Historical epidemiology of hepatitis C virus (HCV) in select countries – volume 2


1Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, India; 2St. James’s Hospital, Dublin, Ireland; 3Department of Gastroenterology and Hepatology, Erasmus MC University Medical Center Rotterdam, Rotterdam, The Netherlands; 4Departamento de Gastroenterología, Instituto Nacional de Ciencias Médicas y Nutrición “Salvador Zubirán”, Vasco de Quiroga No. 15, Delegación Tlalpan, México, D.F., México; 5Division of Hepatology, Department of Medicine, University of Cape Town and Groote Schuur Hospital, Cape Town, South Africa; 6Liver Unit, Cemrad Medical Center, Bruce Rappaport Faculty of Medicine, Technion, Israeli Institute of Technology, Haifa, Israel; 7Department of Gastroenterology, Helsinki University Central Hospital, Helsinki, Finland; 8Christchurch Hospital and University of Otago, Christchurch, New Zealand; 9Department of Gastroenterology, All India Institute of Medical Sciences, New Delhi, India; 10Department of Infectious Diseases, Helsinki University Central Hospital, Helsinki, Finland; 11HCV Task Force, Indian National Association for the Study of Liver, Indraprastha Apollo Hospital, Sarita Vihar, New Delhi, India; 12Division of Medical Virology, Department of Pathology, Faculty of Health Sciences, Stellenbosch University, Stellenbosch, South Africa; 13Centre Hospitalier de Luxembourg, Luxembourg City, Luxembourg; 14Centre de Recherche Public de la Santé, Strassen, Luxembourg; 15Department of Infectious Diseases, Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia; 16The Hepatitis Foundation of New Zealand, Whakatane, New Zealand; 17Liver Disease Center, Sheba Medical Center, Tel Hashomer and the Sackler School of Medicine, Tel-Aviv University, Tel-Aviv, Israel; 18Trinity College, Dublin, Ireland; 19University of Rosario School of Medicine, Rosario, Argentina; 20Center for Disease Analysis (CDA), Louisville, Colorado, USA; 21Hospital of Infectious Diseases #1, Moscow, Russia; 22Canterbury District Health Board, Christchurch, New Zealand; 23Department of Gastroenterology and Hepato-Biliary Sciences, Fortis Memorial Research Institute, Gurgaon, Haryana, India; 24Reference Center for Viral Hepatitis, Central Research Institute of Epidemiology, Moscow, Russia; 25UMAE # 25 Instituto Mexicano del Seguro Social, Monterrey, N.L., Mexico; 26Trimbos Institute, Utrecht, The Netherlands; 27Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia; 28Department of Infectious Diseases, Akershus University Hospital, Oslo, Norway; 29Sección Hepatología, Hospital de Clínicas San Martín, Universidad de Buenos Aires, Buenos Aires, Argentina; 30Gomor Foundation, Ulaanbaatar, Mongolia; 31Department of Gastroenterology and Hepatology, Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia; 32University Medical Center Groningen, Groningen, The Netherlands; 33Department of Infectious Diseases and Hepatology, Medical University of Bialystok, Bialystok, Poland; 34Italian Hospital of Buenos Aires, Buenos Aires, Argentina; 35Auckland Hospital Clinical Studies Unit, Auckland, New Zealand; 36Department of Infectious Diseases and Hepatology, CMUMK Bydgoszcz, Bydgoszcz, Poland; 37Department of Hygiene, Epidemiology and Medical Statistics, Athens University Medical School, Athens, Greece; 38New Zealand Needle Exchange Programme, Christchurch, New Zealand; 39Health Directorate, Luxembourg City, Luxembourg; 40St. Vincent’s University Hospital, Dublin, Ireland; 411st Department of Internal Medicine, SZU, Bratislava, Slovak Republic; 42Clinic of Infectious Diseases, Medical Faculty, Kosice, Slovak Republic; 431st Department of Internal Medicine, Medical Faculty, PJ Safárik University, Kosice, Slovak Republic; 44Instituto Nacional de Ciencias Médicas y Nutrición, Tlalpan, Mexico; 45IIA Consulting, Krakow, Poland; 46Department of Infectology and Travel Medicine, Medical Faculty, PJ Safárik University, Kosice, Slovak Republic; 47Tel-Aviv University, Tel-Aviv, Israel; 48Liver Unit, Shaarey Zedek Medical Center, Jerusalem, Israel; 49Department of Internal Medicine, University of Witwatersrand, Johannesburg, South Africa; 50The Clinical Diagnostics and Research Center, Moscow, Russia; 51Liver Research Unit, Medica Sur Clinic
SUMMARY. Chronic hepatitis C virus (HCV) infection is a leading cause of liver related morbidity and mortality. In many countries, there is a lack of comprehensive epidemiological data that are crucial in implementing disease control measures as new treatment options become available. Published literature, unpublished data and expert consensus were used to determine key parameters, including prevalence, viremia, genotype and the number of patients diagnosed and treated. In this study of 15 countries, viremic prevalence ranged from 0.13% in the Netherlands to 2.91% in Russia. The largest viremic populations were in India (8 666 000 cases) and Russia (4 162 000 cases). In most countries, males had a higher rate of infections, likely due to higher rates of injection drug use (IDU). Estimates characterizing the infected population are critical to focus screening and treatment efforts as new therapeutic options become available.

Keywords: diagnosis, disease burden, epidemiology, HCV, hepatitis C, incidence, mortality, prevalence, treatment.

INTRODUCTION

The epidemiology of hepatitis C virus (HCV) infection remains poorly understood in many countries. At the same time, HCV-related mortality continues to increase as the infected population ages [1] and HCV-related morbidity is forecasted to increase as the infected population advances to late-stage liver diseases [2–4].

Abbreviations: CHS, Clalit Health Services; G, Genotype; HCV, hepatitis C virus; HPSC, Health Protection Surveillance Centre; IDU, injection drug use; MELD, Model for End Stage Liver Disease; Peg-IFN, Pegylated interferon; RBV, ribavirin; RNA, ribonucleic acid; THL, National Institute for Health and Welfare; UN, United Nations.

Correspondence: Vivek A. Saraswat, MD, DM, Department of Gastroenterology, Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS), Lucknow 226014, India.

E-mail: vivek@sgpgi.ac.in

†Denotes senior authors for each country.

© 2014 John Wiley & Sons Ltd
In 2010, the World Health Assembly adopted resolution WHA 63.18 that recognized viral hepatitis as a global public health problem [5]. By 2014, the World Health Organization adopted resolution WHA76.6 asking countries to develop comprehensive national hepatitis strategies [6]. However, countries require reliable data and an understanding of the disease dynamics to develop robust strategies.

A number of studies have characterized HCV infection rates across different countries/regions [7–12], but they have typically focused on quantifying the anti-HCV infections. This study is a continuation of a project to quantify HCV epidemiology in countries around the world in a systematic manner.

The aim of this study was to develop consensus estimates, using the best available published and unpublished data, for the total number of viremic infections [HCV ribonucleic acid (RNA) positive], the total number of viremic-diagnosed individuals, the number of viremic newly diagnosed, annual number of treated patients and the number of liver transplants attributed to HCV in each country. The countries were selected based on the availability of published data and the willingness to collaborate. Other countries are being analysed and will be published separately.

METHODOLOGY

A systematic review of the literature was conducted to identify studies reporting the total number of HCV cases diagnosed, treated and cured. The review encompassed all studies between January 1990 and July 2013. Indexed articles were found by searching PubMed and Embase. Non-indexed sources were identified through individual countries’ ministry of health websites and international agencies’ reports. In addition, an expert panel in each country provided proceedings of local conferences, unpublished data and data from large liver centres that could be extrapolated to the national level.

Face-to-face meetings were conducted to review findings and analyses with the expert panel. When no input data were available, analogues (data from countries with a similar healthcare practice and/or risk factors) or expert inputs were used. Ranges were used to capture uncertainty in inputs, with wider ranges implying greater uncertainty.

Viremic infections represented current RNA-positive HCV, or chronic HCV infections. The term viremic was used throughout this study to highlight the presence of HCV. The term incidence was used for new HCV infections (acute or infections among immigrants entering the country) per calendar year and not newly diagnosed. Care was taken to collect and list the year of the reported collection since the data were reported over a wide range of years. As shown in the next publication in this supplement [13], a modelling approach was used to estimate the HCV-infected populations (viremic, diagnosed and treated) in 2013. Unless stated, population data were obtained from the United Nations’ (UN) population database by age, gender and five-year age cohort [14].

The annual number of liver transplants was gathered from national or international databases and adjusted for the proportion attributed to HCV. The number of antibody positive and RNA-positive-diagnosed cases was gathered from national databases, use of analogues or expert panel input. It was explicitly stated when published or official data were not available. In countries where HCV was a notifiable infection and a reliable annual number of newly diagnosed cases was reported, the total diagnosed cases was calculated by summing data from all years after taking into consideration the mortality among the diagnosed cases. In countries where the number of total and newly diagnosed cases was not available, expert panel input was used. Diagnosis rates from the known countries (analogues) were provided to the expert panel, and the panel selected one or more countries that had similar profiles. It was assumed that the viremic rate among the diagnosed population was the same as the total infected population, and the same viremic rate was used to estimate the number of viremic-diagnosed individuals.

Two methods were used to estimate the total number of treated HCV patients. In countries where reliable national data were available, the reported numbers were used. In other countries, the annual number of units of Pegylated-Interferon (Peg-IFN) or ribavirin (RBV) sold, as reported by IMS Health [15], were converted to treated patients using the average number of units per patient. The number of treated patients was calculated using the genotype distribution of the infected population (assumed the genotype distribution of the treated population was the same as the overall population), the duration of treatment for each genotype, the number of Peg-IFN or RBV units per week and the per cent of patients who completed their treatment (80% in most countries unless stated otherwise). The annual number of units was adjusted using inputs from the expert panel to account for uses other than HCV as well as potential under-reporting.

RESULTS

The results of the literature review, including estimates of antibody and viremic prevalence, genotype and viremic diagnosis, as well as annual treatment and liver transplants are shown in Table 1. Figure 1 shows the age and gender distribution of the HCV-infected population collected for each country.

Argentina

HCV-infected population

HCV epidemiology data are sparse in Argentina. The prevalence of anti-HCV in adults (individuals aged ≥20 years) was estimated at 1.50% based on expert consensus, with lower
Table 1 Hepatitis C virus (HCV) epidemiology by country

<table>
<thead>
<tr>
<th>Country's Population (000)</th>
<th>Argentina</th>
<th>Finland</th>
<th>Greece</th>
<th>India</th>
<th>Ireland</th>
<th>Israel</th>
<th>Luxembourg</th>
<th>Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCV Antibody Positive (000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cases</td>
<td>428</td>
<td>27</td>
<td>168</td>
<td>10 730</td>
<td>40</td>
<td>145</td>
<td>4.0</td>
<td>950</td>
</tr>
<tr>
<td>(133 - 829)</td>
<td>(21 - 34)</td>
<td>(91 - 245)</td>
<td>(6376 - 19 127)</td>
<td>(26 - 66)</td>
<td>(67 - 156)</td>
<td>(2.3 - 4.6)</td>
<td>(750 - 1090)</td>
<td></td>
</tr>
<tr>
<td>Prevalence</td>
<td>1.0%</td>
<td>0.5%</td>
<td>1.5%</td>
<td>0.8%</td>
<td>6.9%</td>
<td>2.0%</td>
<td>0.7%</td>
<td>1.0%</td>
</tr>
<tr>
<td>(0.3% - 2.0%)</td>
<td>(0.4% - 0.6%)</td>
<td>(0.8% - 2.1%)</td>
<td>(0.5% - 1.5%)</td>
<td>(0.6% - 1.5%)</td>
<td>(0.9% - 2.1%)</td>
<td>(0.4% - 0.9%)</td>
<td>(0.8% - 1.1%)</td>
<td></td>
</tr>
<tr>
<td>Viremic Infections (000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Viremic Cases</td>
<td>342</td>
<td>22</td>
<td>134</td>
<td>8666</td>
<td>30</td>
<td>110</td>
<td>3.1</td>
<td>619</td>
</tr>
<tr>
<td>Viremic Prevalence</td>
<td>0.8%</td>
<td>0.4%</td>
<td>1.2%</td>
<td>0.7%</td>
<td>0.7%</td>
<td>1.5%</td>
<td>0.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>(0.3% - 1.0%)</td>
<td>(0.3% - 0.5%)</td>
<td>(0.6% - 1.7%)</td>
<td>(0.4% - 1.2%)</td>
<td>(0.4% - 1.1%)</td>
<td>(0.7% - 1.6%)</td>
<td>(0.3% - 0.7%)</td>
<td>(0.8% - 1.1%)</td>
<td></td>
</tr>
<tr>
<td>Viremic Rate (%)</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>81%</td>
<td>75%</td>
<td>76%</td>
<td>77%</td>
<td>65%</td>
</tr>
<tr>
<td>Genotypes (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1a</td>
<td>20%</td>
<td>-</td>
<td>-</td>
<td>9%</td>
<td>42%</td>
<td>12%</td>
<td>-</td>
<td>18%</td>
</tr>
<tr>
<td>1b</td>
<td>38%</td>
<td>-</td>
<td>-</td>
<td>16%</td>
<td>14%</td>
<td>57%</td>
<td>-</td>
<td>31%</td>
</tr>
<tr>
<td>1 Other</td>
<td>1%</td>
<td>32%</td>
<td>45%</td>
<td>3%</td>
<td>-</td>
<td>-</td>
<td>55%</td>
<td>20%</td>
</tr>
<tr>
<td>2</td>
<td>59%</td>
<td>32%</td>
<td>45%</td>
<td>28%</td>
<td>56%</td>
<td>69%</td>
<td>55%</td>
<td>69%</td>
</tr>
<tr>
<td>3</td>
<td>22%</td>
<td>16%</td>
<td>7%</td>
<td>-</td>
<td>4%</td>
<td>8%</td>
<td>4%</td>
<td>21%</td>
</tr>
<tr>
<td>4</td>
<td>18%</td>
<td>46%</td>
<td>34%</td>
<td>64%</td>
<td>39%</td>
<td>20%</td>
<td>34%</td>
<td>7%</td>
</tr>
<tr>
<td>5</td>
<td>1%</td>
<td>6%</td>
<td>14%</td>
<td>7%</td>
<td>1%</td>
<td>3%</td>
<td>6%</td>
<td>0%</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0%</td>
<td>-</td>
<td>-</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Other</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2%</td>
</tr>
<tr>
<td>Diagnosed (Viremic)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cases</td>
<td>112 300</td>
<td>16 400</td>
<td>32 000</td>
<td>408 300</td>
<td>9900</td>
<td>22 000</td>
<td>2600</td>
<td>155 800</td>
</tr>
<tr>
<td>Annual Newly Diagnosed</td>
<td>4900</td>
<td>900</td>
<td>2000</td>
<td>52 600</td>
<td>800</td>
<td>2200</td>
<td>100</td>
<td>14 700</td>
</tr>
<tr>
<td>Treated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Number Treated</td>
<td>200</td>
<td>300</td>
<td>1970</td>
<td>15 000</td>
<td>400</td>
<td>1010</td>
<td>100</td>
<td>3100</td>
</tr>
<tr>
<td>Liver Transplants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Liver Transplants</td>
<td>329</td>
<td>56</td>
<td>57</td>
<td>375</td>
<td>61</td>
<td>75</td>
<td>10</td>
<td>101</td>
</tr>
<tr>
<td>HCV Liver Transplants</td>
<td>74</td>
<td>6</td>
<td>9</td>
<td>109</td>
<td>12</td>
<td>26</td>
<td>1</td>
<td>32</td>
</tr>
<tr>
<td>% due to HCV</td>
<td>22%</td>
<td>11%</td>
<td>16%</td>
<td>29%</td>
<td>20%</td>
<td>35%</td>
<td>13%</td>
<td>32%</td>
</tr>
<tr>
<td>Country's Population (000)</td>
<td>Mongolia</td>
<td>Netherlands</td>
<td>New Zealand</td>
<td>Norway</td>
<td>Poland</td>
<td>Russia</td>
<td>Slovak Republic</td>
<td>South Africa</td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------</td>
<td>-------------</td>
<td>-------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>----------------</td>
<td>--------------</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HCV Antibody Positive (000)</th>
<th>Total Cases</th>
<th>Prevalence</th>
<th>Year of Estimate</th>
<th>Virusemic Infections (000)</th>
<th>Total Virusemic Cases</th>
<th>Virusemic Prevalence</th>
<th>Year of Estimate</th>
<th>Virusemic Rate (%)</th>
<th>Year of Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(250 - 460)</td>
<td>(8.7% - 15.6%)</td>
<td>2013</td>
<td>(179 - 320)</td>
<td>(6.1% - 10.9%)</td>
<td>(70%)</td>
<td>2004</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(9 - 50)</td>
<td>(0.06% - 0.30%)</td>
<td>2009</td>
<td>(7 - 37)</td>
<td>(0.04% - 0.22%)</td>
<td>74%</td>
<td>2002-2005</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(35 - 94)</td>
<td>(0.8% - 2.1%)</td>
<td>2013</td>
<td>(27 - 72)</td>
<td>(0.6% - 1.6%)</td>
<td>76%</td>
<td>2013</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(22 - 35)</td>
<td>(0.5% - 0.7%)</td>
<td>2012</td>
<td>(18 - 28)</td>
<td>(0.4% - 0.6%)</td>
<td>80%</td>
<td>2001</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(197 - 380)</td>
<td>(0.5% - 1.0%)</td>
<td>2009</td>
<td>(138 - 266)</td>
<td>(0.4% - 0.7%)</td>
<td>70%</td>
<td>2003-2012</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4930 - 620)</td>
<td>(3.5% - 4.6%)</td>
<td>2010</td>
<td>(3500 - 4700)</td>
<td>(2.5% - 3.3%)</td>
<td>71%</td>
<td>2012</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(39 - 88)</td>
<td>(0.7% - 1.6%)</td>
<td>2011</td>
<td>(19 - 44)</td>
<td>(0.4% - 0.8%)</td>
<td>49%</td>
<td>2003-2007</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(320 - 810)</td>
<td>(0.6% - 1.6%)</td>
<td>2010</td>
<td>(246 - 623)</td>
<td></td>
<td>77%</td>
<td>2010-2012</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Genotype (%)</th>
<th>1a</th>
<th>-</th>
<th>-</th>
<th>44%</th>
<th>18%</th>
<th>2%</th>
<th>2%</th>
<th>1%</th>
<th>2%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1b</td>
<td>99%</td>
<td>-</td>
<td>-</td>
<td>11%</td>
<td>18%</td>
<td>77%</td>
<td>53%</td>
<td>69%</td>
<td>22%</td>
</tr>
<tr>
<td>1 Other</td>
<td>-</td>
<td>49%</td>
<td>-</td>
<td>4%</td>
<td>79%</td>
<td>55%</td>
<td>-</td>
<td>-</td>
<td>90%</td>
</tr>
<tr>
<td>1</td>
<td>99%</td>
<td>49%</td>
<td>55%</td>
<td>40%</td>
<td>79%</td>
<td>55%</td>
<td>69%</td>
<td>22%</td>
<td>7%</td>
</tr>
<tr>
<td>2</td>
<td>1%</td>
<td>10%</td>
<td>7%</td>
<td>9%</td>
<td>8%</td>
<td>4%</td>
<td>4%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>29%</td>
<td>35%</td>
<td>50%</td>
<td>14%</td>
<td>36%</td>
<td>7%</td>
<td>13%</td>
<td>32%</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>11%</td>
<td>-</td>
<td>1%</td>
<td>5%</td>
<td>-</td>
<td>1%</td>
<td>12%</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2%</td>
<td>-</td>
<td>2%</td>
<td>-</td>
<td>36%</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>-</td>
<td>1%</td>
<td>-</td>
<td>0%</td>
<td>-</td>
<td>1%</td>
<td>-</td>
<td>1%</td>
<td>7%</td>
</tr>
</tbody>
</table>

|------------------|------|-----------|------|------|-----------|------|-----------|-----------|

<table>
<thead>
<tr>
<th>Diagnosed (Viremic)</th>
<th>Total Cases</th>
<th>Annual Newly Diagnosed</th>
<th>Year of Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60 000</td>
<td>1300</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>12 000</td>
<td>700</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>20 000</td>
<td>900</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>12 000</td>
<td>1100</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>30 200</td>
<td>3000</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>1 789 500</td>
<td>55 900</td>
<td>2012</td>
</tr>
<tr>
<td></td>
<td>3 400</td>
<td>300</td>
<td>2012</td>
</tr>
<tr>
<td></td>
<td>54 600</td>
<td>100</td>
<td>2013</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treated</th>
<th>Annual Number Treated</th>
<th>Year of Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>200</td>
<td>2011</td>
</tr>
<tr>
<td></td>
<td>900</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>900</td>
<td>2011</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>2100</td>
<td>2011</td>
</tr>
<tr>
<td></td>
<td>5500</td>
<td>2011</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>2011</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>2011</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liver Transplants</th>
<th>Total Liver Transplants</th>
<th>Year of Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>135</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>110</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>204</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>2013</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>% due to HCV</th>
<th>Year of Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>38%</td>
<td>2013</td>
</tr>
<tr>
<td>12%</td>
<td>2013</td>
</tr>
<tr>
<td>36%</td>
<td>2013</td>
</tr>
<tr>
<td>23%</td>
<td>2013</td>
</tr>
<tr>
<td>28%</td>
<td>2013</td>
</tr>
<tr>
<td>32%</td>
<td>2013</td>
</tr>
<tr>
<td>23%</td>
<td>2013</td>
</tr>
<tr>
<td>5%</td>
<td>2013</td>
</tr>
</tbody>
</table>

HCV antibody prevalence – prevalence of past or active HCV infection, viremic prevalence – prevalence of active HCV infections, viremic rate – per cent of past or active infections who have an active infection, viremic-diagnosed – the number individuals diagnosed with an active infection, annual newly diagnosed – the number of active HCV infections diagnosed for the first time.
prevalence among younger individuals. A viremic rate of 80% was applied [16]. The total viremic population in 2013 was estimated at 342,000 individuals, corresponding to viremic prevalence of 0.83%. For the age and gender distribution of the infected population, a hybrid distribution was constructed using notification data for HCV infection [17].

© 2014 John Wiley & Sons Ltd
for individuals aged 0–59 years and transplant data [18] organized by age and gender for individuals aged ≥60 years. The notified and transplanted populations were aged to the year 2013, accounting for mortality and cured patients. The genotype distribution of the prevalent population was estimated using data from a population of over 200 treated patients [19], while the distribution of G1 subtypes was based on sentinel unit data [20].
Diagnosed
Estimates of the diagnosed population were based upon data for positive blood donations from the Pan American Health Organization [12]. The annual number of notifications was scaled up to account for diagnosis in other venues. There were an estimated 112 300 previously diagnosed cases in 2010 and 4900 newly diagnosed cases.

Treated
It was estimated that 200 patients annually were treated based on expert consensus and IMS data for standard units of Peg-IFN sold after adjustment to account for under-reporting.

Liver transplants
In 2013, there were 329 liver transplants performed in Argentina: 74 (22.4%) were attributable to HCV. The annual number of liver transplants was available from a national organ registry for the years 1999 to 2013 [18]. The proportion of liver transplants attributable to HCV was reported as 22.0% before the adoption of the Model for End Stage Liver Disease (MELD)-based allocation and 22.4% after MELD allocation [21].

Finland
HCV-infected population
There are no studies reporting anti-HCV prevalence in the general population in Finland. Thus, in 2012 expert consensus estimated the anti-HCV prevalence in the general population to be 0.49% using the known number of diagnosed cases in the country. The viremic rate was estimated to be 79.5% using a Norwegian study [22], corresponding to a viremic prevalence of 0.39% in 2012 with 21 800 infected individuals. The age and gender distribution was developed using diagnosed data from the National Institute for Health and Welfare (THL) [23]. The number of RNA-positive-diagnosed cases was available from 1995 to 2013. The diagnosed population was adjusted for mortality and cured, by year, and was aged to 2013. It was assumed that the age and gender distribution of the diagnosed population was reflective of the current distribution in Finland.

Diagnosed
The THL reported 16 400 patients living with a diagnosis [23] in 2013. There were 930 individuals newly diagnosed during the same year.

Treated
According to a panel of experts, 300–400 individuals were treated per year from 2008 to 2012.

Liver transplants
Liver transplant data were available through Scandiatransplant. In 2011, there were 56 liver transplants performed in Finland [24]. It was estimated that 1–6 liver transplants per year were attributable to HCV.

Greece
HCV-infected population
Estimates for prevalence were based upon data reported from a 2012 nationally representative phone survey conducted among Greek adults 18–70 years of age [25]. Prevalence rates were age-standardized and corrected for high-risk populations not included in the survey. The age-adjusted anti-HCV prevalence was 1.79%. When taking into account high-risk individuals, an anti-HCV prevalence of 1.87% was estimated for 2011. Assuming that the prevalence among individuals 0–17 years is 0.10%, the total prevalence was estimated at 1.47%. There are no robust studies to estimate the prevalence of HCV-RNA in Greece. A viremic rate of 80% was applied to this analysis [26], corresponding to a viremic prevalence of 1.18% (134 000 viremic infections) in 2011.

For the age and gender distribution of the infected population, data were available by birth year from more than 1200 patients participating in clinical trials or observational studies from multiple sites across Greece [27]. The population was adjusted for mortality and cure, and aged to 2012. The genotype distribution was developed using data from the nationwide HEPNET-GREECE cohort study which included patients from 20 centres from 1997 to 2006 [28].

Diagnosed
In 2011, it was estimated that 32 000 cases had been diagnosed. In the same year, it was estimated that 4000 individuals were newly diagnosed per year.

Treated
According to a previous study [25], 58% of diagnosed chronic HCV patients have ever been treated. This corresponds to approximately 15 700 treated patients through 2011. The same study and IMS data were used to estimate 1970 patients treated in 2011.

Liver transplants
Liver transplant data were available through the Hellenic Transplant Organization. In 2011, there were 57 liver transplants for Greek patients, and in 2013, there were 54 (25 performed in Greece and 29 performed abroad) [29]. It is estimated that 16.0% of transplants were attributable to HCV [29].

India
HCV-infected population
The anti-HCV seroprevalence was estimated at 0.84% in 2013. This estimate was calculated using a weighted aver-
age of published estimates from nonblood donor and non-
tribal population studies [30–39]. An anti-HCV range of
0.5%–1.5% was chosen from a consensus document pub-
lished by the HCV Taskforce of the Indian National Associ-
ation for the Study of the Liver (personal communication
with P. Puri 2014). A viremic rate of 80.8% [30] was
used, corresponding to 0.68% (0.40%–1.21%) viremic
prevalence in 2012. A 2005 age distribution was chosen
from a study of volunteer blood donors, in which seropre-
valence was highest among individuals 41–50 years of
age, and males were more commonly infected than females
(M:F ratio – 1.64:1.00) [40].

The genotype distribution was obtained from a subtyp-
ing analysis of 398 patients (personal communication
with Samir Shah, 2014). Genotypes 3 and 1 accounted
for 64% and 28% of HCV infections, respectively, with
16% (of all infections) genotype 1b. Genotype 4a
accounted for the remaining 7% of infections, with <1%
genotype 5.

**Diagnosed**

There were an estimated 408 300 previously diagnosed
viremic infections by 2012. This estimate was generated
using blood bank reports and linear extrapolations. The
number of HCV-positive blood units from 2004 to 2008
were used to estimate the number of HCV positive units
in 2003, 2005–2007 and 2009–2012 [41,42]. It was
then assumed that for every diagnosis in blood banks,
two other cases were diagnosed among physicians or
hospitals. The total number of diagnosed cases from
blood banks was multiplied by a factor of 2 to account
for diagnoses occurring outside of the blood supply sys-
tem and adjusted for viremia using the above viremic
rate. In 2012, there were an estimated 52 600 new
viremic diagnoses.

**Treated**

IMS data were used to estimate 15 000 patients were trea-
ted annually in 2011.

**Liver transplants**

Liver transplant data from 1998 to 2013 were extrapo-
lated using published literature [43] and expert feedback.
The first liver transplant occurred in 1998, and by 2007,
a total of 343 transplants had been performed in India
[43]. Following 2007, the number of transplants annually
began to increase rapidly, with 300 transplants in 2009
and 800–900 in 2013 (Expert consensus). An estimated
40% of transplants were attributable to HCV [44], and
expert consensus suggests that approximately 50% of
transplants were performed on patients from other
countries. In 2011, an estimated 375 transplants were
performed, with 109 (29%) attributable to HCV.

**Ireland**

**HCV-infected population**

The viremic population was estimated at 29 700 individu-
als at the end of 2009 [45] corresponding to viremic
prevalence of 0.67%. With a viremic rate of 75% [45],
anti-HCV prevalence was estimated at 0.89%, or 39 700
cases. Age and gender specific newly diagnosed cases
from 2004–2006 to 2008–2012 were reported by the
Health Protection Surveillance Centre (HPSC) [46]. These
data were used to estimate the age distribution of the
prevalent population in 2013 after accounting for mor-
tality and cured patients. The genotype distribution of
the prevalent population is based upon a study of sam-
ple data collected between 1989 and 2004 in Ireland [45],
while the distribution of G1 subtypes were from clinical
data.

**Diagnosed**

Based on a national study, there were estimated to be
9900 viremic individuals in Ireland who are living with a
diagnosis as of 2010 [45]. In 2012, 820 viremic individu-
als were newly diagnosed, based on the 1036 notifications
reported by HPSC [47], with adjustment for viremia and
application of the previously published under-reporting
factor (100/95) [45].

**Treated**

In 2011, it is estimated that 360 patients were treated in
Ireland, using IMS data for units of Peg-IFN sold in Ire-
land, after accounting for under-reporting.

**Liver transplants**

Annual liver transplants and the proportion attributable to
HCV are collected through the Liver Transplant Unit at St.
Vincent’s University Hospital in Dublin. Between 2000 and
2013, there were 111 liver transplants performed in Ire-
land for HCV liver-related disease [48]. In 2011, 12 HCV-
related liver transplants were conducted.

**Israel**

**HCV-infected population**

The anti-HCV seroprevalence was estimated at 1.96% in
2010. This estimate was calculated using unpublished data
from Clalit Health Services (CHS), as described in Cornberg
2011 [10]. A viremic rate of 75.5% was used [49], corre-
sponding to a 1.48% viremic prevalence, or approximately
109 800 viremic cases in 2010. The age and gender distri-
bution were derived from CHS lab data for 15 300 patients
[10,49].

The predominant HCV genotype in Israel is genotype 1
(69%), followed by genotype 3 (20%) [10,49].
**Diagnosed**

CHS data were used to estimate the total number of diagnosed cases after taking into consideration that CHS covers ~60% of the population. It was estimated that 21,960 viremic individuals were diagnosed, and 2,200 viremic cases are newly diagnosed annually.

**Treated**

Expert consensus estimated that 1,010 individuals received treatment in 2011.

**Liver transplants**

Liver transplant data from 2003 to 2013 were available from the Ministry of Health [50], and transplant data prior to 2003 were extrapolated to achieve 769 transplants from 1991 to 2011, as suggested in a recent study [51]. During the same time, expert consensus suggests that approximately 100 transplants were performed abroad. An estimated 35% of transplants were attributable to HCV, using published studies [51] and expert consensus to account for transplants performed outside of Israel.

**Luxembourg**

**HCV-infected population**

The anti-HCV prevalence in 2013 was estimated at 0.7% in the general population, based on two databases and the consensus of an expert panel. The National Health Laboratory (LNS) database has records of 2,205 cases from 1990 to 2013, with 94% confirmed chronic HCV \(n = 2,062\) [52]. Additionally, the Centre Hospitalier of Luxembourg (CHL) database has records for 2,141 cases from 2002 to 2013, with 93% confirmed chronic HCV \(n = 1,988\) [53]. A viremic rate of 77% was calculated after removing cured patients from database estimates. This viremic rate corresponded to 3,080 viremic cases in 2013.

The age and gender distribution of the infected population was estimated using CHL and LNS databases [52, 53] and accounting for mortality and cure. Using this method, in 2013 the median age was 35–39 years, with a 2:1 ratio of males to females.

The genotype distribution was obtained through an analysis of 1,368 patients in the CHL cohort [54]. Genotypes 1 (55.3%) and 3 (33.6%) predominated, followed by genotypes 4 (6.4%), 2 (4.3%) and 5 (0.4%) [54].

**Diagnosed**

CHL and LNS databases were used to estimate the number of individuals living with an HCV diagnosis in 2013 [52, 53]. A diagnosis rate of 84% was calculated, corresponding to 2,590 diagnosed viremic infections, with approximately 100 new viremic cases diagnosed annually.

**Treated**

In 2013, approximately 100 patients were treated, based on IMS data for standard units of Peg-IFN sold [15] and an adjustment factor for use of Peg-IFN for other indications (32%). Additionally, it was assumed that 26 cases were treated in prisons in 2010, an increase from 10 cases in 2004.

**Liver transplants**

The number of liver transplants from 2003 to 2012 was available through Eurotransplant [55]. As little data were available on the per cent of transplants attributable to HCV in Luxembourg, a Belgian analog of 12.6% was used [56].

**Mexico**

**HCV-infected population**

The estimate for anti-HCV prevalence in the general Mexican population was derived from data obtained from the 2000 National Health Survey [57]. This study reported an anti-HCV prevalence of 1.40% (95% CI: 1.1–1.6%) in the adult population (>20 years of age). It was estimated that the anti-HCV prevalence in the entire population was 0.95% [12]. The age and gender distribution was developed using the age and gender distribution from the National Health Survey analysis with an exponential decrease, by 5-year cohort, for individuals <20 years of age. The viremic rate, 65.2%, was derived from an analysis of individuals participating in general screening programs conducted by the Mexican Liver Foundation from 2007 to 2013. This led to a viremic prevalence of 0.62% (619,000 cases) in 2000. A weighted average of three studies totalling more than 11,000 patients from multiple regions was used for the genotype distribution [58–60].

**Diagnosed**

Using blood donation screening by the Centro Nacional de la Trasfusion Sanguinea and unpublished general screening data from the Mexican Liver Foundation, it was estimated that 155,800 of the infected population was living with a diagnosis 2011 [61–64]. In 2011, 14,700 individuals were newly diagnosed.

**Treated**

Using unpublished data from the Mexican Social Security Institute, it was estimated that 3,110 patients were treated in 2011.

**Liver transplants**

Liver transplant data were available through the Centro Nacional de Trasplantes. In 2011, there were 101 liver transplants performed in Mexico, and in 2013, there were 149 transplants [65]. It was estimated that 31.8% of liver transplants per year were attributable to HCV [66–69].
Mongolia

HCV-infected population
Based on expert consensus, the prevalent viremic population in 2013 was estimated at 200,000 individuals, equivalent to 6.8% prevalence. An overall viremic rate of 70% was estimated, resulting in an anti-HCV prevalence of 9.8% (285,700 cases). The high estimate for prevalence came from a study in the general population [70], while the low prevalence estimate was based upon a study of blood donors [71]. For the age and gender distribution of the infected population, published estimates by age and gender were applied [70]. The genotype distribution of the prevalent population was estimated using data from 167 RNA samples collected throughout the country [70].

Diagnosed
Based on expert consensus, there were an estimated 60,000 previously diagnosed cases and 1300 newly diagnosed cases in 2013.

Treated
It was estimated that 200 patients annually were treated based on expert consensus and IMS data for standard units of Peg-IFN sold after adjustment to account for underreporting.

Liver transplants
In 2013, there were an estimated eight liver transplants in Mongolia; three (38%) were estimated to be attributable to HCV.

The Netherlands

HCV-infected population
The most recent HCV estimate among the Dutch general population, as well as specific risk groups, reports an anti-HCV prevalence of 0.22% (0.07–0.37%) among 15- to 79-year-olds in 2009 [72]. When applied to the entire population, this estimate corresponds to an anti-HCV prevalence of 0.18%. The viremic rate was estimated to be 74% [73], corresponding to a viremic prevalence of 0.13% in 2009 and 21,800 infected individuals. There were no reliable age and gender distributions available for The Netherlands but the median age was reported at 54 years old in 2006-2007 [74] similar to the United States. In addition, the United States and Dutch gender ratios were considered comparable as well as the timing of the peak infections [72,75]. The Dutch age and gender distributions were established using the United States as an analog [75]. The genotype distribution was established using data from an analysis of patient data collected between 2002 and 2005 from 53 hospitals in 11 of the 12 Dutch provinces [76].

Diagnosed
Based on expert consensus, there were estimated to be 12,000 viremic individuals in the Netherlands with a known diagnosis of chronic HCV in 2013. It was estimated that each year 650 viremic individuals were newly diagnosed.

Treated
In 2013, 880 patients were treated for chronic (or acute) HCV infection in the Netherlands [77].

Liver transplants
Liver transplant data were available through the Eurotransplant Statistics Report Library. In 2011, there were 135 liver transplants performed in the Netherlands, increasing to 142 in 2013 [78]. It is estimated that 12% of liver transplants per year are attributable to HCV [79].

New Zealand

HCV-infected population
In New Zealand, the viremic population was estimated at 50,000 individuals in 2013, corresponding to viremic prevalence of 1.11% [80]. A viremic rate of 76.5% was applied, based on clinic data collected from patients in New Zealand [81], resulting in an anti-HCV prevalence of 1.45%. The age and gender distribution of the infected population was based on demographic data collected through March 2014 from over 1000 HCV individuals attending an HCV clinic [81]. The genotype distribution of the prevalent population was based upon New Zealand clinic data [82].

Diagnosed
Based on expert consensus, 40% of the viremic population was previously diagnosed in 2013 (20,000 individuals). Based on the ratio of newly to previously diagnosed in Australia [83,84], it was estimated that 910 cases were newly diagnosed in 2013.

Treated
In 2013, it is estimated that 900 patients were treated in New Zealand, based on expert consensus and IMS data for standard units of Peg-IFN sold in New Zealand, which were adjusted for under-reporting. Approximately 50% of patients were treated with Peg-IFN and RBV (reimbursed by the government) and the remaining 50% of patients were treated within clinical trials.

Liver transplants
In 2013, there were 36 liver transplants performed in New Zealand of whom 24 were in adults. Thirteen transplants were attributable to HCV (54% of all adult transplants). The total number of annual liver transplants was available from transplant registry reports for the years 1997 to 2012 [85]. The proportion of all liver transplants attribut-
able to HCV varied by years and was estimated at 38% for all years [85].

Norway

HCV-infected population

The anti-HCV prevalence in 2012 was estimated at 0.55% in the general population, based on notification data and consensus from local experts. A viremic rate of 79.5% was chosen, corresponding to 21 800 viremic cases in 2012 [22]. The age and gender distribution of the infected population was estimated using annual notification data (1990–2013) aged to 2013 accounting for mortality, cure and spontaneous clearance [86]. Using this method, in 2013, 54% of the population was between 40 and 55 years of age. By comparison, 54% of notifications were between 30 and 50 years of age in 2013. A 2003 study of the general population found the highest prevalence in individuals between 40 and 45 years of age, suggesting a 2013 average age of 50–55 [22].

The genotype distribution was predominantly genotype 3 (50%) and genotype 1 (40%), with 9% genotype 2 and 1% genotype 4 (personal communication with Olav Dalgard, 2013). A genotype 1a/1b split was obtained from a 2003 study [22] and applied to the distribution presented above.

Diagnosed

Notification data from 1990 to 2013, as reported to the Norwegian Surveillance System for Communicable Diseases (MSIS), were aged to 2013 accounting for mortality, cure and spontaneous clearance rates [86]. An estimated 12 000 viremic-infected patients were living with a diagnosis in 2013, with approximately 1090 new viremic infections diagnosed in 2013 [86].

Treated

In 2013, approximately 605 patients were treated, based on Ribavirin user data collected by the Norwegian Prescription Registry [87]. Ribavirin user data from 2004 to 2013 were calibrated in 2010 to IMS data for standard units of Peg-IFN sold to account for duplication of use across years.

Liver transplants

The number of liver transplants from 1999 to 2012 was available through Scandiatransplant [88]. Among 110 transplanted in 2013, approximately 22.7% of those who received a liver transplant were anti-HCV positive (personal communication with Olav Dalgard, 2014). Prior to 2008, the number transplanted with anti-HCV (1984–1994, 2.1%; 1995–2004, 6.9%; 2005–2008, 11.2%) were calculated using the frequency of diagnoses in liver transplants and assuming that 40% of hepatocellular carcinoma was attributable to HCV [89,90].

Poland

HCV-infected population

There are a number of studies reporting anti-HCV prevalence in Poland [91–101]. The largest study determined a viremic (RNA positive) rate of 0.60% [91]. However, it also determined an antibody positive prevalence of 1.94%. A more recent study found an antibody prevalence of 1.91% with a single ELISA test and 0.86% with confirmatory tests [92]. Thus, in 2009, the anti-HCV prevalence in the adult population (18+) in Poland was estimated to be 0.86%, with an estimated prevalence of 0.72% for all ages. The viremic prevalence was estimated to be 0.60% in adults. For this analysis, it was estimated that there were 200 000 viremic infections in 2009 (for all ages), corresponding to a prevalence of 0.52%.

The age and gender distribution was developed using diagnosed data from 1999 to 2012 from the National Institute of Public Health–National Institute of Hygiene (NIPH–NIH) [102]. The number of RNA-positive-diagnosed cases was available from 1999 to 2012. The diagnosed population was adjusted for mortality and cured, by year, and was aged to 2012. It was assumed that the age and gender distribution of the diagnosed population was reflective of the current distribution in Poland.

Diagnosed

At the end of 2012, there were 30 200 patients living with a diagnosis and 2290 individuals were newly diagnosed [102]. For this analysis, 3000 newly diagnosed were assumed per year, beginning in 2012.

Treated

An average number of 3470 individuals were treated per year from 2008 to 2012, with 2100 treated in 2011. In the light of increased triple therapy treatment for previously warehoused patients, the total number of treated patients increased to 4040 for the first time in 2013. It was anticipated that the number of treated patients would decrease to the 2008–2012 average with an estimated 3500 individuals treated in 2014.

Liver transplants

Liver transplant data were available through Poltransplant, the Center for Organizational and Coordination for Transplantation. In 2011, there were 300 liver transplants performed in Poland, increasing to 318 transplants in 2013 [103]. It was estimated that 28% of transplants were attributable to HCV [104].

Russia

HCV-infected population

The estimate for prevalence in the general Russian population was derived from a general consensus of 4.1% in
2010 reported in multiple sources [8,105,106]. Applying a viremic rate of 71% [107], the viremic prevalence in 2010 was estimated at 2.91%, corresponding to 4162000 infections. The age and gender distribution was developed using the age distribution and gender ratio of infection presented previously [108]. The genotype distribution was developed using data from a regional registry of more than 40000 patients with chronic viral hepatitis [108].

**Diagnosed**
Using unpublished data and an analysis of regional registries conducted by the Russian National Reference Center for Viral Hepatitis, approximately 43% of the infected population in 2012 had received anti-HCV testing [109]. In 2012, 55900 chronic individuals were newly diagnosed (unpublished data).

**Treated**
Using regional registries, it was estimated that 5500 patients were treated in 2011.

**Liver transplants**
Liver transplant data were available through the Russian National Reference Center for Viral Hepatitis, approximately 43% of the infected population in 2012 had received anti-HCV testing [109]. In 2012, 55900 chronic individuals were newly diagnosed (unpublished data).

**Slovak Republic**

**HCV-infected population**
The estimate for prevalence in the general Slovak population came from an unpublished analysis of 4596 individuals across all regions in the Slovak Republic from 2010 to 2011 (EPID Study). This study reported an anti-HCV prevalence of 1.40% among adults with a viremic rate of 49.2%, corresponding to a viremic prevalence of 0.70%. The anti-HCV prevalence among all ages was estimated at 1.24% with a viremic prevalence of 0.61% corresponding to 33400 viremic infections.

The age and gender distribution was developed using the age distribution and gender ratio of infection from specimens received by the National Institute of Communicable Diseases (NICD) from 2010 to 2012 [118]. The genotype distribution was developed using specimens available for analysis from the NICD sample [118].

**Diagnosed**
According to expert consensus, approximately 10% of the infected population were patients living with a diagnosis in 2012. Between 2006 and 2012, an average of 270 individuals yearly were newly diagnosed [115].

**Treated**
It was estimated by expert consensus that 320 patients were treated in 2011.

**Liver transplants**
Liver transplant data were available through the Slovak Centre of Organ Transplantation as reported by the International Registry in Organ Donation and Transplantation. In 2011, there were 21 liver transplants performed in the Slovak Republic [116]. It was estimated that 23% of liver transplants per year were attributable to HCV [117]; however, there is evidence that transplantation due to HCV is increasing with 12 of 13 transplants being attributed to chronic HCV infection to date in 2014 (unpublished data).

**South Africa**

**HCV-infected population**
The burden of chronic HCV disease in South Africa is largely unknown and epidemiological data describing the characteristics of the disease are limited. It has been estimated that the prevalence of anti-HCV ranges from 1.4% to 1.8% among blood donors and healthcare workers [118]. For this analysis, an anti-HCV prevalence estimate of 1.7% in 2009 was applied for the adult population [119], which corresponded to 1.12% among all ages when a lower prevalence among children was taken into consideration. Applying a viremic rate of 76.9% (consensus estimate), the viremic prevalence was estimated at 0.86%, corresponding to 432000 infections among all ages.

The age and gender distribution was developed using the age distribution and gender ratio of infection from specimens received by the National Institute of Communicable Diseases (NICD) from 2010 to 2012 [118]. The genotype distribution was developed using specimens available for analysis from the NICD sample [118].

**Diagnosed**
From 2008 to 2013, it was estimated that 10000 individuals were diagnosed through the national healthcare system and that 54600 individuals were living with a diagnosis in 2013.

**Treated**
According to the panel of experts, an estimated 100 patients were treated in 2011.

**Liver transplants**
Liver transplant data were available through the Organ Donor Foundation. In 2011, there were 31 adult liver transplants performed in South Africa [120]. It was estimated that 5% of liver transplants per year are attributable to HCV.
DISCUSSION

The goal of this analysis was to develop consensus estimates of the HCV epidemiology using best available published and unpublished data. The analysis was supported by an exhaustive literature search to identify relevant published studies in each country. The results were then reviewed with a panel of experts in each country, which provided hospital level and other unpublished data.

The data presented here can be used by researchers for a number of different purposes – modelling HCV disease burden, exploring the impact of immigration on HCV infections and determining potential response rate of therapies that vary by genotype. The next manuscript in this supplement will describe how these data can be used to project HCV disease progression using a mathematical model [13]. However, the topic of immigration as a source of new HCV infections has been one of growing interest [121]. The breakout of prevalence by age and gender (Fig. 1) should provide sufficient detail to inform estimates of HCV infections for people moving across borders. It is interesting to note that HCV prevalence in most countries drops in individuals aged 30–35 (Fig. 1), the average age of immigrants to most countries. Exceptions are found in countries where injection drug use (IDU) is the main source of new HCV infections – Finland, Ireland, Luxembourg, Norway, Poland, Russia and Slovak Republic. Although HCV prevalence among 30- to 35-year-olds is high in these countries, the IDU population with an HCV infection is an unlikely source of new immigrants. Thus, care should be taken in using the data presented here without adjustments.

A number of countries had centralized registries for diagnosed HCV cases – Finland, Ireland, Norway and Poland. Additionally, Luxembourg is in the planning stages for a centralized registry. Although Israel does not have a central registry for HCV, one national healthcare provider, CHS, covers over 60% of the population and retains detailed data. Russia has regional registries, and work is underway to consolidate data across the country. Greece recently used an innovative technique of using a randomized national phone survey to quantify the diagnosis rate in the country [25]. Although the method has some limitations, it does provide a quick technique to quantify diagnosis rates in countries where central registries are not available.

Great care was taken to combine data, analysis and expert panel consensus to provide the best available data. However, there were a number of limitations with this analysis. In some countries, very little data were available and the consensus numbers reported here may not be representative of the true state of HCV infection in the country. This highlights the need for more robust epidemiology studies to quantify HCV in the general population while considering the urban, rural and marginalized populations (IDU, people in institutions, etc.).

In countries where registries or epidemiology studies were available, it was assumed that the reported numbers are representative of the countries’ HCV-infected population. Data reported to the registries could have a selection bias as testing and reporting may not be uniform across all subpopulations. In addition, viremic rate and genotype distribution were typically based on studies with relatively small sample sizes. Data from multiple studies were compared to minimize bias, but it is worth noting that both variables can change over time due to treatment rate and immigration.

The number of treated patients was estimated based on the drug sales when a central registry was not available. There was considerable variation in the number of treated patients across countries (Table 1). The use of drug sales data has a number of limitations including under-reporting, the use of drugs in multiple indications and the need to incorporate average adherence and genotype distribution. An effort was made to deal with these limitations using expert panels. In countries where drug sales data were not available or where data are limited, the expert panel estimates were used which may over or under-estimate the total number of treated patients in the country.

This analysis highlights the need for more robust HCV epidemiology analyses that take into consideration the general population and subpopulations that may not be captured in a national study. The data required for a detailed analysis of HCV disease burden include anti-HCV and viremic prevalence, the number previously and newly diagnosed, the annual number of treated patients and the genotype distribution. Ideally, future studies will be conducted in multiple regions of the country to provide accurate national estimates as well as variations across different geographies.

ACKNOWLEDGEMENTS

This work represents the collaboration of many experts across numerous countries, and we are indebted to them all. We would like to thank J.E. van Steenbergen and Anna Krabbe-Lagnér of the National Institute of Public Health and Environment for all their contributions, review of the data and discussion of the Netherlands’ analyses. We are grateful to Lelia Thornton (Health Protection Surveillance Center), Cathal Walsh and Jennifer Kieran of Trinity College in Dublin for providing data and validating our assumptions in Ireland. We are also thankful for the contributions of Markku Kuusi, Henrikki Brummer-Korvenkontio, Elisa Huovinen, Salla Toikkanen, Mikko Virtanen and Maarit Sillanpää of THL, and Martti Färkkilä of Finland. They provided data and were involved in the discussion of national data that were used in this analysis. This project was supported by Gilead Sciences.
DISCLOSURES

V. Saraswat has no conflict of interests.

S. Norris has served as a speaker or advisor for AbbVie, Bristol-Myers Squibb, MSD, Gilead and Roche. She has participated in clinical trials or received research grants from AbbVie, Bristol-Myers Squibb, Roche and Merck.

R.J. de Knegt has served as a speaker or advisor for AbbVie, Bristol-Myers Squibb, Gilead, Roche, Merck and Novartis. He has participated in clinical trials or received research grants from AbbVie, Bristol-Myers Squibb, Gilead, Roche, Meittonic and Merck.

J. F. Sanchez Avila has served as a speaker or advisor for AbbVie, Gilead, Janssen, MSD and Roche. He has received research support from AbbVie, Bayer, Bristol-Myers Squibb, Janssen, MSD and Novartis.

M. Sonderup has served as an advisor to AbbVie and received travel support from Janssen and Roche.

E. Zuckerman has no conflict of interests.

C. Stedman has served as a speaker or advisor for Gilead Sciences, MSD, and Janssen.

M.I. Andersson has received research support from Gilead, Roche and Alere. She has served on AbbVie advisory board.

P. Arkkila has no conflict of interests.

S. Blach, C. Estes, E. Gower, H. Razavi and K. Razavi-Shearer have no conflict of interest. They are employees of The Center for Disease Analysis and are barred from accepting any personal consulting or any other outside funding. The Center for Disease Analysis has receive research funding from public and private sources (Gilead Sciences, Boehringer Ingelheim, and AbbVie), but its projects are limited to basic epidemiology and modelling research.

Z. Ben-Ari has served as a speaker or advisor for AbbVie, Gilead, Bristol-Myers Squibb, Janssen, Boehringer Ingelheim, MSD and Roche.

N. Blokhina has served as a speaker or lecturer for Bristol-Myers Squibb and Janssen.

V. Chulanov has served as a speaker or advisor for AbbVie, Bristol-Myers Squibb, Gilead, Janssen, MSD and Novartis. He has received grant or research support from AbbVie, Bristol-Myers Squibb and Janssen.

L. Cisneros has served as a speaker or advisor for AbbVie, Bristol-Myers Squibb and Roche.

E. Croes is project leader of a hepatitis C project in addiction care for which her institute received unrestricted grants from the Ministry of Health, research organization ZonMW, Janssen, Roche and MSD.

R. Filiak has served as a speaker or advisor for AbbVie, Bristol-Myers Squibb, Gilead, Janssen, MSD, Novartis and Roche.

E. Gane is a member of advisory boards for Gilead Sciences, AbbVie, Idenix, Achillion, Novartis, Roche and Janssen.

W. Halota has served as a speaker or advisor for AbbVie, Bristol-Myers Squibb, Gilead, Janssen, MSD and Roche.

A. Hatzakis has served as the co-chair of the Hepatitis B and C Public Policy Association funded by AbbVie, Bristol-Myers Squibb and Gilead. He has served also as speaker, consultant or advisor for AbbVie, BMS and Gilead. He has received grant support from AbbVie, BMS and Novartis.

K. Kostrewska is an employee with HTA Consulting.

M. Leshno has consulted with AbbVie.

N. Mamonova has served as a speaker for Bristol-Myers Squibb and Gilead. She has received research grants from Bristol-Myers Squibb.

E. Nurmukhametova has served as a speaker or lecturer for Bristol-Myers Squibb and Janssen.

G. Papatheodoridis has served as a speaker, consultant or advisor for AbbVie, Boehringer Ingelheim, Bristol-Myers Squibb, Gilead, GlaxoSmithKline, Janssen, Merck Sharp & Dohme, Novartis and Roche. He has received grant support from AbbVie, Bristol-Myers Squibb, Gilead, Janssen and Roche. He served on the Data Safety Management Board for Gilead.

N. Pimenov has served as an advisor to Gilead.

M. Prins has served as a speaker and has worked on several research projects for which her institute received unrestricted grants from Gilead, Roche and MSD.

A. Rakhmanova has served as a speaker, lecturer or advisor for Bristol-Myers Squibb, Hoffmann-La Roche, Janssen and R-Pharma. She has served as an advisor for Gilead.

H. W. Reesink has served as a consultant and provided research support for AbbVie, Bristol-Myers Squibb, Gilead, Janssen-Cilag, Merck/MDS, PRA-International, Roche, Santaris and Regulus. He has served as a consultant for Astex, GlaxoSmithKline, R-Pharm and Korean Green Cross. He has provided research support for Boehringer Ingelheim.

O. Sagalova has served as a speaker or lecturer for Alfin-Vasserman, Biocad, Bristol-Myers Squibb, Farmstandart, GSK, Janssen and MSD. She has served on an advisory board for MSD and participated in clinical trials for Bristol-Myers Squibb, Boehringer Ingelheim, Hepatera LLC, MSD and R-Pharm.

S. Sokolov has served as a speaker or lecturer for Roche.

W. Spearman has served as an advisor for AbbVie. She has received travel grants from Janssen.

E. Streblkova has served as a speaker or lecturer for Bristol-Myers Squibb and MSD Pharmaceuticals.

K. Tomaszewicz has served as a speaker or advisor for AbbVie, Bristol-Myers Squibb, Gilead, Janssen, MSD and Roche.

A.J. van der Meer has received financial compensation for lectures for Gilead and MSD.

F.R. Zuure has received financial support for the printing of her thesis from Gilead, Roche, MSD, AbbVie and Boehringer Ingelheim, and has worked on several research projects for which her institute received unrestricted grants from Gilead, Roche and MSD.
REFERENCES


23. National Institute for Health and Welfare. [Infectious disease registry statistical database]. February 25, 2014. Available at: https://sampo.thl.fi/sampo_prom/cgi-bin/cognos.cgi?b_action=powerPlayService&ui.action =run&TARGET=%2Ffolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfolder%5Bfo
transplant.org/ (accessed 29 November 2013).
25 Papatheodoridis G, Sypsa V, Kanta-
28 ntsou M, Nikolakopoulos I, Hatza-
25 kis A. Estimating the treatment cas-
28 cade of chronic hepatitis B and C in
Greece using a telephone sur-
26 Sypsa V, Touloumi G, Ta-
31 ssopoulos NC et al. Reconstructing and pre-
27 dicting the hepatitis C virus epi-
31 demic in Greece: increasing trends of cir-
27 rhosis and hepatocellular car-
31 cinoma despite the decline in inci-
27 dence of HCV infection. J Viral
27 Katsoulidou A, Sypsa V, Tassopoulos
NC et al. Molecular epidemiology of
hepatitis C virus (HCV) in Greece:
temporal trends in HCV genotype-
specific incidence and molecular
characterization of genotype 4 iso-
28 Raptopoulou M, Touloumi G, Tzourmakliotis D et al. Significant
epidemiological changes in chronic
hepatitis C infection: results of the
nationwide HEPNET-GREECE
cohort study. Hippokratia 2011;
29 National Transplant Organization
at: http://www.eom.gr/index.php?
option=com_k2&view=item&id=138&Itemid=142&lang=el
(accessed 12 February 2014).
30 Chowdhury A, Santra A, Chaud-
32 huri S et al. Hepatitis C virus infec-
tion in the general population: a
community-based study in West
Bengal, India. Hepatology 2003;
37: 802–809.
31 Duseja A, Arora L, Masih B et al.
Hepatitis B and C virus–prevalence
and prevention in health care
workers. Trop Gastroenterol 2002;
32 Kumar A, Sharma KA, Gupta RK,
Kar P, Murthy NS. Hepatitis C
virus infection during pregnancy
in North India. Int J Gynaecol
33 Kumar A, Sharma KA, Gupta RK,
Kar P, Chakravarti A. Prevalence
& risk factors for hepatitis C virus
among pregnant women. Indian J
34 Mahalakshmi B, MadhavanHN,
Pushpalaitha R, Margarita S. Seroprevalence of human immunodefi-
ciency virus, hepatitis B virus and
hepatitis C virus among eye
donors. Indian J Ophthalmol
35 Sharma A, Gur R, Bhalla P. Study
on prevalence of needle stick injury
among health care workers in a
tertiary care hospital in New Delhi:
a two-year review. Indian J Public
36 Sood A, Sarin SK, Midha V et al.
Prevalence of hepatitis C virus in a
selected geographical area of
northern India: a population based
survey. Indian J Gastroenterol
37 Sukriti, Puti NT, Sethi A et al. Low
levels of awareness, vaccine cover-
age, and the need for boosters among
health care workers in tertiary care
care hospitals in India. J Gastroenterol
38 Thakral M, Marwaha N, Chawla
YK et al. Prevalence & significance
of hepatitis C virus (HCV) seroposi-
tivity in blood donors. Indian J Med
39 Mittal G, Gupta P, Gupta R, Ahuja
V, Mittal M, Dhar M. Seropreva-
ience and risk factors of hepatitis B
and hepatitis C virus infections in
Uttarakhand, India. J Clin Exp Hepa-
40 Bagga PK, Singh SP. Seropreva-
ience of hepatitis C antibodies in
healthy blood donors—a prospective
study. Indian J Pathol Microbiol
41 Ramani KV, Mavalankar D, Govil
D. Management of Blood Transfus-
ion Services in India: An Illustra-
tive Study of Maharashtra and
2007-03-09. Available at: http://
www.imadh.ernet.in/publications/
data/2007-03-09_kvramani.pdf
(accessed 13 May 2014).
42 National AIDS Control Organi-
zation. Annual CMIS Bulletin
naco.gov.in/upload/HIV%20data/
NACO%20CMIS%2OBULLETIN%20
2008-09.pdf (accessed 13 May
2014).
43 Kakodkar R, Soin A, Nundy S.
Liver transplantation in India: its
evolution, problems and the way
20: 53–56.
44 Lubana PS. Liver Transplantation:
Present Scenario in India; Slide 17.
slideshare.net/nicks1969/liver-trans-
plantation-present-scenario-in-india#
(18 March 2014).
45 Thornton L, Murphy N, Jones L et
al. Determination of the burden of
hepatitis C virus infection in
Ireland. Epidemiol Infect 2011; 8:
1461–8.
46 Health Protection Surveillance
Centre. HPSC Annual Reports, 2013.
47 Health Protection Surveillance
Centre. National Hepatitis C Data-
base for infection acquired through
blood and blood products, 2010.
48 Houlihan D, Cooney A, St Vin-
cent’s University Hospital Dublin.
Annual HCV-related transplants
reported by Liver Transplant Unit,
St. Vincent’s University Hospital
Dublin. Center for Disease Analy-
sis, Louisville, CO, USA, 2014.
49 Zuckerman E. Liver Unit, Carmel
Medical Center, Haifa, Israel.
Sources for the epidemiology of
hepatitis C in Israel. Conversation
with: Razavi HA. Center for Dis-
ease Analysis, Kromite, Louisville,
CO, USA, August 2, 2010.
50 Ministry of Health Israel. Organ
Available at: http://www.health.
gov.il/Subjects/Organ_transplant/
transplant/Pages/default.aspx
(accessed 4 March 2014).
51 Carmiel-Haggai M. [Two decades of
liver transplantation in Israel].
Harefuah 2012; 151: 679–683,
721.
52 Mossong J. Hepatitis C in Luxem-
bourg: a preliminary epidemiological
analysis of cases confirmed at the
National Health Laboratory,
53 Devaux C. Report HCV CHL data-
base Luxembourg, 2014.
54 Staub T. Hepatitis C virus (HCV)
genotype in Luxembourg. Conversa-
tion with: Razavi H, et al. Center
for Disease Analysis, Louisville, CO,
55 Eurotransplant. Statistics Report
Library. 2013. Available at: http://


81 Brunton C. Canterbury District Health Board, Christchurch, New Zealand. HCV clinic data. Center for Disease Analysis, Louisville, CO, USA, 2014.

82 Gane E. Hepatitis C virus (HCV) genotype in New Zealand. Center for Disease Analysis, Louisville, CO, USA, February 20, 2014.


84 The Kirby Institute for Infection and Immunity in Society. HIV, viral hepatitis and sexually trans-


100 Ganczak M, Szych Z. [Rationale for the implementation of preoperative testing for HCV in the light of anti-HCV and HBsAG tests results in surgical patients from a teaching hospital]. Przegl Epidemiol 2009; 63: 387–392.


104 Krawczyk M, Grat M, Barski K et al. 1000 liver transplantations at the Department of General, Transplant and Liver Surgery, Medical University of Warsaw—analysis of indications and results. Pol Przegl Chir 2012; 84: 304–312.


107 Iashina TL, Favorov MO, Shakhgil’dian IV et al. [The spread of hepatitis C markers among the population of regions of Russia and Central Asia]. Zh Mikrobiol Epidemiol Immunobiol 1993; (5): 46–49.

108 Pimenov NN, Chulanov VP, Komarova SV et al. [Hepatitis C in Russia: current epidemiology and approaches to improving diagnosis and surveillance]. Epidemiol Infect Dis 2012; 4: 4–10.


114 Schreter I, Kristian P, Klement C et al. [Prevalence of hepatitis C © 2014 John Wiley & Sons Ltd


