

V0 Schield: 2021 CNMCC Slides 1

Teaching Statistical Literacy at a Community College

Milo Schield
 <SchieldMilo@UNM.edu>
 Consultant: University of New Mexico
 Fellow: American Statistical Association
 President: National Numeracy Network
 US Rep: International Statistical Literacy Project

Nov 18, 2021
 Central New Mexico Community College
www.StatLit.org/pdf/2021-Schield-CNMCC-Slides.pdf

V0 Schield: 2021 CNMCC Slides 2

Goal:

To convince you to teach Statistical Literacy

Statistical Literacy is a course that

- *shows the power of mathematics and statistics.*
 As math-stat teachers, we see beauty, value and power in quantitative thinking. We wish our students could see what we see. But all too often they don't.
- *community college students will find valuable.*
 I have taught this at Augsburg University: a four-year college where the average SAT is 60th percentile! Most are ESL or first generation. My students are similar to those at community colleges.

V0 Schield: 2021 CNMCC Slides 3

Student Survey

After my course, I ask my students three questions.

1. Did this course improve your critical thinking?
2. Would you recommend this course to a friend?
3. Should all students be required to take this course?

When I teach traditional statistics I get 'Yes' (Agree or Strongly agree) from 15% to 25% of the students.

When I teach Statistical Literacy to art, music and management majors, I get 'Yes' from at least 50%.

V0 Schield: 2021 CNMCC Slides 4

Statistical Literacy: UNM Math 1300

Statistical Literacy is a new GenEd course at UNM.

Statistical Literacy is designed for consumers of statistics: students in non-quantitative majors that don't require a specific mathematics course such as Journalism, Political Science, Communications, Philosophy, English, Film, Archeology, Music, etc.

Statistical Literacy focuses on the social statistics in the everyday media: how these statistics are constructed and manipulated, and how they are used as evidence in arguments.

V0 Schield: 2021 CNMCC Slides 5

Statistical Literacy: Students learn... #1

1. Statistics are different from numbers
2. Statistics are numbers in context (in reality)
3. Statistics can be influenced by reality:
 - In arithmetic, 1 plus 1 is always 2.
 - In reality math:
 - 1 bunny plus 1 bunny can give three bunnies
 - 1 ice-cube plus 1 ice-cube can give zero ice-cubes

V0 Schield: 2021 CNMCC Slides 6

Statistical Literacy: Students learn... #2

4. Most social statistics are crude associations: They are mixed-fruit comparisons (apples & oranges).
 - *Patient death rate at City hospital is higher than that at Rural.* But after **taking into account** patient condition, patient death rate at City is lower than that at Rural.
 - *People who read home and fashion magazines are likely to get pregnant than those who read car and sport magazines.* But after **controlling for** gender, the pregnancy difference decreases substantially

V0 Schield: 2021 CNMCC Slides 7

Statistical Literacy: Students learn... #3

- Learn how to “take something into account”.
 - How? Give both groups the same mix.
- Learn to think hypothetically about how things could have been defined, counted, measured, and presented.
- Learn how to read and interpret statistics in news stories, tables and graphs.

V0 Schield: 2021 CNMCC Slides 8

Statistical Literacy: Students learn... #4

- How to express conditional probability using ordinary English.
 - The percentage of women who run
 - The percentage of women among runners
 - Widows are more likely to commit suicide than widowers.
 - Among those who commit suicide, widows are more likely [to be found] than widowers.
- Association is not [necessarily] causation; Disparity is not [necessarily] discrimination.

V0 Schield: 2021 CNMCC Slides 9

Crude Comparison: Simpson's Paradox

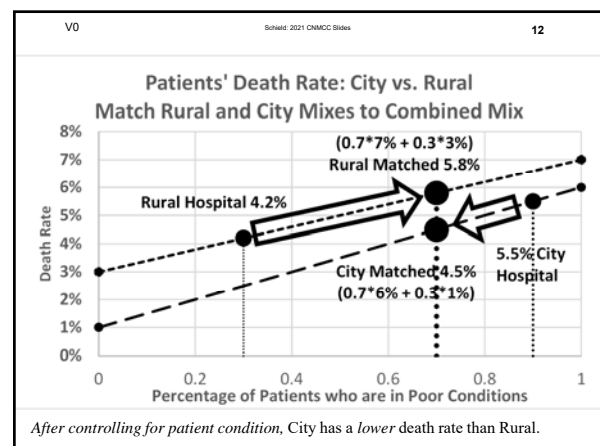
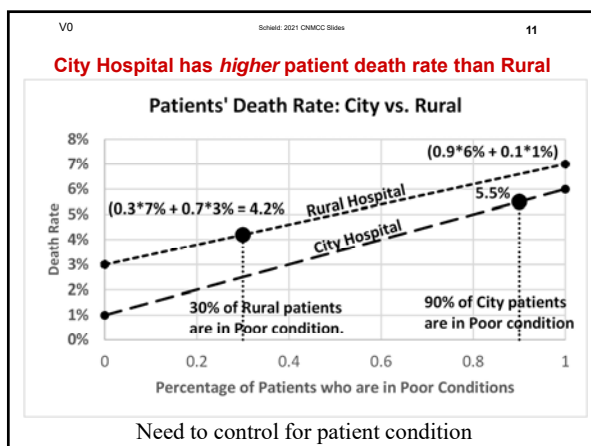
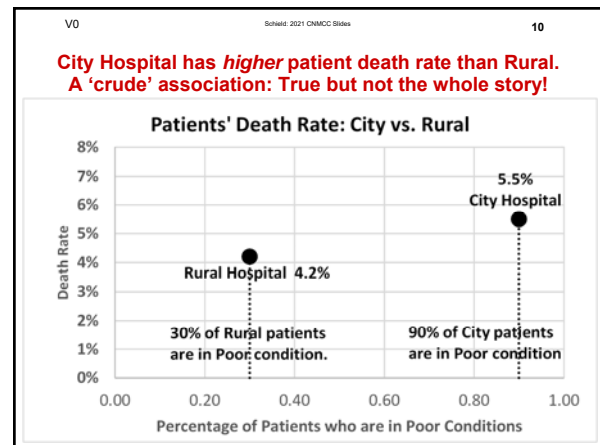
Vaccinated are 2.5 times as likely to die as unvaccinated.

Death rates	Crude		Number of Cases			---Weights---		Standard	
	<50	50+	All	<50	50+	All	<50		50+
Un-vac	0.03%	5.96%	0.17%	147,612	3,440	151,054	0.977	0.023	0.71%
Vaccinated	0.02%	1.68%	0.41%	89,807	27,307	117,115	0.767	0.233	0.21%
			2.47	237,419	30,747	268,169	0.885	0.115	3.38

Crude Comparison: mixed-fruit comparison Standardized: Both groups have same mix
 $0.17\% = 0.977 \cdot 0.03\% + 0.023 \cdot 5.96\%$ $0.71\% = 0.885 \cdot 0.03\% + 0.115 \cdot 5.96\%$
 $0.41\% = 0.767 \cdot 0.02\% + 0.233 \cdot 1.68\%$ $0.21\% = 0.885 \cdot 0.02\% + 0.115 \cdot 1.68\%$

50+ are 10 times as prevalent among the vaccinated (23%) as among the unvaccinated (2.3%).
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009243/Technical_Briefing_20.pdf

After controlling for age, unvaccinated are 3.4 times as likely to die from Covid19 Delta as are the vaccinated.



V0 Schield: 2021 CNMCC Slides 13

Statistical Literacy: Comparison

Statistical Literacy has less than a 30% overlap with regular statistics taken by most college students.

No balls and urns, no theorems,
 More focus on big data than on small samples
 More focus on observational data than on experiments.
 More focus on confounding than on randomness.

Statistical literacy has a different mathematical emphasis;
 Doesn't need algebra: no functions, no linear equations.
 Need higher-order mathematical thinking.

V0 Schield: 2021 CNMCC Slides 14

Statistical Literacy: Empirically Based

Yes, this course is different – radically different. It focuses on statistics that students will encounter in the everyday media. It is empirically based on...

- content of over a thousand news stories
 - Association, Between (action verbs), Causation
- thousands of actual uses of ratio grammar:
 - Percent, percentage, rate and chance (probability) grammar.
- practices in epidemiology:
 - percentage attributable to...; cases attributable to...
- practices in multivariate regression:
 - Take into account; control for.

V0 Schield: 2021 CNMCC Slides 15

Statistical Literacy: Deals with a BIG Problem

Today's social and political arguments typically involve social statistics.

Most of these statistics are crude statistics.

Most of the comparisons are crude associations.

But most of those arguing have never been taught that there may be a story behind these statistics.

Most of those arguing have no idea of what it means to take into account (control for) a related factor.

V0 Schield: 2021 CNMCC Slides 16

Statistical Literacy: Provides a "Solution"

Statistical literacy helps students

- see the story behind the statistics.
- understand what it means to *control for* something.
- understand the confusion of the inverse $P(A|B)$.NE. $P(B|A)$.
- understand that statistical significance can be reversed by controlling for a confounder.
- offer more nuanced arguments involving disparities, discrimination and systemic racism.

V0 Schield: 2021 CNMCC Slides 17

Statistical Literacy: Can Improve our World

Our world is

- drowning in data
- drowning in "studies say"
- convinced that many (most?) statistics are lies
- convinced that disparities prove discrimination
- cannot identify a crude association.

We can change that.

We can make our world a better place.

V0 Schield: 2021 CNMCC Slides 18

Next Steps

1. Review "Offering Statistical Literacy". Copy at www.statlit.org/pdf/2021-Schild-Offering-Statistical-Literacy.pdf
2. Obtain, read and study the textbook.
3. View Schield's recorded lectures for each chapter.*
4. Email Schield about attending his online classes
5. Teach some topics at the end of a statistics class.
6. Review materials presented to get StatLit approved for general education: www.StatLit.org/UNM.htm

* Recordings at: <https://drive.google.com/drive/folders/1-0UbYELnxQytCkaYbFIJo2QyfSa2CKCW>

VO SCHIELD 2021 CNMCC Slides 19

**Will Central New Mexico C/C
be the World Leader?**

UNM is the first public university in the world to offer a rigorous statistical literacy course focused on social statistics, observational studies and confounding.

Will you – the faculty at New Mexico Community College – accept this challenge and offer Statistical Literacy to your students.

It won't be easy, but your students will see mathematics and statistics in a different way: a way they can appreciate.

Teaching Statistical Literacy at a Community College

Milo Schield

<SchieldMilo@UNM.edu>

Consultant: University of New Mexico

Fellow: American Statistical Association

President: National Numeracy Network

US Rep: International Statistical Literacy Project

Nov 18, 2021

Central New Mexico Community College

www.StatLit.org/pdf/2021-Schield-CNMCC-Slides.pdf

Goal:

To convince you to teach Statistical Literacy

Statistical Literacy is a course that

- *shows the power of mathematics and statistics.*
As math-stat teachers, we see beauty, value and power in quantitative thinking. We wish our students could see what we see. But all too often they don't.
- *community college students will find valuable.*
I have taught this at Augsburg University: a four-year college where the average SAT is 60th percentile! Most are ESL or first generation. My students are similar to those at community colleges.

Student Survey

After my course, I ask my students three questions.

1. Did this course improve your critical thinking?
2. Would you recommend this course to a friend?
3. Should all students be required to take this course?

When I teach traditional statistics I get 'Yes' (Agree or Strongly agree) from 15% to 25% of the students.

When I teach Statistical Literacy to art, music and management majors, I get 'Yes' from at least 50%.

Statistical Literacy: UNM Math 1300

Statistical Literacy is a new GenEd course at UNM.

Statistical Literacy is designed for consumers of statistics: students in non-quantitative majors that don't require a specific mathematics course such as Journalism, Political Science, Communications, Philosophy, English, Film, Archeology, Music, etc.

Statistical Literacy focuses on the social statistics in the everyday media: how these statistics are constructed and manipulated, and how they are used as evidence in arguments.

Statistical Literacy: Students learn... #1

1. Statistics are different from numbers
2. Statistics are numbers in context (in reality)
3. Statistics can be influenced by reality:
 - In arithmetic, 1 plus 1 is always 2.
 - In reality math:
 - 1 bunny plus 1 bunny can give three bunnies
 - 1 ice-cube plus 1 ice-cube can give zero ice-cubes

Statistical Literacy: Students learn... #2

4. Most social statistics are crude associations: They are mixed-fruit comparisons (apples & oranges).
- *Patient death rate at City hospital is higher than that at Rural. But after **taking into account** patient condition, patient death rate at City is lower than that at Rural.*
 - *People who read home and fashion magazines are likely to get pregnant than those who read car and sport magazines. But after **controlling for** gender, the pregnancy difference decreases substantially*

Statistical Literacy: Students learn... #3

5. Learn how to “take something into account”.
 - How? Give both groups the same mix.
6. Learn to think hypothetically about how things could have been defined, counted, measured, and presented.
7. Learn how to read and interpret statistics in news stories, tables and graphs.

Statistical Literacy: Students learn... #4

8. How to express conditional probability using ordinary English.
 - The percentage of women who run
 - The percentage of women among runners

 - Widows are more likely to commit suicide than widowers.
 - Among those who commit suicide, widows are more likely [to be found] than widowers.

9. Association is not [necessarily] causation;
Disparity is not [necessarily] discrimination.

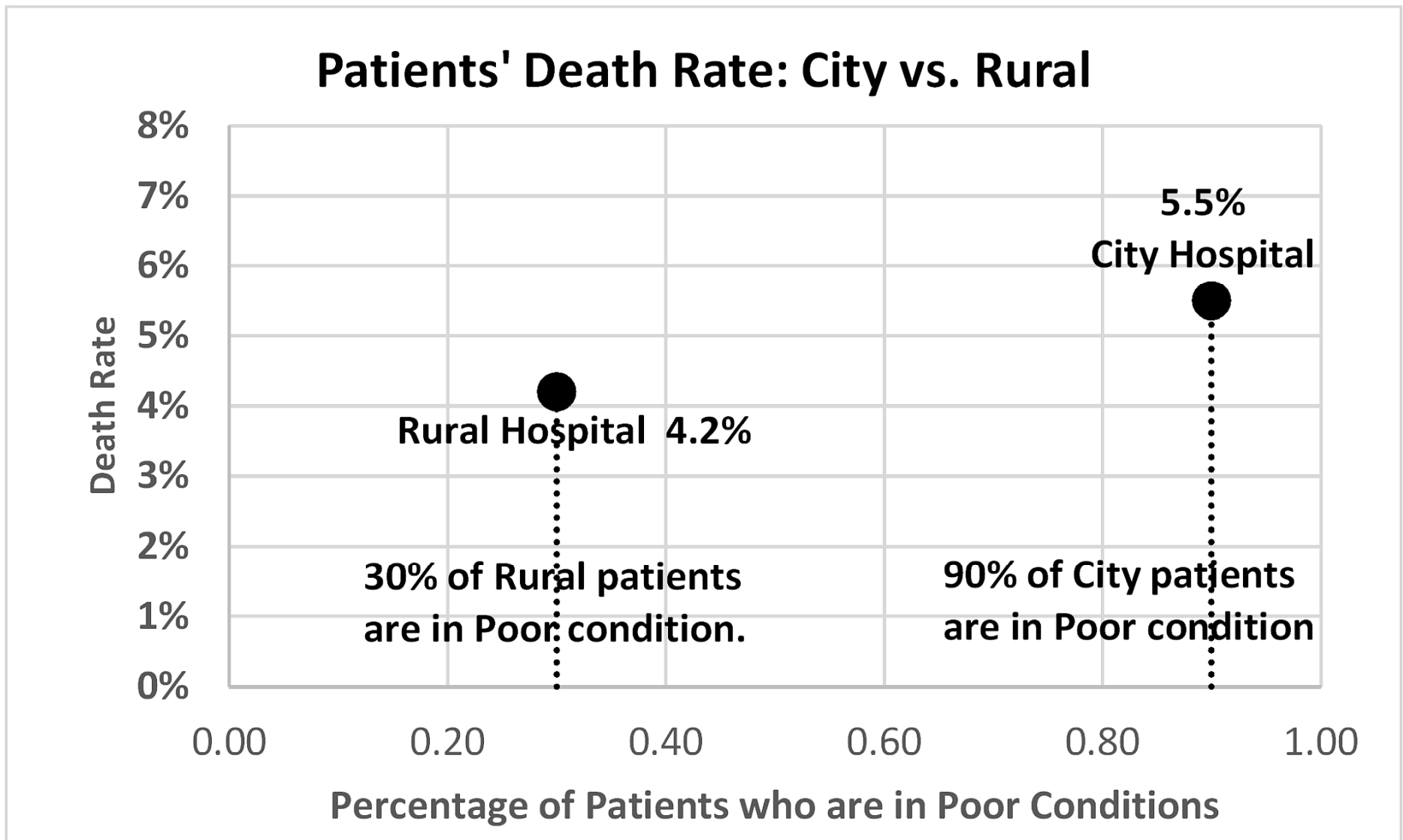
Crude Comparison: Simpson's Paradox

Vaccinated are 2.5 times as likely to die as unvaccinated.

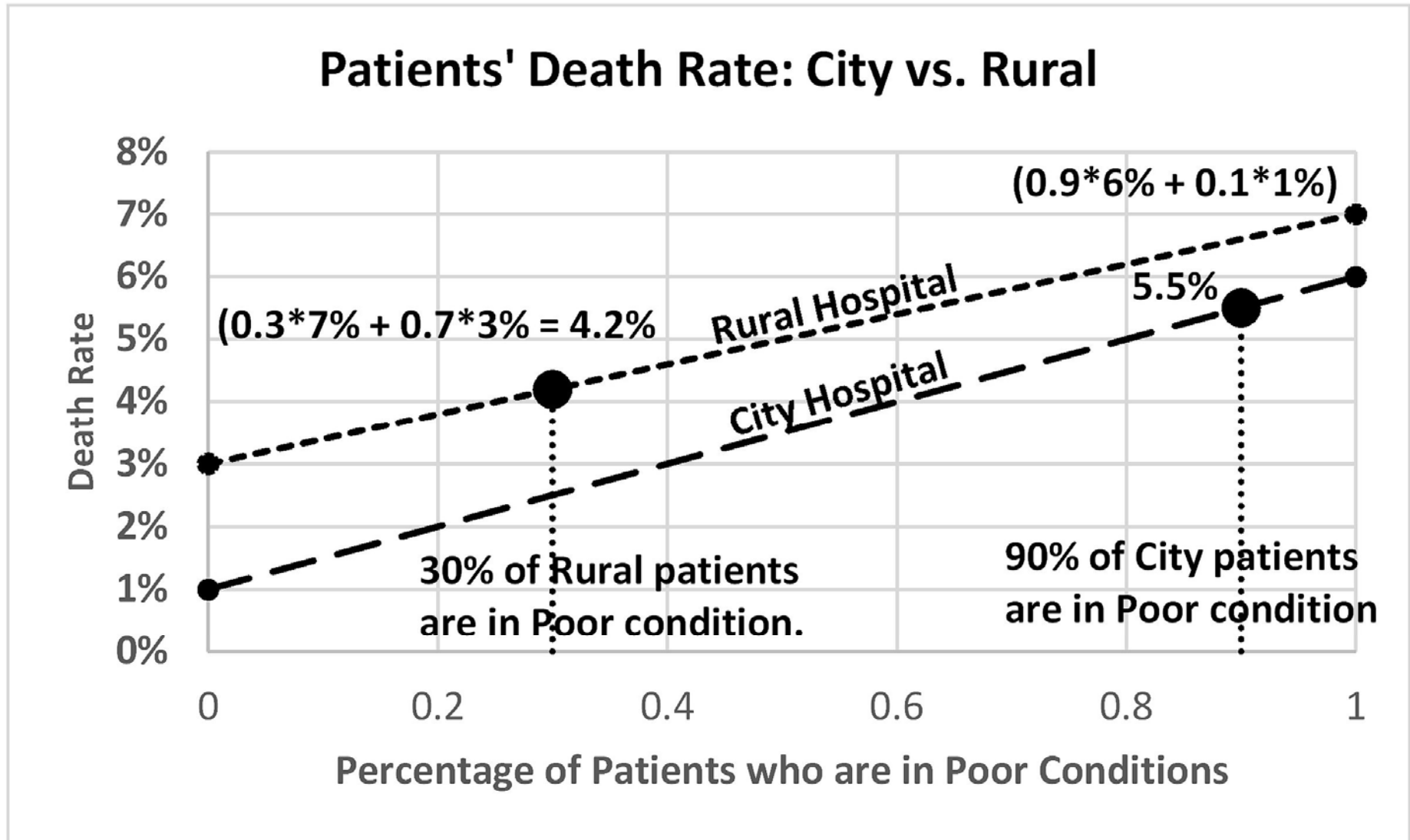
Death rates	Crude			Number of Cases			----Weights ----			Standard
	<50	50+	All	<50	50+	All	<50	50+	All	
Un-vac	0.03%	5.96%	0.17%	147,612	3,440	151,054	0.977	0.023	0.71%	
Vaccinated	0.02%	1.68%	0.41%	89,807	27,307	117,115	0.767	0.233	0.21%	
			2.47	237,419	30,747	268,169	0.885	0.115	3.38	
Crude Comparison: mixed-fruit comparison						Standardized: Both groups have same mix				
0.17% = 0.977*0.03% + 0.023*5.96%						0.71% = 0.885 *0.03% + 0.115 *5.96%				
0.41% = 0.767*0.02% + 0.233*1.68%						0.21% = 0.885 *0.02% + 0.115 *1.68%				
50+ are 10 times as prevalent among the vaccinated (23%) as among the unvaccinated (2.3%).										
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009243/Technical_Briefing_20.pdf										

After controlling for age, unvaccinated are 3.4 times as likely to die from Covid19 Delta as are the vaccinated.

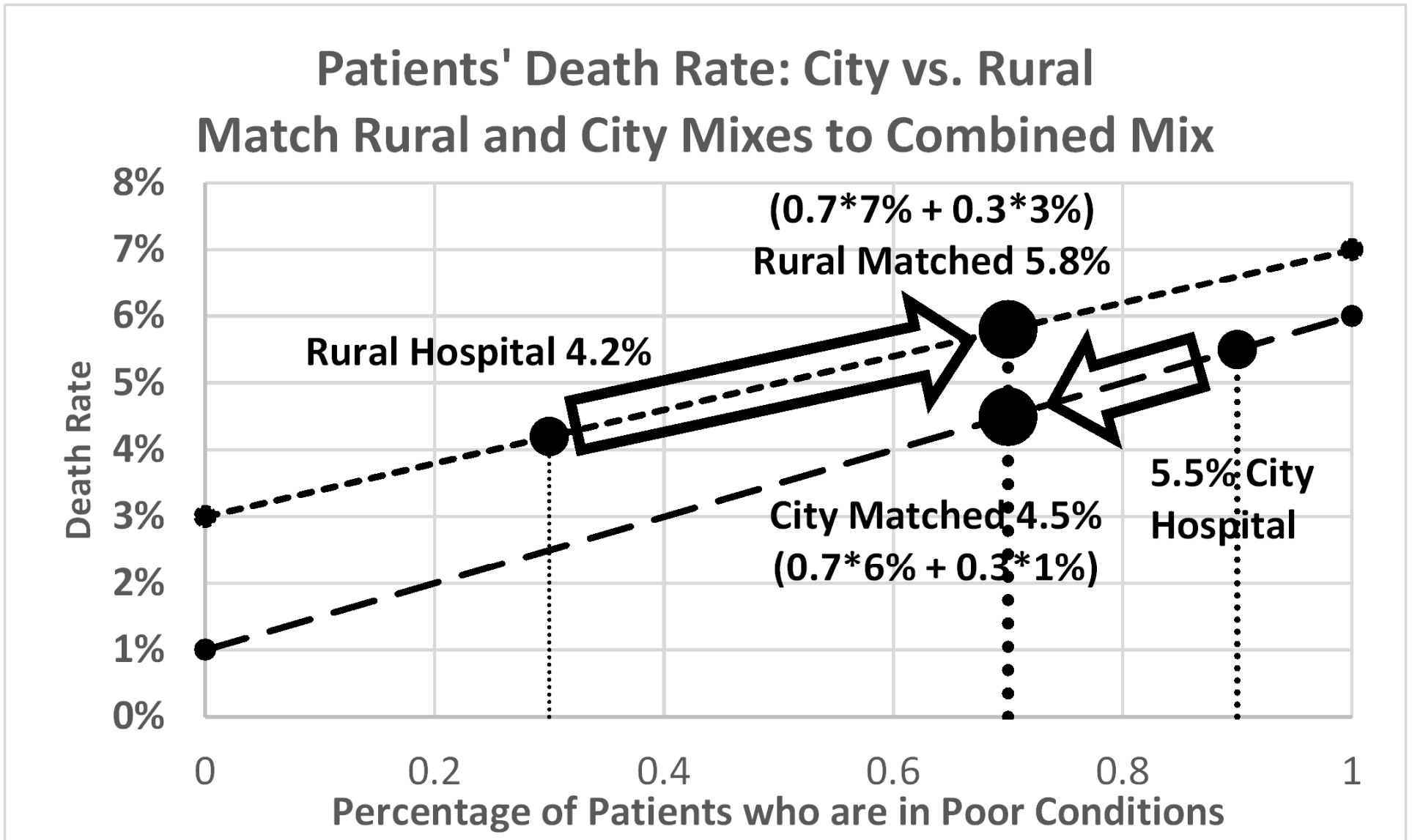
**City Hospital has *higher* patient death rate than Rural.
A 'crude' association: True but not the whole story!**



City Hospital has *higher* patient death rate than Rural



Need to control for patient condition



After controlling for patient condition, City has a lower death rate than Rural.

Statistical Literacy: Comparison

Statistical Literacy has less than a 30% overlap with regular statistics taken by most college students.

No balls and urns, no theorems,

More focus on big data than on small samples

More focus on observational data than on experiments.

More focus on confounding than on randomness.

Statistical literacy has a different mathematical emphasis;

Doesn't need algebra: no functions, no linear equations.

Need higher-order mathematical thinking.

Statistical Literacy: Empirically Based

Yes, this course is different – radically different. It focuses on statistics that students will encounter in the everyday media. It is empirically based on...

- content of over a thousand news stories
 - *Association, Between (action verbs), Causation*
- thousands of actual uses of ratio grammar:
 - *Percent, percentage, rate and chance (probability) grammar.*
- practices in epidemiology:
 - *percentage attributable to...; cases attributable to...*
- practices in multivariate regression:
 - *Take into account; control for.*

Statistical Literacy: Deals with a BIG Problem

Today's social and political arguments typically involve social statistics.

Most of these statistics are crude statistics.

Most of the comparisons are crude associations.

But most of those arguing have never been taught that there may be a story behind these statistics.

Most of those arguing have no idea of what it means to take into account (control for) a related factor.

Statistical Literacy: Provides a “Solution”

Statistical literacy helps students

- see the story behind the statistics.
- understand what it means to *control for* something.
- understand the confusion of the inverse $P(A|B)$.NE. $P(B|A)$.
- understand that statistical significance can be reversed by controlling for a confounder.
- offer more nuanced arguments involving disparities, discrimination and systemic racism.

Statistical Literacy: Can Improve our World

Our world is

- drowning in data
- drowning in “studies say”
- convinced that many (most?) statistics are lies
- convinced that disparities prove discrimination
- cannot identify a crude association.

We can change that.

We can make our world a better place.

Next Steps

1. Review “Offering Statistical Literacy”. Copy at www.statlit.org/pdf/2021-Schield-Offering-Statistical-Literacy.pdf
2. Obtain, read and study the textbook.
3. View Schield’s recorded lectures for each chapter.*
4. Email Schield about attending his online classes
5. Teach some topics at the end of a statistics class.
6. Review materials presented to get StatLit approved for general education: www.StatLit.org/UNM.htm

* Recordings at: <https://drive.google.com/drive/folders/1-0UbYELnxQytCkaYbFIJo2QyfSa2CKCW>

Will Central New Mexico C/C be the World Leader?

UNM is the first public university in the world to offer a rigorous statistical literacy course focused on social statistics, observational studies and confounding.

Will you – the faculty at New Mexico Community College – accept this challenge and offer Statistical Literacy to your students.

It won't be easy, but your students will see mathematics and statistics in a different way: a way they can appreciate.