Estimating the Global Burden of HCV Infections Associated with Unsafe Health Care Injections

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Background

- Modes of HCV transmission that are predominant in industrialized countries are unlikely to account for most infections in developing and transitional countries.
- HCV has been originally perceived as a pathogen associated with transfusion of contaminated blood.
  - “Non-A non-B post transfusion hepatitis”
- Injections may account for a substantial proportion of new infections.
Objectives of the Study

• Estimate the number of new HCV infections attributable to unsafe health care injections in 2000
• Estimate the future global burden of disease associated with HCV infections acquired through unsafe health care injections in 2000
Methods

• Model
• Input parameters for injection practices
• Input parameters for HCV epidemiology
• Validation
Methods

- Model
  - Original mass action model (Kane et al. 1999)
  - Adapted to fit the “Comparative risk assessment” WHO project
    - Estimation of the proportion exposed to at least one contaminated injection
    - Estimation of relative risks associated with receiving at least one contaminated injection
    - Analysis by age, gender and 14 regions
- Input parameters for injection practices
- Input parameters for HCV epidemiology
- Validation
Modelling of the Burden of Disease Attributable to Unsafe Injections: Kane et al. 1999

\[ P(\text{infection}) = 1 - (1 - P(\text{susceptible}) \times P(\text{exposure}) \times P(\text{transmission}))^n \]

Annual probability of infection from injections

Prevalence of susceptibility

Prevalence of active infection \times \text{prop of re-use of equipment}

Annual no of injections

Probability of infection if re-used syringe/needle

Methods

- Model
- Input parameters for injection practices
  - Two parameters
    - Annual number of injections per person
    - Proportion of injections given with reused equipment
  - Literature review
  - Standardized decision-making algorithm for regional estimates
  - Truncation of injection frequency estimates above 90th percentile
- Input parameters for HCV epidemiology
- Validation
Methods

• Model
• Input parameters for injection practices
• Input parameters for HCV epidemiology
  – WHO country prevalence estimates averaged by regions
  – Catalytic models used to estimate incidence on the basis of prevalence (Equilibrium assumed)
  – Susceptibility estimated by age on the basis of prevalence and catalytic models
  – 1.8% transmission potential (needlestick studies)
  – Future deaths estimated on the basis of natural history and background mortality
• Validation
Methods

• Model used
• Input parameters for injection practices
• Input parameters for HCV epidemiology
• Validation
  - Comparison of the attributable fraction obtained with the results of epidemiological studies
Safe and Unsafe Injections by Region, 2000

- Injections given with non-sterile equipment
- Injections given with sterile equipment

Regions:
- AMRB
- EURB
- AMRD
- AFRE
- AFRD
- SEARB
- WPRB
- EURC
- SEARD
- EMRD

Number of injections per person and per year
### HCV Infections Attributable to Unsafe Injections, 2000

<table>
<thead>
<tr>
<th>Region</th>
<th>Attributable fraction</th>
<th>Number of infections</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFR D</td>
<td>16.4%</td>
<td>54 681</td>
</tr>
<tr>
<td>AFR E</td>
<td>13.0%</td>
<td>54 131</td>
</tr>
<tr>
<td>AMR B</td>
<td>0.9%</td>
<td>2 282</td>
</tr>
<tr>
<td>AMR D</td>
<td>9.2%</td>
<td>6 304</td>
</tr>
<tr>
<td>EMR D</td>
<td>81.7%</td>
<td>645 486</td>
</tr>
<tr>
<td>EUR B</td>
<td>0.9%</td>
<td>2 110</td>
</tr>
<tr>
<td>EUR C</td>
<td>21.2%</td>
<td>35 668</td>
</tr>
<tr>
<td>SEAR B</td>
<td>30.8%</td>
<td>94 873</td>
</tr>
<tr>
<td>SEAR D</td>
<td>59.5%</td>
<td>498 166</td>
</tr>
<tr>
<td>WPR B</td>
<td>37.6%</td>
<td>608 200</td>
</tr>
<tr>
<td>World</td>
<td>39.9% *</td>
<td>2 001 901 **</td>
</tr>
</tbody>
</table>

* Uncertainty analysis: 18.2-66.7%

* Uncertainty analysis: 913 254- 3 347 885
Proportion of New HCV Infections Attributable to Contaminated Health Care Injections, 2000

Note: estimates represent averages for each region, not specific estimates for individual countries
## Studies Examining the Association between Health Care Injections and HCV Infection

<table>
<thead>
<tr>
<th>Author</th>
<th>Year of study</th>
<th>Country</th>
<th>Design</th>
<th>Types of cases</th>
<th>AF *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thuring</td>
<td>1990-1991</td>
<td>Cambodia</td>
<td>Survey</td>
<td>Prevalent</td>
<td>90.6%</td>
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<tr>
<td>Chen</td>
<td>1990-1994</td>
<td>China</td>
<td>Case control</td>
<td>Incident</td>
<td>20.1%</td>
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<tr>
<td>Chang</td>
<td>1991</td>
<td>China</td>
<td>Survey</td>
<td>Prevalent</td>
<td>50.4%</td>
</tr>
<tr>
<td>Mohamed</td>
<td>1996</td>
<td>Egypt</td>
<td>Survey</td>
<td>Prevalent</td>
<td>9.9%</td>
</tr>
<tr>
<td>Ho</td>
<td>1993</td>
<td>China</td>
<td>Case control</td>
<td>Prevalent</td>
<td>51%-88%</td>
</tr>
<tr>
<td>Luby</td>
<td>1994</td>
<td>Pakistan</td>
<td>Case control</td>
<td>Prevalent</td>
<td>1.4% - 62.9%</td>
</tr>
<tr>
<td>El Sakka</td>
<td>1996-1997</td>
<td>Egypt</td>
<td>Case control</td>
<td>Incident</td>
<td>87.9%</td>
</tr>
<tr>
<td>Sun</td>
<td>1992</td>
<td>China</td>
<td>Case control</td>
<td>Prevalent</td>
<td>44.4%</td>
</tr>
<tr>
<td>Khan</td>
<td>1995</td>
<td>Pakistan</td>
<td>Case control</td>
<td>Prevalent</td>
<td>24.4% - 78.5%</td>
</tr>
<tr>
<td>Sun</td>
<td>1994</td>
<td>China</td>
<td>Case control</td>
<td>Incident</td>
<td>36.4%</td>
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</tbody>
</table>

* Attributable fraction
# Association between Various Exposures and HCV Infection in Selected Studies

<table>
<thead>
<tr>
<th>Author</th>
<th>Injections</th>
<th>Transfusions</th>
<th>Dental care</th>
<th>Surgery</th>
<th>Razor</th>
<th>Tattoos</th>
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<tbody>
<tr>
<td>Thuring</td>
<td>+</td>
<td>-</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Chen</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>N/A</td>
<td>-</td>
</tr>
<tr>
<td>Chang</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mohamed</td>
<td>+</td>
<td>N/A</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ho</td>
<td>+</td>
<td>-</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-</td>
</tr>
<tr>
<td>Luby</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>N/A</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>El Sakka</td>
<td>+</td>
<td>+</td>
<td>N/A</td>
<td>-</td>
<td>N/A</td>
<td>-</td>
</tr>
<tr>
<td>Sun</td>
<td>+</td>
<td>+</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-</td>
</tr>
<tr>
<td>Khan</td>
<td>+</td>
<td>-</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Sun</td>
<td>+</td>
<td>-</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-</td>
</tr>
</tbody>
</table>

* Attributable fraction
Future Early Deaths Due to Injection-Associated HCV Infections, 2000-2030 (Total 23,700)

WprB
EnvD
SearD
SearB
AfrE
EurC
AfrD
EurB
AmrD
AmrB

Number of deaths

0 1000 2000 3000 4000 5000 6000 7000 8000
Elements Supporting that Unsafe Health Care Injections Account for a High Proportion of New HCV Infections in Developing and Transitional Countries

- High attributable fraction in epidemiological studies
- Low prevalence of history of blood transfusion and injection drug use among case-patients
- High frequency of injections
- High prevalence in the population in some countries that can only be explained by a widespread exposure
Limitations

- Limited availability of injection practices studies
- Limited number of epidemiological studies based upon incident HCV infection cases
- No inclusion of the dynamic effect into the model
- Breaks in infection control practices only included reuse of injection equipment and did not include:
  - Multi-dose vials
  - Work in contaminated environment
  - Breaks in universal precautions in other settings
- Poor documentation of the natural history of HCV infection, particularly in developing countries
Conclusions

- Unsafe health care injections is a major cause of HCV infection worldwide
- Unsafe health care injections may be a driving force of HCV introduction in selected communities
  - Egypt
  - Pakistan
- Safe and appropriate use of injections may help curbing the hidden epidemic of HCV infection in developing and transitional countries
Future Perspectives

• Upcoming cost effectiveness model
• Development of an “Injection safety planner”
  – HIV prevention programmes to communicate risks
  – Essential drugs to ensure procurement
  – EPI to “bundle” AD syringes with vaccines
  – Health system to manage sharps waste
• Ongoing work on the burden of disease associated with HCV infection
  – Revisions of epidemiological and natural history parameters ahead
• Ongoing work on burden associated with needlestick injuries
• Need to further study the modes of HCV transmission in developing countries
For More Information...

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Email: sign@who.int

www.injectionsafety.org