

Infection and cancer: a significant part of the global cancer burden

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Cancer & Infection Session

Global burden of cancers attributable to infections in 2008: a review and synthetic analysis



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Summary

Background Infections with certain viruses, bacteria, and parasites have been identified as strong risk factors for specific cancers. An update of their respective contribution to the global burden of cancer is warranted.

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Global burden of cancers attributable to infections in 2008

Goals

- Estimate the number of incident cancers attributable to infection worldwide:
 - Geographic distribution.
 - Relation to total cancer burden
 - Assess global cancer impact of most important infectious agents
- Help set regional priorities for cancer control
- Update previous estimates for 1990 and 2002



Monograph 100. A review of human carcinogens Part B: Biological agents (February 2009)

<http://monographs.iarc.fr/ENG/Monographs/vol100B/>

Panel 1: Major cancer sites associated with group 1 infectious agents*

- Stomach: *Helicobacter pylori*
- Liver: Hepatitis B virus, hepatitis C virus (HCV), *Opisthorchis viverrini*, *Clonorchis sinensis*
- Cervix uteri: Human papillomavirus (HPV) with or without HIV
- Anogenital (penile, vulva, vagina, anus): HPV with or without HIV
- Nasopharynx: Epstein-Barr virus (EBV)
- Oropharynx: HPV with or without tobacco or alcohol consumption
- Kaposi's sarcoma: Human herpes virus type 8 with or without HIV
- Non-Hodgkin lymphoma: *H. pylori*, EBV with or without HIV, HCV, human T-cell lymphotropic virus type 1
- Hodgkin's lymphoma: EBV with or without HIV
- Bladder: *Schistosoma haematobium*

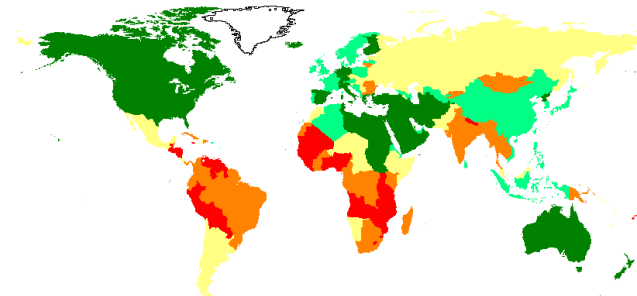
*Classified as carcinogenic to humans in International Agency for Research on Cancer Monograph 100B.¹

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Global burden of cancers attributable to infections in 2008

- GLOBOCAN 2008 (globocan.iarc.fr) estimates of cancer incidence, mortality and prevalence in the year 2008
 - 184 countries
 - 27 cancer sites
- We extended estimates to include sub-sites associated with infection.
- Incidence estimates were aggregated into eight geographic regions.

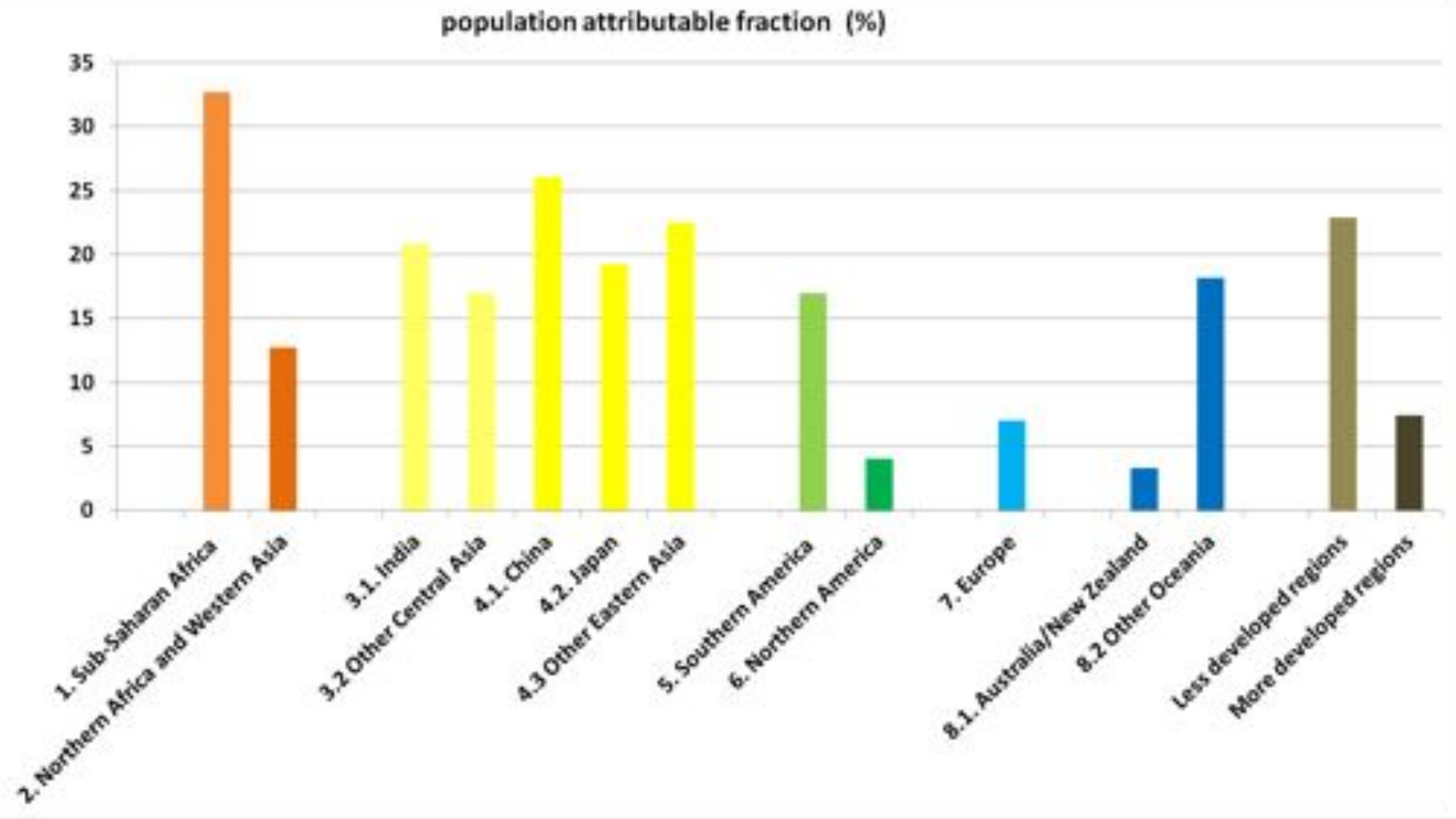
International Agency for Research on Cancer
World Health Organization
Estimated age-standardised incidence rate per 100,000
Cervix uteri, all ages



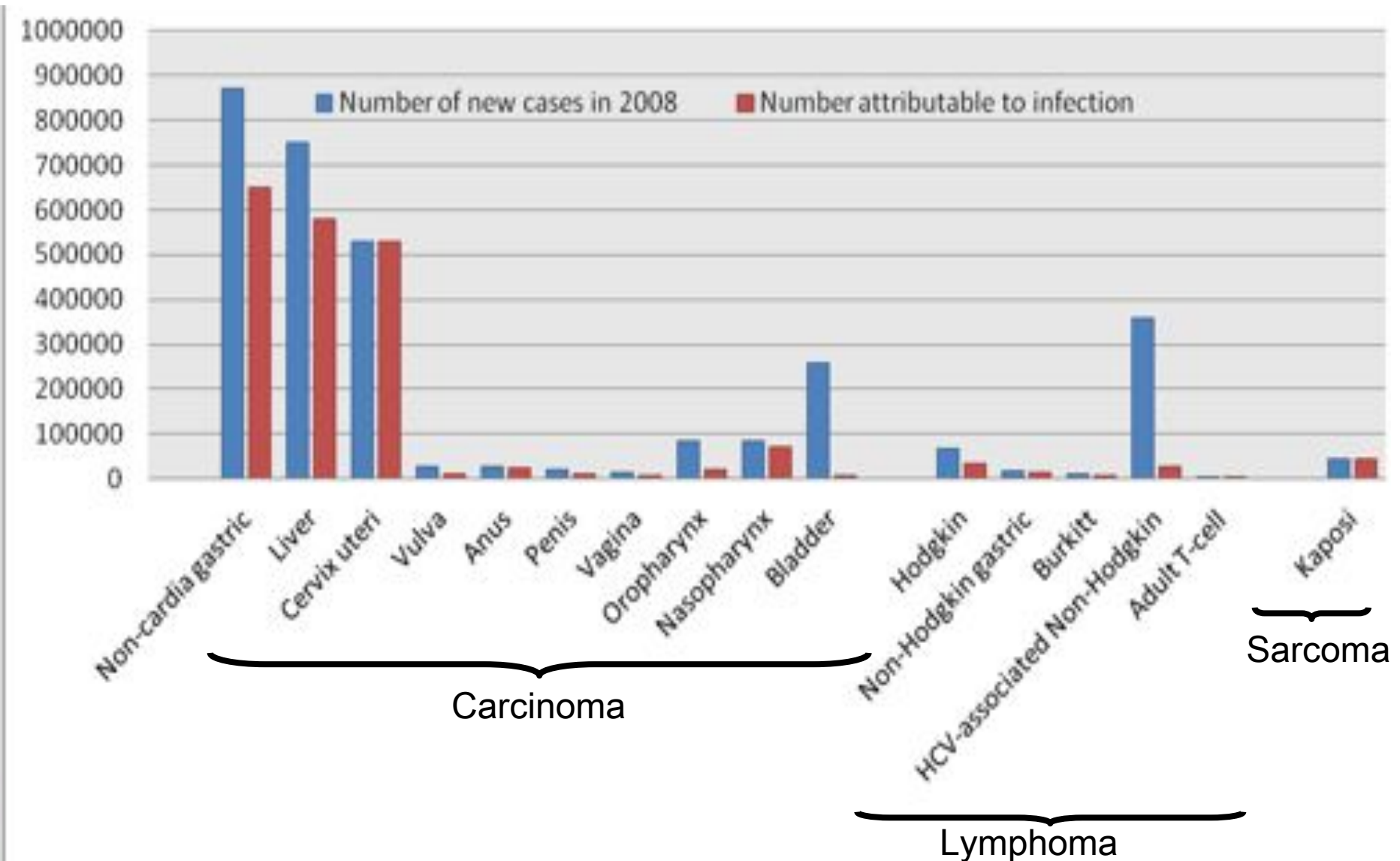
Global burden of cancers attributable to infections in 2008

- 12.7 million cancer cases (Globocan 2008)
- 2.0 million (16%) attributable to infection
 - 22.9% in less developed countries
 - 7.4% in more developed countries
- 10-fold variation between regions
 - 32.7% in Sub-Saharan Africa
 - 3.3% in Australia and New Zealand

Fraction of new cancer cases attributable to infection: Population attributable fraction (PAF) by world regions



Number of new cancer cases occurring in 2008 attributable to infectious agents by anatomic site



Global burden of cancers attributable to infections in 2008

Cancer site	Global incidence estimate	Number attributable to infection	Population Attributable Fraction (%)
Gastric (non-cardia)	870,000	650,000	74.7
Liver	750,000	580,000	76.9
Cervix uteri	530,000	530,000	100
Nasopharynx	84,000	72,000	85.5
Kaposi's sarcoma	43,000	43,000	100
All other	893,000	168,000	
Total		2 million	

Number of new cancer cases attributable to infection in 2008 by development status

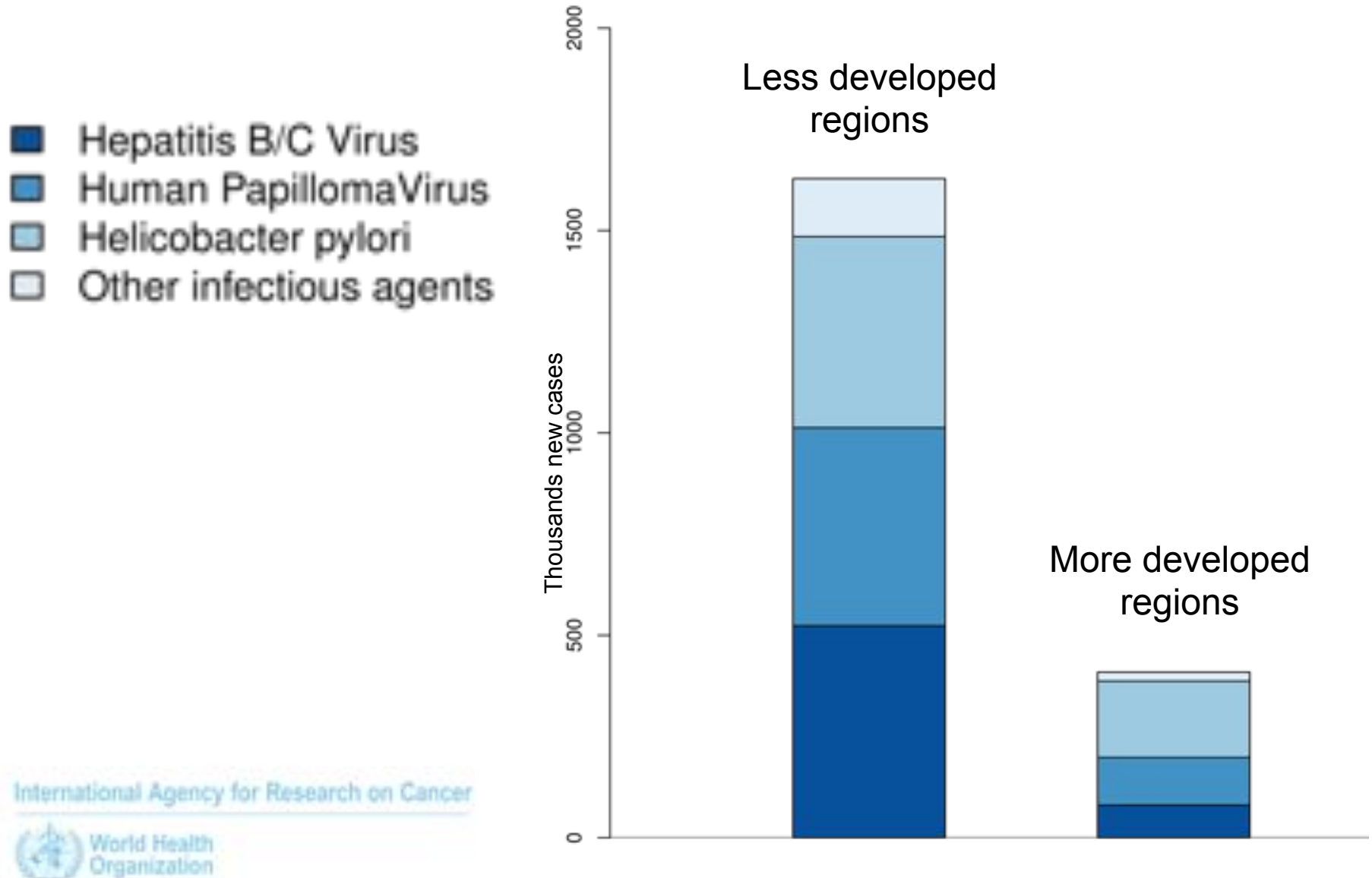
	Less developed regions	More developed regions	World
Hepatitis B and C viruses	520 000 (32.0%)	80 000 (19.4%)	600 000 (29.5%)
Human papillomavirus	490 000 (30.2%)	120 000 (29.2%)	610 000 (30.0%)
<i>Helicobacter pylori</i>	470 000 (28.9%)	190 000 (46.2%)	660 000 (32.5%)
Epstein-Barr virus	96 000 (5.9%)	16 000 (3.9%)	110 000 (5.4%)
Human herpes virus type 8	39 000 (2.4%)	4300 (1.0%)	43 000 (2.1%)
Human T-cell lymphotropic virus type I	660 (0.0%)	3500 (0.4%)	2100 (0.1%)
<i>Opisthorchis viverrini</i> and <i>Clonorchis sinensis</i>	2000 (0.1%)	0 (0.0%)	2000 (0.1%)
<i>Schistosoma haematobium</i>	6000 (0.4%)	0 (0.0%)	6000 (0.3%)
Total	1 600 000 (100.0%)	430 000 (100.0%)	2 000 000 (100.0%)

Data are number of new cancer cases attributed to a particular infectious agent (proportion of the total number of new cases attributed to infection that is attributable to a specific agent). *Numbers are rounded to two significant digits.

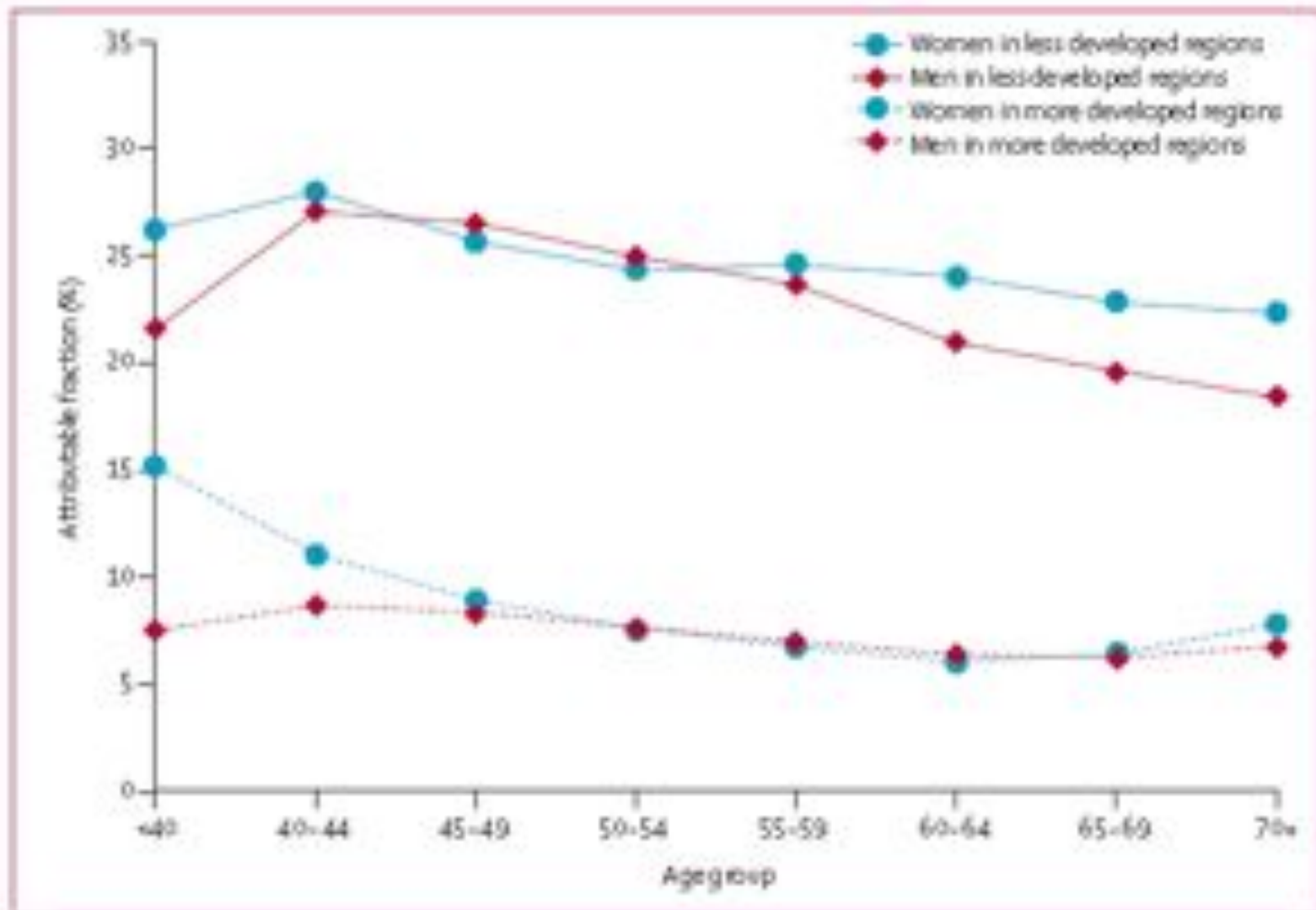
Table 2: Number of new cancer cases* in 2008 attributable to infection, by infectious agent and development status

Numbers are rounded to two significant digits

Number of new cancer cases attributable to infection in 2008 by development status



Relative percentage of new cancer cases attributable to infection by sex, age group, and development status

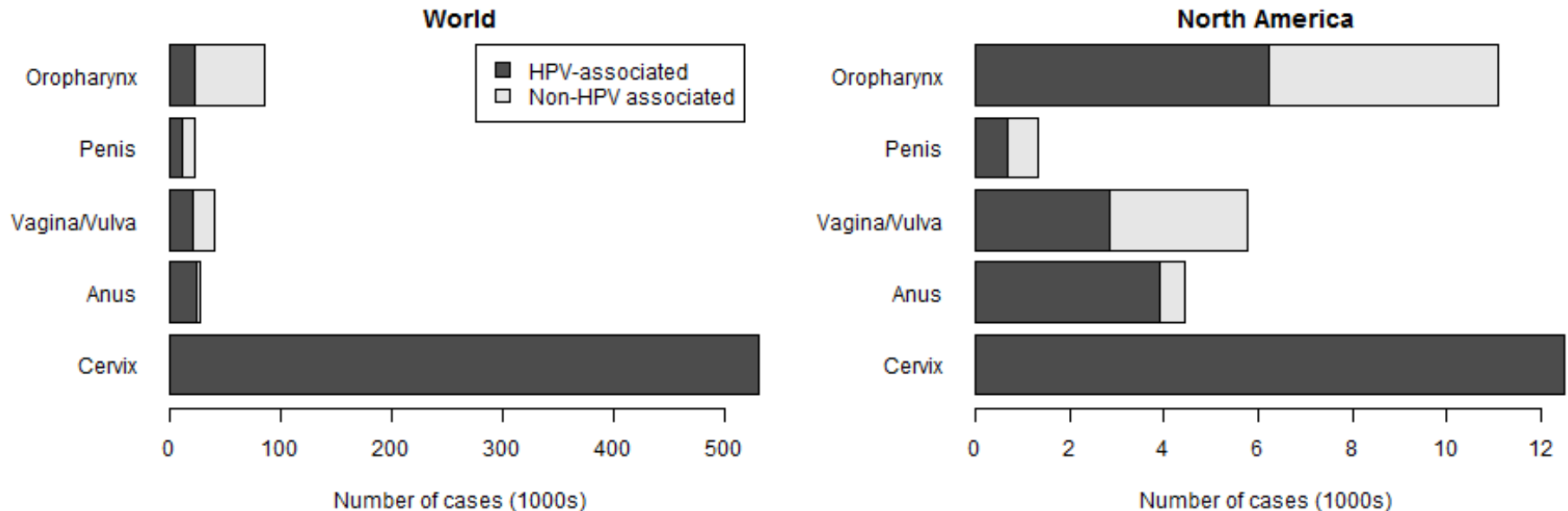


Human papillomavirus

- HPV is a necessary cause of cervical cancer
- Prevalent in other anogenital cancers:
 - Penis: 50%
 - Anus: 88%
 - Vulva: 43%
 - Vagina: 70%
- Found in a sub-set of oropharyngeal cancers (oropharynx, including tonsils and base of tongue)
 - Prevalence from 56% (N America) to 13% (Outside Europe, N America, Australia & New Zealand, Japan)

Cancers attributable to HPV

Worldwide, cervical cancer dominates the HPV-associated cancers

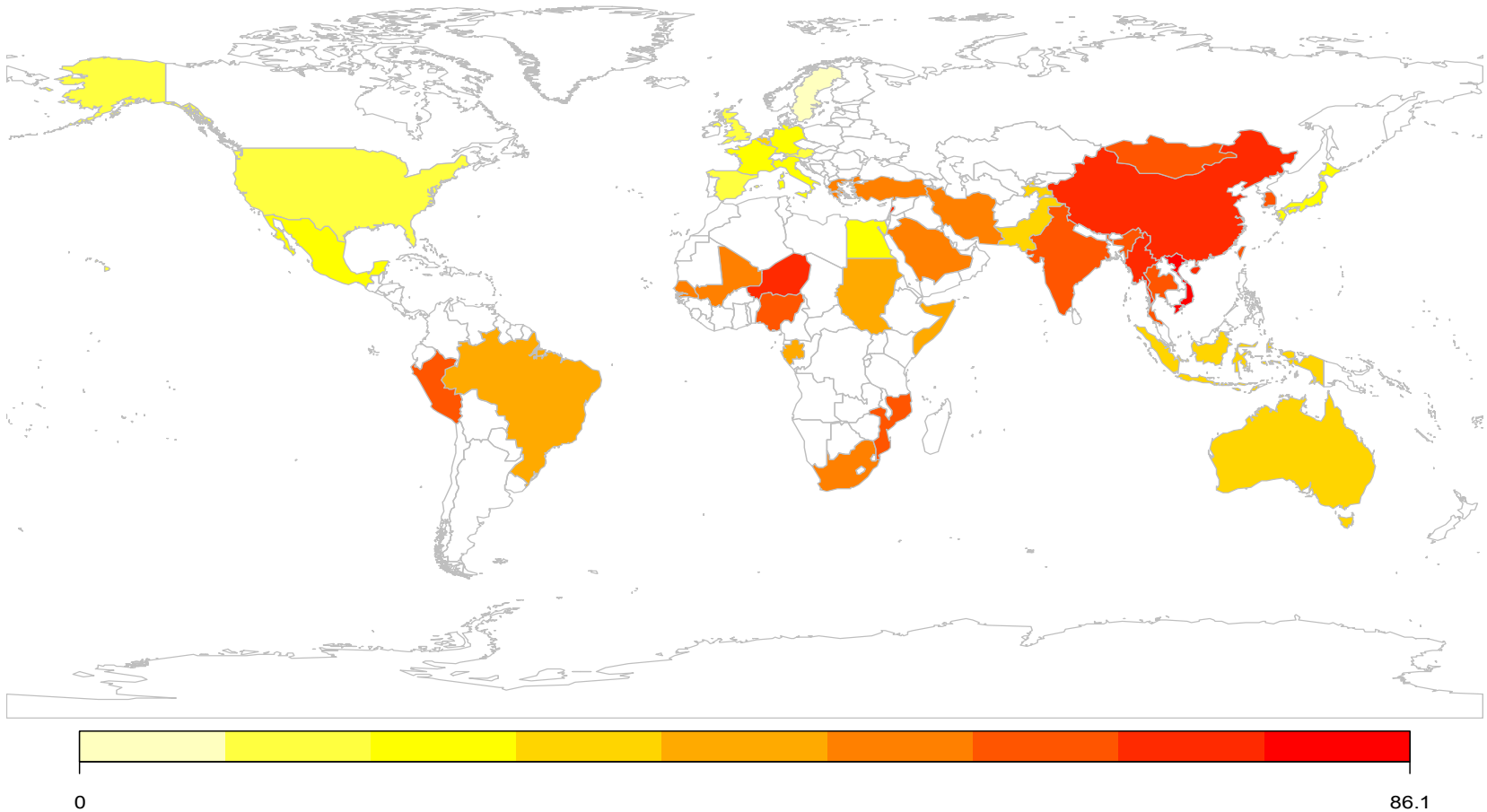


In N America, where cervical cancer is controlled by screening, HPV-associated cancers at other sites are equally important.

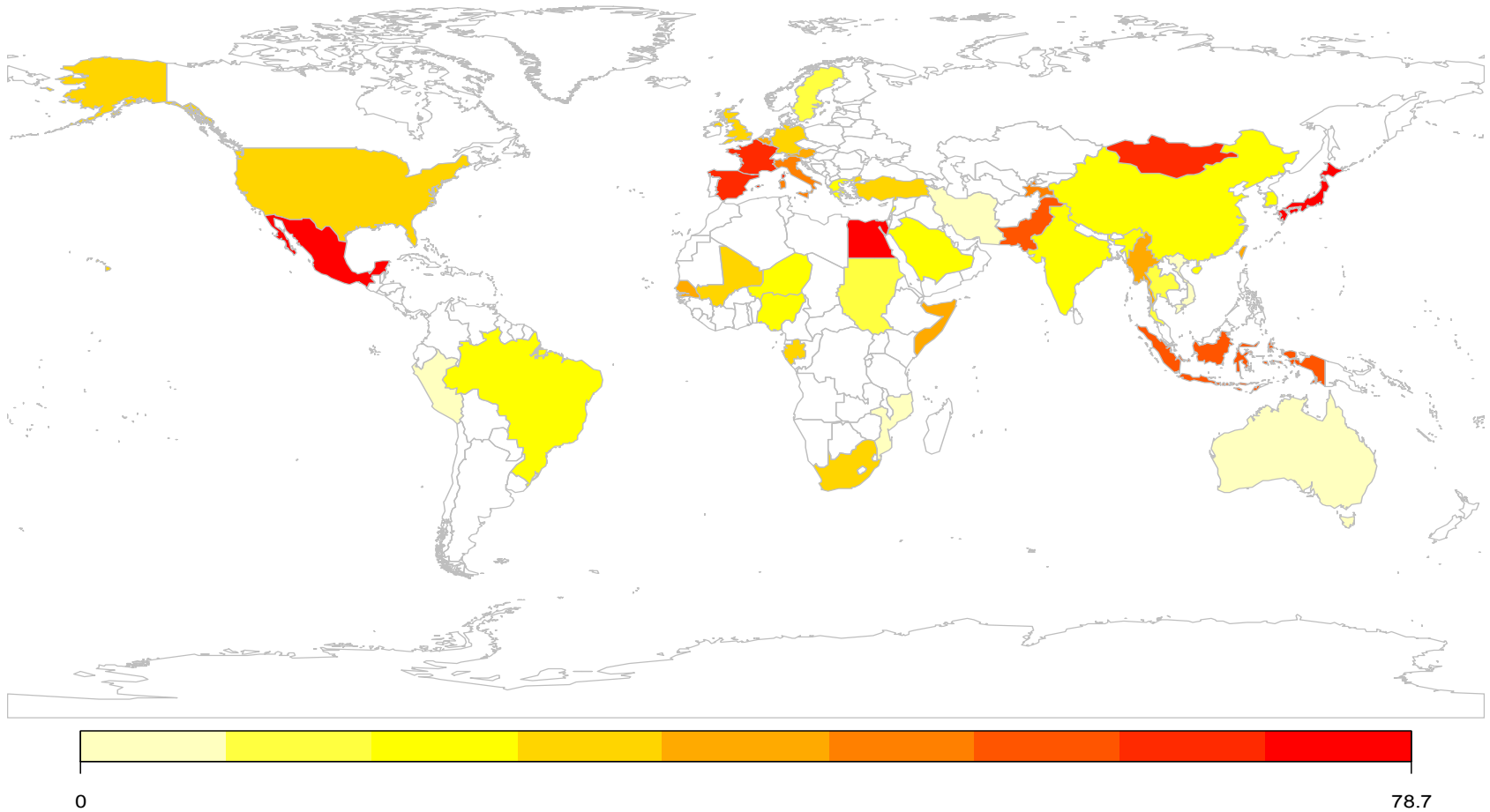
Hepatitis viruses

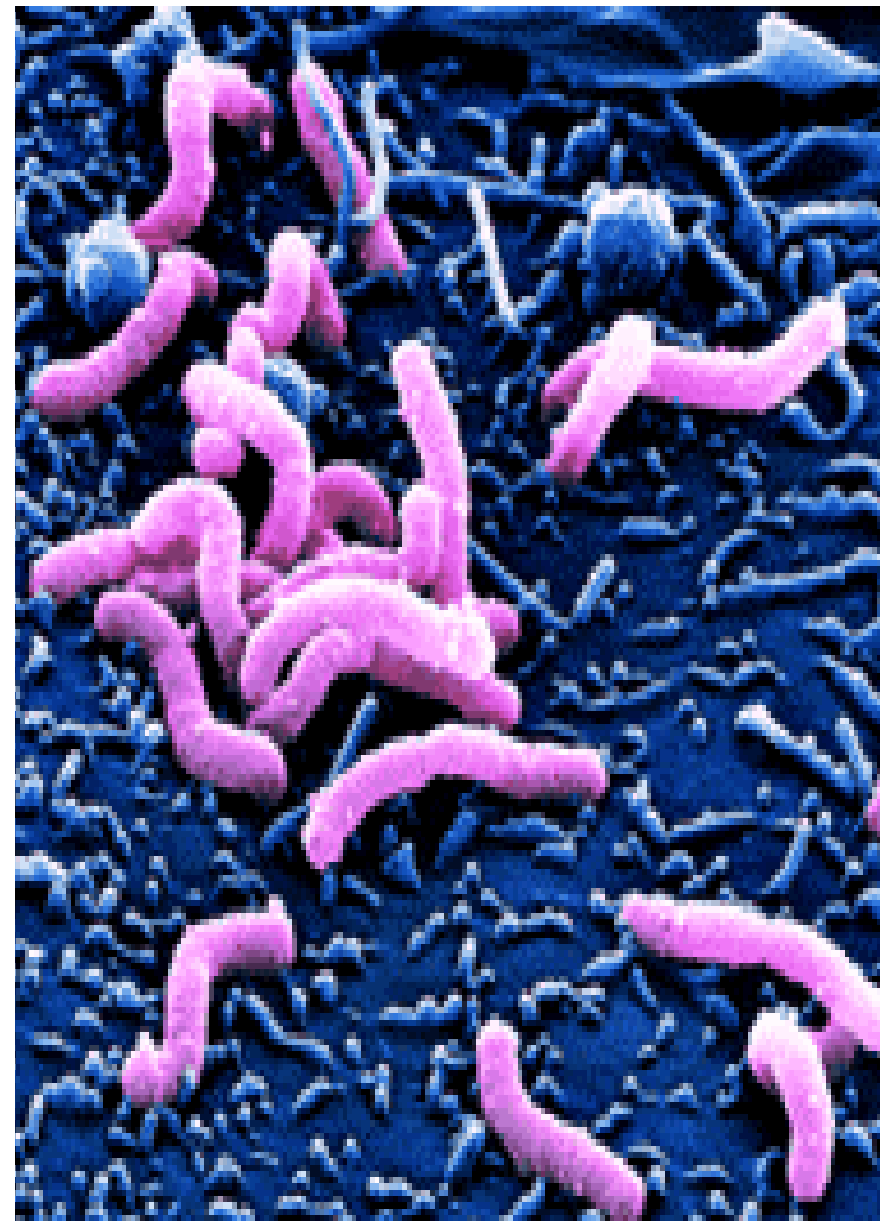
- Both HBV and HCV are strong risk factors for liver cancer ($R \sim 20$)
- HCV is also associated with non-Hodgkin lymphoma (PAF=8%)
- Strong geographical variation in prevalence of both HBV and HCV in liver cancer cases.

Prevalence of HBV in cases of hepatocellular carcinoma



Prevalence of HCV in cases of hepatocellular carcinoma





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Helicobacter pylori

- *H. pylori* is a risk factor for gastric cancer, but risk is restricted to non-cardia location.
- *H. pylori* is also associated with non-Hodgkin lymphoma of gastric location (MALT and DLBC), PAF=74%
- Once acquired (usually in childhood), infection tends to be lifelong
- Treatment is c. 90% effective with a combination of antibiotics and acid lowering drugs
- Screen and treat is a policy that may be an effective means of preventing gastric cancer – not yet adequately evaluated

Comparison of other estimates of proportion of cancers attributable to infection

- World (2002)
 - 17.8% (Parkin 2006) vs 16.1%
- China
 - 25.9% (Xiang et al 2011) vs 26.1%
- South Korea
 - 21.2% (Shin et al 2011) vs 22.5% (E Asia)
- UK
 - 3.1% (Parkin 2011) vs 7.0% (Europe) or
 - vs 4.0% (N America)

Global burden of cancers attributable to infections in 2008

Conclusions

- Wide geographic variation in the fraction of cancers attributable to infection.
- Almost a quarter of all cancers in less developed countries have an infectious cause.
- Importance of HPV, *H. pylori*, HBV, and HCV as main cancer-related infectious agents.
- Available strategies for prevention
 - vaccination against HBV and HPV
 - use of safe injection practices and avoidance of parenteral treatment for HCV
 - antibiotics for control of *H. pylori* (requires evaluation)

Global burden of cancers attributable to infections in 2008

Infection and Cancer Epidemiology Group

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De Martel C, Ferlay J, Vignat J, Franceschi S, Bray F , Forman D, and Plummer M. Global burden of cancers attributable to infections in 2008: A review and synthetic analysis. *Lancet Oncology*,13:607-15, 2012