

mild bronchitis. The duration of an impaired health state, which can range from a day or two to several years or even a lifetime (e.g., birth defects inducing mental retardation), need to be considered carefully. Information on both the severity and duration of an impaired health state are necessary before the task of monetization can be performed.

When monetizing nonfatal health effects, it is important to consider two components: (1) The private demand for prevention of the nonfatal health effect, to be represented by the preferences of the target population at risk, and (2) the net financial externalities associated with poor health such as net changes in public medical costs and any net changes in economic production. Revealed-preference or stated-preference studies are necessary to estimate the private demand; health economics data from published sources can typically be used to estimate the financial externalities of poor health. If you use literature values to monetize nonfatal health and safety risks, it is important to make sure that the values you have selected are appropriate for the severity and duration of health effects to be addressed by your rule.

If data are not available to support monetization, you might consider an alternative approach that makes use of health-utility studies. Although the economics literature on the monetary valuation of impaired health states is growing, there is a much larger clinical literature on how patients, providers and community residents value diverse health states. This literature typically measures health utilities based on the standard gamble, the time tradeoff or the rating scale methods. This health utility information may be combined with known monetary values for well-defined health states to estimate monetary values for a wide range of health states of different severity and duration. If you use this approach, you should be careful to acknowledge your assumptions and the limitations of your estimates.

#### b. Premature Mortality Risks

The adoption of a monetary value for projected reductions in premature mortality is the subject of continuing research and discussion within the economics and policy analysis communities. Although there is a substantial academic literature on this topic, the methods used and resulting estimates vary substantially. The two most widely used measures consider the number of statistical lives saved and the number of expected years of life saved and their associated monetary values. Both of these measures are applicable to settings where a rule changes small probabilities of death faced by the public.

The phrase "statistical life" is widely used in the technical literature but it can be misleading and easily misinterpreted. Unlike an identified life, whose name and background are known (e.g., a trapped coal miner or patient dying of kidney failure), a statistical life refers to the sum of risks experienced by a population. For example, if 10,000 people each face a risk of 1 in 10,000 of immediate death, one statistical life is expected to be lost. Statistical lives that are lost are real people but, given the background rate of fatal events in the population, it is not

feasible to determine which actual lives will be saved or lost by a specific rule.

The monetary value of saving a statistical life (VSL) is derived by assessing the public's willingness to pay to avert one statistical fatality. The bulk of the studies in the literature, which address wage premiums for hazardous jobs, are based on revealed preference. A small but growing number of stated-preference studies have also been used to derive VSLs. The estimates of VSL in the literature vary considerably but this is not surprising because VSL is not expected to be a universal constant. Economic theory predicts that VSLs may vary in different lifesaving contexts depending upon factors such as the magnitude of the probabilities and the health preferences of the target population.

You should not use a VSL estimate without considering whether it is appropriate for the size and type of risks addressed by your rule. Studies aimed at deriving VSL values for middle-aged populations are not necessarily applicable to rules that address lifesaving among children or the elderly. Moreover, VSL values based on fatal cancers or heart attacks are not necessarily relevant to a rule that prevents fatal causes of trauma, violence, or infectious disease. If you choose to apply a VSL derived in one setting to a different setting, you should disclose the salient differences in the lifesaving contexts and, where feasible, make appropriate quantitative adjustments to the VSL value.

Since everyone is expected to die sooner or later, it has been suggested that the VSL be replaced or augmented by the monetary value of a statistical life year (VSLY). The assumption is that the public is willing to pay more money for a rule that saves an average of 10 life years per person than a rule that saves one life year per person. A key assumption implicit in this approach is that public willingness to pay for risk reduction is strictly proportional to the number of life years at risk. This may not always be the case. For example, the elderly may have substantial willingness to pay for reductions in their mortality risk precisely because they have relatively few life years remaining. Where there is good reason to believe that these values are not strictly proportional, you should attempt to develop appropriate estimates. In all instances, whether or not you are able to develop ideal estimates, agencies should consider providing estimates of both VSL and VSLY, while recognizing the developing states of knowledge in this area.

In summary, you should use valid, relevant data and methods to assign monetary values to changes in the risk of premature death, illness or injury. Some of the key issues include:

- Whether the monetary valuations have been shown to be appropriately sensitive to the scope of the health change, considering probability, severity and longevity.
- Whether the specific data and methods used for monetization are relevant to the specific health change induced by a proposed regulation.

The valuation of fatal and nonfatal risk reduction is an evolving area in terms of research design, methods and results. You should utilize valuation methods that you

consider appropriate for the regulatory circumstances. You should present estimates based on alternative approaches, and if you monetize mortality risk reduction, you should do so on a consistent basis to the extent feasible. You should clearly indicate your methodology and document your choice of a particular methodology. If you use different methodologies in different rules, you should clearly disclose the fact and explain your reasons.

#### C. What Discount Rate To Use

Benefits and their associated costs do not always take place in the same time period, and when they do not, it is usually incorrect simply to add up all of the expected benefits or costs without taking account of when they actually occur. If benefits or costs are delayed or otherwise separated in time from each other, the difference in timing should be reflected in your analysis.

As a first step, you should present the annual time stream of benefits and costs expected to result from the rule, clearly identifying when the benefits and costs are expected to occur. The beginning point for your stream of estimates should be the year in which the final rule will begin to have effects, even if that is expected to be some time in the future. In presenting the stream of benefits and costs, it is important to measure them in constant dollars. That way you avoid the misleading effects of inflation on your estimates. If the benefits or costs are initially measured in prices reflecting expected future inflation, you can convert them to constant dollars by dividing through by an appropriate inflation index, one that corresponds to the inflation rate underlying the initial estimates of benefits or costs.

Once these preliminaries are out of the way, you can begin to adjust your estimates for differences in timing. This is a separate calculation from the adjustment needed to remove the effects of future inflation. Whether or not inflation is expected, it is generally true that the sooner benefits occur the more valuable they are. Resources that are invested will normally earn a positive return, so current consumption is more expensive than future consumption, because you are giving up that expected return when you consume today. Looking at it another way, postponed benefits have a cost because people are impatient and generally prefer present to future consumption. Also, if consumption continues to increase over time, as it has for most of U.S. history, an increment of consumption will be less valuable in the future than it would be today, because as total consumption increases, its marginal value tends to decline. These are all reasons for valuing future costs and benefits less than those occurring in the present.

A discount factor should be used to adjust the estimated costs and benefits for differences in timing. The further in the future the costs and benefits are expected to occur, the larger is this discount factor. The discount factor can be calculated given a discount rate. The formula is  $1/(1 + \text{the discount rate})^t$  where "t" measures the number of years in the future that the benefits or costs are expected to occur. Benefits or costs that have been adjusted in