

due to poor general nutrition or deficiencies in specific nutrients that increase the risk of infections.

- **Ischemic heart disease and cerebrovascular disease remain the leading causes of death in developed countries.** In these countries the main risk factors associated with loss of healthy life are smoking, high blood pressure, obesity, high cholesterol, and alcohol abuse.
- **In developing countries, five of the 10 leading causes of death are infectious diseases:** respiratory infections, human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS), diarrheal diseases, tuberculosis, and malaria. In 2010, HIV/AIDS and related infections such as tuberculosis were responsible for about 45% of years of life lost in Southern sub-Saharan Africa and about 10% in Southeast Asia.
- **In the postnatal period, about 50% of all deaths in children younger than 5 years of age are attributed to only three conditions, all preventable: pneumonia, diarrheal diseases, and malaria.** Nevertheless, thanks largely to public health measures, some progress has been made on this front; worldwide, deaths in children younger than 5 years of age declined from approximately 11.5 million in 1990 to approximately 7 million in 2010, even though the number of live births increased steadily during this time.

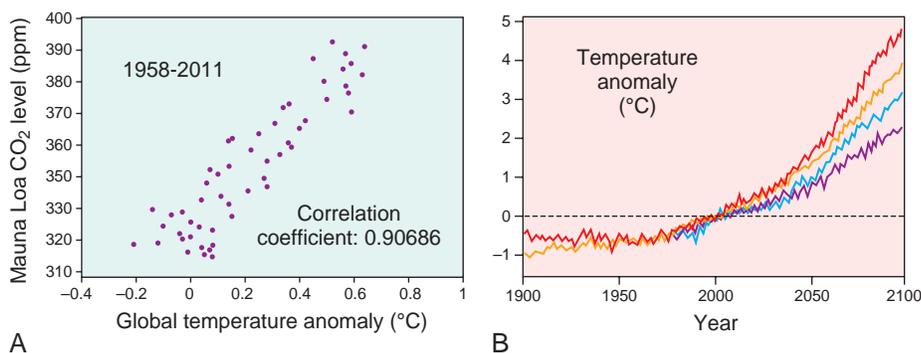
*Emerging infectious diseases* also constitute an important component of the global burden of disease. Emerging infections are defined as infectious disorders whose incidence has recently increased or could reasonably be expected to increase in the near future. Their emergence may occur by chance, but often finds its basis in some change in environmental and socioeconomic conditions. Categories of emerging infectious diseases include: (1) *diseases caused by newly evolved strains or organisms*, such as multidrug-resistant tuberculosis, chloroquine-resistant malaria, and methicillin-resistant *Staphylococcus aureus*; (2) *diseases caused by pathogens endemic in other species that recently “jumped” to human populations*, such as HIV; and (3) *diseases caused by pathogens that have been present in human populations but show a recent increase in incidence*. An example of the latter is dengue fever, which due to warming climate appears poised to spread into the southern United States.

## Health Effects of Climate Change

**Without immediate action, climate change stands to become the preeminent global cause of environmental disease in the twenty-first century and beyond.** Temperature measurements show that the earth has warmed at an accelerating rate over the past 50 years, perhaps at a rate greater than in any period during the preceding 1000 years. Since 1960 the global average temperature has increased by approximately 0.6°C, with the greatest increases seen over land areas between 40 degrees north and 70 degrees north. Notably, nine of the 10 hottest years in the meteorologic record have occurred in the twenty-first century. These increases in global temperature have been accompanied by the rapid loss of glacial and sea ice, leading to predictions that the iconic glaciers of Glacier National Park in Montana and Mt. Kilimanjaro in Tanzania may disappear by the year 2025, and that the Arctic Ocean will be completely ice-free in summer by no later than the year 2040.

Although politicians quibble, among scientists there is a general acceptance that climate change is, at least in part, man-made. The principal culprit is the rising atmospheric level of greenhouse gases, particularly carbon dioxide (CO<sub>2</sub>) released through the burning of fossil fuels (Fig. 9-2A), as well as ozone (an important air pollutant, discussed later) and methane. These gases, along with water vapor, produce the so-called greenhouse effect by absorbing and re-emitting infrared energy radiated from the Earth's surface that otherwise would be lost into space. The annual average level of atmospheric CO<sub>2</sub> in late 2012 (about 391 ppm) was higher than at any point in approximately 650,000 years and, without changes in human behavior, is expected to increase to between 500 to 1200 ppm by the end of this century — levels not experienced for tens of millions of years. This increase stems not only from increased CO<sub>2</sub> production but also from deforestation and the attendant decrease in carbon fixation by plants.

Depending on which computer model is used, increased levels of greenhouse gases are projected to cause the global temperature to rise by 2°C to 5°C by the year 2100 (Fig. 9-2B). Part of the uncertainty about the extent of the



**Figure 9-2** Climate change, past and future. **A**, Correlation of CO<sub>2</sub> levels measured at the Mauna Loa Observatory in Hawaii with average global temperature trends over the past 50 years. “Global temperature” in any given year was deduced at the Hadley Center (United Kingdom) from measurements taken at more than 3000 weather stations located around the globe. **B**, Predicted temperature increases during the twenty-first century. Different computer models plot anticipated rises in global temperatures of 2°C to 5°C by the year 2100. (**A**, Courtesy Dr. Richard Aster, Department of Geophysics, Colorado State University, Fort Collins, Colo.)