Potential Incongruities in Relative Measures of Disparities in Sexually Transmitted Diseases

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Outline

- Background and methods
- Description of 3 selected summary disparity measures
  - Index of disparity
  - Index of disparity, weighted
  - Gini coefficient
- Audience opinion vs. disparity measures

Background

- Racial and ethnic disparities in the burden of sexually transmitted diseases (STDs) in the US have been described and documented for decades
- Numerous summary measures of disparity have been used
  - Index of disparity
  - Gini coefficient
  - Population attributable proportion
  - Concentration index
  - Index of dissimilarity
  - Theil index
  - Mean log deviation

*Hoover et al., Sex Transm Dis 2008; Harper et al., Am J Epidemiol 2008; Regidor, J Epidemiol Community Health 2004

Background

- Racial and ethnic disparities in the burden of sexually transmitted diseases (STDs) in the US have been described and documented for decades
- Numerous summary measures of disparity have been used
  - Index of disparity
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Measures of disparity

- Rate ratio compares two groups
  - Black-to-White rate ratio, Hispanic-to-White rate ratio, etc.
  - Most commonly used disparity measure in STDs
    - 2013 CDC Surveillance report
      - "The rate of gonorrhea among blacks in 2013 was 426.6 cases per 100,000 population, which was 12.4 times the rate among whites"
- Summary measures are needed to assess disparity across all racial/ethnic groups*
  - Most summary measures assess relative differences (not absolute differences) in STD rates by race/ethnicity
    - No change in relative disparity measures if STD rates in all race/ethnic groups change by the same relative degree

*Hoover et al., Sex Transm Dis 2008

Incongruities among disparity measures

- Summary measures of racial disparity in STDs can be useful to quantify racial/ethnic disparities and to assess trends
  - However, these measures may at times seem to differ from reasonable, practical assessments of disparity
- The purpose of this study was to provide specific examples of these "incongruities"
  - Scenarios in which subjective personal assessments of disparity might reasonably differ from objective summary measures of disparity

Methods

- **We developed a series of hypothetical examples**
  - Each example contained a comparison of two distinct, hypothetical distributions of STDs across five racial/ethnic groups.
- **Each author reviewed the series of examples**
  - Assessed which scenario had the higher degree of disparity
- **A "potential incongruity" was defined when the assessment of two or more authors differed from one or more of three disparity measures we examined**
  - Index of disparity
  - Index of disparity, weighted
  - Gini coefficient

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Outline

- **Background and methods**
- **Description of 3 selected summary disparity measures**
  - Index of disparity
  - Index of disparity, weighted
  - Gini coefficient
- **Audience opinion vs. disparity measures**

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INDEX OF DISPARITY

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Index of Disparity

- **Pearcy and Keppel defined the Index of Disparity:**
  - "the average of the absolute differences between rates for specific groups within a population and the overall population rate, divided by the rate for the overall population and expressed as a percentage."
- **The average distance of each racial group from the overall rate, as a percentage of the overall rate**

Pearcy JN, Keppel KG. A summary measure of health disparity. Public health reports 2002;117:273-80.

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Index of Disparity, example

Gonorrhea

Group	Cases	Population	Rate	
White, Non-Hispanic	60,000	200,000,000	30.0	
Black, Non-Hispanic	170,000	40,000,000	425.0	
Hispanic	30,000	55,000,000	54.5	
Asian/Pacific Islander	3,000	20,000,000	15.0	
Am. Indian/Alaskan Native	3,000	3,000,000	100.0	
Total	266,000	318,000,000	83.6	

Example for gonorrhea 2012: Case numbers and population have been adjusted for illustrative purposes.

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Index of Disparity, example

Gonorrhea

Group	Cases	Population	Rate	Group rate minus total rate (absolute value)
White, Non-Hispanic	60,000	200,000,000	30.0	
Black, Non-Hispanic	170,000	40,000,000	425.0	
Hispanic	30,000	55,000,000	54.5	
Asian/Pacific Islander	3,000	20,000,000	15.0	
Am. Indian/Alaskan Native	3,000	3,000,000	100.0	
Total	266,000	318,000,000	83.6	

STEP ONE: For each group, calculate the absolute value of the difference between the group's rate and the total rate

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Index of Disparity, example

Gonorrhea

Group	Cases	Population	Rate	Group rate minus total rate (absolute value)
White, Non-Hispanic	60,000	200,000,000	**30.0**	**53.6**
Black, Non-Hispanic	170,000	40,000,000	425.0	
Hispanic	30,000	55,000,000	54.5	
Asian/Pacific Islander	3,000	20,000,000	15.0	
Am. Indian/Alaskan Native	3,000	3,000,000	100.0	
Total	266,000	318,000,000	**83.6**	

For example, for whites, calculate the absolute value of the white rate (30) minus the total rate (83.6), which is 53.6.

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Index of Disparity, example

Gonorrhea

Group	Cases	Population	Rate	Group rate minus total rate (absolute value)
White, Non-Hispanic	60,000	200,000,000	30.0	**53.6**
Black, Non-Hispanic	170,000	40,000,000	425.0	**341.4**
Hispanic	30,000	55,000,000	54.5	**29.1**
Asian/Pacific Islander	3,000	20,000,000	15.0	**68.6**
Am. Indian/Alaskan Native	3,000	3,000,000	100.0	**16.4**
Total	266,000	318,000,000	83.6	

Do this for all the groups.

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Index of Disparity, example

Gonorrhea

Group	Cases	Population	Rate	Group rate minus total rate (absolute value)
White, Non-Hispanic	60,000	200,000,000	30.0	**53.6**
Black, Non-Hispanic	170,000	40,000,000	425.0	**341.4**
Hispanic	30,000	55,000,000	54.5	**29.1**
Asian/Pacific Islander	3,000	20,000,000	15.0	**68.6**
Am. Indian/Alaskan Native	3,000	3,000,000	100.0	**16.4**
Total	266,000	318,000,000	83.6	

Average: 101.8

Step 2: Calculate the average value of this column

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Index of Disparity, example

Gonorrhea

Group	Cases	Population	Rate	Group rate minus total rate (absolute value)
White, Non-Hispanic	60,000	200,000,000	30.0	**53.6**
Black, Non-Hispanic	170,000	40,000,000	425.0	**341.4**
Hispanic	30,000	55,000,000	54.5	**29.1**
Asian/Pacific Islander	3,000	20,000,000	15.0	**68.6**
Am. Indian/Alaskan Native	3,000	3,000,000	100.0	**16.4**
Total	266,000	318,000,000	**83.6**	

Average: 101.8

Step 2: Calculate the average value of this column
Step 3: Divide the average value (101.8) by the total rate (83.6), and multiply by 100

(**101.8** / **83.6**) x 100 = 1.217 x 100 = **121.7**

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WEIGHTED INDEX OF DISPARITY

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Weighted Index of Disparity

- **Weighted Index of disparity is the same as the Index of Disparity except that each group's disparity is weighted by the group's population size**

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Index of Disparity, example

Gonorrhea

Group	Cases	Population	Rate	Group rate minus total rate (absolute value)
White, Non-Hispanic	60,000	200,000,000	30.0	53.6
Black, Non-Hispanic	170,000	40,000,000	425.0	341.4
Hispanic	30,000	55,000,000	54.5	29.1
Asian/Pacific Islander	3,000	20,000,000	15.0	68.6
Am. Indian/Alaskan Native	3,000	3,000,000	100.0	16.4
Total	266,000	318,000,000	83.6	

Average: 101.8

(**101.8** / **83.6**) x 100 = 1.217 x 100 = **121.7**

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Weighted Index of Disparity, example

Gonorrhea

Group	Cases	Population	Rate	Group rate minus total rate (absolute value)
White, Non-Hispanic	60,000	200,000,000	30.0	53.6
Black, Non-Hispanic	170,000	40,000,000	425.0	341.4
Hispanic	30,000	55,000,000	54.5	29.1
Asian/Pacific Islander	3,000	20,000,000	15.0	68.6
Am. Indian/Alaskan Native	3,000	3,000,000	100.0	16.4
Total	266,000	318,000,000	83.6	

Population weighted Average: 86.2

(**86.2** / **83.6**) x 100 = 1.03 x 100 = **103.0**

The Weighted Index of Disparity is calculated in the same manner except that a population-weighted average is applied, as shown in purple

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GINI COEFFICIENT

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Gini coefficient

- **Originally used to describe income inequality**
- **Coefficient varies between 0 and 1**
  - 0 is complete equality (all race groups have the same disease rate)
  - 1 is complete inequality (all disease is concentrated in one risk group)

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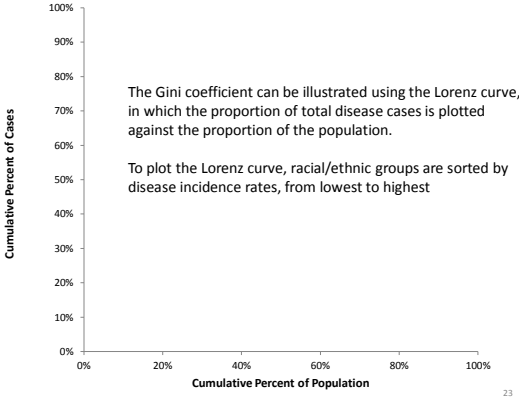

The Gini coefficient can be illustrated using the Lorenz curve, in which the proportion of total disease cases is plotted against the proportion of the population.

To plot the Lorenz curve, racial/ethnic groups are sorted by disease incidence rates, from lowest to highest

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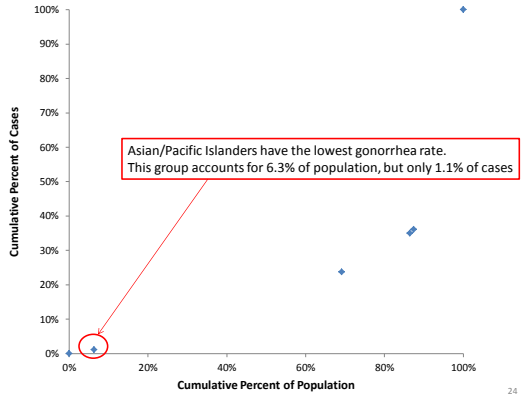

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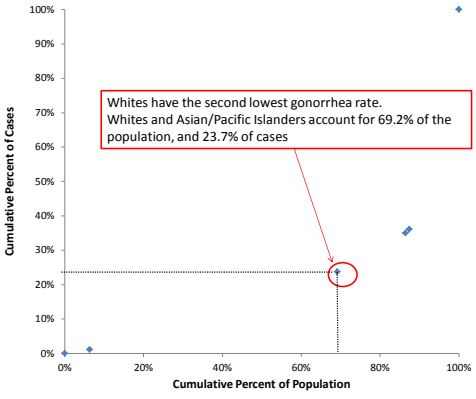

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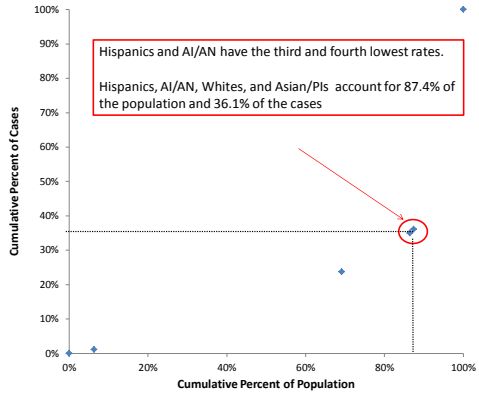

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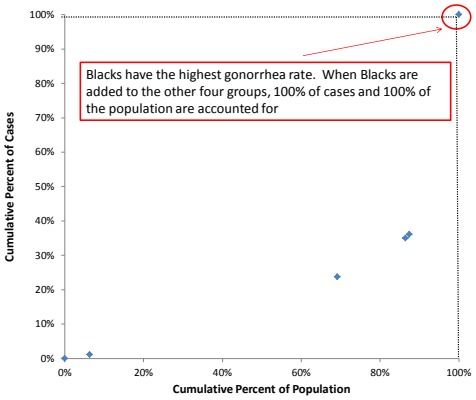

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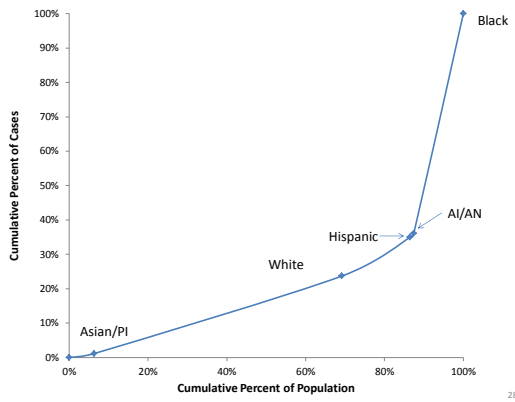

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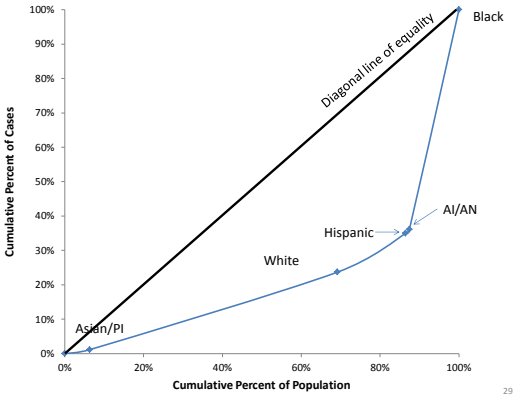

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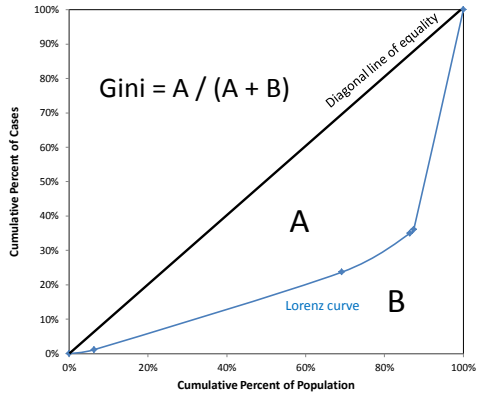

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- Background and methods
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  - Index of disparity
  - Index of disparity, weighted
  - Gini coefficient
- Audience opinion vs. disparity measures

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Audience survey

- 2 scenarios per example
- In each example, choose which scenario you think has the greater degree of racial/ethnic disparity in STD rates

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Example 1

Group	Population	Scenario A		Scenario B	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	0	0	0	0
Black, non-Hispanic	40,000,000	50,000	125.0	5,000	12.5
Hispanic	55,000,000	0	0	0	0
Asian / Pacific Islander	20,000,000	0	0	0	0
Am. Indian / Alaska native	3,000,000	0	0	0	0

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Example 1

Group	Population	Scenario A		Scenario B	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	0	0	0	0
Black, non-Hispanic	40,000,000	50,000	125.0	5,000	12.5
Hispanic	55,000,000	0	0	0	0
Asian / Pacific Islander	20,000,000	0	0	0	0
Am. Indian / Alaska native	3,000,000	0	0	0	0
Gini coefficient		0.874		0.874	
Index of Disparity		219.0		219.0	
Weighted Index of Disparity		174.8		174.8	

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Example 2

Group	Population	Scenario C		Scenario D	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	0	0	0	0
Black, non-Hispanic	40,000,000	40,000	100	0	0
Hispanic	55,000,000	0	0	0	0
Asian / Pacific Islander	20,000,000	0	0	0	0
Am. Indian / Alaska native	3,000,000	0	0	1	0.03

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Example 2

Group	Population	Scenario C		Scenario D	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	0	0	0	0
Black, non-Hispanic	40,000,000	40,000	100	0	0
Hispanic	55,000,000	0	0	0	0
Asian / Pacific Islander	20,000,000	0	0	0	0
Am. Indian / Alaska native	3,000,000	0	0	1	0.03
Gini coefficient		0.874		0.991	
Index of Disparity		219.0		2,180.0	
Weighted Index of Disparity		174.8		198.1	

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Example 2

Group	Population	Scenario C		Scenario D	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	0	0	0	0
Black, non-Hispanic	40,000,000	40,000	100	0	0
Hispanic	55,000,000	0	0	0	0
Asian / Pacific Islander	20,000,000	0	0	0	0
Am. Indian / Alaska native	3,000,000	0	0	1	0.03
Gini coefficient		0.874		0.991	
Index of Disparity		219.0		2,180.0	
Weighted Index of Disparity		174.8		198.1	

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Example 3

Group	Population	Scenario G		Scenario H	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	2,000	1.0	2,000	1.0
Black, non-Hispanic	40,000,000	800	2.0	800	2.0
Hispanic	55,000,000	1,650	3.0	1,650	3.0
Asian / Pacific Islander	20,000,000	800	4.0	0	0.0
Am. Indian / Alaska native	3,000,000	150	5.0	0	0.0

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Example 3

Group	Population	Scenario G		Scenario H	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	2,000	1.0	2,000	1.0
Black, non-Hispanic	40,000,000	800	2.0	800	2.0
Hispanic	55,000,000	1,650	3.0	1,650	3.0
Asian / Pacific Islander	20,000,000	800	4.0	0	0.0
Am. Indian / Alaska native	3,000,000	150	5.0	0	0.0
Gini coefficient		0.291		0.300	
Index of Disparity		93.1		77.2	
Weighted Index of Disparity		51.7		50.4	

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Example 3

Group	Population	Scenario G		Scenario H	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	2,000	1.0	2,000	1.0
Black, non-Hispanic	40,000,000	800	2.0	800	2.0
Hispanic	55,000,000	1,650	3.0	1,650	3.0
Asian / Pacific Islander	20,000,000	800	4.0	0	0.0
Am. Indian / Alaska native	3,000,000	150	5.0	0	0.0
Gini coefficient		0.291		0.300	
Index of Disparity		93.1		77.2	
Weighted Index of Disparity		51.7		50.4	

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Example 4

Group	Population	Scenario I		Scenario J	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	2,000	1.0	2,000	1.0
Black, non-Hispanic	40,000,000	800	2.0	0	0
Hispanic	55,000,000	1,650	3.0	0	0
Asian / Pacific Islander	20,000,000	800	4.0	0	0
Am. Indian / Alaska native	3,000,000	150	5.0	0	0

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Example 4

Group	Population	Scenario I		Scenario J	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	2,000	1.0	2,000	1.0
Black, non-Hispanic	40,000,000	800	2.0	0	0
Hispanic	55,000,000	1,650	3.0	0	0
Asian / Pacific Islander	20,000,000	800	4.0	0	0
Am. Indian / Alaska native	3,000,000	150	5.0	0	0
Gini coefficient		0.291		0.371	
Index of Disparity		93.1		91.8	
Weighted Index of Disparity		51.7		74.2	

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Example 5

Group	Population	Scenario K		Scenario L	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	0	0	10,000	5.0
Black, non-Hispanic	40,000,000	50,000	125.0	10,000	25.0
Hispanic	55,000,000	0	0	10,000	18.2
Asian / Pacific Islander	20,000,000	0	0	10,000	50.0
Am. Indian / Alaska native	3,000,000	0	0	10,000	333.3

Example 5

Group	Population	Scenario K		Scenario L	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	0	0	10,000	5.0
Black, non-Hispanic	40,000,000	50,000	125.0	10,000	25.0
Hispanic	55,000,000	0	0	10,000	18.2
Asian / Pacific Islander	20,000,000	0	0	10,000	50.0
Am. Indian / Alaska native	3,000,000	0	0	10,000	333.3
Gini coefficient		0.874		0.540	
Index of Disparity		219.0		476.2	
Weighted Index of Disparity		174.8		85.8	

Example 5

Group	Population	Scenario K		Scenario L	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	0	0	10,000	5.0
Black, non-Hispanic	40,000,000	50,000	125.0	10,000	25.0
Hispanic	55,000,000	0	0	10,000	18.2
Asian / Pacific Islander	20,000,000	0	0	10,000	50.0
Am. Indian / Alaska native	3,000,000	0	0	10,000	333.3
Gini coefficient		0.874		0.540	
Index of Disparity		219.0		476.2	
Weighted Index of Disparity		174.8		85.8	

Example 6

Group	Population	Scenario M		Scenario N	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	0	0	10,000	5.0
Black, non-Hispanic	40,000,000	50,000	125.0	10,000	25.0
Hispanic	55,000,000	0	0	10,000	18.2
Asian / Pacific Islander	20,000,000	0	0	10,000	50.0
Am. Indian / Alaska native	3,000,000	0	0	3,750	125.0

Example 6

Group	Population	Scenario M		Scenario N	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	0	0	10,000	5.0
Black, non-Hispanic	40,000,000	50,000	125.0	10,000	25.0
Hispanic	55,000,000	0	0	10,000	18.2
Asian / Pacific Islander	20,000,000	0	0	10,000	50.0
Am. Indian / Alaska native	3,000,000	0	0	3,750	125.0

Example 6

Group	Population	Scenario M		Scenario N	
		Cases	Rate	Cases	Rate
White, non-Hispanic	200,000,000	0	0	10,000	5.0
Black, non-Hispanic	40,000,000	50,000	125.0	10,000	25.0
Hispanic	55,000,000	0	0	10,000	18.2
Asian / Pacific Islander	20,000,000	0	0	10,000	50.0
Am. Indian / Alaska native	3,000,000	0	0	3,750	125.0
Gini coefficient		0.874		0.475	
Index of Disparity		219.0		249.9	
Weighted Index of Disparity		174.8		80.1	

Summary: Potential problems with disparity measures

- The Index of Disparity is potentially biased against larger minority populations
  - Weighted version prevents this problem
- Disparity measures can sometimes be incongruous with reasonable, practical assessments of disparity
- Most summary measures of disparity do not account for which groups are disproportionately burdened
  - Scenario of higher STD rates in advantaged populations is treated the same as a scenario of higher STD rates in disadvantaged populations

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Limitations

- Hypothetical distributions of STDs across racial/ethnic groups were arbitrarily selected
  - Potential incongruities were based on authors' subjective assessments
- We did not include all known disparity measures
- Gini coefficients we calculated were based on groups, not individuals
  - Sometimes referred to as "pseudo Gini coefficients"

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Conclusions

- Relative measures of racial disparity in STDs can be useful to quantify racial/ethnic disparities and assess trends
- Potential drawbacks in the use of a single disparity measure
  - To assess changes in disparities from one year to the next
  - To measure program performance in addressing disparities
- Choice of which relative disparity measure(s) to use depends upon many factors
  - Including subjective assessments by those who use these measures
- Relative measures of racial/ethnic disparity in STD should be considered along with absolute measures

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Thank You

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For more information please contact Centers for Disease Control and Prevention

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