Can We Actually Measure Health Disparities?

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This presentation examines four binary measures of differences between rates at which two groups experience or avoid some outcome.[1]

[SLIDE 2]

They are:

1 Relative differences between rates of experiencing an outcome

2 Relative differences between rates of avoiding an outcome

3 Odds ratios

4 Absolute differences between rates

I'll explain how the first two measures tend to changes in opposite directions as an outcome changes in overall prevalence. Then I'll explain how odds ratios and absolute differences also tend to change systematically in opposite direction as an outcome changes in prevalence – though in a more complicated pattern.

My point is not simply that different measures will tend to lead to different conclusions about whether a disparity is increasing or decreasing over time - or is otherwise larger in one setting than another (though that is certainly a matter of some consequence). Nor does the point involve which of these measures may offer the most meaningful information. Rather, the point is that, without more, none of these measures can provide useful information about which disparity is larger in a meaningful sense – that is, with respect to whether the underlying risk distributions of two groups are more similar in one setting than another.

One will of course observe many departures from the patterns I describe. These can occur because some meaningful change in the relative situation of two groups is sufficient to outweigh the tendencies. It is in these situations, I would add, that there exists the greatest opportunity to identify meaningful changes in disparities. But one may also observe departures from the patterns because of irregularities in the underlying distributions of factors associated with some outcome.

Yet the underlying tendencies will have a sufficient role in almost every situation where we might attempt to compare the sizes of differences between rates in two or more settings that it makes no sense to do so while ignoring the tendencies. At the same time, the fact that we cannot predict the precise role of these tendencies in a particular setting will greatly complicates efforts to appraise the size of disparities while taking these tendencies into account.

[SLIDE 3 – REFERENCES]

[1] This presentation should be read in conjunction with the PowerPoint presentation at: http://www.jpscanlan.com/images/2008_ICHPS.ppt

Within a few days, this presentation will be on my web site – jpscanlan.com – and soon thereafter a more extensive elaboration of some of the points. On that site there is a "health disparities measuring" tab listing 70 or so efforts to explain the implications of these tendencies in various contexts, including the law as well as the social and medical sciences. This slide lists a few of the more significant recent references,[2] with section numbers indicating where they appear on the web page. I will also make a few references to other items on this page according to those section numbers. So to the extent I seem to address some points rather summarily, there should be ample clarification on that site.

[SLIDE 4 - FIGURE 1]

Figure 1 is based on two normal distributions of factors related to experiencing some outcome, where the distributions have the same standard deviation and where the advantaged group (AG) has an average that is one half a standard deviation greater than the average for the disadvantaged group (DG). The numbers along the bottom, which are used as benchmarks for overall prevalence of the adverse outcome, show the proportion of the advantaged group that falls below each point. Think of each point as representing a cutoff on a test on which two groups differ in their average performance, and consider moving from left to right as reflecting the lowering of the cutoff from one point to another such as to serially enable the population between the two points to pass the test. But recognize that we would observe the same patterns if, instead of lowering the cutoff, we improved test performance such as to allow everyone between the two points to pass the test at the higher cutoff.

The blue line with the diamond marker represents the ratio of DG's rate of falling below each point to AG's rate of falling below the point, hence failing the test. For ease of reference I'll call such ratio "AOR" – for "adverse outcome ratio." Notice that as we move from left to right and failure becomes less common, relative differences between failure rates tend to increase.

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[2] A12. Can we actually measure health disparities? *Chance* 2006:19(2):47-51: http://www.jpscanlan.com/images/Can_We_Actually_Measure_Health_Disparities.pdf

A10. Race and mortality. *Society* 2000;37(2):19-35 (reprinted in *Current* 2000 (Feb)): http://www.jpscanlan.com/images/Race_and_Mortality.pdf.

B7. The Misinterpretation of Health Inequalities in the United Kingdom, presented at the British Society for Populations Studies Conference 2006, Southampton, England, Sept. 18-20, 2006:http://www.jpscanlan.com/images/BSPS_2006_Complete_Paper.pdf.

B12. Measurement Problems in the National Healthcare Disparities Report, presented at American Public Health Association 135th Annual Meeting & Exposition, Washington, DC, Nov. 3-7, 2007: http://www.jpscanlan.com/images/ORAL_ANNOTATED.pdf

It is the failure to recognize this pattern – that is, that the rarer an outcome the greater tends to be the relative difference between rates of experiencing it – that alone undermines a great deal of the research in health disparities and every other area in which group differences are studied in terms of ratios of the adverse outcome rates of two groups. Almost universally, during times of declining mortality and other adverse health outcomes, increasing relative differences in mortality have been interpreted to indicate that health inequality is increasing in some meaningful sense. But such interpretation has been arrived at without regard to whether the observed increases in adverse outcome ratios are more than – or less than – would be expected to occur solely due to the decrease in overall prevalence. It has also been arrived at without regard to whether the disparity in the opposite outcome is decreasing.

[SLIDE 5 – FIGURE 2]

So let us now examine the other side of the picture, the relative difference between rates of experiencing the opposite outcome – in this case the favorable outcome. Figure 2 adds to the first figure a red line with a box marker, which represents the ratio of AG's pass rate to DG's pass rate at each point – termed "FOR" for "favorable outcome ratio." And here we see that as we move from left to right and failure becomes less common – and success becomes more common – the relative difference in experiencing the favorable outcome declines.

Thus do we observe how relative differences in experiencing an outcome and relative differences in avoiding the outcome tend to change systematically in opposite directions as the prevalence of an outcome changes.

Sometimes ratios of favorable outcome rates use AG's rate as the denominator – the opposite of what I have here. This has a minor implication as to the size of the percentage difference; but it is not otherwise of consequence. I specifically use DG's rate as the denominator here to facilitate putting both ratios on one figure, and to illustrate an additional matter concerning the intersection of the two ratios. In that regard note that I have identified the intersection of the two ratios as Point X; the area to the left of Point X as Zone A; and that to right as Zone B. I'll give further attention to these designations shortly.

At this juncture, I note that many disparities between groups tend to be measured in terms of relative differences in favorable outcomes. That is how the discriminatory impact of tests has typically been measured; and reducing cutoffs has generally been regarded as a means of reducing the disparate impact of a test because it reduces relative differences in pass rates (even though reducing cutoffs tends to increase relative differences in failure rates). Until recently relative differences in healthcare – mammography, prenatal care, immunization – were typically measured in terms of the favorable outcome. And as those favorable outcomes were becoming more common, the disparities were usually deemed to be declining.

But since 2004 NCHS has recommended that all disparities in health and healthcare be measured in terms of relative differences in adverse outcomes. I am not sure that recommendation has yet had great effect outside of government. But, as Dr. Keppel will discuss, it does inform the government's approach to health disparities measurement.

I have challenged this approach in various places, particularly with regard to the National Healthcare Disparities Report published yearly by the Agency for Healthcare Research and Quality (AHRQ). For, even though AHRQ seems to believe that improvement in quality will tend to reduce healthcare disparities, in fact improvements in quality – like reducing cutoffs or improving test performance – while tending to reduce relative differences in favorable outcome rates, will tend to increase relative differences in adverse outcome rates. Thus, under the usual measurement approach of AHRQ, improvements in healthcare will tend to be accompanied by increasing healthcare disparities.

[SLIDE 6 – FIGURE 3]

Figure 3 adds a yellow line with a triangle marker. It represents the ratio of DG's odds of failure to AG's odds of failure. Some researchers favor the odds ratio because differences measured by an odds ratio remain the same whether one examines the favorable or the adverse outcome. Some also favor it because it can be directly derived from a logistic regression.

Figure 3 shows how the odds ratio starts out large when failure is nearly universal; grows smaller as failure becomes less common; then grows large again when failure becomes rare. It is smallest near the intersection of AOR and FOR.

And here let me clarify a key purpose of these illustrations. In order for a measure to reliably identify a meaningful change in a disparity – that is, one that is not simply the result of an overall change in prevalence – the measure must remain constant when there occurs solely a change in prevalence such as that effected by the lowering of a cutoff. That way, when the measure does change, we can know it means something of consequence. The prior figures illustrated why neither AOR nor FOR serves that purpose. Figure 3 shows that odds ratios do not serve that purpose either.

[SLIDE 7 – FIGURE 4]

Figure 4 adds the absolute difference between rates. Because the absolute difference involves a different scale, I have broken the figure into two parts. Some researchers favor absolute differences as measures of disparities because, like odds ratios, they are the same whether one examines the adverse or the favorable outcome. And some favor absolute over relative differences because absolute differences better reflect the proportion of the disadvantaged group that is harmed by its disadvantaged position.

But we observe that, like the other measures, absolute differences tend also to change solely because of a change in prevalence. The absolute difference starts out small when

almost everyone experiences the adverse outcome, grows larger as the outcome becomes less common, then grows small again as the outcome becomes rare. Thus, changes in absolute differences do not alone provide a means of identifying changes that are other than a result of changes in overall prevalence.

I have presented the various measures together in order to illustrate the relationship of the absolute difference to the other measures – specifically, that the absolute difference reaches a maximum at approximately the intersection of AOR and FOR, and that the absolute difference exhibits a pattern that is the opposite of the odds ratio pattern.

As it happens, things like mortality and acute morbidity tend to get examined in rate ranges that fall well into Zone B. Thus, for example, mortality declines - which tend to be accompanied by increasing relative differences - are commonly accompanied by declining absolute differences, as was discussed yesterday with respect to racial differences in infant mortality. The situation is a bit more complicated as to absolute differences with respect to a variety of other outcomes, particularly in healthcare, and especially when issues are examined as to subpopulations deemed to require special attention.

[SLIDE 8 – FIGURE 5 (midsection of Fig.4)]

Figure 5 provides somewhat greater detail across a mid-range of values that encompass Point X. I present this illustration because I have written a good deal about the ways absolute differences tend to change in Zones A and B; and I don't want to create an unjustified impression of great precision as to these zones. For one sees that, even in this normal distribution, there is a broad range where it is hard to know exactly what to expect with regard to patterns of changes in absolute differences and odds ratios. That will be even more so in distributions where there is any modest irregularity.

There is increasing debate about relative and absolute differences as measures of health and healthcare disparities. And many often emphasize the importance of presenting both measures, sometimes observing that both provide important information (even when, or especially when, they provide opposite interpretations of a pattern of change over time). I maintain, however, that in fact neither changes in relative differences (whether AOR or FOR) nor changes in absolute differences provide useful information about meaningful changes over time – unless they are examined with an understanding of the ways such measures tend generally to change as an outcome increases or decreases in overall prevalence.

[SLIDE 9 – FIGURE 6 (income data)]

Next I want to quickly illustrate the same patterns with some other than hypothetical data. Figure 6 is a counterpart to Figure 4, based on black and white income, with the reference points on the X-axis being various percentages of the poverty line and the adverse and favorable outcomes being to have an income falling below or above each point. And here we observe the same general patterns of the four measures that we observed in

hypothetical normal data. To make the illustration more concrete, we observe in the far right how decreasing poverty - such as, for example, to elevate from poverty everyone between the poverty line and 50 percent of the poverty line - will tend to increase relative differences in poverty rates (though decrease relative differences in rates of avoiding poverty). On the other hand, increasing poverty would have the opposite effect. Because these changes would occur in Zone B, the decline in poverty would reduce the absolute difference between rates, while an increase in poverty would increase the absolute difference. But if we instead examined success and failure in terms of falling above or below the higher percentages of the poverty line observed in Zone A, the patterns of absolute difference changes would be reversed.

[SLIDE 10 – FIGURE 7 (NHANES SBP)]

Figure 9 is based on actual data on black and white systolic blood pressure (SBP) of men age 45-64 in NHANES samples. Here there is a good deal of irregularity in the data, for the black sample is rather small. But we generally observe the same patterns of differences in rates of falling above and below certain levels that one finds in normal data. Thus, we see, for example, that – using 140 as a cutoff for hypertension – a program that brought everyone with SBP as high as 150 down to below 140 would increase relative differences in experiencing the adverse outcome (hypertension); but it would reduce relative differences in the favorable outcome (avoiding hypertension). And, since we are here dealing with Zone B, absolute differences would decline. Serially bringing under control the SBP of those at even higher levels would continue to show these patterns.

[SLIDE 11 – SEHGAL]

I want to further illustrate some of the implications of these tendencies by reference to several studies. The next slide presents data from a 2003 JAMA study. It found that, during a period of substantial increase in rates of adequate hemodialysis, absolute differences between black and white rates declined. The study has been cited as showing how improving healthcare reduces disparities, including by AHRQ officials responsible for the National Healthcare Disparities Reports. The slide provides the black and white rates at the beginning and end of the period, along with the AOR and FOR, and the absolute differences. And we see that the absolute difference and the relative difference in receipt of adequate care both declined during this period, indeed to the point of being what some might deem negligible. But note that the relative difference in the adverse outcome (failure to receive adequate dialysis), which is what AHRQ would use to measure this disparity, has increased. This is discussed further in the references.[3]

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[3] B2: Measurement Problems in the National Healthcare Disparities Report, presented at American Public Health Association 135th Annual Meeting & Exposition, Washington, DC, Nov. 3-7, 2007: http://www.jpscanlan.com/images/ORAL_ANNOTATED.pdf

D23: Effects of choice measure on determination of whether health care disparities are increasing or decreasing. *Journal Review* May 1, 2007, responding to Trivedi AN, Zaslavsky AM, Schneider EC, Ayanian JZ. Trends in the quality of care and racial disparities in Medicare managed care. *N Engl J Med* 2005;353:692-700 (and several other articles in the same

I have also added two figures at the bottom. These reflect the difference between means of hypothetical underlying, continuously-scaled distributions of factors associated with receiving adequate hemodialysis. I'll return to these figures shortly when I discuss possibilities for addressing the problems I've raised with standard approaches to measuring disparities.

[SLIDE 12 - TWO CONTRASTING STUDIES]

The two studies on this slide were among a group of three studies in a 2005 issue of the NEJM discussing changing racial disparities in healthcare. Jha et al. examined racial difference in rates of receiving certain procedures where the overall rates were increasing. It found that, for the most part, racial disparities –measured in terms of absolute differences – had been increasing.

Trivedi et al. examined a number of favorable healthcare outcomes – mainly process outcomes but a few clinical outcomes as well – where the overall rates also were generally increasing over time. It found that, for the most part, racial disparities – also measured in terms of absolute differences between rates – had been declining.

So why the different findings?

Basically, Jha was examining relatively uncommon procedures like hip replacement, where the rate ratios were generally far over in to the left-hand side of Zone A, and where overall increases tend generally to increase absolute differences. Trivedi, on the other hand, examined much more common outcomes where rate ratios were usually in Zone B, and where further increases in prevalence of the favorable outcome tend usually to cause absolute differences to decline. This matter is also explored further in the references.[4]

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issue):http://www.journalreview.org/view_pubmed_article.php?pmid=16107620&webenv=00P_2r_lHBKZPkExnEkCR_j5-u8waNcJ-87aLnoSJWxvN_ljFKstOR3CAx%402B600907661FF950_0034SID&qkey=1&rescnt=2&retstart=0&q=%22vaccarino+v%22+%22rathore+ss%22

D23a. Correction to statements concerning the measurement of healthcare disparities in the National Healthcare Disparities Reports in earlier comment on Vaccarino et al. Journal Review Nov. 6, 2007: http://www.journalreview.org/view_pubmed_article.php?pmid=16107620&specialty_id=

D42. Recognizing the way correlations between improvements in healthcare and reductions in healthcare disparities tend to turn on the choice of disparities measure. *Journal Review* Nov. 9, 2007, responding to Kaytur FA, Clancy CM. Improving quality and reducing disparities. JAMA 2003;289:1033-34: http://www.journalreview.org/view_pubmed_article.php?pmid=12597759&specialty_id=22

[4] D23: Effects of choice measure on determination of whether health care disparities are increasing or decreasing. Journal Review May 1, 2007, responding to Trivedi AN, Zaslavsky AM, Schneider EC, Ayanian JZ. Trends in the quality of care and racial disparities in Medicare managed care. N Engl J Med 2005;353:692-700 (and several other articles in the same issue):http://www.journalreview.org/view_pubmed_article.php?pmid=16107620&webenv=00P_2r_lHBKZPkExnEkCR_j5-u8waNcJ-

The next several slides will be discussed in greater detail in the version of this presentation on my web site. Briefly, they are intended to show the extent to which these patterns show up in populations that are not normal because they are truncated versions of larger populations. But they also address the particular implications of the fact that researchers sometimes examine disparities within general populations and sometime examine them within populations needing special attention. While the Trivedi study found a clear tendency for improved healthcare to decrease absolute differences in process outcomes, it failed to find such a tendency for clinical outcomes; and it has been several times cited as showing that healthcare improvements will tend to reduce the former disparities but not the latter.

Figure 8-11 are intended to show that the seemingly different patterns are results of the fact that process outcomes tend to be examined in overall populations, where the focus is commonly in Zone B, and where improvements tend to reduce absolute differences, while clinical outcomes tend to be examined in truncated populations where the focus is more often in Zone A and where improvements will tend to increase absolute differences. To put it more concretely, suppose we reduce the SBP for everyone as high as 150 down to below 140. That will tend to reduce the absolute difference in hypertension rates in the population at large. But it will tend to increase the absolute differences between black and whites rates of control within a population diagnosed as hypertensive.

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D23a. Correction to statements concerning the measurement of healthcare disparities in the National Healthcare Disparities Reports in earlier comment on Vaccarino et al. Journal Review Nov. 6, 2007: http://www.journalreview.org/view_pubmed_article.php?pmid=16107620&specialty_id=

D40. Understanding the ways improvements in quality affect different measures of disparities in healthcare outcomes regardless of meaningful changes in the relationships between two groups' distributions of factors associated with the outcome. Journal Review Aug. 30, 2007, responding to Sequist TD, Adams AS, Zhang F, Ross-Degnan D, Ayanian JZ. The effect of quality improvement on racial disparities in diabetes care. Arch Intern Med. 2006;166:675-681:
http://www.journalreview.org/view_pubmed_article.php?pmid=16567608&specialty_id=

D41. Understanding patterns of correlations between plan quality and different measures of healthcare disparities. Journal review Aug. 30, 2007, responding to Trivedi AN, Zaslavsky AM, Schneider EC, Ayanian JZ. Relationship between quality of care and racial disparities in Medicare health plans. JAMA 2006;296:1998-2004:
http://www.journalreview.org/view_pubmed_article.php?pmid=17062863&specialty_id=

D41a. Correction to statements concerning the measurement of healthcare disparities by the Agency for Healthcare Research and Quality in earlier comment on Trivedi et al. Journal Review Nov. 15, 2007:
http://www.journalreview.org/view_pubmed_article.php?pmid=17062863&specialty_id=

B11. Methodological Issues in Comparing the Size of Differences between Rates of Experiencing or Avoiding an Outcome in Different Settings, presented at the British Society for Populations Studies Conference 2007, St. Andrews, Scotland, Sept. 11-13, 2007:
http://www.jpscanlan.com/images/2007_BSPS_Oral_Presentation.pdf

Now I want to address certain aspect of the patterns I describe with respect to other than normal settings and in doing so address certain perceptions about the way improvements in health care may affect disparities in different types of outcome.

[SLIDE 13 – FIGURE 8 (normal truncated at 30)]

Figure 8 is simply a replication of Figure 4, except that it is restricted to the population below the point defined by a fail rate of 30 percent for the advantaged group. This population, a truncated part of a normal distribution, is not itself normal. Nevertheless, within this truncated population, as cutoffs are further lowered to allow parts of this subpopulation also to pass the test, we observe the same patterns of changes relative difference and the absolute difference as in the overall population. But we do not observe the same pattern for the odds ratio.

I present this data partly as an illustration the way that certain of the patterns observed in normal distributions tend also to exist in non-normal distributions. But it is also intended to illustrate something else. For sometimes health disparities are examined within overall populations, and sometimes they are examined with populations defined by the need for special care, as for example, among the hypertensive. And, though the same tendencies may be found in the truncated population as in the larger one, there still may be different perceptions about disparities depending on which population we examine. This has certain implications as to the comparative size of AOR and FOR. But I will limit my observations here to implications for absolute differences.

[SIDE 14 – FIGURE 9 (normal and truncated AD)

The top part of the figure show the pattern of the change of the absolute difference in the total population as the cutoff is serially lowered. The bottom part shows the impact within the truncated population, as, say, the cutoff is serially lowered beyond point 30. And we see that because the focus is well over in Zone B in the larger population, the lowering tends to continue to reduce the absolute difference within that population. Thus, for example, when the cutoff is reduced from point 30 to point 15, the absolute difference in the overall population falls steeply. But within the restricted universe, the changes occur in Zone A; thus, the absolute difference between rates, as examined within the restricted universe, increases.

[SLIDE 15 – FIGURE 10 (NHANES SBP>139)

Next we consider the same issues with actual data. Figure 10 is based the same data as Figure 7, that is, NHANES data on systolic blood pressure of black and white men 45 to 64. But Figure 10 is limited to a group that would meet the threshold for the systolic component of hypertension. Within this population, there is much irregularity, for the black sample is quite small. But we see essentially the same patterns of changes that we saw with truncated normal data. That is, we observe generally the same patterns of changes for relative and absolute differences that we observed within the larger universe

– but a somewhat different pattern for odds ratios. But note that a good part of the focus within the truncated population will be in Zone A. Whereas within the larger population, point X was at about 135, within this truncated population, point X is just above 150. Thus suppose that we are able to reduce below 140 the SBP of everyone initially as high as 150. Within the overall population we would observe decreases in absolute differences. But within the restricted population we would observe increases in absolute differences. These patterns as to absolute differences are shown in Figure 11, which is a counterpart to Figure 9.

[SLIDE 16 – FIGURE 11 (NHANES and truncated AD)

I present this illustration because, while the Trivedi study mentioned above found a consistent pattern whereby improvements in health (evaluated in terms of increasing rates of beneficial outcomes) tended to reduce absolute differences in process outcomes, it did not find a similar pattern for clinical outcome like control of hypertension among those diagnosed as hypertensive. And the study has been several times cited as illustrating the way improvements in healthcare tend to reduce process outcomes but not clinical outcomes. But I think that, closely examined, the differing patterns for the two types of outcome will be seen as functions of the different universes that tend to get examined and the differences with respect to where point X falls within each universe.

I briefly turn now to prospects for measuring disparities notwithstanding the issues I have raised above. So far as I have been able to determine, the issues I raise would not apply to genuinely continuous variables. The next slide lists some measures that on their face seem to be continuous. But often measures that seem continuous are in whole or in part functions of changes in some dichotomy and hence implicate the same issues as standard binary measures. In any case, various such measures are listed here (with references to places where they are discussed more fully). And, as I've said, this presentation will be available on my web site for further review. I note that one group of such measures, listed at the bottom, includes the concentration index. The references explain why these measures do not meet the crucial criterion of remaining constant as the prevalence of an outcome changes. But I expect to learn more about possibilities for addressing the issue from Dr. Wagstaff's presentation.

[SLIDE 18 – Approaches 1 and 2]

In a few places I have broadly discussed the possibilities for identifying meaningful changes based on departures from the typical patterns I describe. In reference D43,[5] I

[5] D43. Comparing the size of inequalities in dichotomous measures in light of the standard correlations between such measures and the prevalence of an outcome. *Journal Review* Jan. 14, 2008, responding to Boström G, Rosén M. Measuring social inequalities in health – politics or science? *Scan J Public Health* 2003;31:211-215:
http://www.journalreview.org/view_pubmed_article.php?pmid=12850975&specialty_id=
(version with properly formatted tables:
http://www.jpscanlan.com/images/Bostrom_and_Rosen_Comment.pdf)

attempt to apply such approaches to data from a 2003 study on mortality changes over time in certain European countries, as well as changes in disparities in smoking and overweight in Sweden. Also, in D43, I attempt an approach alluded to earlier with regard to the data on adequate hemodialysis. That is, one can take two groups' rates of experiencing an outcome at two points in time and derive two estimates for the difference between means of hypothetical, underlying normal distributions of continuously scaled factors associated with the outcome. In the case of the hemodialysis study, the decline from .26 to .14 standard deviations differences in hypothesized means, listed at the bottom of the slide, employs the same principle.

You will see in D43 repeated questioning of the reliability of either approach given that we are not sure what the underlying distributions actually look like. But whether or not either approach is reliable enough to give one any confidence in the results, to my mind each is superior to studying health disparities the way it is currently done. For an approach that is unmindful of the implications of the way measures tend to change solely due to prevalence changes not only erroneously attributes significance to changes that may be nothing other than the standard result of a change in prevalence comparable to that effected by the lowering of a test cutoff. Such approach also fails to identify meaningful changes when they do occur.