



Health Cost Management Newsletter

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Hot Topic...

Life Expectancy

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Life Expectancy

**Abridged from original article by Scott J. Kush, MD, MPH
Please contact HCM for a copy of the full text with references**

Other than the quality of life, it is difficult to imagine a factor as important to an individual as the number of years remaining to live. And while most will rightly understand that there is no way to pinpoint an individual's exact date and time of death, few are aware that there is a widely-used and well-accepted scientific method to compute various summary measures of survival, such as the life expectancy. Medical researchers use their education, training, and expertise – together with the world's medical literature and standard scientific methods – to calculate life expectancy. I discuss these methods, and their application, in the present article.

Survival time is the actual number of years a person will live. The life expectancy of an individual (or group of similar persons) of a given age and condition is the average number of remaining years of life. While a person's *actual survival time cannot be predicted with any accuracy*, their life expectancy, in most instances, *can be calculated with considerable accuracy*.

A related question may arise: What is the point after which exactly half of a large group of persons like our individual are still alive? Or, put another way, what is the *more likely than not* survival time? The answer is the median survival time, the middle value of all survival times if they were ordered from smallest to largest, and this quantity derives from the same analyses that yield the life expectancy.

Life expectancy most commonly comes from a life table. The table is a summary of the mortality experience of a population, and is a key tool of actuaries and others concerned with survival. It has been used for hundreds of years, dating from John Graunt's use to describe survival in Britain about the time of the Great Plague. (See the full text article for more details about the life table.)

Factors known to affect survival include demographics, lifestyle, and medical conditions. Demographics are age, sex, family history, race, and education. Lifestyle factors are smoking, alcohol, obesity and amount of exercise. Some common medical conditions include heart disease, cancer, and diabetes. In each case, the type and severity of the condition can be important. Disabilities also affect survival, as is evidenced by an abundant literature on cerebral palsy, traumatic brain injury, and spinal cord injury.

The above-noted "risk factors" (diseases, conditions, or lifestyles) affect mortality rates. The difference between the death rate in a study population (the group with the risk factor in question) and that in a suitable reference population (usually those without such risk) is the excess death rate (EDR). The ratio of the same two quantities is the relative risk (RR).

To calculate life expectancy for an individual with a given set of risk factors, the baseline, or starting, mortality rates at all ages are adjusted, usually using EDRs or RRs, and a new life table is constructed. If EDRs for a given factor are known, they are added to the standard rates. If instead RRs are known, the standard rates are multiplied by these. For example, if a given condition confers an extra 1% risk of death per year (EDR) at ages 50+, then the mortality rates at ages 50 and up are to be increased by 1%. Doing so, and constructing a new life table, we find that the life expectancy at age 10 for a U.S. male decreases from 65.5 to 61.6. On the other hand, if favorable lifestyle and other conditions apply, and a (favorable) factor of 0.8 (RR) applies for life, the life expectancy increases from 65.5 to 68.2.

In general, it would not be appropriate to use the general population (GP) life tables for someone with serious medical conditions or disabilities. Instead, a new life table must be constructed taking specifically into consideration their various lifestyles, conditions, and disabilities. For example, persons with ("mild") diabetes have a risk of death that is 50% higher than that of the general population. This fact is documented in over 100 independent, peer-reviewed, published studies in the medical literature. Quantitatively, it means that the baseline mortality rates should be increased using an (a) RR of 1.5, or (2) EDR of 0.5 times the baseline rate. One then constructs a life table with the new rates, and "reads off" the new life expectancy. At age 50, say, the life expectancy is now 24.6 years, rather than 28.5 using the general population rates for a man, or 3.9 years lower.

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Similarly, for very healthy persons, the absence of risk factors must be taken into account. For most diseases and conditions, there is an abundant scientific literature to consult. Depending on their age and myriad other factors, a person's life expectancy can vary from less than a year to as many as 85+ additional years.

Examples of life expectancies for various groups are shown below. As can be seen, life expectancy can vary greatly, even for persons of the same age and sex.

Life expectancies (additional years) for various groups:

Group	Life Expectancy
Male at birth	75
Female at birth	80
20 year-old female	61
20 year-old with paraplegia due to spinal cord injury	46
20 year-old in a persistent vegetative state	11
35 year-old male	42
35 year-old male with minor traumatic brain injury	37
35 year-old male with severe traumatic brain injury	19
50 year-old male	29
50 year-old male non-smoker	31
50 year-old male heavy smoker	22
50 year-old male with 2 vessel coronary artery disease and normal ejection fraction	24
65 year-old male on dialysis for life	3
70 year-old male	14
90 year-old woman	4
Person with untreatable metastatic cancer	< 1

The science of life expectancy has found myriad applications over the years. The most common application is life insurance, wherein annual premium payments depend critically on the person's short- or long-term survival prospects. A related product, and one usually sold by a division of a life insurance company, is a life annuity (the sale of a lifetime stream of payments, like a pension, in exchange for a lump sum). Most recently, the opposite of this, a so-called reverse mortgage (wherein the owner is given a lump sum now, in exchange for agreeing to transfer the trust deed on a house upon death), has gained popularity.

In a civil litigation setting, life expectancy can be a major factor in determining damages. It is a key input for economists, who compute the present value of future medical expenses. It is also frequently noted by lifecare planners, who estimate the yearly future expenses.

Life expectancy is part of the pattern jury instructions for most jurisdictions in the United States. The jury (or "the trier of fact"), is often advised to use the standard tables, and to adjust those to account for lifestyle and medical factors. As we have seen, this can be done using standard scientific methods and the medical literature.