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Measuring Progress in Healthy People 2010

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Abstract

Background—Healthy People 2010 (HP2010) objectives are based on two overarching goals: 1) to increase years and quality of healthy life, and 2) to eliminate disparities among subgroups of the population. Four hundred and sixty-seven specific objectives consistent with these goals were outlined, baseline data were identified when available, and specific targets were set for the year 2010. This report discusses the techniques that are being used to measure progress toward these two goals.

Process—In order to promote consistency in monitoring across different objectives, a minimum template of subgroups was adopted for the population-based objectives in HP2010. A workgroup of individuals representing the U.S. Department of Health and Human Services agencies involved in HP2010 was convened to consider the issues related to monitoring progress toward the two goals of HP2010. The workgroup concurred with the recommendations in this report.

Recommendations—Progress toward target attainment can be monitored for all objectives with at least one data point beyond the baseline. For those objectives that are based on data for a population, progress toward target attainment can also be measured for subgroups of the population. Progress toward the elimination of disparity for individual population subgroups can be measured in terms of the percent difference between each subgroup rate and the most favorable or "best" subgroup rate in each domain. For purposes of measuring disparity relative to the "best" subgroup rate, all measures are expressed in terms of adverse events.

Keywords: goals • objectives • health disparity

Introduction

The first goal of HP2010 is to increase years and quality of healthy life for all individuals (1). This goal is embodied in 467 objectives that are intended to improve the length and quality of life. These objectives correspond to specific measures of health and targets were set for the year 2010 that would require substantial improvement for each measure. The second goal of HP2010 is to eliminate health disparities among subgroups of the population. Subgroups include those defined in terms of gender, race and ethnicity,

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education or income level, disability status, geographic location, or sexual orientation. This goal applies to 383 population-based objectives for which disparities between these subgroups are to be eliminated. The techniques that are being used to measure progress toward these two goals are described here (2).

A workgroup of individuals representing the U.S. Department of Health and Human Services agencies involved in the HP2010 initiative was convened to discuss the measurement of progress toward the goals of Healthy People. Representatives from the following agencies participated in the workgroup: Agency for Health Care Research and Quality, Centers for Disease Control and Prevention, Indian Health Service, Health Resources and Services Administration, National Institutes of Health, Office of the Assistant Secretary for Planning and Evaluation, Office of Disease Prevention and Health Promotion, Office of Minority Health, Office on Women's Health, and the Substance Abuse and Mental Health Services Administration. This workgroup met three times between July 12 and October 24, 2002. Agreement was reached on the techniques described here. These techniques have been successfully applied to a wide variety of HP2010 objectives. Some adjustment to these procedures may be necessary in specific instances. The workgroup also recommended that the National Institutes of Health and other Federal agencies should encourage researchers to investigate other measures of disparity, to identify the determinants of disparity, and to consider other measures of progress toward the elimination of disparity.

Two Distinct Goals to Be Monitored

The first goal of HP2010 is to increase the years and quality of healthy life for individuals of all ages. Consistent with this goal, 467 objectives that would contribute to an increase in the length and/or quality of life were outlined. One or more specific measures of health were identified for each objective. These measures focus on health-related behaviors, risk factors, outcomes, preventive services, and characteristics of the health care and public health systems. Baseline values have been established for each measure for which data are available (3). In order to increase years and quality of healthy life, specific targets were set for each of these objectives for the year 2010. One of the following target setting methods was used for each measure:

- Set a target to surpass the value achieved by any racial or ethnic group at the baseline (''better than the best'').
- Set a target that represents improvement for a substantial proportion of the population.
- Set a target of ''total coverage'' or ''total elimination.''
- Set a target consistent with another national program (for example, national education goals).
- Retain the Healthy People 2000 target.

As more recent data points become available, progress toward the target can be measured. For each objective, progress toward target attainment represents an increase in years and quality of healthy life.

The second goal of HP2010 is to eliminate health disparities among segments of the population (1). This goal applies to 383 objectives for which measures are based on individuals in a population. For the population-based objectives, a minimum template of subgroups was defined for each of the following domains: race and ethnicity, gender, family income level, and education level. The template does not apply to population-based objectives that are tracked using counts of events rather than rates or percents. Additional domains were defined for selected measures based on geographic location, health insurance status, disability status, and sexual orientation. A single target for the year 2010 was set for each measure and this target applies to the total population and to each population subgroup. Data are not available for all subgroups for all measures. However, when data are available, measurable reductions in disparities between subgroups are expected. For each population-based objective, progress toward the elimination of disparities can be monitored in terms of the differences between subgroups.

Progress toward target attainment and progress toward elimination of disparity are measured separately. Progress toward target attainment can be measured for all objectives with at least one data point beyond the baseline. For the population-based objectives, progress toward target attainment will be measured for the total population and for each population subgroup. Progress toward elimination of disparity can be measured for population-based objectives with at least one data point beyond the baseline. Techniques for measuring progress toward target attainment and techniques for measuring progress toward the elimination of disparity are described below.

Because the two overarching goals are fundamentally distinct, it is important to remember that progress toward target attainment does not necessarily entail progress toward the elimination of disparity and vice versa. Progress toward the target could occur for all subgroups in a domain without any reduction in the disparity between subgroups and progress toward reduction in the disparity between groups could occur without any progress toward the target for specific subgroups. HP2010 calls for both progress toward attainment of the targets and progress toward reduction in disparities among subgroups.

Defining Population Subgroups for Healthy People 2010

HP2010 calls for monitoring progress for social and demographic subgroups of the population. In order to promote consistency in tracking progress for specific subgroups, a minimum template was adopted for monitoring the population-based objectives in HP2010 (1). The initial template was altered based on new standards for Federal data on race and ethnicity published by the Office of Management and Budget (4). The new standards allow each

individual to identify with one race only or with more than one race. The revised minimum template for population-based objectives includes the following characteristics and categories:

Race:
- American Indian and Alaska Native only
- Asian and Pacific Islander only
  - Asian only
  - Native Hawaiian and Other Pacific Islander only
- Black or African American only
- White only
- 2 or more races
  - American Indian and Alaska Native; White
  - Black or African American; White

Ethnicity:
- Hispanic or Latino
- Not Hispanic or Latino
  - Black or African American only
  - White only

Gender:
- Female
- Male

Family income level:	*or*	Education level:
Poor		Less than high school
Near poor		High school graduate
Middle/high income		At least some college

Data systems are revising their collection and tabulation procedures to comply with the new standards on racial and ethnic identification. All Federal data systems were required to implement the new standards by January 1, 2003. Some data systems began reporting data using the new standards beginning with data for calendar year 1999. Some data systems implemented the new standards between 1999 and 2003 and others are still in the process of revising their collection and tabulation procedures; therefore, templates for race and Hispanic origin will vary across objectives. The on-line data system for Healthy People, DATA2010, is adding data for the new categories as soon as they become available (3). The data systems used to track the population-based objectives in HP2010 may not provide data for all of these domains and subgroups. However, some data systems provide data for additional subgroups, for example, Hispanic origin subgroups: Cuban, Mexican American, and Puerto Rican.

This template does not apply to nonpopulation-based objectives such as those that measure schools, worksites, or States. Because of problems in interpreting risk, the template also does not apply to population-based objectives that are tracked using counts of events rather than rates or percents (5). Additional subgroups are included for specific objectives, including: geographic location (urban/rural), health insurance status, disability status, chronic disease status, sexual orientation, and specific age groups. These subgroups are defined in Tracking Healthy People 2010 (5). In the discussion that follows, the terms ''group'' and ''subgroup'' are used interchangeably.

Measuring Progress Toward Target Attainment

In the Healthy People 2000 Midcourse Review and in the Final Review, progress toward the Healthy People 2000 targets was measured using the percentage of targeted change that was achieved or the ''progress quotient'' (6,7). The progress quotient expresses any change from the baseline relative to (as a percent of) the initial difference between the baseline and the target. The progress quotient is being used again to monitor progress in HP2010. In addition, an absolute measure of the difference remaining between the target and the most recent data value is being used to compare the remaining progress needed among the subgroups.

Baseline data values were published at the beginning of the decade for those measures for which data were available (1). Baseline data for additional measures have become available since the publication of Healthy People 2010 (3). As subsequent data points become available, changes between the baseline and the most recent data value can be measured. These changes can be measured in absolute terms (in terms of the units in which the objective is measured) or they can be measured in relative terms (relative to some standard). Absolute and relative measures provide complementary information about changes over time. The workgroup concluded that both absolute and relative measures were important in monitoring progress toward target attainment.

Absolute differences

The absolute difference between the target and the most recent data value provides information about the progress that is still required to attain the target. In table 1 the absolute difference between the target and the most recent data value for objective 16–1c that calls for a reduction in infant mortality rates is shown in the last column. In order to achieve the year 2010 target, the annual total infant mortality rate would have to decline by an additional 2.4 infant deaths per 1,000 live births. The difference between the target and the most recent value can be used to compare the absolute progress required among subgroups for the population-based objectives. In this example, the infant mortality rate for infants of American Indian or Alaska Native mothers would have to decline by an additional 3.8 infant deaths per 1,000 live births to achieve the target, and the rate for infants of non-Hispanic black or African American mothers would have to decline by an additional 9.1 infant deaths per 1,000 live births to achieve the target.

Relative changes

The progress quotient is a relative measure of change over time. It can be used to monitor progress for both

Table 1. Measuring progress toward target attainment for Objective 16–1c: Reduction in infant mortality rates

Selected characteristic	Target attainment							
	Infant mortality rate (per 1,000 live births)			Difference between most recent and baseline b–a	Percent change between most recent and baseline (b–a)/a × 100	Difference between target and baseline c–a	Progress quotient (percent) (b–a)/(c–a) × 100	Difference remaining between the target and the most recent value c–b
	Baseline (1998) a	Most recent (2000) b	Target (2010) c					
Total	7.2	6.9	**4.5**	*−0.3	−4.2	−2.7	11.1	−2.4
Mother's race and ethnicity								
American Indian and Alaska Native	9.3	8.3	**4.5**	−1.0	−10.8	−4.8	20.8	−3.8
Asian and Pacific Islander	5.5	4.9	**4.5**	*−0.6	−10.9	−1.0	60.0	−0.4
Asian	5.0	4.5	**4.5**	−0.5	−10.0	−0.5	100.0	0.0
Native Hawaiian and other Pacific Islander	10.0	8.2	**4.5**	−1.8	−18.0	−5.5	32.7	−3.7
Black or African American	13.8	13.5	**4.5**	−0.3	−2.2	–9.3	3.2	−9.0
White	6.0	5.7	**4.5**	*−0.3	−5.0	−1.5	20.0	−1.2
Hispanic or Latino	5.8	5.6	**4.5**	−0.2	−3.4	−1.3	15.4	−1.1
Not Hispanic or Latino	7.5	7.2	**4.5**	*−0.3	−4.0	−3.0	10.0	−2.7
Black or African American	13.9	13.6	**4.5**	−0.3	−2.2	−9.4	3.2	−9.1
White	6.0	5.7	**4.5**	*−0.3	−5.0	−1.5	20.0	−1.2
Gender								
Female	6.5	6.2	**4.5**	*−0.3	−4.6	−2.0	15.0	−1.7
Male	7.8	7.5	**4.5**	*−0.3	−3.8	−3.3	9.1	−3.0
Mother's education level (aged 20 years and over)								
Less than high school	8.2	7.9	**4.5**	*−0.3	−3.7	−3.7	8.1	−3.4
High school graduate	7.6	7.3	**4.5**	*−0.3	−3.9	−3.1	9.7	−2.8
At least some college	5.3	5.0	**4.5**	*−0.3	−5.7	−0.8	37.5	−0.5
Mother's disability status								
Mothers with disabilities	DNC	DNC	**4.5**	- - -	- - -	- - -	- - -	- - -
Mothers without disabilities	DNC	DNC	**4.5**	- - -	- - -	- - -	- - -	- - -

*The difference between the most recent value and the baseline is statistically significant.
- - - Data are not available.
DNC = Data were not collected.
0.0 Quantity more than zero but less than 0.05.

SOURCE: National Vital Statistics System, National Center for Health Statistics, Centers for Disease Control and Prevention.

population-based and nonpopulation-based objectives. The progress quotient measures the percent of the targeted change that has been achieved. The formula for the progress quotient is:

$$\frac{\text{most recent value} - \text{baseline value}}{\text{year 2010 target} - \text{baseline value}} * 100$$

For example, school-based objective 7–2c calls for an increase in the proportion of middle, junior high, and senior high schools that provide school health education to prevent violence, from a baseline of 58 percent in 1994 to a target of 80 percent in 2010. In 2000, 73 percent of schools provided education to prevent violence. Using the formula above, 68.2 percent of the difference between the baseline and the year 2010 target had been achieved in 2000.

$$\frac{73 - 58}{80 - 58} * 100 = 68.2 \text{ percent}$$

For the population-based objectives, the progress quotient can also be used to measure progress toward the target for each population subgroup for which at least two reliable data points are available. In table 1, for example, the progress quotient is computed for objective 16–1c to reduce infant mortality rates. For the total population, 11.1 percent of the difference between the baseline and the year 2010 target had been achieved in 2000. The progress quotient ranged from 100 percent (target attained) among infants of Asian mothers, to 3.2 percent among black or African American mothers.

The progress quotient will be positive when the rate has moved toward the target. A negative value would indicate that the rate moved away from the target (see the example in table 2 below). The progress quotient can also be used to compare progress for one objective, relative to its baseline, with progress for other objectives, relative to their baselines.

Table 2. Measuring progress toward target attainment for Objective 5–3: Reduce the prevalence of diabetes

Selected characteristic	Target attainment: Prevalence of diagnosed diabetes (age adjusted per 1,000 standard population) Baseline (1997) a	Baseline for race-origin groups[2] (1999) a'	Most recent (2001) b	Target (2010) c	Difference between most recent and baseline b–a or b–a'	Percent change between baseline and most recent (b–a)/a × 100 or (b–a')/a' × 100	Difference between target and baseline c–a or c–a'	Progress quotient[1] (percent) (b–a)/(c–a) × 100 or (b–a')/(c–a') × 100	Difference remaining between the target and the most recent value c–b
Total	**39.7**	**41.3**	**48.3**	**25**	*8.6	21.7	−14.7	**−58.5**	−23.3
Race and ethnicity[3]									
American Indian and Alaska Native only		DSU	106.3	**25**	DSU	DSU	DSU	DSU	–81.3
Asian only		34.0	37.4	**25**	3.4	10.0	−9.0	**−37.8**	−12.4
Native Hawaiian and other Pacific Islander only		DSU	DSU	**25**	DSU	DSU	DSU	DSU	DSU
Black or African American only	NA	69.1	76.9	**25**	7.8	11.3	−44.1	**−17.7**	−51.9
White only		37.2	44.0	**25**	*6.8	18.3	−12.2	**−55.7**	−19.0
2 or more races		70.7	85.6	**25**	14.9	21.1	−45.7	**−32.6**	−60.6
Hispanic or Latino		64.5	69.3	**25**	4.8	7.4	−39.5	**−12.2**	−44.3
Not Hispanic or Latino		39.5	46.7	**25**	*7.2	18.2	−14.5	**−49.7**	−21.7
Black or African American only		69.2	77.5	**25**	8.3	12.0	−44.2	**−18.8**	−52.5
White only		35.7	42.4	**25**	*6.7	18.8	−10.7	**−62.6**	−17.4
Gender									
Female	40.4	NA	45.7	**25**	*5.3	13.1	−15.4	**−34.4**	−20.7
Male	39.2		51.5	**25**	*12.3	31.4	−14.2	**−86.6**	−26.5
Education level (aged 25 years and over)									
Less than high school	92.1	NA	107.8	**25**	*15.7	17.0	−67.1	**−23.4**	−82.8
High school graduate	57.8		79.6	**25**	*21.8	37.7	−32.8	**−66.5**	−54.6
At least some college	44.5		55.3	**25**	*10.8	24.3	−19.5	**−55.4**	−30.3
Geographic location									
Urban	40.4	NA	46.2	**25**	*5.8	14.4	−15.4	**−37.7**	−21.2
Rural	38.2		54.0	**25**	*15.8	41.4	−13.2	**−119.7**	−29.0
Disability status									
Persons with disabilities	86.6	NA	99.4	**25**	*12.8	14.8	−61.6	**−20.8**	−74.4
Persons without disabilities	28.1		36.7	**25**	*8.6	30.6	−3.1	**−277.4**	−11.7

*The difference between the most recent value and the baseline is statistically significant.
NA = Not applicable.
DSU = Data do not meet the criteria for statistical reliability, data quality, or confidentiality (data are suppressed).
DNA = Data have not been analyzed.
[1]The progress quotient is the percent of the original difference between the baseline value and the target that has been eliminated based on the most recent data value. When the progress quotient is negative **(in bold)** the difference from the target has increased, that is, the most recent value is further from the target than the baseline. See footnote 2 concerning the baseline year for data by race and Hispanic origin.
[2]For purposes of calculation, the baseline year for data by race and ethnicity has been changed to the first year for which data are available according to the new OMB standards.
[3]Starting with data year 1999, estimates by race and ethnicity are tabulated using the 1997 Standards for Federal data on race and ethnicity.
SOURCE: National Health Interview Survey, National Center for Health Statistics, Centers for Disease Control and Prevention.

There are, however, some limitations to the interpretation of this statistic. First, the progress quotient measures the difference between the baseline year and the most recent year only. Fluctuations in the measure during the intervening years are not reflected. In addition, the number of years between the baseline and the most recent data value and the number of years between the baseline and the year 2010 will vary from one objective to another. When progress quotients are compared across objectives, it is important to remember that they may be based on different time periods. In order to help interpret these comparisons, the baseline year and the most recent data year will be shown when progress quotients are compared across objectives. In table 1, the baseline data year is 1998 and the most recent data year is 2000. Second, the progress quotient is based on the actual change between the baseline and the most recent data value without any consideration of variability in the data that may substantially affect the size of the progress quotient from year to year. Third, the absolute change required to attain the target may differ among subgroups or across measures

having the same progress quotients. Therefore, equal progress quotients do not reflect equal absolute progress from the baseline. This is why the absolute difference remaining between the target and the most recent data value is also employed to monitor progress and to compare progress among subgroups. Finally, the progress quotient is not applicable to subgroups of the population where the year 2010 target was already equaled or exceeded at the baseline. The percent change between the baseline and the most recent data value is included so that the size and direction of changes can be examined for each subgroup even if the target had been achieved at the baseline.

Interpreting progress among subgroups

These absolute and relative statistics can be interpreted together to better understand differences among subgroups. Subgroups begin with different baselines but have the same target. Groups that have experienced similar proportions of progress may, therefore, have very different absolute levels of progress remaining to achieve the target. While about 20 percent of the difference from the target was eliminated for both infants of American Indian and Alaska Native mothers and infants of non-Hispanic white mothers, the absolute change in the infant mortality rate required to achieve the target for American Indian and Alaska Native mothers (3.8 infant deaths per 1,000 live births) is more than three times the change required by non-Hispanic white mothers (1.2 infant deaths per 1,000 live births) (table 1).

Statistical significance

When estimates of variability for the data values are available, the statistical significance of the difference between the baseline and the most recent rate or percent for a subgroup can be tested directly using a Z statistic.

$$Z = (R_{mr} - R_b) / \sqrt{SE_{mr}^2 + SE_b^2}$$

Where:

R_{mr} = rate or percent based on the most recent data,
R_b = rate or percent at the baseline,
SE_{mr} = standard error of the most recent data value, and
SE_b = standard error of the rate or percent at the baseline.

This formula assumes that the group rates are independent. The comparison of the Z statistic with some Z-critical value determines the significance of the difference between the two rates. If $|Z| \geq 1.96$, the difference is significant at an alpha (α) level of 0.05. The difference between the most recent data value and the baseline is flagged (*) when it is statistically significant at the 0.05 level. In table 1, for example, the standard error for the total infant mortality rate was 0.043 in 1998 and 0.041 in 2000. When they are available, estimates of standard errors are included in the HP2010 database, DATA2010 (3). Using the formula above, the change in the total infant mortality rate from 1998 to 2000 was statistically significant and the difference between the most recent value and the baseline is flagged accordingly.

$$Z = (R_{mr} - R_b) / \sqrt{SE_{mr}^2 + SE_b^2}$$

$$Z = (6.9 - 7.2) / \sqrt{0.041^2 + 0.043^2}$$

$$|Z| = 5.05$$

When measures of variance cannot be produced, it is not possible to assess the statistical significance of the difference between the most recent data value and the baseline. The difference might be the result of sampling error or random variability. This is particularly true for smaller subgroups such as Asians, Native Hawaiians and other Pacific Islanders, and American Indians and Alaska Natives.

Defining racial and ethnic subgroups

The data in table 1 come from the National Vital Statistics System prior to the implementation of the 1997 OMB standards for the classification of race and ethnicity. Until data based on the new standards become available, progress quotients will be computed for the old race-origin groups. Because the subgroups defined under the old standards are not strictly comparable to the subgroups defined under the new standards, it is not appropriate to compute progress quotients when the baseline and the most recent data are based on different standards. For those data systems that change to the new standards, the first year for which data are available according to the new standards will be used as the baseline for computing the progress quotient for racial and ethnic subgroups. This truncates the period between the baseline and the most recent data value.

In table 2, progress quotients are computed for objective 5–3, which calls for a reduction in the prevalence of diabetes. Between 1997 and 2001 the progress quotient for the total population was −58.5 percent, indicating movement away from the target. Stated differently, the difference between the year 2010 target and the diabetes prevalence rate was 58.5 percent greater in 2001 than in 1997.

Beginning in 1999, data for this objective from the National Health Interview Survey are available for the new race and Hispanic origin groups. Progress quotients for the race and Hispanic origin groups are computed with 1999 data as the baseline rather than the original 1997 data. Between 1999 and 2001 the progress quotient for Asians was −37.8 percent, indicating movement away from the target. This change is not due to any change in the way in which Asians are defined. The change for racial and ethnic groups is, however, based only on the period from 1999 to 2001. Progress quotients for groups in the gender, education level, geographic location, and disability status domains are computed with the original 1997 data as the baseline. These groups are not affected by the change in race-origin categories, therefore, progress quotients for groups in these domains are based on 2 additional years of data and are not strictly comparable with progress quotients for the race-origin groups in this example.

Measuring Progress Toward the Elimination of Disparity

The words ***disparity*** and ***difference*** are synonyms according to most dictionaries. The population-based objectives in HP2010 are measured in terms of rates, percents, means, or some other quantitative measure. In the context of public health, a ***disparity*** is the quantity that separates a group from a reference point on a particular measure of health that is expressed in terms of a rate, proportion, mean, or some other quantitative measure. Disparity cannot be measured for those HP2010 objectives based on counts of events rather than rates or percents.

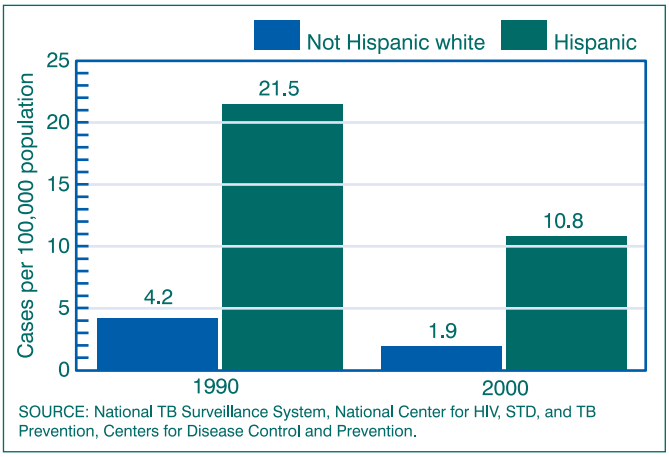
The second goal calls for the elimination of disparities among subgroups of the population. It does not presume that membership in a particular group is the primary or even a necessary cause of differences between groups. The purpose of the second goal of Healthy People is to call attention to differences in health between groups regardless of the cause. In order to eliminate disparities, specific causes or determinants need to be identified. The National Institutes of Health Strategic Research Plan and Budget to Reduce and Ultimately Eliminate Health Disparities indicates that a multifactorial approach is needed to identify the determinants of disparities in health (8).

In a similar vein, when there is no disparity or difference between groups in one of the Healthy People measures it does not prove that none exists. For example, the age-adjustment procedures employed in measuring Healthy People objectives may obscure differences between groups at specific ages or failure to compare groups by both race and sex may obscure differences associated with these two factors combined.

Three questions were considered by the workgroup in order to determine how to measure progress toward the elimination of disparities in HP2010. First, should disparity be measured in absolute or in relative terms? Second, should disparity be measured in terms of favorable events or in terms of adverse events? And finally, what reference point should disparity be measured from? The answers to these questions provide a framework for measuring disparity in HP2010.

Measuring disparity in absolute and relative terms

As discussed in the section on target attainment above, differences between rates can be measured in absolute or in relative terms. Changes in disparity over time can also be measured in absolute or in relative terms. However, absolute and relative measures of disparity may lead to different conclusions about changes over time. In figure 1, for example, tuberculosis case rates are shown for non-Hispanic white persons and Hispanic persons in 1990 and in 2000 (9). The absolute difference between rates for non-Hispanic white persons and Hispanic persons decreased from 17.3 cases per 100,000 population in 1990 (21.5 − 4.2), to 8.9 cases per 100,000 population in 2000 (10.8 − 1.9). However,



SOURCE: National TB Surveillance System, National Center for HIV, STD, and TB Prevention, Centers for Disease Control and Prevention.

Figure 1. Tuberculosis case rates for not Hispanic white persons and Hispanics: United States, 1990 and 2000

when these rates are compared based on the percent difference, a relative measure of disparity, we are led to a different conclusion. In 1990 the percent difference between the tuberculosis rates for non-Hispanic white persons and Hispanic persons is equal to 412 percent of the rate for non-Hispanic white persons ((21.5 − 4.2) / 4.2 * 100 = 412). In 2000 the percent difference is equal to 468 percent of the rate for non-Hispanic white persons ((10.8 − 1.9) / 1.9 *100 = 468). In this example the absolute difference declined but the relative difference increased.

When rates are declining, a reduction in the absolute difference between group rates can occur without a reduction in the relative difference (as in the example above). When rates are declining, a reduction in the relative difference between group rates always corresponds to a reduction in the absolute difference. On the other hand, when rates are increasing, a reduction in the absolute difference between group rates always corresponds to a reduction in the relative difference but reduction in the relative difference can occur without a reduction in the absolute difference. A decline in both absolute and relative differences is the best evidence of progress toward the elimination of disparity. In Healthy People 2000 a relative measure of change in disparity was employed to determine whether progress was being made toward the goal of reducing disparity. A ‘‘ratio of percent change’’ was used to compare the change in the rate for each special population group with the change in the rate for a reference population (7). Relative measures of disparity will again be the primary basis for assessing progress toward the elimination of disparity in HP2010 because relative measures adjust for changes in the level of the reference point over time. Relative measures of disparity have the additional advantage of adjusting for differences in the level of the reference point when comparisons are made across objectives.

It is important to remember that the absolute and relative perspectives are fundamentally different yet complementary. Large relative differences do not necessarily imply large absolute differences. For example, the relative difference between rates of 1 and 2 deaths per 100,000 population is the same as the relative difference between 50

and 100 deaths per 100,000 population. However, more lives would be saved by eliminating the second disparity than would be saved by eliminating the first disparity. The absolute difference will be used as a secondary means of assessing disparity among subgroups in a domain.

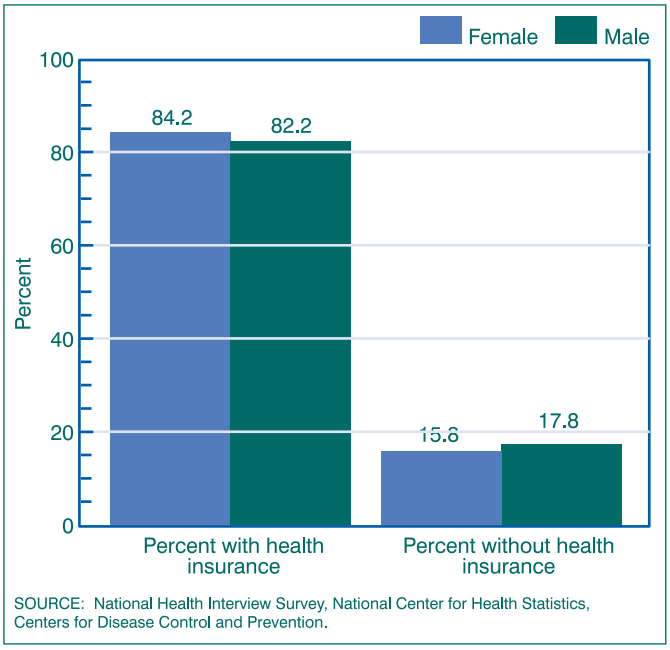
Measuring disparity in terms of favorable or adverse events

Some HP2010 objectives are expressed in terms of favorable events or conditions that are to be increased and others are expressed in terms of adverse events or conditions that are to be reduced. The choice to measure objectives in terms of favorable or adverse events can have a substantial impact on relative measures of disparity. On the left side of figure 2, for example, the percent of females with health insurance is 2.4 percent greater than the percent of males with health insurance ((84.2−82.2) / 82.2 * 100 = 2.4 percent) (10). On the right side of the figure, the percent of females without health insurance is 11.2 percent less than the percent of males without health insurance ((15.8−17.8) / 17.8 * 100 = −11.2 percent). While the absolute difference is the same for both favorable and adverse conditions (2 percentage points), the size and direction of the percent difference depends on whether it is computed for the percent with health insurance or for the percent without health insurance. Similarly, conclusions about changes in disparity over time also depend on whether the objective is expressed in terms of favorable events or in terms of adverse events.

It would not be appropriate to compare the relative disparity for one objective expressed in terms of favorable events (which tend to occur more frequently than adverse events among HP2010 objectives) with the relative disparity for another objective expressed in terms of adverse events (which tend to be more rare). In order to facilitate comparisons of relative disparity across different objectives, disparity will be measured in terms of adverse events in HP2010. Objectives that call for an increase will be transformed for purposes of measuring disparity. These objectives will not be restated but when relative measures of disparity are computed, the objective will be expressed in terms of adverse events or conditions.

Reference point for measuring disparity

Disparity can be measured in relation to various reference points, including the year 2010 target rate, the total population rate, an average of group rates, the rate for a specific group such as the largest group, or the group with the ‘‘best’’ or most favorable rate. There are advantages and disadvantages associated with each of these choices. The advantages of the year 2010 target include the fact that it is fixed for a decade and it has no sampling or other random error associated with it. However, there is no advantage to using a relative measure of disparity to measure change over time when the target does not change. The total population rate is a weighted average of the subgroup rates. It reflects the average experience of all individuals in the population. However, the total population rate is not a good reference



SOURCE: National Health Interview Survey, National Center for Health Statistics, Centers for Disease Control and Prevention.

Figure 2. Percent of persons under 65 years of age with health insurance coverage and without health insurance coverage, female and male (age adjusted), United States, 2000

point for measuring changes in disparity among several groups over time because the total rate depends on the distribution of the population among the groups and this distribution can change over time. The mean of group rates in a domain is an unweighted average of the group rates and, therefore, not affected by changes in the distribution of persons among groups, but it is more affected by outlying group rates than some of the other choices. The largest group rate is generally the most reliable of the group rates but it singles out one group as the standard of comparison for all objectives. The ‘‘best’’ or most favorable group rate is theoretically achievable by other groups. Implicit in the use of the ‘‘best’’ rate as the reference point is the idea that all differences are inequitable. However, the ‘‘best’’ group rate will differ from one domain to the next, the group with the ‘‘best’’ rate may change over time, and the ‘‘best’’ group rate might be the least reliable.

The ‘‘best’’ group rate was chosen as the reference point for measuring disparity in HP2010. Choosing the ‘‘best’’ rate eliminates the difficulty of describing the disparity for any group with a rate better than the reference point. Use of the ‘‘best’’ rate is also consistent with the idea behind using a rate ‘‘better than the best’’ as a target rate. The ‘‘best’’ rate is employed whether it is the ‘‘best’’ group rate in a domain of two groups or the ‘‘best’’ group rate in a domain of three or more groups. It is important to remember that, for a particular objective, the ‘‘best’’ rate may differ from one domain to the next. The ‘‘best’’ group rate among race-origin groups may differ from the ‘‘best’’ group rate among groups defined in terms of gender, education, location, disability or sexual orientation. The ‘‘best’’ group may also change over time. At baseline, females might have the ‘‘best’’ rate and several years later males might have the ‘‘best’’ rate.

Concerns about the stability of the ''best'' group rate can be alleviated by imposing a standard of reliability on the selection of the group with the ''best'' rate. When estimates of reliability are available, the rate for the ''best'' group must have a relative standard error less than 10 percent; otherwise the next most favorable rate will be used as the reference point. This is more stringent than the 30 percent relative standard error used by many HP2010 data sources (11). When estimates of variance are available, differences between each of the other group rates and the ''best'' group rate will be evaluated for statistical significance (see the discussion below). Finally, it should be kept in mind that change in the ''best'' group rate itself may be responsible for changes in disparity. For example, if the rates for other groups remained unchanged, any change in the ''best'' group rate would result in a change in disparity.

In summary, in the context of HP2010, disparity is being measured in both absolute and relative terms. Disparities are measured with the ''best'' group rate in each domain as the reference point and the objectives/measures are expressed in terms of rates or percents of adverse events. Different choices might lead to different conclusions about changes in disparity over time or across objectives. However, in the interests of consistency, disparity and changes in disparity in HP2010 will be governed by these choices.

Measuring Disparity

Nearly all of the population-based objectives in HP2010 are measured in terms of rates, percents, and means. Most of these objectives are essentially dichotomous and are expressed in terms of a rate or percent for which the techniques described below are appropriate. In the interest of brevity, the term ''rates'' is used to refer to both rates and percents. Similar principles can be applied to the measurement of disparities in means.

Absolute disparity will be measured as the simple difference between other group rates and the rate for the ''best'' group in the domain:

$$R_i - R_r$$

where R_i is the rate for a group of interest and R_r is the rate for the reference point, the ''best'' group rate.

Relative disparity will be measured in terms of the percent different between the rates for other groups and the rate for the ''best'' group in the doman. The percent difference indicates how much larger the rate for each group is compared to the rate for the ''best'' group in the same domain. The formula for the percent difference is:

$$(R_i - R_r) / R_r * 100$$

where R_i is the rate for a group of interest and R_r is the rate for the reference point, the ''best'' group rate. The ''best'' group rate is the lowest rate of adverse events among the set of mutually exclusive and exhaustive groups in each domain.

For example, the simple difference and the percent difference between subgroup rates and the ''best'' group rate in each domain are calculated for Objective 5–3 in table 3. This objective calls for a reduction in the prevalence rate of diabetes. Baseline data for this objective come from the 1997 National Health Interview Survey. As discussed previously, for purposes of measuring disparity by race and Hispanic origin, baseline data for this objective come from the 1999 National Health Interview Survey. In the race and ethnicity domain, the ''best'' group rate was chosen from the following groups: American Indian and Alaska Native only; Asian only; Native Hawaiian and other Pacific Islander only; 2 or more races; Hispanic or Latino; Not Hispanic or Latino, black or African American only; and Not Hispanic or Latino, white only. For purposes of measuring disparity, these groups are treated as if they were mutually exclusive although small numbers of persons in the first four groups also identified themselves as Hispanic. These persons are included in both the race-specific group and the Hispanic group. Among the race-origin groups in 1999, Asians had the lowest rate of diabetes (34.0 per 1,000 population). The rate of diabetes among American Indians and Alaska Natives was statistically unreliable. The differences are not applicable for Asian only because this group had the most favorable rate in 1999. The rate for Native Hawaiians and other Pacific Islanders was statistically unreliable. The rate for black persons was 35.1 cases per 1,000 population higher than the''best'' group rate or 103.2 percent higher than the ''best'' group rate, etc.

For domains other than race and ethnicity, baseline data are shown for 1997. In 1997, the diabetes rate for females was 1.2 cases per 1,000 population or 3.1 percent higher than the rate for males. Among persons 25 years and over, the diabetes rate for those with less than a high school education was 47.6 cases per 1,000 population or 107.0 percent higher than the diabetes rate for persons with at least some college and the diabetes rate for high school graduates was 13.3 cases per 1,000 population or 29.9 percent higher than the diabetes rate for persons with at least some college. The diabetes rate for persons in urban areas was 2.2 cases per 1,000 population or 5.8 percent higher than the diabetes rate in rural areas. The diabetes rate for persons with disabilities was 58.5 cases per 1,000 population or 208.2 percent higher than the diabetes rate for persons without disabilities. Trends in disparity will be assessed primarily in terms of changes in the percent difference from the ''best'' group rate.

Statistical significance of the disparity between each group rate and the "best" group rate

When methods for assessing the variability of rates and percents are available, the statistical significance of the difference between the two rates on which the percent difference is based will be tested. The methods used to assess the variability of rates and percents depend on the source of the data (11). Methods are not available for assessing the variability of rates and percents for all HP2010 objectives. Assuming that estimates of the standard errors for rates are available, the statistical significance of

Table 3. Measuring progress toward disparity elimination for Objective 5–3: Reduce the prevalence of diabetes

Domains	Disparity elimination									
	Prevalence of diagnosed diabetes (age adjusted per 1,000 standard population)									Change in disparity from baseline to most recent (percentage points)
	Baseline (1997)			Baseline for race-origin groups[2] (1999)			Most recent (2001)			
	Rate	Simple difference from "best"[1]	Percent difference from "best"[1]	Rate	Simple difference from "best"[1]	Percent difference from "best"[1]	Rate	Simple difference from "best"[1]	Percent difference from "best"[1]	
Total	**39.7**	NA	NA	**41.3**	NA	NA	**48.3**	NA	NA	NA
Race and ethnicity[3]										
American Indian and Alaska Native only				DSU	DSU	DSU	106.3	68.9	*184.2	DSU
Asian only				*34.0*	NA	NA	*37.4*	NA	NA	NA
Native Hawaiian and other Pacific Islander only				DSU	DSU	DSU	DSU	DSU	DSU	DSU
Black or African American only				69.1	35.1	*103.2	76.9	39.5	*105.6	2.4
White only	NA	NA	NA	37.2	3.2	9.4	44.0	6.6	17.6	8.2
2 or more races				70.7	36.7	*107.9	85.6	48.2	*128.9	21.0
Hispanic or Latino				64.5	30.5	*89.7	69.3	31.9	*85.3	−4.4
Not Hispanic or Latino				39.5	5.5	16.2	46.7	9.3	24.9	8.7
Black or African American only				69.2	35.2	*103.5	77.5	40.1	*107.2	3.7
White only				35.7	1.7	5.0	*42.4*	5.0	13.4	8.4
Gender										
Female	40.4	1.2	3.1	NA	NA	NA	*45.7*	NA	NA	NA
Male	*39.2*	NA	NA				51.5	5.8	*12.7	9.6
Education level (aged 25 years and over)										
Less than high school	92.1	47.6	*107.0				107.8	52.5	*94.9	−12.1
High school graduate	57.8	13.3	*29.9	NA	NA	NA	79.6	24.3	*43.9	**14.0
At least some college	*44.5*	NA	NA				*55.3*	NA	NA	NA
Geographic location										
Urban	40.4	2.2	5.8	NA	NA	NA	*46.2*	NA	NA	NA
Rural	*38.2*	NA	NA				54.0	7.8	*16.9	11.1
Disability status										
Persons with disabilities	86.6	58.5	*208.2	NA	NA	NA	99.4	62.7	*170.8	−37.4
Persons without disabilities	*28.1*	NA	NA				*36.7*	NA	NA	NA

*The difference between the rate for this group and the "best" group rate is statistically significant.

**The difference between the percent difference at baseline and the percent difference for the most recent year is statistically significant.

NA = Not applicable.

DSU = Data do not meet the criteria for statistical reliability, data quality, or confidentiality (data are suppressed).

[1]For each domain (Race and ethnicity, Gender, Education level, Geographic location, and Disability status) the percent difference is computed between the rate for each of the other groups and the rate for the group with the "best" or lowest rate. The lowest rate in each domain is shown in italics. In the race and ethnicity domain, the "best" group rate was chosen from the following groups that are treated is if they were mutually exclusive: American Indian and Alaska Native only; Asian only; Native Hawaiian and other Pacific Islander only; 2 or more races; Hispanic or Latino; Not Hispanic or Latino, Black or African American only; and Not Hispanic or Latino, White only.

[2]The baseline year for data by race and ethnicity is the first year for which data are available according to the latest OMB standards.

[3]Starting with data year 1999, estimates by race and ethnicity are tabulated using the 1997 standards for Federal data on race and ethnicity.

SOURCE: National Health Interview Survey, National Center for Health Statistics, Centers for Disease Control and Prevention.

the difference between groups can be assessed using the following Z statistic:

$$Z = (R_i - R_r) / \sqrt{SE_i^2 + SE_r^2}$$

where:

R_i = rate for a group of interest,
R_r = rate for the reference group,
SE_i = standard error of the rate for a group of interest, and
SE_r = standard error of the rate for the reference group.

This formula assumes that the groups are independent. The comparison of the Z statistic with some Z-critical value determines the significance of the difference between the two rates, and by inference the significance of the percent difference between the two rates. If $|Z| \geq 1.645$, the difference is significant at an alpha (α) level of 0.05. Because the comparison is made to the ''best'' rate the other group rate can only be larger, therefore, a one-tailed test is employed. The difference between the rate for a group of interest and

the ''best'' group rate is flagged (*) when it is statistically significant at the 0.05 level.

In table 3, for example, the diabetes prevalence rate for blacks or African Americans only was 69.1 per 1,000 and the rate for Asians only was 34.0 per 1,000. Standard errors for these two point estimates were calculated using SUDAAN (12), a statistical package that adjusts for the effects of the complex design of the National Health Interview Survey (3.5 and 6.4 per 1,000, respectively). Using the formula above:

$$Z = (R_i - R_r) / \sqrt{SE_i^2 + SE_r^2}$$

$$Z = (69.1 - 34.0) / \sqrt{(3.5^2 + 6.4^2)}$$

$$|Z| = 4.81$$

Because Z is greater than the critical value (1.645), the difference between the diabetes prevalence rate for black or African Americans only and Asians only is statistically significant at the 0.05 level, and the percent difference is flagged accordingly.

If the purpose of the analysis were to determine whether the rate for more than one group in a domain was different from the ''best'' group rate, the Z-critical value should be adjusted for the number of comparisons by dividing the alpha (α) level by the number of comparisons. In the example above, if both of the other education groups were compared with the ''best'' group in 1997, the alpha (α) level would be ($0.05 / 2 = 0.025$). The Z-critical value for an alpha (α) of 0.025 is 1.96 for a one-tailed test. Z values for the other education groups were 10.5 and 4.0, respectively. The prevalence of diabetes among persons 25 years and over with less than a high school education and for those with a high school education was significantly different from the prevalence for the ''best'' group. The Z-critical value for both groups exceeded the critical value for multiple comparisons (13). The more stringent requirements of the multiple comparison test compensate for the increased probability that at least one significant difference might occur by chance.

Measuring change over time in disparity for individual groups

The change in disparity for individual groups can be measured in terms of the change in the percent difference from the ''best'' group rate. The absolute change in the percent difference from the ''best'' rate is computed by subtracting the percent difference at the earlier period from the percent difference at the later period as illustrated in the example for Objective 5–3 in table 3. An increase in the percent difference is indicative of an increase in disparity and a decrease in the percent difference is indicative of a decrease in disparity.

Between 1999 and 2001, the percent difference from the ''best'' rate increased by 8.4 percentage points for the non-Hispanic white group. The term ''percentage points'' is used to signify that this is an absolute difference between two percents. The absolute change over time in the percent difference from the ''best'' group can be used to identify the group with the greatest change relative to the ''best'' group—Asians only in this example. Among the race-ethnic groups in table 3, persons who identified with 2 or more races had the greatest increase in the rate of diabetes (that is, the greatest increase in disparity) relative to the ''best'' group. Relative to the ''best'' group, the percent difference for Hispanics declined by 4.4 percentage points. This was the only race-origin group for which the percent difference from the ''best'' group decreased.

Because they are not affected by changes in racial and ethnic classification, baseline data for the other domains (gender, family income level, and geographic location) are shown for 1997. Between 1997 and 2001, the disparity in diabetes rates by gender increased by 9.6 percentage points relative to the ''best'' rate. Note that the group with the most favorable rate changed from males in 1997 to females in 2001. In 1997 the rate for females was 3.1 percent higher than the rate for males. In 2001 the rate for males was 12.7 percent higher than the rate for females. The net change in the percent difference from the ''best'' rate was therefore 9.6 percentage points ($12.7 - 3.1 = 9.6$ percentage points). In the education domain the disparity between persons with less than high school and persons with at least some college decreased by 12.1 percentage points relative to the ''best'' rate and the disparity between high school graduates and persons with at least some college increased by 14.0 percentage points relative to the ''best'' rate. The disparity in diabetes rates by geographic location increased by 11.1 percentage points relative to the ''best'' rate. In the disability status domain, the disparity between persons with disabilities and persons without disabilities decreased by 37.4 percentage points relative to persons without disabilities, indicating a decrease in disparity.

Statistical significance of changes in disparity over time

In order to evaluate the statistical significance of a change in the percent difference over time, standard errors for the percent difference at the baseline and at the most recent data point are needed. The percent difference is based on the ratio of the simple difference to the reference point as shown above. The relative standard error of a ratio is computed based on the relative standard error of the numerator and the denominator. The relative standard error (RSE) for the simple difference (SD) is calculated as:

$$RSE_{SD} = \sqrt{SE_i^2 + SE_r^2} / (R_i - R_r)$$

where SE_i is the standard error of the rate for a group of interest (i), SE_r is the standard error for the reference group rate (r), R_i is the rate for the group of interest, and R_r is the reference group rate.

The relative standard error of the rate for the reference point is computed as:

$$RSE_r = SE_r / R_r.$$

The relative standard error for the percent difference RSE_{PD} is computed based on the relative standard errors of the numerator (RSE_{SD}) and the denominator (RSE_r) as:

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

The standard error of the percent difference is obtained from the relative standard error as:

$$SE_{PD} = RSE_{PD} * PD.$$

The statistical significance of a change in the percent difference from the ''best'' group rate over time can be assessed using the following Z statistic:

$$Z = (PD_1 - PD_0) / \sqrt{SE_{PD_1}^2 + SE_{PD_0}^2}$$

where

PD_1 = percent difference at time 1 (the most recent data point),
PD_0 = percent difference at time 0 (the baseline),
SE_{PD_1} = standard error of the percent difference at time 1, and
SE_{PD_0} = standard error of the percent difference at time 0.

In table 3, the diabetes prevalence rate for females was 3.1 percent higher than the rate for males in 1997 and the rate for males was 12.7 percent higher than the rate for females in 2001. In this example, the net change in the percent difference from the ''best'' group rate is 9.6 percentage points. Standard errors for the four group rates were calculated using SUDAAN (12). The relative standard error for the simple difference between the rate for the group of interest and rate for the reference point is calculated as:

$$RSE_{SD} = \sqrt{SE_i^2 + SE_r^2} / (R_i - R_r).$$

Baseline:

$$RSE_{SD,0} = \sqrt{1.4^2 + 1.5^2} / (40.4 - 39.2)$$
$$= \sqrt{4.21} / 1.2$$
$$= 1.708 \text{ or } 170.8\%$$

Most recent:

$$RSE_{SD,1} = \sqrt{1.9^2 + 1.4^2} / (51.5 - 45.7)$$
$$= \sqrt{5.57} / 5.8$$
$$= 0.407 \text{ or } 40.7\%$$

The relative standard error for the reference point rates are calculated from the standard error as:

$$RSE_r = SE_r / R_r.$$

Baseline:

$$RSE_{r,0} = 1.5 / 39.2$$
$$= 0.038 \text{ or } 3.8\%$$

Most recent:

$$RSE_{r,1} = 1.4 / 45.7$$
$$= 0.031 \text{ or } 3.1\%$$

The relative standard error for the respective percent differences are calculated as:

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

Baseline:

$$RSE_{PD,0} = \sqrt{1.708^2 + 0.038^2}$$
$$= \sqrt{2.919}$$
$$= 1.709 \text{ or } 170.9\%$$

Most recent:

$$RSE_{PD,1} = \sqrt{0.407^2 + 0.031^2}$$
$$= \sqrt{0.617}$$
$$= 0.409 \text{ or } 40.9\%$$

The standard errors for the percent differences are calculated as:

$$SE_{PD} = RSE_{PD} * PD.$$

Baseline:

$$SE_{PD,0} = 1.709 * 3.1\%$$
$$= 5.30\%$$

Most recent:

$$SE_{PD,1} = 0.409 * 12.7\%$$
$$= 5.19\%$$

Finally, the Z test for the significance of the change in the percent difference:

$$Z = (PD_1 - PD_0) / \sqrt{SE_{PD,1}^2 + SE_{PD,0}^2}$$
$$= (12.7 - 3.1) / \sqrt{5.19^2 + 5.30^2}$$
$$= 9.6 / 7.42$$
$$= 1.29.$$

That is, $|Z| = 1.29$. Because the percent difference from the ''best'' group rate could increase or decrease, a two-tailed test is employed ($|Z| \geq 1.96$). Because the absolute value of Z is not equal to or greater than the critical value, there was no significant change in the disparity between males and females in the prevalence of diabetes between 1997 and 2001.

Table 4. Measuring progress toward elimination of gender disparity for selected Healthy People 2010 objectives

Objectives and gender	Disparity elimination				
	Prevalence				Change in disparity from baseline to most recent (percentage points)
	Baseline 1997		Most recent 2001		
	Rate or percent	Percent difference from "best"[1]	Rate or percent	Percent difference from "best"[1]	
Objective 5–3					
Prevalence of diagnosed diabetes (age adjusted per 1,000 standard population)					
Female	40.4	3.1	*45.7*	0.0	NA
Male	*39.2*	0.0	51.5	*12.7	9.6
Objective 5–15					
Percent without an annual dental visit among persons with diabetes (persons aged 2 years and over)					
Female	*41.3*	0.0	*39.1*	0.0	NA
Male	47.9	16.0	45.7	*16.9	0.9
Objective 22–1					
Percent of persons with no physical activity (adults aged 18 years and over)					
Female	43.0	*18.8	40.1	*15.6	−3.2
Male	*36.2*	0.0	*34.7*	0.0	NA
Objective 22–2					
Percent of persons without moderate physical activity (adults aged 18 years and over)					
Female	71.3	*10.2	71.2	*10.2	0.0
Male	*64.7*	0.0	*64.6*	0.0	NA

*The difference between the rate for this group and the "best" group rate is statistically significant.
**The difference between the percent difference at baseline and the percent difference for the most recent year is statistically significant (none in this table).
NA = Not applicable.
0.0 Quantity more than zero but less than 0.05.
[1]The percent difference is computed between the rate for each of the other groups and the rate for the group with the "best" or most favorable rate. The most favorable rate in each domain is shown in italics.

SOURCE: National Health Interview Survey, National Center for Health Statistics, Centers for Disease Control and Prevention.

Comparisons Across Healthy People Objectives

As a relative statistic, the percent difference can be compared among groups in a domain or over time as illustrated in table 3. When the percent difference at one point in time is compared with the percent difference at a later point in time, it is essential that the groups of interest and the reference point group be defined in the same way at both points in time. As noted previously, the specific group with the "best" rate may change over time, but whichever group has the "best" rate should be chosen from the same set of group rates at each point in time. The percent difference can also be compared across objectives. In table 4, the change in the percent difference by gender between 1997 and 2001 is shown for four HP2010 objectives based on data from the National Health Interview Survey. Note that for purposes of measuring disparity, all of these objectives are expressed in terms of adverse conditions or events.

As indicated above, the gender disparity in the prevalence of diabetes increased by 9.6 percentage points relative to the "best" rate, which changed from males in 1997 to females in 2001. Relative to the change in the "best" rate, this change was not statistically significant. The gender disparity in the percent without an annual dental visit among persons with diabetes increased by 0.9 percentage points. The gender disparity in the percent of persons with no leisure-time physical activity decreased by 3.2 percentage points and the gender disparity in the percent of persons without moderate physical activity was unchanged. None of these changes in disparity between the baseline in 1997 and 2001 is statistically significant.

Measuring Disparity for Domains of 3 or More Groups

In HP2010 several population domains are defined in terms of two groups (gender, geographic location, and disability status). When there are just two groups in a domain the disparity from the "best" group can be measured directly in terms of the percent difference and the change in

Table 5. Measuring disparity and changes in disparity among several groups: Objective 16–1c: Reduction in infant mortality rates

Domain	Infant mortality rate per 1,000 live births		Percent difference from "best"[1]	
	Baseline 1998	Most recent 2000	Baseline 1998	Most recent 2000
Mother's race and ethnicity				
American Indian and Alaska Native	9.3	8.3	86.0	84.4
Asian	*5.0*	*4.5*	NA	NA
Native Hawaiian and other Pacific Islander	10.0	8.2	100.0	82.2
Hispanic or Latino	5.8	5.6	16.0	24.4
Not Hispanic or Latino, black or African American	13.9	13.6	178.0	202.2
Not Hispanic or Latino, white	6.0	5.7	20.0	26.7
Index of disparity (percent)	NA	NA	80.0	84.0

NA = Not applicable.
[1]The "best" group rate for each year is shown in italics.
SOURCE: National Vital Statistics System, National Center for Health Statistics, Centers for Disease Control and Prevention.

disparity can be measured in terms of the absolute change in the percent difference, as described previously. When there are more than two groups in a domain (race and ethnicity, education, and income) the disparity among several group rates or percents can be measured using an index of disparity that summarizes the differences among the groups (14,15). While the percent difference measures disparity from the ''best'' group rate for individual groups, an index of disparity can be used to measure the disparity between several groups and the ''best'' group. An index of disparity provides a way to determine whether the disparity between several groups in a domain is getting larger or smaller relative to the ''best'' group rate. The formula for an index of disparity is:

$$(\Sigma_{i=1}^{n-1} PD_i) / (n-1)$$

where PD_i is the percent difference for each group rate of interest and n is the total number of groups. Because this statistic is based on the average of differences from the ''best'' group rate, the average is computed using the number of groups minus 1 ($n-1$).

In table 5 the index of disparity is computed based on six race and ethnic groups for infant mortality rates in 1998 and 2000. Ideally the groups in a domain should be mutually exclusive and exhaustive. In this example, however, small numbers of mothers in the first three groups also identified themselves as Hispanic. These mothers are included in both the race-specific group and the Hispanic group. When the index of disparity is calculated for categories of race and ethnicity based on the new standards, seven groups would be used and treated as if they were mutually exclusive and exhaustive: American Indian and Alaska Native only, Asian only, Native Hawaiian and other Pacific Islander only, 2 or more races, Hispanic or Latino, Not Hispanic or Latino Black only, and Not Hispanic or Latino White only.

In both 1998 and 2000, infants born to Asian mothers had the most favorable infant mortality rate. The percent difference for each of the other groups is calculated as described previously. The index of disparity is equal to the mean of the five percent differences from the ''best'' group rate. In 1998, the average percent difference from the ''best'' group rate was equal to 80.0 percent of the ''best'' group rate. Like the percent difference, the index of disparity is a relative statistic. The average disparity from the ''best'' group rate is expressed as a percent of the ''best'' group rate.

The index of disparity is based on an average of relative differences. Similar index values can be obtained when the rate for only one group is very different from the reference group, or when the rates for several groups are only moderately different from the reference point. The index of disparity should always be interpreted in terms of the group-specific rates on which it is based. The procedure for estimating the standard error for the index of disparity is described below.

Measuring change over time in disparity for a domain of several groups

The index of disparity can be used to assess changes in disparity among groups in a domain over time. In table 5, the index of disparity by race and ethnicity was computed for both 1998 and 2000 for Objective 16–1c. The index of disparity increased from 80.0 percent in 1998 to 84.0 percent in 2000, an increase of 4 percentage points. Once again the term percentage points is used to emphasize the fact that this is an absolute change in a relative measure of disparity. The average percent difference from the ''best'' group rate, therefore, increased relative to the ''best'' group rate. This finding is consistent with increases in the percent difference from the ''best'' rate for Hispanic, white non-Hispanic, and black non-Hispanic mothers in table 5. An increase in the index of disparity can be interpreted as an increase in disparity by race and ethnicity.

The index of disparity does not indicate whether any of the group rates are increasing or decreasing. A decrease in the statistic does not necessarily indicate that any of the subgroup rates are decreasing; it simply means that there is proportionally less variation in subgroup rates relative to the ''best'' subgroup rate. Because it is based on an average, the index of disparity is sensitive to the number of groups.

When the index of disparity is used to make comparisons over time, across objectives, or across geographic areas the index must be computed using the same number of groups—defined in the same way. If the ''best'' group rate has a relative standard error greater than or equal to 10 percent, it is excluded from the calculation and the next ''best'' group rate is used as the reference point. The index of disparity can also be used to make comparisons of disparity for a particular domain across geographic areas or across populations. Comparisons of the index of disparity across domains may be of interest; however, such comparisons should be made with caution. Differences in the index of disparity should also be interpreted in terms of the group-specific rates on which they are based.

Statistical significance of changes in the index of disparity

In order to obtain a standard error for the index of disparity a type of resampling or ''bootstrap'' procedure is employed (16). This procedure uses the rate and standard error for each group to re-estimate each group rate 25,000 times assuming a random normal distribution. Based on these group rates, 25,000 estimates of the index of disparity are generated and the distribution of these estimates is used to estimate the standard error of the index.

The bootstrap procedure is used to estimate standard errors for the index of disparity at time (1) and time (0) to determine whether the index of disparity changed over time. A Z test for the difference between the index of disparity at $\text{time}_{(1)}$ and $\text{time}_{(0)}$ can be computed as follows:

$$Z = (ID_1 - ID_0) / \sqrt{(SE_1^2 + SE_0^2)},$$

where,

ID_1 = the index of disparity at time (1)
ID_0 = the index of disparity at time (0)
SE_1 = the standard error of the index of disparity at time 1
SE_0 = the standard error of the index of disparity at time 0.

Standard errors for the index of disparity in 1998 and in 2000 were obtained using the bootstrap methodology. The difference between the index value in 1998 and in 2000 for the infant mortality rate (Objective 16–1c) was tested using the formula above.

$$Z = (ID_1 - ID_0) / \sqrt{(SE_1^2 + SE_0^2)}$$
$$Z = (84.0 - 80.0) / \sqrt{(9.2^2 + 9.3^2)}$$
$$Z = 4.0 / 13.08$$
$$|Z| = 0.31$$

Because the value of the index could increase or decrease, a two-tailed test is employed ($|Z| \geq 1.96$). Because the absolute value of Z is not greater than or equal to the critical value, the change in the index of disparity by race and ethnicity for infant mortality rates between 1998 and 2000 was not statistically significant at the 0.05 level.

Summary

There are two overarching goals of the HP2010 initiative: 1) to increase years and quality of healthy life, and 2) to eliminate disparities among subgroups of the population. Progress toward attainment of these two goals can be measured in terms of the specific HP2010 objectives. Progress toward target attainment is measured in terms of a progress quotient— the percent of the difference between the year 2010 target and the baseline that was achieved based on the most recent data value. The absolute difference between the most recent data value and the target is also measured. These measures will be produced for the total population and for each population subgroup for the population-based objectives. The relative progress made and the absolute progress required to reach the target can be compared among subgroups of the population.

Progress toward the elimination of disparity can be measured in terms of the percent difference between each subgroup rate and the most favorable or ''best'' subgroup rate in each domain. For purposes of measuring disparity, all measures are expressed in terms of adverse events. A reduction in the percent difference from the ''best'' group rate is interpreted as a reduction in disparity for the other group. For domains of three or more groups (race and ethnicity, education, or income) disparity for the domain is measured using an index of disparity based on an average of the percent differences from the ''best'' group rate. A reduction in the index is interpreted as a reduction in disparity in group rates relative to the ''best'' group rate.

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