

A Novel Approach for Measuring and Communicating State Health Trends Over Time

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ABSTRACT

Objective: To develop a method to assess long-term and recent progress for leading health indicators in Wisconsin.

Methods: Data from state and national sources were compiled. Baseline (10-year) trends for 20 health indicators were measured and compared to the Healthy People 2020 improvement standard of 1% per year. Additionally, current rates were assessed by comparing the most recent year of data to the expected rate had the previous 10-year baseline trend continued. Where available, health indicator trends were reported by gender, race/ethnicity, geography, and socioeconomic status.

Results: Wisconsin improved on 10 of the 20 indicators over the past decade, with decreasing mortality rates for all age groups. The largest improvement was a decline of 3.0% per year in deaths among 1 to 24 year olds. The rates of teen births and adult excessive drinking also improved by 2.5% per year and 1.4% per year, respectively. Other indicators worsened. For example, increasing rates of low birthweight (+0.6% per year), adults in fair or poor health (+1.6% per year), and all socioeconomic indicators worsened (high school dropouts [+0.9% per year], unemployment [+5.9% per year], children in poverty [+5.1% per year], and violent crime [+2.3% per year]). Health indicators varied substantially across subgroups within Wisconsin. For example, African Americans were twice as likely to experience low birthweight compared to other racial subgroups, and males experienced death rates higher than females across all ages.

Conclusion: Reporting current estimates and 10-year trends of leading health indicators helps identify areas of progress and opportunities for improvement. Despite progress in reducing death rates and several other health factors, self-reported health status is worsening in Wisconsin. Worsening socioeconomic conditions and health disparities represent significant public health challenges for Wisconsin's future.

BACKGROUND

The development of a national agenda for health improvement began with the 1979 Surgeon General's Report on Health Promotion and Disease Prevention.¹ This agenda was expanded

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by the work of Healthy People 2020 (HP2020). HP2020 is a national initiative to promote longer and healthier lives for all Americans through encouraging collaboration across community sectors, empowerment of individuals, and preventive activities.² In 2010, health achievement objectives for the nation to reach by 2020 were established for numerous health indicators. Although HP2020 will provide an assessment of whether or not the goal was achieved, there is no current national effort to measure annual change or to understand whether current health interventions are resulting in sufficient improvements to meet the goals. Following HP2020, the Wisconsin State Health Plan for 2020 established a goal for everyone to live longer and healthier lives.³ Measuring progress annually and identifying trends can indicate whether or not these goals are likely to be achieved.

Current research is heavily focused on analyzing trends in morbidity and mortality rates.⁴ In addition, nationally, "America's Health Rankings" tracks yearly

changes in health measures with significant changes reported at the $P < 0.05$ level.⁵ States reporting on trends (eg, Connecticut, New Hampshire, Oklahoma, and Utah) use general assessments such as those from America's Health Rankings or focus on reporting specific health outcome data, but do not delve into other measures or describe how these measures differ over time or by subgroup.⁶⁻⁹

One method used to measure cancer trends over time was developed by the Surveillance, Epidemiology, and End Results Program of the National Cancer Institute and has been applied heavily across different subpopulations and cancer types.¹⁰ This method may be used to quantify changes in other health measures over time.

In addition to measuring trends over time, it is important to examine disparities across population subgroups. For example, the Center on Social Disparities in Health compares rate ratios and differences between subgroups to the most advantaged stratum to identify areas of inequality.¹¹ Other methods identified include ratios (by groups or percentiles), correlations and regressions, Gini-like coefficients, population attributable risk, and dissimilarity indices to detect disparities across subgroups.⁴

Building on these efforts, the University of Wisconsin Population Health Institute has developed an approach to measure and assess trends in leading health indicators. This analysis is designed to help researchers and policy makers understand the state's progress in its goal of everyone living, longer healthier lives and where to focus efforts in order to increase the improvement rate of specific health indicators. Results of this analysis have been reported annually since 2011 in a brief, user-friendly non-technical report known as the *Wisconsin Health Trends: Progress Report*.¹² The report assesses progress on 20 health indicators by looking at trends over the past 10 years and comparing data for the current year to those trends. The report is accompanied by additional material available online that assesses the health indicators by subgroup and highlights areas where adequate health for all has not been achieved.¹³

This paper provides more background on the data and methods provided in the report and online, as well as a discussion of the results and implications for Wisconsin. Specifically, it describes how we measured 10-year trends for several health indicators in Wisconsin and performed 2 assessments for 20 health indicators: (1) an assessment of the health indicator's trend over the past 10 years, and (2) an assessment of the most current year of data compared to where it would be expected to be if the previous 10-year trend line had continued through the current year. In addition, trends were broken into subgroups to identify disparities in trends over time.

METHODS

Data

Using the County Health Rankings model of population health, relevant health indicators were identified to be evaluated against the HP2020 goal of a 1% per year improvement rate.¹⁴ Of these, health indicators with at least 11 years of consecutive Wisconsin data were used. A complete list of the data sources and years used are included in the report.^{15(p13)}

Assessment

More descriptive assessment methods can be found in the report itself.¹⁵ Briefly, 10-year trends were measured and the most currently available data were compared to these trends. To assess the magnitude of the 10-year trend, a linear regression line was used to calculate the annual percentage change for each indicator.¹⁰ An increase in the annual percentage change indicated a

worsening health trend, while a decrease indicated improvement. Assessments of the 10-year baseline trend were ascribed based on the magnitude of the annual percent change for each indicator.

Using the 10-year baseline trends, the expected current rate for each indicator was determined. The current observed rate was compared with the expected rate. Current progress was determined by calculating the percent difference between the observed and expected rates. Statistical significance at $P < 0.10$ indicated that a value was "much better" or "much worse" than expected. This value of 0.10 was chosen to provide substantial statistical validity and also variation in assessment among measures.

The same methodology for reporting the annual percent change was repeated for the subgroups of gender, race/ethnicity, geography, and socioeconomic status where the data was available to visually communicate trends by subgroup over time, highlighting important health disparities. These data were from the same sources used in the entire Wisconsin health indicator analysis. Due to small sample sizes, a baseline trend was calculated, but an assessment of this trend line was not provided due to high variability and, thus, lack of statistical significance.

RESULTS

Baseline Trends

The 10-year baseline trend, current observed value, current expected value, and percent difference value for each indicator, along with their assessments, are provided in Table 1. Wisconsin is experiencing improving trends on 10 of 20 health indicators. For health outcomes, death rates are improving for every age group indicating positive trends. However, worsening trends are evident among self-reported health and low birthweight. For health factors, Wisconsin is experiencing improving trends on 3 of 5 health behavior indicators, 1 of 2 clinical care indicators, zero of 4 social and economic factors, and there is no observed change on the physical environment indicator.

Eight of the indicators received a "much better" rating, showing sustained improvement at a rate greater than 1% per year. These indicators are all ages death rate, premature death rate, 1- to 24-year-old death rate, 65+ year-old death rate, smoking, excessive drinking, teen birth rate, and no health insurance (0-17). Seven of the indicators received a "much worse" rating, with rates of self-reported fair or poor health, obesity, chlamydia incidence, adults (18-64) without health insurance, unemployment, children in poverty and violent crime increasing at a rate greater than 1% per year (Table 1).

The largest improvement was among the percentage of children without health insurance, decreasing at a rate of -3.6% per year. The teen birth rate and adult smoking percentage also experienced substantial improvements, both decreasing at a rate of -2.5% per year (Table 1). The indicator worsening the fastest was unemployment rates at an average rate of +5.9% per year. The percentage of children in poverty, and obesity among adults

Table 1. Health Progress Assessment Table From 2014 Progress Report^{15(p5)}

Measure	Current Observed Rate	Expected	Percent Difference	Current Progress	Baseline Trend (% change/year)	10-Year Trend Progress
Health Outcomes						
Premature death rate (YPLL-75 per 100,000)	5714	5548	+3.0	●	-1.2	↓
Low birthweight (%)	7.2	7.1	+0.8	○	+0.6	↑
Self-reported poor or fair health (%) ^a	14.0				+1.6	↑
All ages death rate (per 100,000)	707	692	+2.1	●	-1.1	↓
Infant death rate (per 1,000)	5.7	6.1	-7.2	○	-0.9	↓
1- to 24-year-old death rate (per 100,000)	33.5	31.5	+6.4	○	-3.0	↓
25- to 64-year-old death rate (per 100,000)	283	273	+3.4	●	-0.7	↓
65+ year-old death rate (per 100,000)	4274	4205	+1.6	●	-1.1	↓
Health Factors						
Health Behaviors						
Smoking (%) ^a	20.4				-2.5	↓
Obesity (%) ^a	29.7				+3.1	↑
Excessive drinking (%) ^a	22.8				-1.4	↓
Teen birth rate (per 1,000)	22.1	25.9	-14.7	●	-2.5	↓
Chlamydia incidence rate (per 100,000)	433	405	+6.9	●	+2.8	↑
Clinical Care						
No health insurance (0-17) ^a (%)	7.0				-3.6	↓
No health insurance (18-64) ^a (%)	14.6				+1.8	↑
Social and Economic Factors						
High school dropouts (%)	1.9	2.2	-14.9	●	+0.9	↑
Unemployment (%)	6.7	8.1	-17.0	●	+5.9	↑
Children in poverty (%)	18.3	19.0	-3.8	●	+5.1	↑
Violent crime rate (per 100,000)	280	283	-0.9	○	+2.3	↑
Physical Environment						
Air pollution (µg/m ³)	9.6	10.6	-9.4	●	-0.3	→

Current Observed Rate = Rate or percentage provided for the most current year from the data sources.
 Expected = Value expected for the current year using a 10-year linear regression model for the previous 10 years.
 Percent Difference = (Observed Value – Expected Value) / Expected Value x 100.
 Current Progress = Based on magnitude and significance of the percent difference value. Black dot, better than expected; dark gray dot, worse than expected; white dot, as expected.
 Baseline Trend = (e^{b-1}) x 100 where e=exponential function and b=slope of the logarithmic trend-line.
 Trend Progress = Based on magnitude of the baseline trend. Up arrow, worse; down arrow, improved; right arrow, no change
^aDue to changes in the methodology by which Behavioral Risk Factor Surveillance System and Family Health Survey collected data, “current progress” was not analyzed for 6 indicators: self-reported fair or poor health, smoking, obesity, excessive drinking, no health insurance (age 0-17) and no health insurance (age 18-64).
 Abbreviation: YPLL, years of potential life lost.

also experienced large deteriorations, worsening at rates of +5.1% per year and +3.1% per year respectively (Table 1).

Current Progress

Five indicators received a “better” rating, where the current rate was statistically better than expected (*P*<0.10). These indicators are teen birth rate, high school dropouts, unemployment, children in poverty, and air pollution. Five indicators received a “worse” rating, where the current rate was statistically worse than expected with *P*<0.10. These indicators are all ages death rate, premature death rate, 25- to 64-year-old death rate, 65+ year-old death rate, and chlamydia incidence (Table 1).

The best current progress was for unemployment rate at 17.0% better than expected. High school dropouts and teen birth rate also performed better than expected, with percent differences of -14.9% and -14.7%, respectively. The worst current progress was experienced for chlamydia rates, with a percent dif-

ference of +6.9% (Table 1).

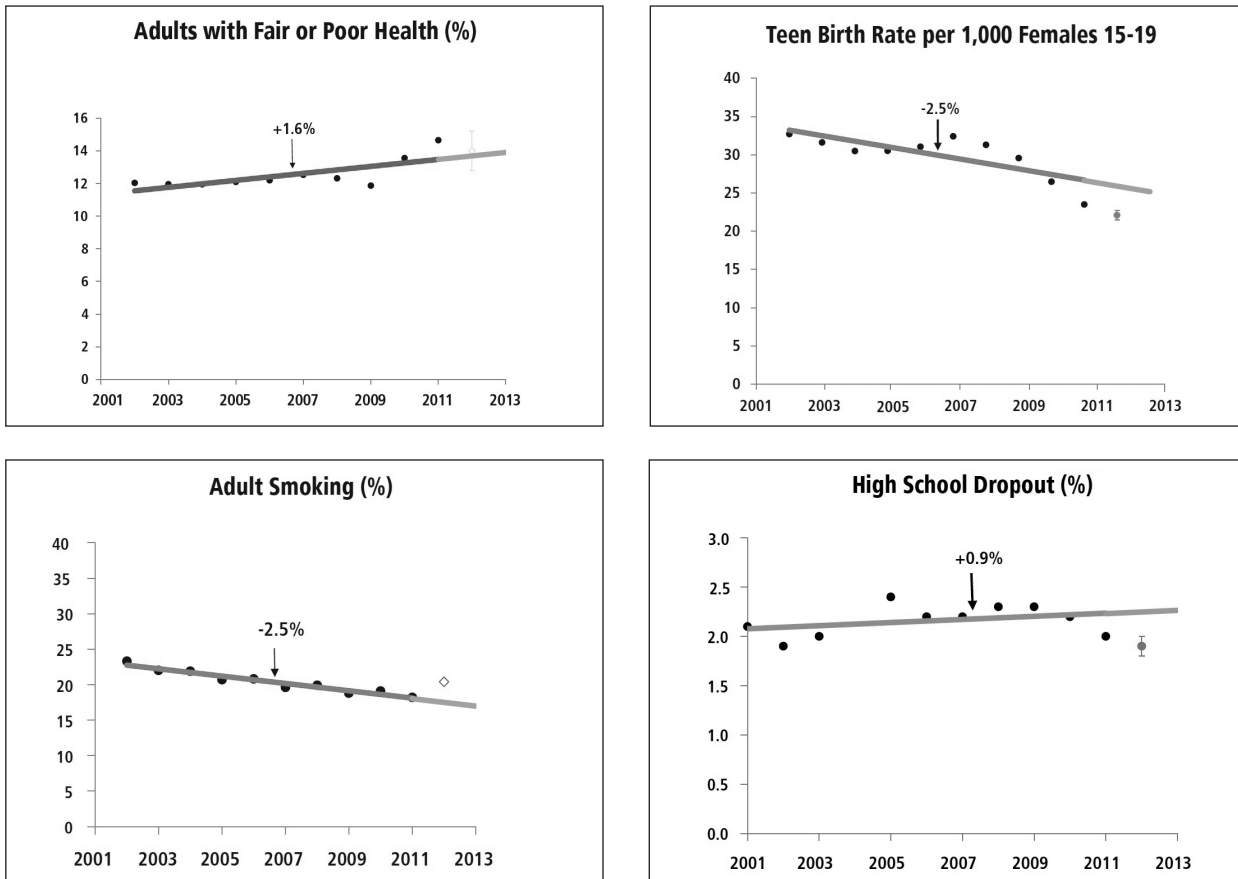
In some cases, current progress and baseline trends were not in agreement. For example, unemployment increased over the past 10 years at an average rate of +5.6% per year, but performed better than expected (-17.0%) for the current year (Table 1). However, in other cases, the 10-year baseline trend and current progress are in complete concordance. For example, over the past 10 years teen birth rate has improved -2.5% per year, and the current rate was -14.7% better than expected (Figure 1).

Disparities

Substantial differences in health status, as well as marked different trends, are seen when indicators are examined by gender, geography, socioeconomic status, or race/ethnicity.¹³ Examples illustrating these disparate trends are provided in Figure 2.

Smoking rates differ by socioeconomic factors. For example, in Wisconsin, those with less than a high school education have

Figure 1. Trend Graphs for 4 Leading Health Indicators From the 2014 Progress Report



an almost 6 times higher rate of smoking (42.7%) compared with those with a college degree (7.7%) (Figure 2). Looking at 10-year trend data by socioeconomic status further reveals that smoking rates are declining twice as quickly for those with a college degree (-3.7% vs -1.6% per year).

Disparities also exist by race. Blacks and American Indians fare worse on all health indicators compared to whites, Hispanics, and Asians. The current rate of infant deaths among blacks is 13.2 deaths per 1000 live births and among American Indians is 10.9 deaths per 1000 live births, compared with all other racial groups at 6.3 deaths per 1000 live births or better (Figure 2). Looking at trends over a decade, the infant death rate is improving for blacks at rates 3 times as high as the HP2020 standard.

Geographic disparities in health continue to persist in Wisconsin as well. Those living in suburban and nonurban areas are healthiest for all indicators where geography disparity data was available. The teen birth rate was almost 3 times higher in urban counties compared with suburban counties (40.0 vs 15.4 births per girls ages 15-19) in 2012. The trend is improving for all geographic groups, but improving more than 4 times as fast

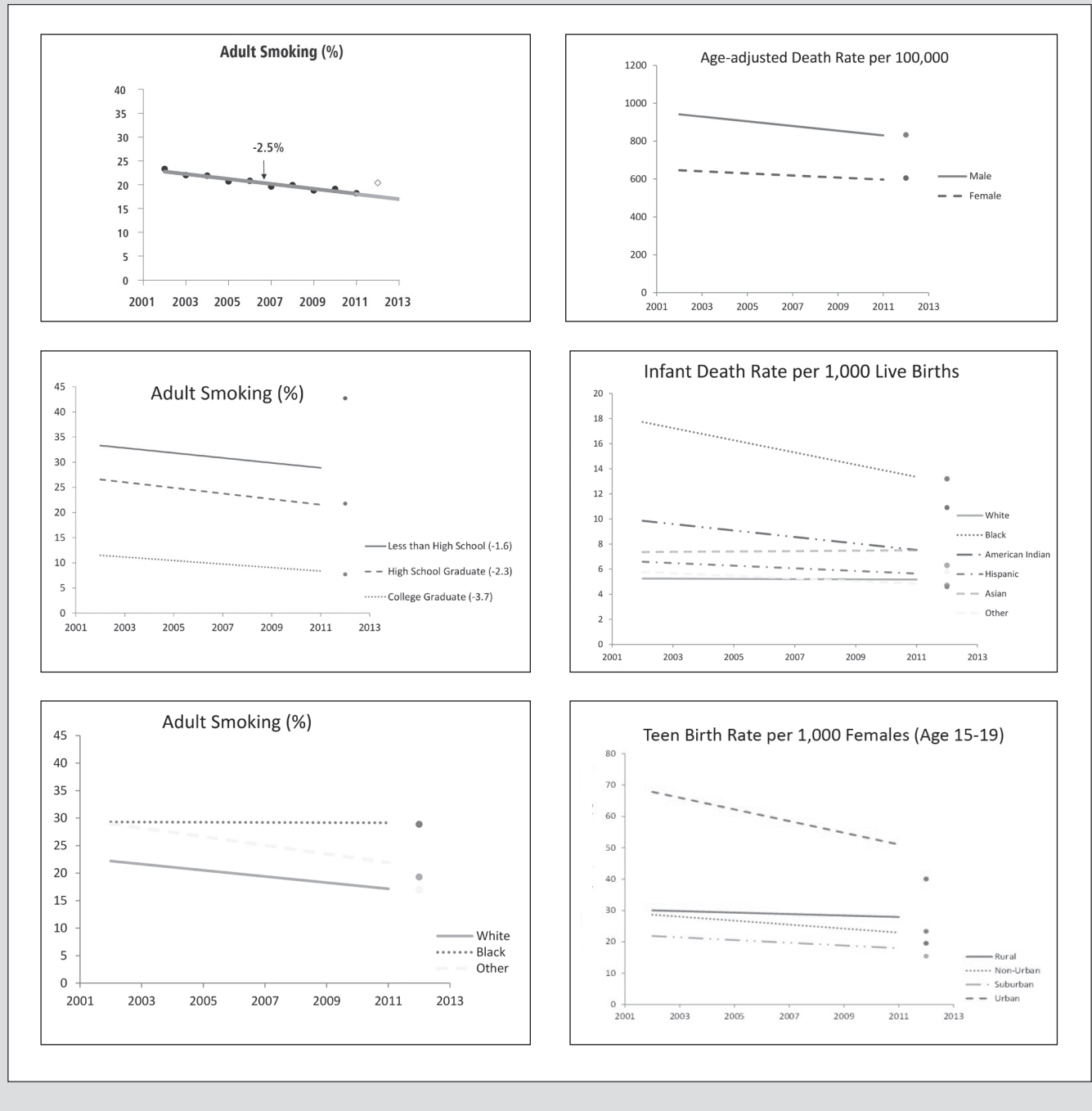
for urban areas compared with rural areas (-3.4 vs -0.8) (Figure 2).

DISCUSSION

It's been said that "what gets measured, matters." Measuring health trends is an important—but underutilized—way to evaluate overall progress toward the goal of improving the length and quality of life for all. *The Wisconsin Health Trends: Progress Report* is unique in providing 2 assessments of health: (1) the health indicator's baseline trend over the past 10 years, and (2) the most current year of data compared to its expected value, a short-term trend. Together, these assessments provide a clearer picture of Wisconsin's health, allowing researchers, policymakers and others interested in the health of Wisconsin to assess where improvements are occurring and what indicators require more attention.

This report shows that the health of Wisconsin is mixed, with improvements in some indicators and declines in others. The improvements in age-specific death rates are encouraging, as they reflect progress in 1 of the key health goals for Wisconsin and the nation—longer lives. The progress in other areas, such as a signifi-

Figure 2. Example of Health Disparity Trend Graphs by Subgroup for 4 Leading Health Indicators



cant improvement in teen birth rates, suggests that evidence-based programs and policies are leading to measurable improvements in health outcomes. Unfortunately, not all trends are improving. The increasing rates of low birthweight and self-reported quality of life among adults suggests that we are not making progress toward the goal of “living better.” Further exacerbating this concern are the worsening trends in all of the socioeconomic indicators, with increasing rates of high school dropouts, children in poverty, and violent crime—suggesting even more challenges for the public’s

health in the future. Even more troubling are the differences in health trends that are apparent by subgroups with regard to gender, race/ethnicity, socioeconomic status, or geography.

Assessing trends each year allows us to detect the impact of major economic or policy changes, as well as identify instances where effects take longer to materialize. For example, we can see a large spike in the unemployment and child poverty rates in 2009 consistent with the national recession. This measurement technique can be used to identify when changes occurred and allow

researchers to further investigate what might be contributing to that change in a particular year. This method also can be used to measure current policy changes to assess whether or not they are having an impact on the health of the states' population overall or among specific subgroups. For example, in 2010, Wisconsin instituted a statewide smoking ban in public places.¹⁶ Although the impact of the ban is not obvious in any single year, adult smoking continues to decrease annually in Wisconsin. We know that change does not happen overnight, but we expect to see the magnitude of the decrease to improve in coming years. Another example to place a spotlight on reductions in disparity is the efforts of the many partners who have worked to reduce African American infant mortality in Milwaukee and other southeastern Wisconsin communities. Their work may be having an impact: the rate of infant mortality in Milwaukee County, Wisconsin's only urban county, is decreasing faster than all other geographical areas (Figure 2).¹⁷ Finally, with the implementation of health insurance reforms and purchasing strategies under the Affordable Care Act (ACA) in 2014, we anticipate detecting decreases in uninsured rates in the coming years.

Disparities

The Health of Wisconsin Report Card highlights significant disparities in health outcomes.¹⁸ The *Wisconsin Health Trends: Progress Report* takes this analysis a step further by providing data on the leading health indicators by gender, race/ethnicity, geography, and socioeconomic status.^{12,15,19} This analysis vividly illustrates the need to look beyond averages. In the case of adult smoking, for example, the overall 10-year baseline trend is positive, with an average rate of decline of 2.5% annually (Figure 1). Looking at smoking rates by educational attainment, however, we see that adults with less than a high school education report smoking at rates about 5 times higher than those having a college degree (Figure 2) suggesting that without intervention, disparities in smoking rates among populations with different levels of educational attainment will continue to grow. Similarly, while smoking rates are declining for members of all other racial and ethnic groups, smoking rates for blacks have been flat for a decade (Figure 2). Researchers and policymakers need to choose interventions that have been demonstrated to reduce these kinds of disparities. For example, choosing to implement a technology-based intervention might worsen disparities, while increasing funding for a comprehensive statewide tobacco program might reduce disparities and still improve the health of the entire population.²⁰ This analysis illustrates the need to better understand differences in health outcomes and health factors by subgroups within the population, and to better tailor policies, programs, and other interventions to realize faster improvements for those groups whose health continues to lag that of the population as a whole. Work should center on the need to close these evident racial, gender, socioeconomic, and geographic disparities.

Strengths and Limitations

This report of the long-term and recent health trends in Wisconsin used a consistent approach to assess progress and challenges for the state, across 20 leading health indicators. Current progress was assessed annually by comparing how the current value compared to the expected value for that year given the 10-year baseline trend line. Because the current progress assessment is based only on 1 year of data, it is much more susceptible to annual variation. Teen birth rates, for example, have improved over the last 10 years, but in the 2013 report (using 2010 data), the rates improved to a lesser degree than in the 2014 report (using 2011 data), 9.4% compared to 14.7%.^{12,19} On the other hand, violent crime has increased since the 2011 report. In the 2013 report, the increase was larger in magnitude than in the 2011 report, showing cause for concern (12.6% better than expected for 2011 compared to 0.9% for 2012).^{12,19} These volatile annual changes indicate the need to measure both current progress and long-term trends, and also demonstrate the limited understanding that can be gained from any single year's results.

Linear trends are used in this report in order to have a standard method for assessing progress across different indicators. The use of linear regression minimizes the impact of year-to-year variation during the time period.²¹ However, there are limitations of using 10-year linear trends for several indicators. Not all trends fit best into a linear model. For example, a parametric model may fit violent crime and unemployment data better.

Interpreting the data with arrows facilitates communication about the trends in Wisconsin. In addition, providing an assessment of the trend for the most recent year's data offers a glimpse at how the trend may shift in the future. Due to lag time in data, however, "current" is not always as current as people expect it to be.

The use of graphs for statewide and subgroup trends allows for visualization and easy understanding of large quantities of data. Ten years of data are summarized onto a single graph for easy understanding. Additionally, the use of trend lines and current values helps communicate positive or negative trends. Using data from large-scale national and statewide surveillance systems allows for the comparison of data over time. A standard methodology allows for comparison of slopes across indicators. Providing graphs by subgroup allows for disparities to be easily represented and communicated to public health and nonpublic health professionals. We encourage other states to measure health trends using this methodology to be able to effectively communicate health trends to a variety of audiences.

CONCLUSIONS

The Wisconsin Health Trends: Progress Report provides a picture for the health of Wisconsin as a whole and of subgroups in Wisconsin.^{12,15,19} Wisconsin shows continuous reductions in

death rates at all ages, as well as many health behavior indicators. However, Wisconsin's trends are worsening on all socioeconomic and quality of life indicators. If these trends persist, it is likely the costs of medical care will grow, as people living longer yet less healthy lives will require additional medical care. Additionally, current trends in health indicators are markedly disparate across subgroups. Many health disparities exist across gender, racial, geographic, and socioeconomic status domains. Presenting the data is only the first step—the question now is how this data will be translated into appropriately tailored actions to promote longer and healthier lives for all.

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