Measuring Health and Healthcare Disparities

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[A paper associated with this presentation will be published with the proceedings some time after February 7, 2014. Sometime before December 31, 2013, a draft of that paper will be available by means of this link.]

Key Points

- Standard measures of differences between outcome rates (proportions) cannot quantify health and healthcare disparities because each measure is affected by the overall prevalence (frequency) of an outcome.

- Health (including healthcare) disparities research is in disarray because researchers and institutions rely on a chosen measure without recognizing the way the measure tends to be affected by the prevalence of an outcome.

- There exists only one answer to the question of whether a disparity has increased or decreased over time or is otherwise larger in one setting than another.

- That answer can be divined, albeit imperfectly, by deriving from each pair of outcome rates the difference between means of the underlying risk distributions.

Key Questions

- Can health disparities research be useful without taking the effects of prevalence into account?

- Can determinations of whether health disparities are increasing or decreasing over time turn on value judgments?

Key References

- Measuring Health Disparities (MHD), Mortality and Survival, Immunization Disparities, and Scanlan's Rule pages of jpscanlan.com. See Section E.7(consensus) and the Pay for Performance subpage of MHD.

- "Misunderstanding of Statistics Leads to Misguided Law Enforcement Policies" (*Amstat News*, Dec. 2012)
- "Can We Actually Measure Health Disparities?" (Chance, Spring 2006)
- "Race and Mortality" (S*ociety*, Jan/Feb 2000)
- "Race and Mortality Revisited (*Society*, May/June 2014)

- Harvard University Measurement Letter (Oct. 9, 2012). See Institutional Correspondence subpage of MHD

The Two Relative Differences

- The rarer an outcome, the greater tends to be the relative difference in experiencing it and the smaller tends to be the relative difference in avoiding it. Thus, for example:
  - As mortality declines, relative differences in **mortality** tend to **increase** while relative differences in **survival** tend to **decrease**.
  - As rates of appropriate healthcare increase, relative differences in **receipt** of appropriate care tend to **decrease** while relative differences **in non-receipt** of appropriate care tend to **increase**.
  - Relative racial, gender, socioeconomic differences in **adverse** outcomes tend to be **larger**, while relative differences in **favorable** outcomes tend to be **smaller**, among comparatively **advantaged subpopulations** (well-educated, high-income, insured, young, British civil servants) than among comparatively disadvantaged subpopulations.
  - See pages 7-9 of Harvard Letter for other examples.

Absolute Differences and Odds Ratios

- As uncommon outcomes become more common, absolute differences tend to increase; as already common outcomes become even more common, absolute differences tend to decrease. See Introduction to Scanlan's Rule page for nuances. Thus, for example:
  - As uncommon procedures (e.g., cardiac bypass graft surgery and certain uncommon types of immunization) increase, absolute differences tend to increase.
  - As common procedures (e.g., mammography, prenatal care, common types of immunization) increase, absolute differences tend to decrease.
  - Higher-performing hospitals tend to show larger absolute differences for uncommon procedures, but smaller absolute differences for common procedures, than lower-performing hospitals.
  - As survival rates increase for cancers with generally low survival rates, absolute differences will tend to increase; as survival rates increase for cancers with generally high survival rates, absolute differences will tend to decrease.
- Differences measured by odds ratios tend to change in the opposite direction of absolute differences.

Caveat One

- Do not be distracted by the fact that one commonly finds departures from the patterns described here. Observed patterns are invariably functions of
  - (a) the strength of the forces causing rates to differ and
  - (b) the prevalence-related/distributionally-driven forces described here.
- Society's interest is in (a).
- Only with an understanding of (b) can one discover (a).

Caveat Two

- Do not think that presenting relative and absolute differences (or even both of the two relative differences and the absolute difference) by any means addresses the issues raised here.
- The fundamental problem is that none of the measures is statistically sound.

Specifications for Figures 1 – 3

- Advantaged Group (AG) and Disadvantaged Group (DG) have normal test distributions with means that differ by half a standard deviation (*i.e.*, about 31% of DG scores above the mean for AG) and both distributions have the same standard deviation.

- Rate ratios (RR) for test passage and test failure both use the higher rate as the numerator. Thus, the relative difference is RR-1.

Fig. 1. Ratios of (1) DG Fail Rate to AG Fail Rate and (2) AG Pass Rate to DG Pass Rate at Various Cutoff Points Defined by AG Fail Rate

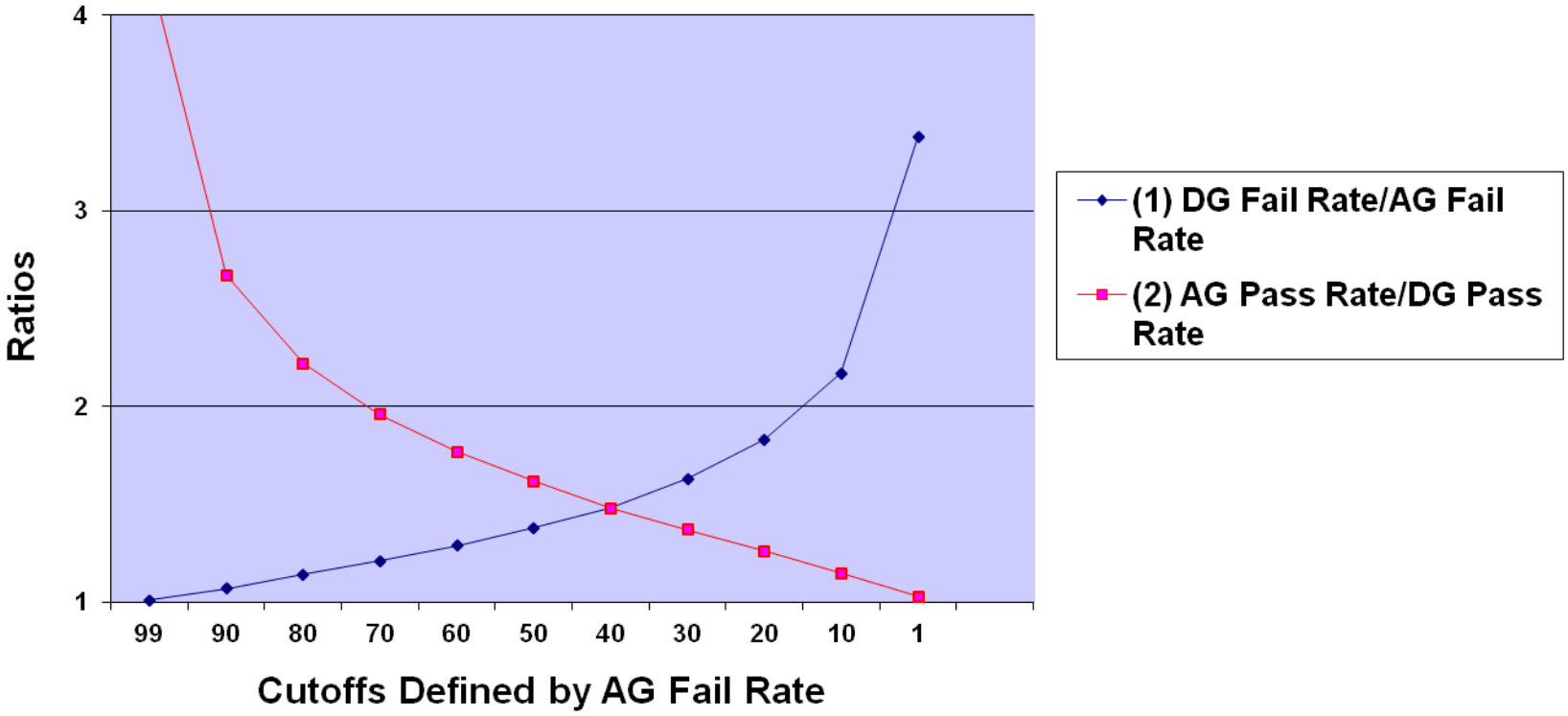


Fig. 2: Absolute Difference Between Rates at various Cutoffs Defined by AG Fail Rate

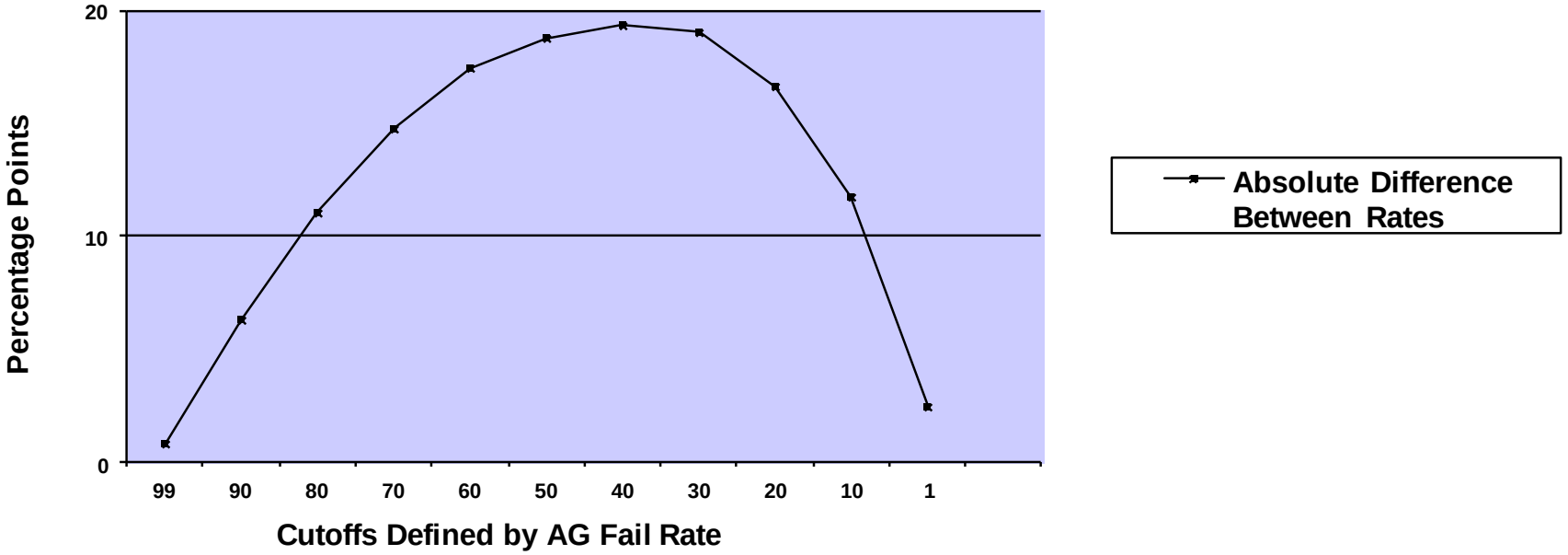


Fig. 3 Ratios of (1) DG Fail Rate to AG Fail Rate, (2) AG Pass Rate to DG Pass Rate, (3) DG Failure Odds to AG Failure Odds; and (4) Absolute Difference Between Rates

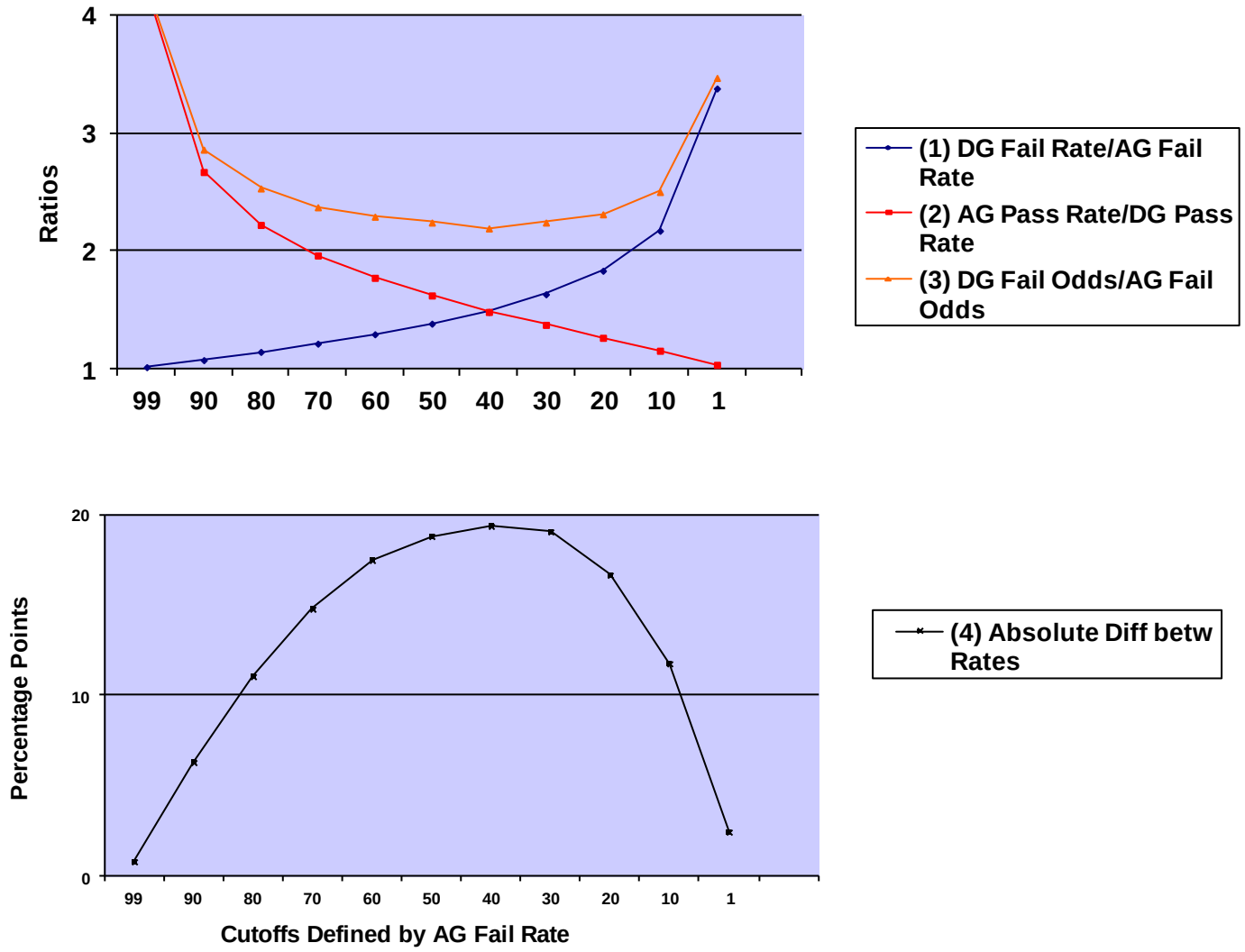
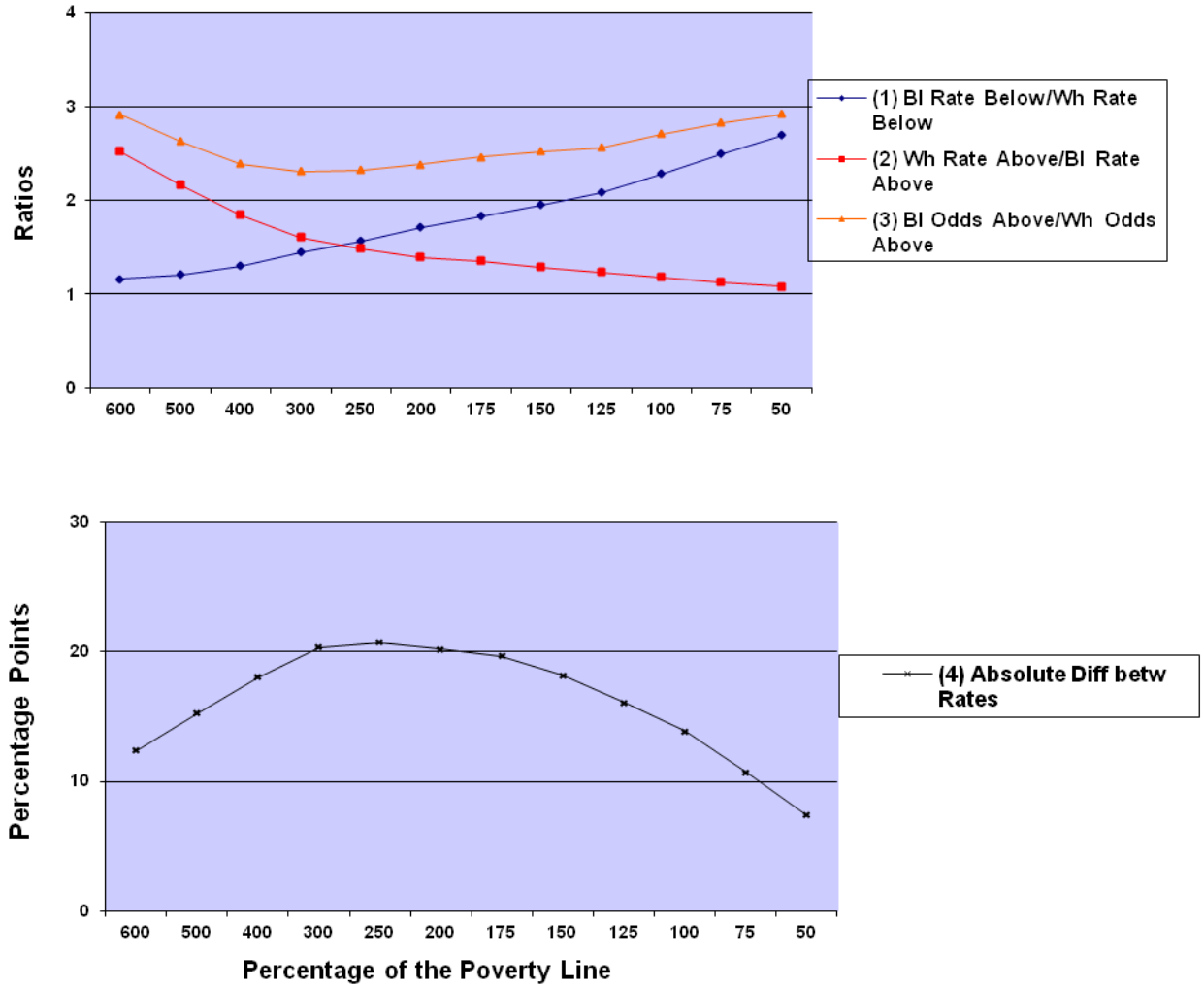


Fig. 4. Ratios of (1) Black to White Rates of Falling Below Percentages of Poverty Line, (2) White to Black Rates of Falling Above the Percentage, (3) Black to White Odds of Falling Below the Percentage, and (4)Absolute Differences Between Rates



Other Illustrative Data on jpscanlan.com

- NHANES Illustrations
- Life Tables Illustrations
- Income Illustrations
- Credit Score Illustrations
- Framingham Illustrations
- Mortality/Survival Illustrations

Main Government Approaches to Disparities Measurement

- NCHS (Health People 2010, 2020, etc.) (see Section E.7 of the MHD and page 28-32 of the Harvard Letter)
  - relative difference in adverse outcomes
- AHRQ(National Healthcare Disparities Report)
  - seems not what AHRQ thinks (see NHDR Measurement subpage of MHD and Table 5 infra)
- CDC (Jan. 2011 Health Disparities and Inequalities Report)
  - (usually) absolute difference between rates

Crucially, none of these agencies considers the way the measure it employs tend to be affected by the prevalence of an outcome and only NCHS has shown any recognition of patterns described here.

Table 1: Varying Appraisals of the Comparative Degree of Employer Bias Using Different Measures of Disparities in Selection/Rejection Rates
(as an illustration that choice of measure does not involve a value judgment and that all standard measures are unsound)

Employer/ Setting	AG Sel Rate	DG Sel Rate	(1) RR Selection	(2) RR Rejection	(3)Abs Diff	(4) Odds Ratio
A	20.0%	9.0%	2.22 (1)	1.14 (4)	0.11 (4)	2.53 (1)
B	40.1%	22.7%	1.77 (2)	1.29 (3)	0.17(2)	2.29 (3)
C	59.9%	40.5%	1.48 (3)	1.48 (2)	0.19 (1)	2.19 (4)
D	90.0%	78.2%	1.15 (4)	2.18 (1)	0.12 (3)	2.50 (2)

Approach 1 (relative favorable): A,B,C,D
Approach 2 (relative adverse): D,C,B,A (opposite of Approach 1)
Approach 3 (absolute difference): C,B,D,A
Approach 4 (odds ratio): A,D,B,C (opposite of Approach 3)

See pages 24 to 28 of the Harvard University Measurement Letter for a full explanation of this table.

How to Measure a Disparity

- Derive from any pair of outcome rates the differences between means of the (hypothesized)underlying distributions in terms of standard deviations.
- EES for “estimated effect size”
- Probit coefficient
- See Solutions subpage of Measuring Health Disparities page of jpscanlan.com regarding limitations, nuances.

Table 2. Illustrations of EES Values

RR Adverse	DG Adverse Rt	AG Adverse Rt	EES	Percent of DG Above AG Mean
1.2	60.0%	50.0%	0.25	40.3%
1.2	18.4%	15.4%	0.12	45.4%
1.5	75.0%	50.0%	0.67	25.3%
1.5	45.0%	30.0%	0.39	35.0%
2	40.0%	20.0%	0.58	28.3%
2	20.0%	10.0%	0.43	33.7%
2	1.0%	0.5%	0.24	40.9%
2.5	24.2%	9.7%	0.6	27.6%
2.5	7.2%	2.9%	0.43	33.7%
3	14.4%	4.8%	0.59	27.9%
3	2.7%	0.9%	0.43	33.7%

Table 3. Changes in White and Hispanic Mammography Rates, with Measures of Differences (from Keppel 2005)

Year	White Mam Rt	Hispanic Mam Rt	RR Mam	RR No Mam	Abs Df	EES
1990	52.7%	45.2%	1.17	1.16	0.075	0.195
1998	68.0%	60.2%	1.13	1.24	0.078	0.210

Keppel KG, Pamuk E, Lynch J, et al. Methodological issues in measuring health disparities. National Center for Health Statistics. Vital Health Stat 2(141). 2005 ("Conclusions about changes in disparity over time also depend on whether an indicator is expressed in terms of favorable or adverse events." Opts for adverse.).

See Section E.7 of MHD and page 28-32 of the Harvard Letter.

Table 4: Changes in Total and Black Rates of Pneumococcal and Influenza Vaccination Rates, 1989-1995 (HHS *Progress Review: Black Americans*, Oct. 26, 1998)

Type	Yr	Total	Blk	RR Vac	RR No Vac	Abs Df	EES
Pneumo	1989	15%	6%	2.50	1.11	0.09	0.53
Pneumo	1995	34%	23%	1.48	1.17	0.11	0.33
Influenza	1989	33%	20%	1.65	1.19	0.13	0.42
Influenza	1995	58%	40%	1.45	1.43	0.18	0.47

HHS found declining disparities based on RR Fav. NCHS would now say the disparity increased. EES shows substantial decrease for one, modest increase for the other.

Table 5. Four Situations Where 2012 NHDR (AHRQ) Highlighted Decreases in Disparities While NCHS Would Find Increases

Ref	YR	AG Fav Rt	DG Fav Rt	RR Fav	RR Adv	AbsDf	EES
3	2006	66.50%	49.40%	1.35	1.51	0.17	0.44
3	2010	83.10%	72.40%	1.15	1.63	0.11	0.36
4	2005	63.90%	45.70%	1.40	1.50	0.18	0.46
4	2010	94.50%	91.70%	1.03	1.51	0.03	0.21
10	2005	63.90%	44.70%	1.43	1.53	0.19	0.49
10	2010	94.50%	88.30%	1.07	2.13	0.06	0.40
11	2005	57.90%	41.50%	1.40	1.39	0.16	0.41
11	2010	92.90%	87.40%	1.06	1.77	0.06	0.32

See Table 13 for clarifying information. Item 10 pertains to Hispanic-White differences in Hospital patients age 65+ with pneumonia who received a pneumococcal screening or vaccination.

Table 6: Illustration Based on Morita (*Pediatrics* 2008) Data on Black and White Hepatitis-B Vaccination Rates Before and After School-Entry Vaccination Requirement (see Comment on Morita)

Period	Grade	Year	White Rate	Black Rate	RR Vac (Morita)	RR No Vac (NCHS)	AbsDf (CDC)	EES
PreRq	5	1996	8%	3%	2.67	1.05	0.05	0.47
Post Y1	5	1997	46%	33%	1.39	1.24	0.13	0.34
PreRq	9	1996	46%	32%	1.44	1.26	0.14	0.37
Post Y1	9	1997	89%	84%	1.06	1.45	0.05	0.24

Authors found dramatic decreases; NCHS would find dramatic increases. Fairly substantial decreases in EES.

Table 7: Illustration Based on Hetemaa et al. (JECH 2003) Data on Finnish Revascularization Rates, 1988 and 1996, by Income Group (see Comment on Hetemaa)

Gender	Year	High Inc RevRt	Low Inc RevRt	RR Rev	RR No Rev	AbsDf	EES
M	**1988**	**17.9%**	**8.3%**	**2.16**	**1.12**	**.096**	**0.48**
M	**1996**	**41.2%**	**25.4%**	**1.63**	**1.27**	**.159**	**0.44**
F	**1988**	**10.0%**	**3.7%**	**2.70**	**1.07**	**.063**	**0.51**
F	**1996**	**30.8%**	**17.1%**	**1.80**	**1.20**	**.137**	**0.45**

Authors rely on relative difference in revascularization rates to find decreasing disparities. Pretty standard approach at the time. Pretty standard results. RR Adverse and Absolute Diff would show increases in disparities. Modest declines in EES for both men and women.

Table 8: Illustration Based on Werner et al. (*Circulation* 2005) Data on White and Black CABG Rates Before and After Implementation of CABG Report Card

(see Comment on Werner)

Period	Wh Rt	Bl Rt	RR CABG	RR No CABG	Abs Df	OR	EES
1	3.60%	0.90%	4.00	1.03	**2.70**	4.11	0.58
2	8%	3%	2.67	1.05	**5.00**	2.81	0.48

Rather than find decreasing disparities like Hetemaa (Table 7), authors rely on absolute difference to find incentive program increases disparities. Study causes numerous researchers to recommend including disparities measure in pay-for-performance. No one says "wait a minute."

Table 9. Illustration of Changes in Absolute Differences over Time to Outcomes of Low (A) and High (B) Prevalence (Re Pay for Performance)

Outcome – Time	AG Fav Rt	DG Fav RT	Abs Df
A – Year One	20%	9%	0.11
A – Year Two	30%	15%	0.15
B – Year One	80%	63%	0.17
B – Year Two	90%	78%	0.12

Increases in low frequency favorable outcomes tend to increase absolute differences; improvements in high frequency favorable outcomes tend to increase absolute differences.

Table 10. Illustration of Absolute Differences at Low and High Performing Hospital as to Outcomes of Different Prevalence (Re Pay for Performance)

Hospital–Outcome	AG Fav Rt	DG Fav RT	Abs Df
Low Performing – A	20%	9%	0.11
High Performing – A	30%	15%	0.15
Low Performing – B	80%	63%	0.17
High Performing – B	90%	78%	0.12

Highlighted rows reflect situation of Massachusetts Medicaid pay for performance program. See page 21-24 of the Harvard Letter and Between Group Variance subpage of Measuring Health Disparities page.

Table 12. Illustration from Albain (J Nat Cancer Inst 2009) Data on Survival Rates of White and Black Women for Various Types of Cancers, from Albains et al., with Disparities Measures

Type	W Surv	B Surv	RR Surv	RR Mort	Abs Df	EES
premenopausal breast cancer	77%	68%	1.13	1.39	0.09	0.27
postmenopausal breast cancer	62%	52%	1.19	1.26	0.1	0.26
advanced ovarian cancer	17%	13%	1.31	1.05	0.04	0.18
advanced prostate cancer	9%	6%	1.50	1.03	0.03	0.21

Studies finding larger relative differences in survival for more survivable cancers (or among the young) are really about relative differences in mortality. See Mortality and Survival page Mortality/Survival Illustration subpage of Scanlan's Rule page.

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Table 12. Illustration from Harper et al. (CEBP 2009) Data on Racial Differences in Mammography (see Comment on Harper)

Year	High Inc Mam Rt	Low Inc Mam Rt	RR Mam	RR No Mam	Abs Df	OR	EES
1987	36.3%	17.20%	2.11	1.30	0.19	2.74	0.60
2004	77.4%	55.20%	1.40	1.98	0.22	2.78	0.62

Abstract: "In contrast, relative area-socioeconomic disparities in mammography use increased by 161%."

Text: Whether a health outcome is defined in favorable or adverse terms (e.g., survival versus death) can affect the magnitude of measures of health disparity based on ratios (11, 12). Consistent with the Healthy People 2010 framework for comparing across outcomes (13), we measured all breast cancer outcomes in adverse terms.

11. Keppel KG, Pearcy JN. Measuring relative disparities in terms of adverse events. J Public Health Manag Pract 2005;11:479 – 83.
12. Keppel K, Pamuk E, Lynch J, et al. Methodological issues in measuring health disparities. Vital Health Stat 2005;2(121):1 – 16.

Both references state that directions of changes over time turn on which relative difference one examines. Rel diff for mammography decreased 64% relative risk no mammography increased by 227%.

Healthy People 2010 Technical Appendix at A-8

"Those dichotomous objectives that are expressed in terms of favorable events or conditions are re-expressed using the adverse event or condition for the purpose of computing disparity [12 [sic],18,19], but they are not otherwise restated or changed."

13. Keppel KG, Pearcy JN, Klein RJ. Measuring progress in Healthy People 2010. Statistical Notes, no. 25. Hyattsville, MD: National Center for Health Statistics. September 2004.

18. Keppel KG, Pamuk E, Lynch J, et al. Methodological issues in measuring health disparities. National Center for Health Statistics. Vital Health Stat 2(141). 2005.

19. Keppel KG, Pearcy JN. Measuring relative disparities in terms of adverse outcomes. J Public Health Manag Pract 11(6). 2005.

Few readers would imagine that by measuring things like immunization disparities in terms of relative differences in no immunization one commonly reverses the direction of change over time, at times causing dramatic decreases to be dramatic increases (as in the Morita study in Table 6).

Table 13: Clarifying References for Table 5

Num	Data Source	AG	DG	BegYr	EndYr	Description
3	Table 2_12_1_14.1	W	B	2006	2010	Short-stay nursing home residents who were assessed and given pneumococcal vaccination
4	Table 2_9_2_6.1	W	Asian	2005	2010	Hospital patients age 65+ with pneumonia who received a pneumococcal screening or vaccination
10	Table 2_9_2_6.1	W	H	2005	2010	Hospital patients age 65+ with pneumonia who received a pneumococcal screening or vaccination
11	Table 2_9_2_5.1	W	H	2005	2010	Hospital patients age 50+ with pneumonia who received an influenza screening or vaccination

Numbers reflect ordering of unnumbered rows in Table H2 (at 14) of 2012 National Healthcare Disparities Report.