPDATE (110): WHO, SUSPECTED, FUNDING, RESEARCH

A ProMED-mail post

ProMED-mail is a program of the International Society for Infectious Diseases

In this update:

WHO Ebola data and statistics [data up to 20 Sep 2015]
WHO situation report [data to 20 Sep 2015]
Ebola survivors suffer complications
Suspected, funding, research


Cumulative cases & deaths as of dates shown

Guinea – as of 20 Sep 2015

Confirmed 3340 (2079)
Probable 453 (453)
Suspected 7 (not available)
Total 3800 (2532) [3 cases in past 21 days]

Liberia (a) – 7 Sep 2015

Confirmed 6 (2) no additional cases
Probable 0 (not available)
Suspected (not available) [not available] Total 6 (2) [0 cases in past 21 days]

Liberia (b) – up to 9 May 2015

Confirmed 3151 (not available)
Probable 1879 (not available)
Suspected 5636 (not available)
Total 10666 (4806)

ProMED-mail
Results of Active Tick Surveillance 2008-2012

Ogden N. et al
Environmental Risk from Lyme Disease in central and eastern Canada: a summary of recent surveillance information. CCDR 2014;40:58-67

Known and suspected Lyme-disease endemic locations

Ogden N. et al
Environmental Risk from Lyme Disease in central and eastern Canada: a summary of recent surveillance information. CCDR 2014;40:58-67
Map of Manitoba showing active surveillance data of the percentage of *Babesia microti* positive ticks, the number of positive rodents and the 2013 human case overlaying the percentage of donations by census division.*

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Results: CBS and Héma Quebec Seroprevalence Study

*Babesia microti* IgG Antibody

**Samples tested (n= 13,993) from July 15, 2013 – Dec. 11, 2013**

<table>
<thead>
<tr>
<th>No. Tested</th>
<th>Clinic</th>
<th>Babesia microti IgG Ab. Test Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Negative</td>
</tr>
<tr>
<td>158</td>
<td>Toronto</td>
<td></td>
</tr>
<tr>
<td>6364</td>
<td>South Central Ontario</td>
<td></td>
</tr>
<tr>
<td>1765</td>
<td>N.S./N.B.</td>
<td>1765</td>
</tr>
<tr>
<td>1775</td>
<td>Winnipeg</td>
<td>1775</td>
</tr>
<tr>
<td>3931</td>
<td>Hema Quebec</td>
<td>3931</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>13,993</td>
</tr>
</tbody>
</table>

**Results: CBS and Héma Quebec Seroprevalence Study**

*Hepatitis E Antibody*

**Table 1: Anti-HEV Data (n = 4110)**

<table>
<thead>
<tr>
<th>No. Tested</th>
<th>Collection Site</th>
<th>Anti-HEV Result</th>
<th>Seroprevalence rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>NEG</td>
<td>POS</td>
</tr>
<tr>
<td>1469</td>
<td>South Central Ontario</td>
<td>1383</td>
<td>86</td>
</tr>
<tr>
<td>333</td>
<td>N.S./N.B.</td>
<td>327</td>
<td>6</td>
</tr>
<tr>
<td>356</td>
<td>Winnipeg</td>
<td>338</td>
<td>18</td>
</tr>
<tr>
<td>1952</td>
<td>Quebec</td>
<td>1821</td>
<td>131</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>3869</td>
<td>241</td>
</tr>
</tbody>
</table>

**PCR Results:** Of **13,993** donors tested there were **0 PCR positives**
Results: CBS and Hema Quebec Seroprevalence Study
Odds ratios of positive results for antibody to hepatitis E virus by demographic variables

<table>
<thead>
<tr>
<th>Demographic Variable</th>
<th>n Positive</th>
<th>n Negative</th>
<th>% Positive</th>
<th>Odds Ratio</th>
<th>95% Confidence Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>95</td>
<td>1,791</td>
<td>5.04</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>146</td>
<td>2,070</td>
<td>6.59</td>
<td>1.33</td>
<td>(1.02 - 1.74)</td>
</tr>
<tr>
<td>Under 30</td>
<td>15</td>
<td>921</td>
<td>1.60</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>30-39</td>
<td>10</td>
<td>524</td>
<td>1.87</td>
<td>1.17</td>
<td>(0.52 - 2.63)</td>
</tr>
<tr>
<td>40-49</td>
<td>30</td>
<td>727</td>
<td>3.96</td>
<td>2.53</td>
<td>(1.35 - 4.75)</td>
</tr>
<tr>
<td>50+</td>
<td>186</td>
<td>1,689</td>
<td>9.92</td>
<td>6.76</td>
<td>(3.97 - 11.51)</td>
</tr>
</tbody>
</table>
### CBS Donor Travel Survey 2014

Table 5 - Weighted percentages of travel destinations of all whole blood donors in the survey sample, and the projected number of donors in the donor population with travel outside Canada in the past 12 months

<table>
<thead>
<tr>
<th>Travel destinations</th>
<th>All respondents (n=8,908)</th>
<th>CBS Donors (N=415,829)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% of sample</td>
<td>Projected Number Donors</td>
</tr>
<tr>
<td>United States</td>
<td>48.0</td>
<td>199,628</td>
</tr>
<tr>
<td>Mexico</td>
<td>7.1</td>
<td>29,530</td>
</tr>
<tr>
<td>Caribbean</td>
<td>9.3</td>
<td>38,852</td>
</tr>
<tr>
<td>South America</td>
<td>0.7</td>
<td>3,035</td>
</tr>
<tr>
<td>Central America</td>
<td>0.5</td>
<td>1,984</td>
</tr>
<tr>
<td>Europe</td>
<td>9.8</td>
<td>40,625</td>
</tr>
<tr>
<td>Middle East</td>
<td>0.6</td>
<td>2,689</td>
</tr>
<tr>
<td>Africa</td>
<td>0.4</td>
<td>1,468</td>
</tr>
<tr>
<td>Asia</td>
<td>2.1</td>
<td>8,527</td>
</tr>
<tr>
<td>Australia / New Zealand / South Pacific</td>
<td>1.0</td>
<td>4,238</td>
</tr>
</tbody>
</table>

Note: A donor could select more than one travel destination.

### CBS Donor Travel Survey 2014

Table 8 - Weighted percentages and projected number of whole blood donors who would return to donate 14 or 28 days post-travel by various travel destination scenarios

<table>
<thead>
<tr>
<th>Travel destinations</th>
<th>All respondents (n=8,908)</th>
<th>CBS Donors (N=415,829)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% of sample</td>
<td>Projected Number Donors</td>
</tr>
<tr>
<td>Caribbean travel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return to donate within 14 days</td>
<td>0.5</td>
<td>1,984</td>
</tr>
<tr>
<td>Return to donate within 28 days</td>
<td>1.6</td>
<td>6,545</td>
</tr>
<tr>
<td>Travel outside of Canada and US</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return to donate within 14 days</td>
<td>1.9</td>
<td>7,930</td>
</tr>
<tr>
<td>Return to donate within 28 days</td>
<td>5.9</td>
<td>24,368</td>
</tr>
<tr>
<td>Travel to AZ, CA, FL, HI, or outside of Canada and US</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return to donate within 14 days</td>
<td>3.0</td>
<td>12,562</td>
</tr>
<tr>
<td>Return to donate within 28 days</td>
<td>9.1</td>
<td>37,967</td>
</tr>
</tbody>
</table>

Based on weighted percentages of travel and self-reported duration until returning to donate in the 2014 Travel Survey and projected number of donors based on number of donors in 2013.

Travel outside of Canada and US included all travel destinations whether tropical or not.
Estimate Risk of Transfusion Transmission of Chikungunya in Canada

- Risk Based on Cases in the Caribbean (PAHO data):
  1 in 8,659,932 donations (1 in 15,172,895 – 1 in 6,060,606)

- Risk Based on Imported Cases from the Caribbean (Laboratory Testing Data):
  1 in 11,803,847 donations (1 in 27,935,302 – 1 in 7,462,687)

Risk-Based Decision-Making Framework for Blood Safety

Changing the Decision-Making Paradigm

Sponsored by the ABO, a team of experts gathered to map out a strategy to change the decision-making paradigm.

- A health sector focus
  - A consistent, standardised approach to decision-making

- Evidence-based decisions using risk assessment tools
  - Acceptable risk based on societal considerations

- Multiple sectors included in the decision-making process
If you think preparedness is expensive, try disease.

Mary Daschler (paraphrased)