

INFECTION

Helicobacter pylori, HPV, HBV and HCV are important cancer-causing infectious agents.

“

“Viruses have had a checkered history in cancer biology over the past century. Depending on the time and the fashion, viruses have been either sought out as the primary cause for cancer, or ignored as inconsequential to this disease. We are now entering a more mature phase of research with the realization that a considerable proportion of cancers are indeed caused by viruses.”

— Patrick S. Moore and Yuan Chang, discoverers of the cancer-causing viruses Kaposi sarcoma-associated herpesvirus and Merkel cell polyomavirus

① Worldwide, infectious agents are responsible for an estimated 2 million new cancer cases annually (16.1% of all cancers). The burden of these infection-related cancers is much higher in less-developed regions (22.9% overall and 32.7% in sub-Saharan Africa) versus more-developed regions (7.4%). The four main cancer-causing infectious agents—*Helicobacter pylori*, human papillomavirus, and hepatitis B and C viruses—are responsible for most infection-related cancers globally (mainly gastric, cervical and liver cancers, respectively).

Infection with the bacterium *Helicobacter pylori* is responsible for nearly 90% of stomach cancers worldwide and approximately 33% of all infection-related cancers. ② The prevalence of infection is especially common in less-developed regions, although it has been declining in recent generations.

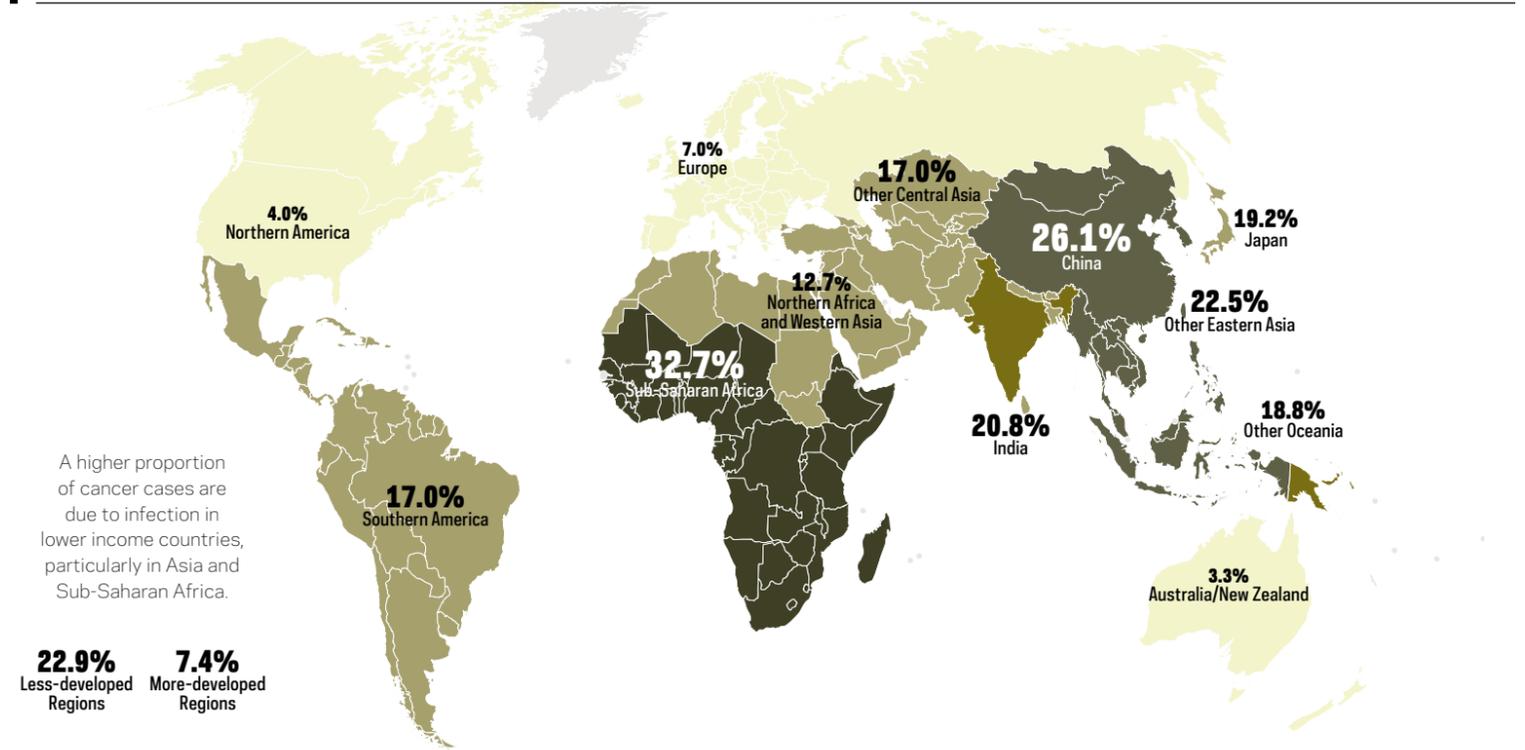
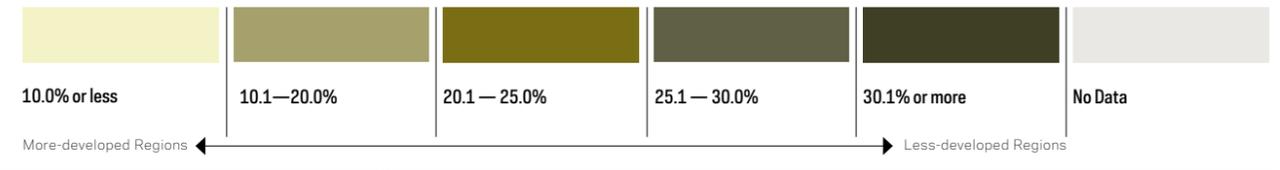
Human papillomavirus (HPV) causes 28% of all infection-related cancers globally. Persistent HPV infection is responsible for nearly all cervical cancers, and a number of other cancers: vulvar (43%), vaginal (70%), anal (88%), penile (50%), and oropharyngeal (26% worldwide but more than 50% in North America, Australia, and Northern Europe). Although there are over 100 HPV types, HPV types 16 and 18 cause approximately 70% all of cervical cancers and about 90% of other HPV-related cancers. Cervical cancer remains a leading cause of cancer deaths among women in many less-developed regions of the world, where screening and treatment is often limited or unavailable.

Chronic infections with hepatitis B virus (HBV) and/or hepatitis C virus (HCV) account for more than 75% of liver cancers and 28% of all infection-related cancers. These infections are the most common infectious cause of cancer among men in less-developed regions of the world. HCV infection also causes some cases of non-Hodgkin lymphoma.

Less-common infections that cause cancer include Epstein-Barr virus, Kaposi sarcoma-associated herpesvirus, human T-cell lymphotropic virus, liver flukes, and schistosomal infections. Human immunodeficiency virus (HIV) infection also causes some cancers indirectly, especially infection-related cancers. Future research will likely identify both additional infections that cause cancer and more cancers associated with known infections.

Global transitions associated with development (including sanitation) and primary prevention including HBV and HPV vaccinations may decrease the infection-related cancer burden. Prevention is key to tackling the increasing cancer burden, particularly for low- and middle-income countries with weak health systems. Treatments for *Helicobacter pylori* and HCV infections are available but not widely used due to, respectively, lack of demonstration of efficacy to prevent gastric cancer and high cost. There is a need to develop low-cost and low-technology prevention and treatment measures for use in resource-limited settings where infection-related cancers are most common.

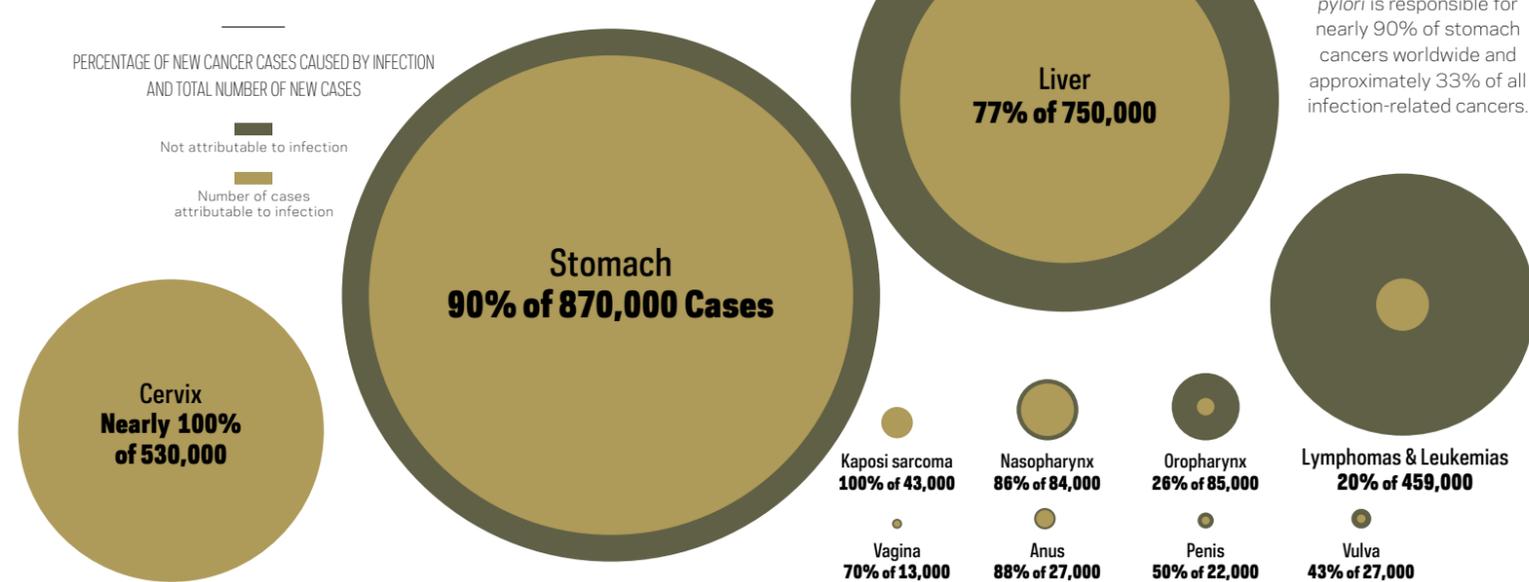
Fraction of new cancer cases attributable to infection



A higher proportion of cancer cases are due to infection in lower income countries, particularly in Asia and Sub-Saharan Africa.

22.9% Less-developed Regions
7.4% More-developed Regions

① Many of the most common cancers are at least partly attributable to infection.



Infection with the bacterium *Helicobacter pylori* is responsible for nearly 90% of stomach cancers worldwide and approximately 33% of all infection-related cancers.

② Less-developed regions have a higher burden of infection-related cancers, particularly those caused by HPV, *Helicobacter pylori*, and hepatitis B & C.

NUMBER OF NEW INFECTION-RELATED CANCER CASES OCCURRING BY SEX AND DEVELOPMENT STATUS

