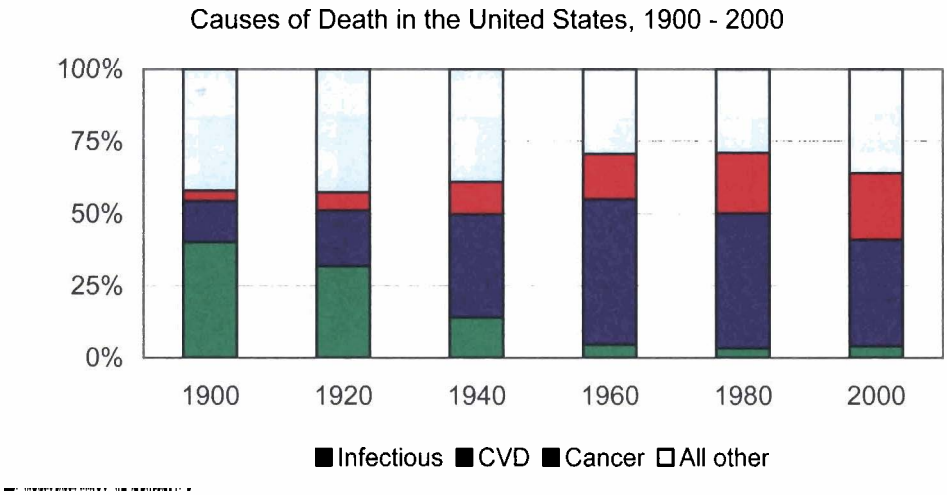
Quarterly Surveillance Report
October 2006
Special Supplement

The Epidemiologic Transition and the Prevalence of Cancer

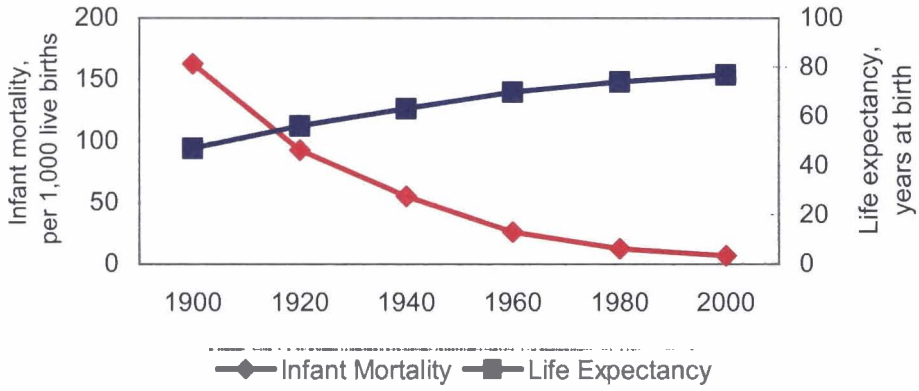
The Epidemiologic Transition is the shift from primarily infectious diseases to primarily chronic diseases as the cause of death in a population.[1] It is the result of advances in Public Health and Medicine and it contributes to the aging of the population. In 1900, one third of all deaths in the United States were attributed to three major categories of infectious disease: pneumonia and influenza, tuberculosis, and diarrheal diseases and enteritis.[2] Many additional deaths were caused by typhoid, meningococcal meningitis, scarlet fever, whooping cough, diphtheria, dysentery, and measles. Altogether, common infectious diseases accounted for 40% of all deaths in 1900 but they accounted for only 4% of all deaths in 2000. Cardiovascular disease (CVD; heart disease and stroke) accounted for 14% of all deaths in 1900 and for 37% in 2000. Cancer accounted for only 4% of all deaths in 1900 but for 23% in 2000.[3]



Many causes of death in 1900 were childhood diseases; high infant mortality (death in the first year of life) and low life expectancy reflect this.[4] In 1900, infant mortality was 162 per 1,000 live births and life expectancy at birth was only 47 years. In 1940, infant mortality was 63 per 1,000 live births and life expectancy was 55 years. In 2000, infant mortality was 7 per 1,000 and life expectancy was 77 years.

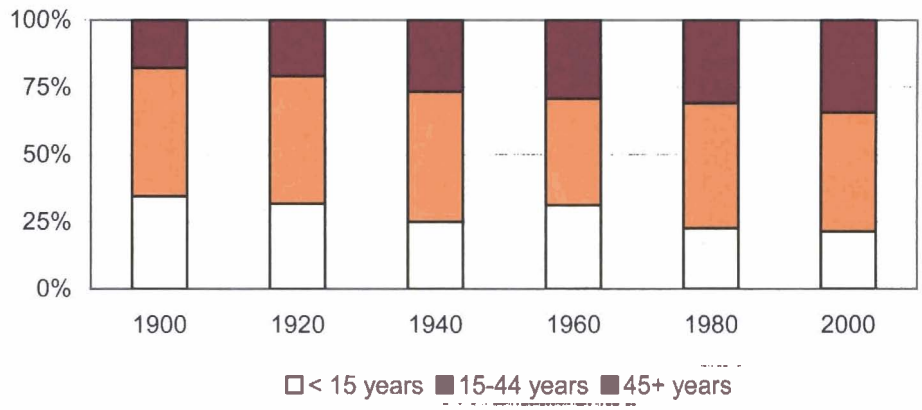
[1] AR Omran, 1971, *Milbank Memorial Fund Quarterly*, 49:509-538
[2] http://www.cdc.gov/nchs/dataawh/statat/unpubd/mortabs/hist293.htm
[3] Mokdad et al., 2004, *JAMA* 291:1238-1245.
[4] http://www.cdc.gov/nchs/fastats/lifexpec.htm

Infant Mortality and Life Expectancy in the United States, 1900 - 2000



As a result of these changes in mortality, and of reduced birth rates, the population of the US is aging.[5] In 1900, only 18% of US residents were age 45 or older. In 1940, 28% were age 45 or older and in 2000, 34% were age 45 or older. In Montana in 2000, 38% were age 45 or older.

Age Distribution of the Population of the United States, 1900 - 2000



Chronic diseases, including cancer, are overwhelmingly diseases of middle age and later. The average age at diagnosis of cancer in the Montana Central Tumor Registry (MCTR) is 65 years. Only 11% of the more than 110,000 patients in the MCTR were diagnosed at less than 45 years.

Cancer, as other chronic diseases, develops over many years, as the result of cumulative action of many risk factors and exposures. Cancer is a multifactorial disease. Genetic

[5] http://www.census.gov/prod/www/abs/decennial/index.htm

predisposition may contribute, possibly by making some people more vulnerable to certain behavioral, lifestyle, or environmental risk factors. Childhood cancers in particular may have a strong genetic component ranging from single-gene mutations to major chromosomal aberrations.

The fundamental process of cancer initiation is a mutation in the genetic material of cells that regulates their function and growth. Most cells in the body constantly grow and divide, making copies of their DNA, a process that has an inherent risk of error. The risk of error increases as people age. Some risk factors increase the chance of a copying error at cell division or cause damage (mutation) to the genetic material in mature cells. However, cells have great capacity to repair their genetic material, so most mutations are not passed on in cell lines, and most damaged cells do not become cancerous.

The current model of cancer development includes three steps:

- Initiation: A mutation occurs and is passed on in a cell line. This is not in itself cancer but it is the first, necessary step toward the development of cancer.
- Promotion: A cell line with a mutation behaves abnormally under the influence of a promoting substance (carcinogen). This is an ongoing process that must be either constant or repeated for initiated cells to eventually progress to cancer.
- Progression: Mutated cell lines, under the prolonged influence of promoters, lose normal regulation and display uncontrolled cell growth, loss of normal cell function, and invasion of other tissues.

The processes that lead to the eventual development of cancer usually take many years. Initiation is an uncommon event because cells with mutations most often die or are repaired. The promotion process acts over many years. Even the most powerful promoters that we know about, such as asbestos or high concentrations of industrial chemicals, require prolonged or repeated exposure.

It is usually difficult to identify a specific cause for an individual case of cancer. The exceptions include cancers associated with tobacco use or occupational exposures to a small number of known carcinogens. The public expresses great concern about the carcinogenic potential of environmental pollutants and other hazards. However, apart from tobacco use and exposure to second-hand smoke, there are few well-established environmental risks and they account for a very small proportion of all cases of cancer. Most cases of cancer remain unexplained.

The aging of the US population and the elimination of many deaths from infectious diseases set the stage for increased morbidity and mortality from chronic diseases, including cancer. In 1900, half the population died before they had an appreciable risk of developing cancer. Now, with life expectancy more than 75 years, one in three residents of the United States is likely to be diagnosed with cancer in his or her lifetime. Healthful behavioral and lifestyle choices and participation in recommended screening and early behavioral and lifestyle choices and participation in recommended screening and early detection programs continue to be the first line of defense against cancer.

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