

APPENDIX A:

Technical Appendix



This appendix provides additional information on a number of issues related to monitoring progress in Healthy People 2010.

- › **Measuring progress toward target attainment**—Procedures used to measure progress toward the targets for Healthy People 2010 objectives.
- › **Measuring quality and years of healthy life**—Procedures used to measure quality and years of healthy life in connection with the first goal of Healthy People 2010.
- › **Measuring health disparities**—Procedures used to measure and track health disparities among select population groups in connection with the second goal of Healthy People 2010.
- › **Mapping**—Procedures used for mapping select Healthy People 2010 objectives.
- › **DATA2010**—The online database for Healthy People 2010 objectives.
- › **General data issues**—The guide to measurement issues in Healthy People 2010.
- › **Tracking period**—A note on how an objective's tracking period is defined in the Healthy People 2010 Final Review.

Measuring Progress Toward Target Attainment

Progress toward the Healthy People 2010 targets at Final Review is shown in a Progress Chart (first figure in each Focus Area chapter). This chart displays the percent of targeted change that has been achieved for each objective.

Percent of Targeted Change Achieved

Targeted change is the difference between the baseline and the Healthy People 2010 (HP2010) target. The formula for the percent of targeted change achieved is as follows:

$$\text{Percent of targeted change achieved} = \frac{\text{Final value} - \text{Baseline value}}{\text{HP2010 target} - \text{Baseline value}} \times 100.$$

The percent of targeted change achieved expresses the difference between the baseline and the final value as a percent of the initial difference between the baseline and the Healthy People 2010 target. As such, it is a relative measure of progress toward attaining the Healthy People 2010 target. In addition, the comparability of the percent of targeted change achieved does not depend on whether the underlying objective is expressed in terms of adverse or favorable events or conditions; see 'Measuring Health Disparities', below. The percent of targeted change achieved was also used to monitor progress in Healthy People 2000 and was previously referred to as the 'progress quotient' [1,2].

Baseline data values were published at the beginning of the decade for Healthy People 2010 objectives for which data were available [3]. Baseline data for additional objectives have become available since the publication of *Healthy People 2010* [4]. Data beyond the baseline are available for about 76% of the objectives in Healthy People 2010.

Example A-1

School-based objective 7-2c in Healthy People 2010 called for an increase in the proportion of middle/junior and senior high schools that provide education to prevent violence, from a baseline of 58% in 1994 to a target of 80%. In 2006, 77% of schools provided education to prevent violence, see Figure 7-1 in the Focus Area 7 chapter. Using the formula above, 86.4% of the targeted change from the 1994 baseline to the Healthy People 2010 target was achieved in 2006. Indeed,

$$\begin{array}{l} \text{Percent of} \\ \text{targeted} \\ \text{change} \\ \text{achieved} \end{array} = \frac{77-58}{80-58} \times 100 = \frac{19}{22} \times 100 = 86.4\%.$$

For population-based objectives, the percent of targeted change achieved also can be used to measure progress toward the Healthy People 2010 target for each population group with data beyond the baseline.

Example A-2

The Healthy People 2010 target for objective 16-1c was to reduce the infant death rate to 4.5 deaths per 1,000 live births. For the total population, the 1998 baseline rate was 7.2 infant deaths per 1,000 live births, whereas the 2006 rate was 6.7 infant deaths per 1,000 live births; see Figure 16-1 in the Focus Area 16 chapter. When the formula above is applied, 18.5% of the targeted change from the 1998 baseline to the Healthy People 2010 target was achieved in 2006:

$$\begin{array}{l} \text{Percent of} \\ \text{targeted} \\ \text{change} \\ \text{achieved} \end{array} = \frac{6.7-7.2}{4.5-7.2} \times 100 = \frac{-0.5}{-2.7} \times 100 = 18.5\%.$$

In contrast, among infants of Asian or Pacific Islander mothers, the infant death rate declined from 5.5 deaths per 1,000 live births at baseline to 4.5 deaths per 1,000 live births in 2006. Using the formula above, 100% of the targeted change from the 1998 baseline to the Healthy People 2010 target was achieved in 2006:

$$\begin{array}{l} \text{Percent of} \\ \text{targeted} \\ \text{change} \\ \text{achieved} \end{array} = \frac{4.5-5.5}{4.5-5.5} \times 100 = \frac{-1.0}{-1.0} \times 100 = 100\%.$$

Thus, the Healthy People 2010 target was met for the Asian or Pacific Islander group in 2006, even though, overall, the population only achieved 18.5% of the targeted change.

Limitations

In addition to assessing differentials in progress toward target attainment within the population, the percent of targeted change achieved may be used to compare how much of the targeted change was achieved for an objective relative to other objectives, although care must be exercised in its interpretation. Generally speaking, the reader is advised to keep the following points in mind:

- › The percent of targeted change achieved is calculated using only the Healthy People 2010 target, baseline, and final data points. Fluctuations that may occur during the intervening years are not considered, even though they may be substantial.

- › The number of years between the baseline and final data points for Healthy People 2010 might vary both between objectives and within objectives.

- Between objectives, differences in the number of years available to meet targets are a function of the data sources and any choices that were made regarding the most appropriate baseline year for each objective.
- To assist the reader in the interpretation of these comparisons, the baseline and final data years used for each objective are shown in parentheses following the short descriptions in the left-most panel of the Progress Chart for each Focus Area.
- Within objectives, differences in the number of years available to meet Healthy People 2010 targets for specific groups within the population can be affected by changes in the data templates used to classify the population (e.g., by race and ethnicity) during the tracking period.
- The period used to compute the percent of targeted change achieved will generally be consistent with the period used to estimate disparities, see the Measuring Health Disparities section below for more details.

- › The (absolute) value of the Healthy People 2010 targeted change from baseline might vary among select populations or across objectives with identical values for the percent of targeted change achieved. Therefore, two objectives may be identical in their percent of targeted change achieved, even though they differ in the magnitude of the change. See Example A-3 below.

Example A-3.

Objective 7-4b in Healthy People 2010 called for 50% of senior high schools with a nurse-to-student ratio of at least 1:750, whereas objective 7-4d called for a target of 48% of elementary school to achieve that same nurse-to-student ratio. The 1994 baseline data point for senior high schools was 26%, thus the absolute value of the targeted change for objective 7-4b was 24 percentage points. On the other hand, the 2000 baseline data point for elementary schools was 42%, resulting in a targeted change of only 6 percentage points. In 2006, 38% of senior high schools and 45% of elementary schools had attained the desired nurse-to-student ratio. As a result, both objectives achieved 50% of their targeted change—12 of the targeted 24 percentage points for objective 7-4b, and 3 of the targeted 6 percentage points for objective 7-4d—even though they differed in the magnitude of the change. See Figure 7-1 in the Focus Area 7 chapter.

In addition to the above limitations, there are a number of cases in which the percent of targeted change achieved cannot be calculated or does not adequately reflect change in an objective. Five hypothetical scenarios

are presented below for the reader's consideration, further illustrating the care that must be exercised in the interpretation of the percent of targeted change achieved in Healthy People 2010.

Scenario 1: Target met at baseline and movement in desired direction

Target = 5; Baseline value = 5; Final value = 4; desired direction = decrease in value.

$$\begin{array}{l} \text{Percent of} \\ \text{targeted} \\ \text{change} \\ \text{achieved} \end{array} = \frac{4-5}{5-5} \times 100 = \frac{-1}{0} \times 100 = \text{undefined.}$$

Cannot divide by 0.

Scenario 2: Target met at baseline and movement in undesired direction

Target = 0; Baseline value = 0; Final value = 2; desired direction = decrease in value.

$$\begin{array}{l} \text{Percent of} \\ \text{targeted} \\ \text{change} \\ \text{achieved} \end{array} = \frac{2-0}{0-0} \times 100 = \frac{2}{0} \times 100 = \text{undefined.}$$

Cannot divide by 0.

Scenario 3: Target exceeded at baseline and movement in desired direction

Target = 30; Baseline value = 35; Final value = 40; desired direction = increase in value.

$$\begin{array}{l} \text{Percent of} \\ \text{targeted} \\ \text{change} \\ \text{achieved} \end{array} = \frac{40-35}{30-35} \times 100 = \frac{5}{-5} \times 100 = -100\%.$$

Here, progress has been made, but the percent of targeted change achieved appears to indicate movement away from the target.

Scenario 4: Target exceeded at baseline and movement in undesired direction

Target = 30; Baseline value = 35; Final value = 25; desired direction = increase in value.

$$\begin{array}{l} \text{Percent of} \\ \text{targeted} \\ \text{change} \\ \text{achieved} \end{array} = \frac{25-35}{30-35} \times 100 = \frac{-10}{-5} \times 100 = 200\%.$$

Here, progress has *not* been made, but the percent of targeted change achieved appears to indicate the target has been exceeded.

In the Progress Chart (first figure in each Focus Area chapter), objectives as in scenarios 1 and 3 above are shown with arrows in the positive direction. Those as in

scenarios 2 and 4 are shown with arrows in the negative direction. In all cases, footnotes indicate the precise amount cannot be calculated.

Finally, when the targeted amount of change is small relative to the actual amount of observed change, the percent of targeted change achieved can have relatively large values that are difficult to interpret. Furthermore, the reader should be aware that target setting has a sizeable impact on the 'percent of targeted change achieved'. This phenomenon is illustrated in the following hypothetical scenario.

Scenario 5: Target set closer to baseline and movement in undesired direction

Baseline value = 50; Final value = 70; desired direction = decrease in value.

Case 1: Target = 30

$$\begin{array}{l} \text{Percent of} \\ \text{targeted} \\ \text{change} \\ \text{achieved} \end{array} = \frac{70-50}{30-50} \times 100 = \frac{20}{-20} \times 100 = -100\%.$$

Case 2: Target = 40

$$\begin{array}{l} \text{Percent of} \\ \text{targeted} \\ \text{change} \\ \text{achieved} \end{array} = \frac{70-50}{40-50} \times 100 = \frac{20}{-10} \times 100 = -200\%.$$

In both cases, progress *has not* been made, the final value having exceeded the baseline value by 20 points. Yet, a target of 40 having been set closer to the baseline value than a target of 30, the percent of targeted change achieved appears to indicate a worse scenario in the second case than in the first, even though the difference between the baseline and final values remains unchanged.

To circumvent the difficulty in interpretation that arises for objectives like in scenario 5 above, movement *away* from the Healthy People 2010 target is not quantified using the percent of targeted change achieved in the Progress Chart (see footnote 1 for Figure 1 in each of the Focus Area chapters) for the Final Review. Instead, for such objectives, the reader is urged to examine the difference between the baseline and the final values to assess progress.

Testing for Trends

As stated in the Limitations section above, the percent of targeted change achieved is calculated using only the Healthy People 2010 target, baseline, and final data points. Fluctuations that may occur during the intervening years are not considered, even though they may be substantial. In addition, the number of years

between the baseline and final data points for Healthy People 2010 might vary both between objectives and within objectives.

Nonetheless, the presence of a monotonic increasing or decreasing trend in the underlying measure can be tested with the nonparametric Mann-Kendall test, and the slope of a linear trend estimated with the nonparametric Sen's method [5].

The Mann-Kendall test is suitable for cases where the trend may be assumed to be monotonic, and thus where no seasonal or other cycle is present in the data.

The Sen's method uses a linear model to estimate the slope of the trend when the variance of the residuals may be assumed constant in time. Missing values are allowed and the data need not conform to any particular distribution. Also, the Sen's method is not greatly affected by single data errors or outliers.

When the number of data points is less than 10, Sen's S statistic can be used. When the number of data points is 10 or more, a normal approximation holds, and a Z statistic can be used instead.

Results of the trend tests described above are used in the Highlights section of selected Focus Area chapters—namely, chapters 6, 10, 13, 15, and 20—to supplement findings on progress toward achieving Healthy People 2010 targets during the decade.

Measuring Quality and Years of Healthy Life

Goal 1 of Healthy People 2010 is to increase the quality and length of healthy life-years. This goal is tracked with three summary measures of health that belong to the family of measures called “healthy life expectancy.” The three summary measures are:

1. Expected years of life in good or better health
2. Expected years of life free of activity limitation
3. Expected years of life free of selected chronic diseases.

These healthy life expectancy measures are given in life-years, which indicate the average number of healthy years a person can expect to live if age-specific death rates and age-specific illness rates remain the same throughout his or her lifetime. Thus, healthy life expectancy is a snapshot of current death and illness patterns and can illustrate the long-range implications of the prevailing age-specific death and illness rates. The methods used to create the healthy life expectancy measures are described next.

Methods

The measures of healthy life expectancy used in the *Final Review* are calculated using a double-decrement life table technique, based on the Sullivan method [6,7]. A traditional life table presents what would happen to a hypothetical cohort if it experienced exactly the same age-specific death rates during a given period of time [8]. A double-decrement life table analyzes what would happen to a hypothetical cohort if it experienced exactly the same age-specific death and age-specific illness rates during a given period of time. Although it is possible to create life tables based on single years of age, this analysis uses an abridged life table, with age intervals of 5 years.

To produce the measures of healthy life expectancy, age-specific death rates are combined with age-specific health prevalence rates to produce an estimate of overall healthy life expectancy [9].

The life table includes the following quantities:

- › *qx*—*Probability of dying*—This column shows the probability of dying during the age interval. It is derived from death rates for a given year.
- › *lx*—*Number surviving*—This column shows the number of persons from birth surviving to the beginning of the next age interval. The life table typically begins with a population at birth of 100,000, called the *radix*.
- › *dx*—*Number dying*—This column shows the number of deaths in each age interval out of the original 100,000 births. It is calculated by multiplying the *qx* for the age interval by the *lx* for the same age interval.
- › *Lx*—*Person-years lived*—This column shows the total time lived (in years) within the age interval by all of those who have survived to the beginning of the age interval.
- › *Tx*—*Total number of person-years lived*—This column shows the total number of person-years lived that would be lived after the beginning of the age interval.
- › *Ex*—*Expectation of life*—This column shows the average number of years remaining to be lived by those surviving to the age interval. It is derived by dividing the total number of person-years lived at the age interval and above by the number surviving to the beginning of the age interval (Tx/lx).

Life tables used to calculate healthy life expectancy include all of the quantities described above in addition to the following quantities regarding illness:

- › *Px*—*Age-specific illness rate*—This column shows the percentage of persons in the age interval in a given poor health state.

- › *Px × Lx—Healthy person-years lived*—This column shows the number of healthy person-years lived during the age interval. This number is derived by multiplying the age-specific illness rate by the corresponding number of person-years lived during the age interval (*Lx*).
- › *THx—Total number of healthy person-years lived*—This column shows the total number of healthy person-years that would be lived after the age interval.
- › *HLE_x—Expectation of healthy life*—The expectation of healthy life is the average number of years in good health remaining for those surviving to a given age with a given set of age-specific death rates and age-specific illness rates. It is derived by dividing the total healthy person-years that would be lived at age *x* by the total number of persons who survived to that age interval (*TH_x/l_x*).

The use of measures of healthy life expectancy enables comparisons across populations, as well as over long periods of time. The use of the Sullivan method for estimating healthy life expectancy is most appropriate for the cross-sectional data used to track Healthy People 2010 [10].

Data Systems

Analyses are based on 2000–01 (2002–03 for chronic conditions) and 2006–07 death data from the National Vital Statistics System (NVSS) and 2000–01 (2002–03 for chronic conditions) and 2006–07 health data from the National Health Interview Survey (NHIS). NHIS is a nationally representative continuing cross-sectional survey, which provides a snapshot of the health of the U.S. population. Approximately 35,000 households are interviewed each year. NVSS is a complete registration of all vital events and includes detailed data on all of the deaths that occur within the U.S.

These data systems are used for the study of healthy life expectancy because they contain detailed information on health and death. However, the institutionalized population is excluded from the NHIS sample. Because the institutionalized population is more likely to report poor health, the Healthy People 2010 healthy life expectancy measures might underestimate the effect of poor health on measures of healthy life expectancy.

Survey Questions

Self-rated health status is measured by the single question from NHIS that asked respondents to rate their health as “excellent,” “very good,” “good,” “fair,” or “poor.” For the purpose of determining Healthy People 2010 healthy life expectancy, a respondent was considered to be in poor health if he or she answered “fair” or “poor.” This self-assessed health rating was shown to be a useful

indicator of one’s health for a variety of populations and allows for broad comparisons across different conditions and populations [11]. The measure also is included in the Behavioral Risk Factor Surveillance Survey (BRFSS), the National Health and Nutrition Examination Survey (NHANES), and other health surveys.

Activity limitation is measured using questions about personal care needs, limitations of activities, and use of special equipment. Adults were asked whether they needed assistance with personal care needs, such as eating, bathing, dressing, or getting around inside the home; whether they needed assistance with routine care needs, such as household chores; and whether they had a mental or physical problem that kept them from working at a job or that limits their activity in any way. They also were asked whether they had health problems that required the use of special equipment, such as a cane, wheelchair, or special telephone. If a respondent answered “yes” to any of these questions, he or she was classified as having activity limitations. Children were considered limited in activity if the proxy adult respondent responded “yes” to any of the limitation, special services, or special equipment questions that were specific to children.

Selected chronic disease prevalence is measured by several questions that asked respondents whether a doctor had ever diagnosed them with a given disease. The list of selected chronic diseases represented those chronic diseases that were included in Healthy People 2010 and NHIS: heart disease, stroke, cancer, diabetes, hypertension, kidney disease, arthritis, and asthma. If a respondent answered “yes” to any of the selected diagnoses, he or she was classified as having a chronic disease. Ideally, such a healthy life expectancy would adjust for severity of disease. However, NHIS does not collect data on the severity of the disease. The primary limitation of this measure is that it is restricted to the diseases noted above, thus, it underestimates the contribution of chronic disease to healthy life expectancy because other chronic conditions, especially chronic mental health conditions, are not included.

Healthy People 2000

The 2010 healthy life expectancy measures differ from the measure used for Goal 1 of Healthy People 2000. The Healthy People 2000 measure combined information about death, self-rated health, and activity limitations into a single measure known as years of healthy life [12]. For Healthy People 2010, these illness components have been separated into distinct measures. This strategy allows for greater ease in interpreting change and determining the mechanisms of change. The same double-decrement life table technique used in Healthy People 2000 is used to create the healthy life expectancy measures for Healthy People 2010.

Limitations

Healthy life expectancy is computed using the Sullivan method, the standard method for computing healthy life expectancy on a routine basis. Although the Sullivan method accurately depicts the current status of the population's health, it does not reflect the underlying transitions into and out of poor health states. In other words, the Sullivan method assumes that if a respondent reports an activity limitation at a given point in time, that respondent is limited in activities for the rest of his or her life. However, as the underlying disease processes have episodic fluctuations of deterioration and improvement over time, poor health states will also fluctuate. For example, a person diagnosed with functional limitations due to severe arthritis may take medication and experience better health states in the future, however, the Sullivan method does not account for future years of good health for such a person.

In addition, the Sullivan method can be biased when evaluating trends over a short period of time. Biases in trends of healthy life expectancy can occur if there are fluctuations in health over a short time period. The Sullivan method is less likely to give misleading estimates of trends in healthy life expectancy when changes in death rates and health status rates are smooth and relatively even.

Future Plans

Goal 1 of Healthy People 2010 challenged the Nation to increase quality and years of healthy life. Identifying the best approaches for measuring quality and years of healthy life is an evolving field, and future research will build upon these initial measures of healthy life expectancy. It would be desirable to include measures that account for the contribution of mental health status to quality of life and other health variables. In addition, the Healthy People 2010 healthy life expectancy measures are expected to be expanded to include expected years of life with good health behaviors in Healthy People 2020.

Measuring Health Disparities

The second overarching goal of Healthy People 2010 calls for eliminating health disparities among segments of the population, including differences that occur by race or ethnicity, sex, education or income, geographic location, disability, or sexual orientation [3]. These characteristics are applicable to objectives that measure aspects of the health of the population and do not apply to objectives that are based on schools, worksites, states, or other units of measures that are not population-based. The Health Disparities Table (second figure in each

Focus Area chapter except Chapter 23) summarizes information about disparities from the best group rate for each of a selected set of population characteristics at the most recent data point, and changes in disparities from the baseline to the most recent data point.

The methods used to create the Health Disparities Table are described below. The rationale for methods employed in measuring disparity in Healthy People 2010 was provided in a previous report [13]. The "Goal 2: Eliminate Health Disparities" section in the *Healthy People 2010 Final Review Overview* presents additional key findings concerning disparities.

Measuring Objectives and Defining Groups

Technical information (i.e., Operational Definitions) concerning the measurement of each objective and the classification of the population characteristics employed in monitoring the objectives is provided in *Tracking Healthy People 2010* [14]. The original classification of racial and ethnic groups shown in *Healthy People 2010* was altered based on revisions to the standards for the classification of Federal data on race and ethnicity that were published by the Office of Management and Budget in 1997 [4,15]. These standards permit each person to identify either with only one race or with more than one race. The race and ethnicity categories used to monitor the Healthy People 2010 population-based objectives were modified accordingly, resulting in the following categories:

- › American Indian or Alaska Native
- › Asian
- › Native Hawaiian or Other Pacific Islander
- › Black or African American
- › White
- › Two or more races
 - American Indian or Alaska Native; white
 - Black or African American; white
- › Hispanic or Latino
- › Not Hispanic or Latino
 - Black or African American
 - White

Federal data systems have been revising their collection and tabulation procedures to comply with the new standards on racial and ethnic identification. Some data systems began reporting data for calendar year 1999 using the new standards, and most of the remaining systems have adopted the new standards since then.

However, some data systems are still in the process of adopting the revised standards, so the availability of comparable data for racial and ethnic groups varies by data source and across objectives.

In the *Healthy People 2010 Final Review*, seven racial and ethnic groups are shown in the Health Disparities Table: American Indian or Alaska Native; Asian; Native Hawaiian or Other Pacific Islander; two or more races; Hispanic; white, not Hispanic; and black, not Hispanic. The first four groups might also include small numbers of persons of Hispanic origin. The data systems used to track the population-based objectives in Healthy People 2010 might not provide data for all of these groups. Departures from the above categories are footnoted in the Health Disparities Table.

To maintain comparability of data by race and ethnicity over time for some objectives, a more recent data year might be used as the baseline because of the revised standards [15]. NHIS, for example, began reporting data according to the new racial and ethnic categories in 1999. Although the baseline year for objectives tracked with NHIS might be 1997 or 1998, data for 1999 are employed as the baseline for measuring disparities for race and ethnicity data only. These departures are indicated by footnotes in the Health Disparities Table.

Education and income are the primary measures of socioeconomic status in Healthy People 2010. Most data systems used in Healthy People 2010 define income as a family's income before taxes. To facilitate comparisons among groups and over time, while adjusting for family size and for inflation, Healthy People 2010 categorizes income using the poverty thresholds developed by the Census Bureau. Thus, the three categories of family income that are primarily used are:

- › Poor—below the Federal poverty level
- › Near poor—100% to 199% of the Federal poverty level
- › Middle/high income—200% or more of the Federal poverty level.

These categories may be overridden by considerations specific to the data system, in which case they are modified as appropriate. See *Healthy People 2010: General Data Issues* [16].

Availability of Data

The data used to monitor the Healthy People 2010 objectives come from a wide variety of data systems. Data for a particular population group might not be available because they are not collected by the data system, because they have been collected but not analyzed, or because they have been suppressed. Data are suppressed when the number of events is too small to produce

statistically reliable estimates, when disclosure might violate confidentiality requirements, when the sample design does not produce representative estimates for a particular group, or when there is high item nonresponse or a large number of unknown entries. Criteria for data suppression for the data systems included in *Healthy People 2010* are published in a previous report [17].

Content of the Health Disparities Table

The Health Disparities Table provides information about disparities between groups for population-based objectives. Short descriptions of the population-based objectives are listed along the left-most column of the table. The baseline data year(s) is (are) shown in parentheses and, when more recent data are available, the most recent data year(s) is (are) also shown. The description of an objective generally also includes in parentheses any applicable information regarding the underlying measure (e.g., measurement unit) and the age of the targeted population.

Characteristics of the population (race and ethnicity, sex, education, income, geographic location, and disability status) are listed across the top of the Health Disparities Table. In general, characteristics applicable to each objective were designated in the original *Healthy People 2010* document [4]. Race and ethnicity, sex, and education or income are available and included for most objectives; geographic location and disability status are included only if applicable and available.

Characteristics that were not designated for a particular objective are shaded in dark gray. When a characteristic is not applicable for any of the objectives in a Focus Area, it is omitted from the Health Disparities Table for that Focus Area. When data are not available for a particular population or for a particular characteristic, the corresponding boxes are shaded in light gray (see the fourth section of the legend reproduced in Figure A-1, below). If there are no characteristic-specific data available for an objective, or if it is not population-based, the objective is excluded from the table and annotated in the notes. In some cases, the data source for an objective provides data for groups that are defined in nonstandard ways. For example, some data sources provide data for the black and white populations that include persons of Hispanic origin. These departures from the standardized template used to monitor the Healthy People 2010 population-based objectives are indicated by footnotes in the Health Disparities Table.

Measuring Disparity From the Best Group Rate

Definition. Disparity from the best group rate is defined as the percent difference between the best group rate and each of the other group rates for a characteristic.

For example, health disparities by race and ethnicity are measured as the percent difference between the best racial and ethnic group rate and each of the other racial and ethnic group rates. Similarly, disparities by sex are measured as the percent difference between the better group rate (e.g., female) and the rate for the other group (e.g., male).

Formula. The formula for disparity from the best group rate for a group G is as follows:

$$\text{Disparity for group G} = \frac{R_G - R_B}{R_B} \times 100,$$

where R_B is the best group rate and R_G is the rate for group G for a particular characteristic.

Note. In computing disparities, the *Final Review* uses the *display values* for rates, proportions, and other estimates in DATA2010. Those are typically rounded to the nearest whole number or to at most one decimal place, see section on DATA2010 below. As a result, the best group rate R_B may in some rare instances be displayed as zero and subsequently treated as a zero in the above formula, resulting in an undefined division by zero. To avoid such an artificial situation, a small continuity correction is applied to enable a meaningful calculation of disparities relative to the best group rate.

Some Healthy People 2010 objectives are expressed in terms of favorable events or conditions that are to be increased, while others are expressed in terms of adverse events or conditions that are to be reduced. To facilitate comparison of disparities across different objectives, disparity is measured only in terms of adverse events or conditions in Healthy People 2010 [1]. Those dichotomous objectives that are expressed in terms of favorable events or conditions are re-expressed using the adverse event or condition for the purpose of computing disparity [12,18,19], but they are not otherwise restated or changed.

Example. Healthy People 2010 objective 1-1, to increase the proportion of persons with health insurance (e.g., 72% of the American Indian or Alaska Native population under age 65 had health insurance in 2008), is expressed in terms of the percentage of persons without health insurance (e.g., $100\% - 72\% = 28\%$ of the American Indian or Alaska Native population under age 65 did not have health insurance in 2008) when the disparity from the best group rate is calculated.

Special cases. Healthy People 2010 objectives 26-9a, 26-9b, and 27-4a, aim to increase the (average) age at first use of alcohol, marijuana, and tobacco, respectively, among adolescents aged 12–17 years. To facilitate comparison of disparities across different objectives, those three objectives are re-expressed using an adverse condition, as follows: decrease the (average) number of

years between the (average) age at first use and age 18. Similarly, objective 27-4b aims to increase the (average) age at first use of tobacco among young adults aged 18–25. This objective is re-expressed as follows: decrease the (average) number of years between the (average) age at first use and age 26. Finally, objective 16-16b aims to increase the median red blood cell (RBC) folate level among nonpregnant women aged 15–44. The underlying measure for this objective is a continuous measure which does not have a known upper limit. Nonetheless, an approximate upper limit is given by the 97.5th percentile of RBC folate concentration among women aged 20–59, estimated at 596 ng/mL [20]. Thus, objective 16-16b can be re-expressed using an adverse measure by subtracting the aggregate median RBC folate level for each population group from the value 596 ng/mL. For the reader's reference, among the population groups considered in the Health Disparities Table, the population group with the highest median RBC folate level was the group with at least some college education, with an aggregate median RBC folate level of 267 ng/mL in 2005–06.

As a result of measuring disparity only in terms of adverse events or conditions, the group identified as having the best rate for a given characteristic in the Health Disparities Table is always the group with the least adverse event or condition. Thus, disparities defined by the above formula remain nonnegative quantities, and equal zero only when the group G for which disparity is being assessed has a rate equal to the best group rate.

In the few instances when two groups for a characteristic have identical best rates, both groups are identified by a "B". To ensure that disparity is measured from a reasonably stable data point, the most favorable group rate must have a relative standard error of less than 10%. When the relative standard error for the most favorable group rate is greater than or equal to 10%, a small letter "b" is included in the cell and the next most favorable group rate with a relative standard error of less than 10% is identified as the reference group for that characteristic. Disparities are not calculated for cells identified by a small letter "b". When there is only one group with a relative standard error of less than 10%, a best group is not identified for purposes of measuring disparity, and the cells for all groups with data are blank, indicating that disparities could not be assessed. The first section of the legend for the Health Disparities Table (reproduced, here, in Figure A-1) addresses the identification of the best group rate for each characteristic.

When standard errors are not available, the best group is determined by the most favorable rate, see 'Estimates of Variability' below.

Representing the Size of Health Disparities by a Color Gradient

In the Health Disparities Table, a color gradient is used to represent the size of the disparities (i.e., the percent differences between each group rate and the best group rate) at the most recent data point. In some cases, baseline data might be the only data available. The color gradient is shown in the second section of the legend, see Figure A-1.

The statistical significance of the (simple) difference $R_G - R_B$ between groups can be assessed using the following Z-statistic:

$$Z = \frac{R_G - R_B}{\sqrt{SE_G^2 + SE_B^2}},$$

where R_G is the rate for a group G of interest, R_B is the rate for the best group, SE_G is the standard error of the rate for group G, and SE_B is the standard error of the best group rate.

Figure A-1. Legend for the Health Disparities Table

LEGEND				
The “best” group rate at the most recent data point.		The group with the best rate for specified characteristic.		
		Most favorable group rate for specified characteristic, but reliability criterion not met.		
		Reliability criterion for best group rate not met, or data available for only one group.		
Percent difference from the best group rate				
Disparity from the best group rate at the most recent data point.		Less than 10%, or difference not statistically significant (when estimates of variability are available).		
		10%–49%		
		50%–99%		
		100% or more		
Changes in disparity over time are shown when: (a) disparities data are available at both baseline and most recent time points; (b) data are not for the group(s) indicated by “B” or “b” at either time point; and (c) the change is greater than or equal to 10 percentage points and statistically significant, or when the change is greater than or equal to 10 percentage points and estimates of variability were not available. See Technical Appendix .	Increase in disparity (percentage points)			
		10–49 points		
		50–99 points		
		100 points or more		
	Decrease in disparity (percentage points)			
		10–49 points		
	50–99 points			
	100 points or more			
Availability of Data		Data not available.		Characteristic not selected for this objective.

When measures of variability (i.e., standard errors) are available, the variability of best group rates is assessed, and statistical significance is tested. For a group G within a given characteristic, a disparity of 10% or more is displayed when the (simple) difference from the best group rate (i.e., $R_G - R_B$) is statistically significant at the 0.05 level (see Figure A-1):

- › The lightest color in the color gradient indicates a group with a disparity < 10%. When measures of variability are available, the lightest color in the color gradient also indicates disparities for which the difference $R_G - R_B$ is not statistically significant at the 0.05 level.
- › The darkest color in the color gradient indicates a group with a disparity $\geq 100\%$ and, when measures of variability are available, a difference $R_G - R_B$ that is statistically significant at the 0.05 level.
- › The two intermediate colors in the color gradient indicate groups with a disparity of 10%–49% and groups with a disparity of 50%–99%.

This formula assumes that the two groups are independent. Because, as mentioned earlier, the difference $R_G - R_B$ remains nonnegative, a one-tailed test is employed to assess statistical significance. When $Z \geq 1.645$, the difference $R_G - R_B$ between the two group rates is statistically significant at the 0.05 level. When the (simple) difference $R_G - R_B$ between the two group rates is significant, the disparity for group G relative to the best group rate is considered significant.

Changes in Health Disparities Over Time

When data beyond the baseline are available, change in disparity over time is estimated by subtracting the disparity at the baseline from the disparity at the most recent data point. The change is expressed in percentage points: positive differences represent an increase in disparity, and negative differences represent a decrease in disparity. See the third section of the legend reproduced in Figure A-1.

Changes in disparity over time are shown when:

- a) Disparities data are available at both baseline and most recent time points;
- b) Data are neither for the group(s) with the best rate for the specified characteristic, nor for the group(s) with the most favorable rate but for which the reliability criterion was not met, at either time point; and
- c) The change is greater than or equal to 10 percentage points and statistically significant, or when the change is greater than or equal to 10 percentage points and estimates of variability are not available.

When standard errors are available for a data system, only statistically significant changes in disparities of 10 percentage points or more between the baseline and the most recent data points are indicated with arrows, see Figure A-1. Several steps are required to evaluate the statistical significance of a change in disparities over time.

Step 1. The disparity or percent difference (PD) from the best group rate at each time point is based on the ratio of the simple difference $SD = R_G - R_B$ between the rate for the group of interest and the best group rate to the best group rate R_B :

$$\text{Disparity for group G} = \frac{SD}{R_B} \times 100.$$

Step 2. The relative standard error (RSE) of the above ratio is computed based on the RSE of the numerator and the denominator. The RSE for the numerator SD is calculated as:

$$RSE_{SD} = \frac{\sqrt{SE_G^2 + SE_B^2}}{R_G - R_B},$$

where SE_G is the standard error of the rate for a group G of interest, SE_B is the standard error for the best rate, R_G is the rate for group G, and R_B is the best group rate.

Step 3. The RSE of the best group rate in the denominator of the ratio in step 1 is given by:

$$RSE_B = \frac{SE_B}{R_B}.$$

Step 4. An approximate relative standard error RSE_{PD} for the disparity or percent difference (PD) is computed via the so-called “Delta Method”—a first-order Taylor series linearization of the variance of the ratio of two random variables [21]—using the numerator RSE (from step 2) and the denominator RSE (from step 3):

$$RSE_{PD} = \sqrt{RSE_{SD}^2 + RSE_B^2}.$$

This first-order linearization assumes the simple difference $SD = R_G - R_B$ between the rate R_G for the group G of interest and the best group rate R_B is independent of the best group rate.

Step 5. An approximate standard error SE_{PD} for the percent difference (PD) is given by:

$$SE_{PD} = RSE_{PD} \times PD.$$

Step 6. The statistical significance of a change in disparity or percent difference from the best group rate over time at the 0.05 level is assessed using the following Z-statistic:

$$Z = \frac{PD_1 - PD_0}{\sqrt{SE_{PD,1}^2 + SE_{PD,0}^2}},$$

where PD_1 is the percent difference at the most recent time point, PD_0 is the percent difference at baseline, $SE_{PD,1}$ is the standard error of the percent difference at the most recent time, and $SE_{PD,0}$ is the standard error of the percent difference at baseline.

Note. Because of the various assumptions involved in deriving an approximate standard error SE_{PD} for the percent difference in step 5 above, and because an alternative, more direct method for testing statistical significance is available for the simple difference $R_G - R_B$ between the two group rates, the standard error SE_{PD} is not used for assessing the significance of disparities at each data point. As explained earlier, when the simple difference $R_G - R_B$ between the two group rates is statistically significant, the disparity for group G relative to the best group rate (i.e., the percent difference) is considered significant.

When measures of variability are not available, the variability of best group rates is not assessed, and statistical significance cannot be tested. Nonetheless, disparities and changes in disparities over time are displayed according to their magnitude. This is usually indicated in the footnotes of the Health Disparities Table by a † footnote. See also the Estimates of Variability section below for more information.

When measures of variability are available only for the most recent data, the variability of best group rates is assessed only for the most recent data, and statistical significance is tested only for the most recent data. Changes in disparities of 10 percentage points or more over time are displayed according to their magnitude, because measures of variability are not available at the baseline and therefore statistical significance of changes in disparity could not be tested. This is usually indicated in the footnotes of the Health Disparities Table by a ‡ footnote. See also the Estimates of Variability section below for more information.

Summary Measures

Disparities are measured as percent differences between the best group rate and other group rates for a given population characteristic. When more than two groups are associated with that characteristic, such as race and ethnicity, income, and education, a summary index provides a way to determine whether, on average, disparities from the best group rate are increasing or decreasing. The formula for the summary index, also known as the index of disparity [22], is:

$$\text{Summary index} = \frac{\sum_{G=1}^{n-1} \text{PD}_G}{n - 1},$$

where PD_G is the nonnegative—possibly zero—disparity (i.e., percent difference) from the best group rate for each of the groups of interest ($G = 1, 2, \dots, n$), and n is the number of groups. Because the disparities are calculated with the best group rate as the reference point, the number of comparisons is equal to the number of groups minus 1. These comparisons are made only when data are available for the same groups defined in the same way at the baseline and most recent data points.

Note. As explained previously, when the relative standard error for the most favorable group rate is greater than or equal to 10%, that group is flagged using a small letter “b” in the Health Disparities Table, and the next most favorable group rate with a relative standard error of less than 10% is identified as the reference group for that characteristic and flagged using a capital letter “B”. As a result, the observed disparity or percent difference from the best group rate for a group that is flagged with a small letter “b” becomes *negative*, because its observed rate is better than the best rate identified. Thus, all such groups with a “b” must be excluded from the calculation of the summary index, since the latter must remain nonnegative. However, in doing so, the summary index no longer accurately reflects the observed disparities in the population, since, by excluding the better rates, it necessarily underestimates the average disparity. For this reason, summary indices are not calculated for objectives where at least one group is identified with a small letter “b” for a given characteristic. The corresponding cell in the Health Disparities Table is shaded in light gray to indicate that data are not available to accurately compute the summary index.

The statistical significance of a change in the summary index over time is assessed when standard errors for the rates on which the summary index is based are available. The magnitude and direction of changes are indicated by arrow symbols as described above. When standard errors are not available for the rates on which the summary index is based, changes are classified by size and direction without regard to statistical significance.

To obtain a standard error for the summary index, a type of resampling or “bootstrap” procedure is employed [23]. This procedure uses the rate and standard error for each group to reestimate each group rate 25,000 times assuming a random normal distribution. Based on these group rates, 25,000 estimates of the summary index of disparity are generated, and the distribution of these estimates is used to estimate the standard error of the summary index.

The bootstrap procedure is used to estimate standard errors for the summary index at the most recent time and at the baseline, to determine whether a change in the summary index over time is statistically significant. A Z -statistic for the change in the summary index can be computed as follows:

$$Z = \frac{\text{ID}_1 - \text{ID}_0}{\sqrt{\text{SE}_{\text{ID},1}^2 + \text{SE}_{\text{ID},0}^2}},$$

where ID_1 is the summary index at the most recent time point, ID_0 is the summary index at the baseline, $\text{SE}_{\text{ID},1}$ is the standard error of the summary index at the most recent time point, and $\text{SE}_{\text{ID},0}$ is the standard error of the summary index at the baseline.

Because the value of the index could either increase or decrease, a two-tailed test is employed to assess statistical significance: a value of $|Z| \geq 1.96$ indicates that the change in the summary index is statistically significant at the 0.05 level.

Estimates of Variability

Estimates of variability (standard errors) are available for most of the population-based objectives in Healthy People 2010. When standard errors are available, they can be employed to assess the reliability of the best group rate as described above. This assessment is performed to ensure that the group chosen as the reference point is reasonably stable. Standard errors also are used to perform the tests of statistical significance described above. Generally speaking, these tests guard against the possibility that observed disparities or changes in disparities occur because of sampling error or other random sources of error.

When measures of variability are not available, the stability of best group rates is not assessed, and statistical significance of disparities and changes in disparities could not be tested. For such objectives, there is no quantifiable assurance that observed disparities and changes in disparities are not due to sampling error or other random sources of error. For such objectives, the reader is urged to exercise caution in interpreting disparities findings.

In the Health Disparities Table, objectives based on data for which estimates of variability are available and those for which estimates of variability are not available are designated by footnotes following the short description of each objective. These footnotes are as follows:

* Measures of variability were available. Thus, the variability of best group rates was assessed, and statistical significance was tested. Disparities of 10% or more are displayed when the differences from the best group rate are statistically significant at the 0.05 level. Changes in disparities over time are indicated by arrows when the changes are greater than or equal to 10 percentage points and are statistically significant at the 0.05 level. See [Technical Appendix](#).

† Measures of variability were not available. Thus, the variability of best group rates was not assessed, and statistical significance could not be tested. Nonetheless, disparities and changes in disparities over time are displayed according to their magnitude. See [Technical Appendix](#).

‡ Measures of variability were available only for the most recent data. Thus, the variability of best group rates was assessed only for the most recent data, and statistical significance was tested only for the most recent data. Disparities of 10% or more are displayed when the differences from the best group rate are statistically significant at the 0.05 level. Changes in disparities over time are displayed according to their magnitude, since measures of variability were not available at baseline and therefore statistical significance of changes in disparity could not be tested. See [Technical Appendix](#).

If a footnote applies to all objectives in a particular Health Disparities Table, then it is added to the notes and no footnote is inserted.

Mapping

When data are available at the subnational level, selected objectives are mapped to display spatial variation in percents, rates, or counts. Subnational data are presented either at the state or Health Service Area (HSA) level. HSAs are defined as "...one or more counties that are relatively self-contained with respect to the provision of routine hospital care" [24]. HSAs are contiguous but may span state boundaries. They frequently contain more than 1 county with an average of 4 and maximum of 20 counties. The current HSA classification system is based on the presence of at least one hospital in the HSA and patterns of travel between counties.

Maps are presented as simple choropleths and use either a Jenks or modified Jenks classification [25]. A Jenks

classification is a way to group ordered data in such a way that within-group variance is minimized and between-group variance is maximized. When geographic units (states or HSAs) have values that met the Healthy People 2010 target, the classification is modified by manually setting the best (lowest for objectives that seek to reduce events and highest for objectives that seek to increase events) cut-point to the Healthy People 2010 target. In some instances where the number of geographic units meeting the target is large, a cut-point in the middle of the distribution is set to the target.

The Jenks classification is an iterative process whereby an arbitrary number of classes are created from an ordered set of data. For most maps presented here, the default number of classes is five. The process proceeds by calculating the sum of the squared deviations between classes (SDBC), calculating the sum of squared deviations from the array mean (SDAM), and subtracting the SDBC from SDAM giving the squared deviation from class means (SDCM). Observations are iteratively moved from classes with larger SDBCs to those with smaller SDBCs until all SDBCs are minimized.

Mapping was done using ArcGIS ArcMap [26]. Maps are presented using a North American conic equidistant projection based on the 1983 North America geographic coordinate system. The states of Alaska and Hawaii retain these attributes but are not shown to scale or correct location, and were placed independently for greater ease of interpretation.

DATA2010

DATA2010 is an online, searchable database that contains baseline data, tracking data, and targets for all measurable objectives in Healthy People 2010 [3]. The database has been updated throughout the decade, generally quarterly, to provide the most accurate and up-to-date data for tracking Healthy People 2010 objectives.

DATA2010 allows users to search the database for estimates by Focus Area, objective, data source, and keyword. In addition, users can access Healthy People 2010 Final Review data by downloading designated standard or statistical data spreadsheets in Excel format by Focus Area, accessible from <http://wonder.cdc.gov/data2010/ftpselec.htm>. Standard spreadsheets contain rounded estimates, whereas statistical spreadsheets contain rounded data as well as unrounded data and standard errors (both rounded to one decimal place), when available.

All of the data used to produce the Final Review Progress Charts and Disparity Tables are reflected in these static Final Review tables. Calculations on the Progress Charts and Disparities Tables are based on standard estimates

and their associated unrounded standard errors, when available.

In addition, DATA2010 contains other technical information related to the Healthy People 2010 objectives, including Operational Definitions for each objective.

General Data Issues

Tracking Healthy People 2010 is a comprehensive guidebook on the statistics used for Healthy People 2010 [14]. It provides detailed information on how the data are derived and the major issues affecting the interpretation of the statistics. During the Healthy People 2010 Final Review, the General Data Issues section, Part A of *Tracking Healthy People 2010*, was updated as a standalone document titled *Healthy People 2010: General Data Issues* [16].

Healthy People 2010: General Data Issues discusses data-related topics that affect multiple objectives. Subjects covered include measuring years of healthy life; measuring health disparities; population estimates; the Healthy People 2010 population templates, including issues related to the revised Federal standards for classifying race and Hispanic origin; issues related to target setting and target adjustment; age adjustment, including implications of changes in the standard population for age adjustment; the ICD used for illness and death classification; state, local, and national data issues; and DATA2010.

Tracking Period

In general, the tracking period for Healthy People 2010 was designed to cover a 10-year period. For most data systems, the final data year for Healthy People 2010 was selected to coincide with the baseline year used in Healthy People 2020 for those systems, even if more recent data were available when the *Healthy People 2010 Final Review* was being prepared. For example, the Healthy People 2010 final data point for most objectives based on data from the National Health Interview Survey (NHIS) was 2008, matching the baseline year for Healthy People 2020, although 2009 data were available. For objectives that were tracked from data sources that are not used in Healthy People 2020, the most recent data available were used as the baseline.

References

1. Department of Health and Human Services, Public Health 236009-A Service. Healthy People 2000 Midcourse Review and 1995 Revisions. Washington, D.C.: Government Printing Office. 1995.
2. National Center for Health Statistics. Healthy People 2000 Final Review. Hyattsville, MD. 2001.
3. DATA2010. Available from <http://wonder.cdc.gov/data2010>.
4. Department of Health and Human Services. Healthy People 2010. 2nd ed. With Understanding and Improving Health and Objectives for Improving Health. 2 vols. Washington, D.C.: Government Printing Office. November 2000.
5. Gilbert RO. Statistical Methods for Environmental Pollution Monitoring. New York, NY: Van Nostrand Reinhold. 1987.
6. Sullivan DF. A single index of mortality and morbidity. HSMHS Health Reports 86, 347–54. 1971.
7. Sullivan DF. Disability components for an index of health. National Center for Health Statistics. Vital Health Stat 2(42). 1971.
8. Anderson RN. Method for constructing complete annual U.S. life tables. National Center for Health Statistics. Vital Health Stat 2(129). 1999.
9. Molla MT, Madans JH, Wagener DK, Crimmins EM. Summary measures of population health: Report of findings on methodologic and data issues. National Center for Health Statistics. Hyattsville, MD. 2003.
10. Crimmins EM. What can we expect from summary indicators of population health? In Murray CJL, et al., eds. Summary Measures of Population Health. Geneva, Switzerland: World Health Organization. 2002.
11. Idler E, Benyamini Y. Self-rated health and mortality: A review of 28 studies. J Health Soc Behav 38(1), 21–37. 1997.
12. Erickson P, Wilson R, Shannon, I. Years of healthy life. Healthy People Statistical Notes, no. 7. Hyattsville, MD: National Center for Health Statistics. 1995.
13. Keppel KG, Pearcy JN, Klein RJ. Measuring progress in Healthy People 2010. Statistical Notes, no. 25. Hyattsville, MD: National Center for Health Statistics. September 2004.

14. Department of Health and Human Services, Public Health Service. Tracking Healthy People 2010. Washington, D.C.: Government Printing Office. November 2000.
15. Office of Management and Budget. Revisions to the standards for the classification of Federal data on race and ethnicity. Federal Register 62/FR, 58781–90. 1997.
16. *Healthy People 2010: General Data Issues*. Available from http://www.cdc.gov/nchs/healthy_people.htm.
17. Klein RJ, Proctor SE, Boudreault MA, Turczyn KM. Healthy People 2010 criteria for data suppression. Statistical Notes, no. 24. Hyattsville, MD: National Center for Health Statistics. June 2002.
18. Keppel KG, Pamuk E, Lynch J, et al. Methodological issues in measuring health disparities. National Center for Health Statistics. Vital Health Stat 2(141). 2005.
19. Keppel KG, Percy JN. Measuring relative disparities in terms of adverse outcomes. J Public Health Manag Pract 11(6). 2005.
20. Pfeiffer CM, Johnson CL, Jain RB, Yetley EA, Picciano MF, Rader JI, et al. Trends in blood folate and vitamin B12 concentrations in the United States, 1988–2004. Am J Clin Nutr 86, 718–27. 2007.
21. Korn EL, Graubard BI. Analysis of Health Surveys. New York, NY: John Wiley & Sons. 1999.
22. Percy JN, Keppel KG. A summary measure of health disparity. Public Health Rep 117, 273–80. May–June 2002.
23. Efron B. The Jackknife, the Bootstrap, and Other Resampling Plans. Philadelphia, PA: SIAM Publishing Company. 1982.
24. Makuc DM, Haglund B, Ingram DD, et al. Health Service Areas for the United States. National Center for Health Statistics. Vital Health Stat (2)112. 1991.
25. Coulson MR. In the matter of class intervals for choropleth maps: with particular reference to the work of George F Jenks. Cartographica: The International Journal for Geographic Information and Geovisualization. 24(2), 16-39. 2006.
26. ArcGIS Desktop: ArcMap 9.3 (build 1770). Redlands, CA: Environmental Systems Research Institute.