

Epidemiology: the big picture



Madhukar Pai, MD, PhD

Professor

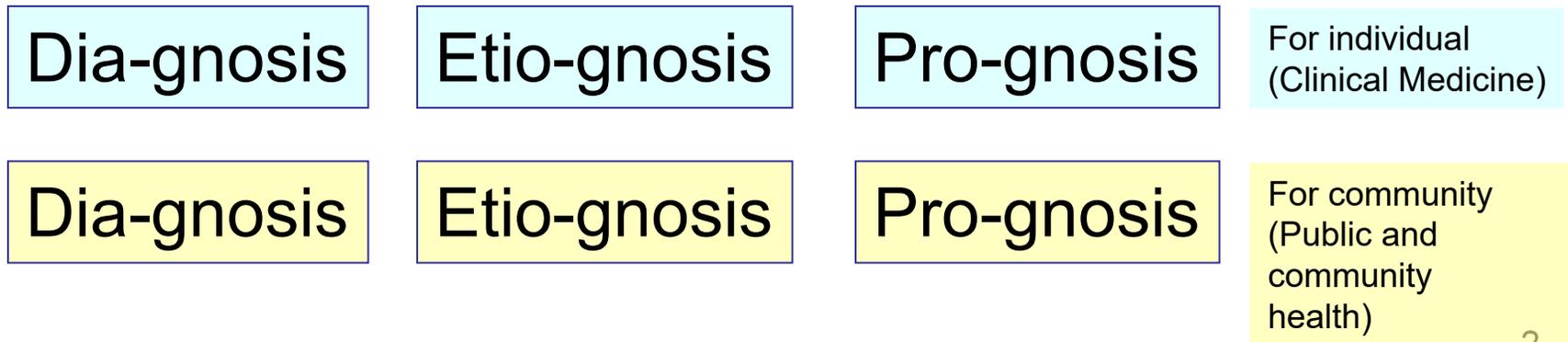
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Why epidemiology?

- We are engaged in healthcare and health research & dissemination
- To effectively practice medicine and public health, we need evidence/knowledge on 3 fundamental types of professional knowing “gnosis”:



All are reflected in the Covid-19 pandemic

- How do we diagnose Covid-19? How good are the tests? How can we detect infection vs disease?
- What is the etiology of Covid-19? Who is likely to die of Covid-19?
- What is the effective treatment for Covid-19? Can we prevent Covid-19 with a vaccine?

Beyond Covid-19

- Does air pollution increase the risk of mortality among people with tuberculosis?
- Does passive smoking increase the risk of spontaneous abortions?
- Are probiotics effective in reducing risk of antibiotic-related diarrhea?
- Does mobile phone use increase the risk of brain cancer?
- Etc, etc.

How do we answer such questions?

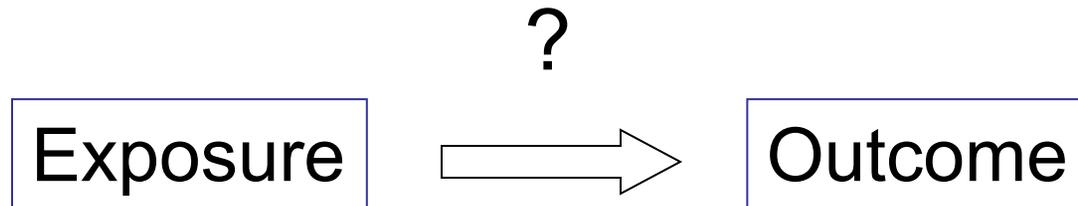
- A: Epidemiologic research
- Not perfect, but it is all we have!

What is epidemiology?

- “Study of the occurrence and distribution of health-related states or events in specified populations, including the study of determinants influencing such states, and the application of this knowledge to control the health problems.” [Porta, IEA Dictionary, 2008]
- “Epidemiology is the study of how disease is distributed in populations and the factors that influence or determine this distribution” [Gordis, 2008]
- “Application of the scientific method to health research” [adapted from Rothman KJ, 2002]

Of the 3 types of knowing (“gnosis”) etiognosis (causality) is the central concern of epidemiology

- Most fundamental application of epidemiology: to identify etiologic (causal) associations between exposure(s) and outcome(s)



Causal claims and associations are frequent in the literature & picked up by the media

Coronavirus pandemic | Study finds link between Vitamin D levels and COVID-19 cases

Zinc can play pertinent role in mitigating COVID-19 : Dr. Soumitra Das

Sunlight destroys coronavirus quickly, say US scientists

Covid-19

Smokers seem less likely than non-smokers to fall ill with covid-19

That may point towards a way of treating it

CORONAVIRUS

Indians May Be Partially Immune to COVID-19 Due to BCG Vaccine, Says US- Based Expert 3

A few cups of coffee may lower colon cancer risk

Posted: 01 August 2007 17:08 hrs

TOKYO : Drinking a few cups of coffee a day may lower the risk of advanced colon cancer, at least for women, Japanese researchers said Wednesday.

The study, supported by Japan's health ministry, showed women who drink more than three cups of coffee a day were 56 percent less likely to develop advanced colon cancer than those who drink no coffee at all.

"Drinking coffee sustains the secretion of bile acid and keeps down cholesterol levels, the mechanisms thought to prevent colon cancer," the report said.

But unfortunately the effect was not seen in men, the medical research team said.

Many men smoke and drink alcohol more than women, and those habits probably offset the effect of coffee, the study said.

The research team tracked down about 96,000 people in Japan aged from 40 to 69 between the early 1990s and 2002, of whom 726 men and 437 women later suffered colon cancer.



Photos 1 of 1 < || >

Causal claims are often inconsistent and contradictory!



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Cancer News: Rectal Cancer: Article [Printable Version](#)

Rectal Cancer News

Coffee Does Not Decrease Risk of Colorectal Cancer

Researchers from the Harvard School of Public Health have reported that, contrary to the results of several previous studies, coffee consumption does not appear to reduce the risk of colorectal cancer. The details of this study were reported in the April 1, 2009 issue of the *International Journal of Cancer*.^[1]

Habitual coffee drinking has been associated with a reduced risk of mortality and chronic diseases, including cancer. Current evidence suggests that coffee consumption is associated with a reduced risk of liver, kidney, and to a lesser extent, premenopausal breast cancer, and colorectal cancer; coffee consumption has no association with prostate, pancreas, and ovarian cancers.

Some studies have indicated that coffee may have a protective effect against colon cancer; however, researchers continue to evaluate this link in an effort to establish more direct evidence. In order to examine the relationship between coffee consumption and colorectal cancer, researchers from Harvard conducted a review of 12 studies that included 646,848 participants and 5,403 cases of colorectal cancer.

They evaluated high versus low coffee consumption and found no significant effect of coffee consumption on colorectal cancer risk. The review included four studies in the United States, five in Europe, and three in Japan. The data from each country was very similar. There were no significant differences by gender or site of cancer; however, there was a slight inverse relationship between coffee consumption and colon cancer for women, which was even more pronounced among Japanese women (21% for total study, 36% for Japanese women).

The researchers observed that inverse associations between coffee consumption and colorectal cancer "were slightly stronger in studies that controlled for smoking and alcohol and in studies with shorter follow-up times."

They concluded that coffee is "unlikely to have a strong protective effect on colorectal cancer risk"; however, they also note that it does not appear to increase the risk of colorectal cancer either.

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Drinking and Dementia: Is There a Link?

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Study Shows Drinkers With Genetic Predisposition to Alzheimer's Disease at Higher Risk

By Salynn Boyles
WebMD Medical News

Sept. 2, 2004 -- Drinking alcohol in middle age may increase the risk of late-life dementia in people who are genetically predisposed to develop Alzheimer's disease, according to findings from a Scandinavian study.

Researchers from Stockholm's Karolinska Institute reported that infrequent drinkers have a twofold increase in the risk of dementia in old age among carriers of a gene that has been linked to Alzheimer's. Gene carriers who frequently drink had a threefold increase in risk.

But the findings also show a protective effect for infrequent drinkers who did not have the genetic risk factor. Low-risk teetotalers and frequent drinkers in the study were twice as likely to experience mild cognitive declines later in life as infrequent drinkers.

The findings are reported in the Sept. 4 issue of the *BMJ* (formerly the *British Medical Journal*).

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Alcohol 'could reduce dementia risk'



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Moderate alcohol consumption could be beneficial. Small amounts of alcohol could reduce the risk of dementia in older people regardless of the type of alcoholic drink consumed, research suggests.

It is known that light-to-moderate consumption lessens the risk of coronary heart disease and stroke, but Dutch scientists think it could be good for mental health.

See also:

- 17 Apr 01 | Health Alcohol 'protects old against heart failure'
- 01 Feb 01 | Health £6bn bill for alcohol abuse
- 06 Dec 00 | Health Alcohol 'improves IQ'
- 15 Apr 01 | Health Why alcohol affects women more
- 06 Jan 01 | Health Alcohol 'cuts strokes in women'
- 18 Dec 00 | Health Beer 'keeps cataracts away'
- 30 Oct 00 | Health Alcoholic liver disease linked to genes

Internet links:

- British Heart Foundation
- The Lancet
- Alzheimer's Society

Genetic association studies are fully of contradictions

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Gene Is Linked to Susceptibility to Depression

By MARY DUENWALD
Published: Friday, July 18, 2003

Scientists have identified a gene that may help explain why some people become depressed in response to the stresses of life and others skate by relatively unscathed.

The gene, which comes in two forms, or alleles, can either protect people from depression or make them more vulnerable, researchers report today in the journal *Science*.

In the study, people who experienced job loss, death in the family, abuse or other traumas were much more likely to develop depression if they possessed two copies of the short allele. Those with two copies of the long allele (pronounced uh-LEEL) were able to withstand such events without becoming depressed.

"No matter how many stressful events they had in a five-year period, they were no more likely to become depressed than people who had

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Report on Gene for Depression Is Now Faulted

By BENEDICT CAREY
Published: June 16, 2009

One of the most celebrated findings in modern [psychiatry](#) — that a single gene helps determine one's risk of depression in response to a divorce, a lost job or another serious reversal — has not held up to scientific scrutiny, researchers reported Tuesday.

[The original finding](#), published in 2003, created a sensation among scientists and the public because it offered the first specific, plausible explanation of why some people bounce back after a stressful life event while others plunge into lasting despair.

The new report, by several of the most prominent researchers in the field, does not imply that interactions between genes and life experiences are trivial; they are

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Next

MOST

E-M

1.

Today's Random Medical News

from the New England
Journal of
Panic-Inducing
Gobbledygook

JIM BORGMAN



Figure 3: New England Journal of Panic-Inducing Gobbledygook.
Source: Jim Borgman, The Cincinnati Enquirer (27 April 1997, E4).

THE SCIENCE NEWS CYCLE

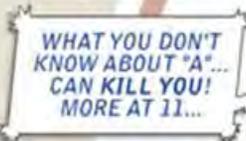
JORGE CHAM © 2009

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YOUR GRANDMA

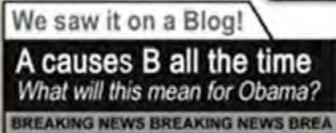
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4 LOCAL EYEWITLESS NEWS

...and caught on ...

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Conclusion: A is correlated with B ($p=0.56$), given C, assuming D and under E conditions.



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SCIENTISTS FIND POTENTIAL LINK BETWEEN A AND B (UNDER CERTAIN CONDITIONS).

...which is then picked up by...

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A CAUSES B, SAY SCIENTISTS.

...who are read by ...

THE INTERNETS

Scientists out to kill us again.

POSTED BY RANDOM OLUC

Comments (377)

OMG! i kneeww itt!!

WTH???????

Poor quality research + bad reporting = chaos

- Too many causal claims; optimism bias is pervasive
- Inconsistency in study findings and too many apparent contradictions
- Causal inferences made on the basis of isolated studies
- Many studies biased or inconclusive
- Most discovered true associations are inflated
- Fear and panic inducing rather than helpful; media-induced hype

Given this mess, here are some key questions:

- Where is the guarantee that causal claims are true?
- Can epidemiological studies be wrong?
- Can they make misleading conclusions?
- How can we know when a study result is incorrect?
- Is common sense adequate to judge and interpret epidemiologic literature?

Causality: is it intuitive?

- Most of us intuitively understand causality, even if we have never formally studied it!
- Even as children, we grow up making associations and causal connections
- However, is epidemiology merely applying common sense?

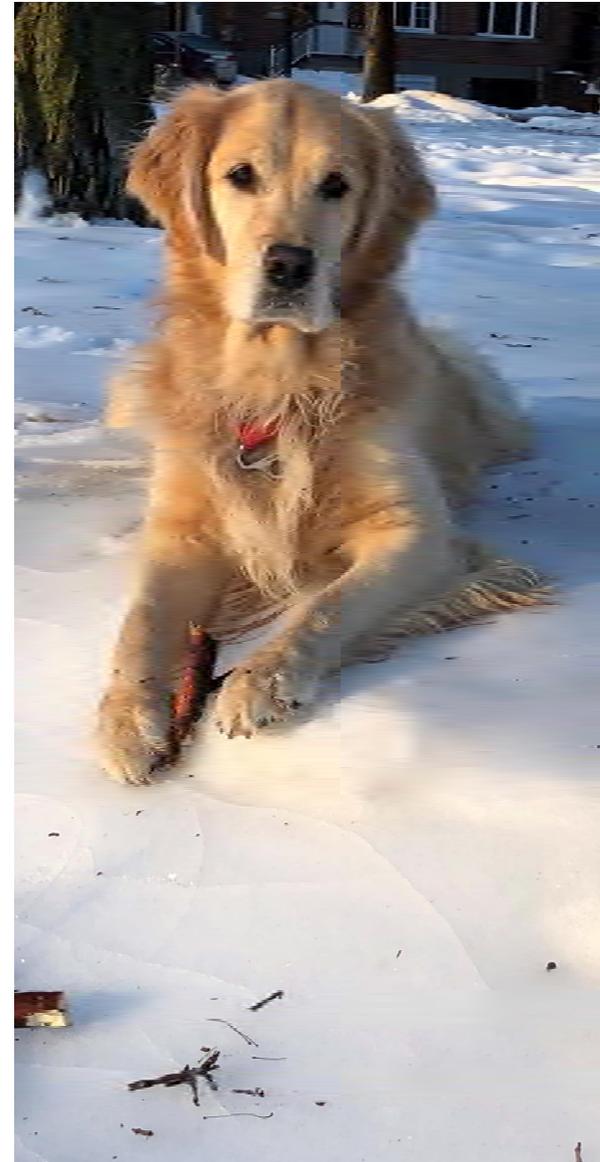
Are senior surgeons incompetent?



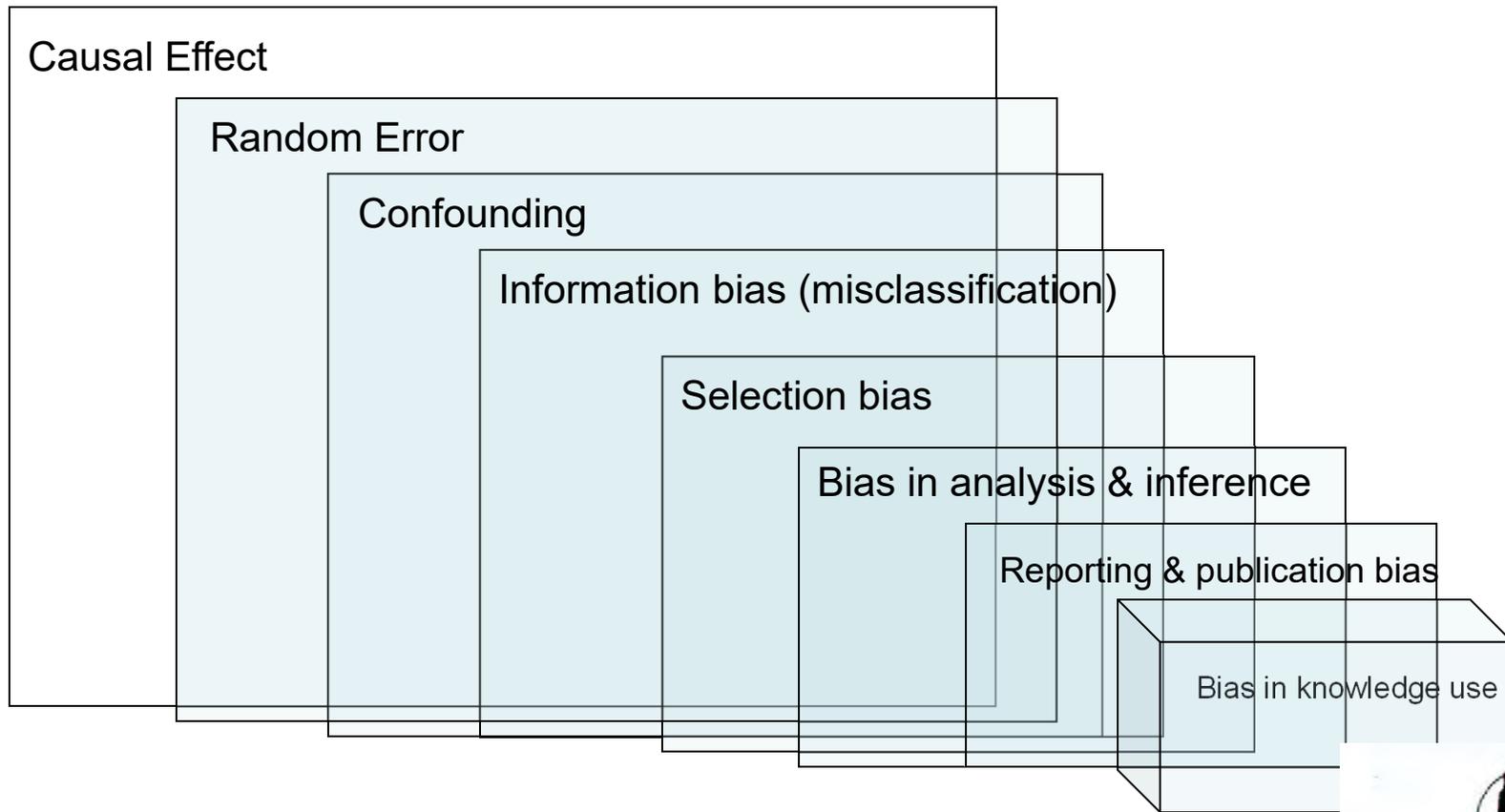
Does anti-snake venom save or kill people?



Dog owners may have lower risk of dying from heart attacks, study says



The long road to causal inference (the “big picture”)



RR_{causal}
“truth”

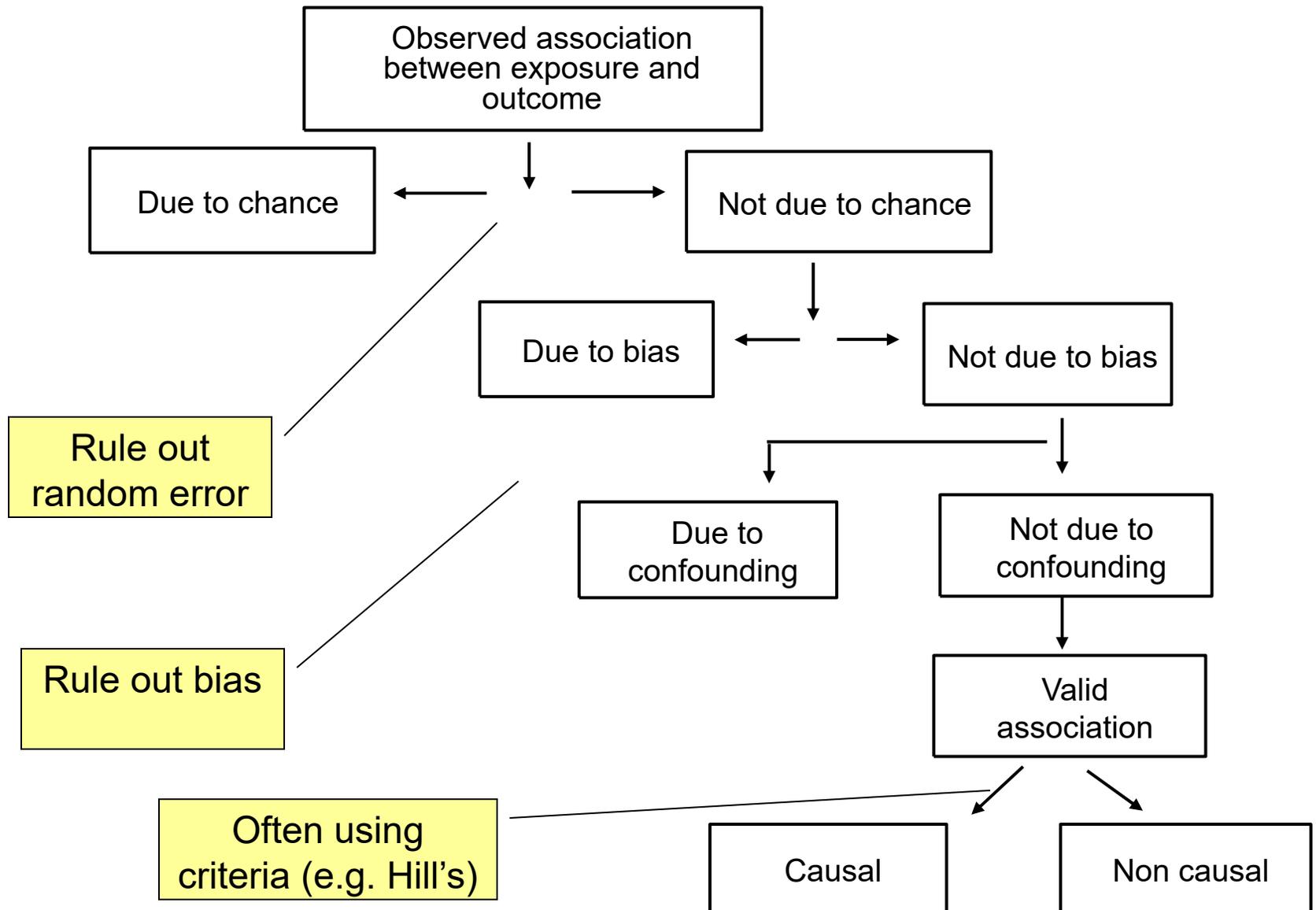


the long road to causal inference...

$RR_{\text{association}}$



A Skeptic's Algorithm for Associations



Epidemiologic Studies, Warts and All, Are Our Best Chance

Miguel A. Hernán

“Despite some bad press, epidemiologists are in high demand these days.... Epidemiologists have often succeeded at delivering correct answers to questions about the benefit-risk of medical treatments in the real world. Appropriate methodologic training and adequate access to high-quality data may help increase the success rate. Because there is no alternative to epidemiologic studies, we better keep improving them....”

Data concerns during this pandemic

- Deliberate suppression of information
- Huge variability in testing rates
- Quality of tests is variable
- Each country has its own timeline and dynamic
- Cause of death data are sketchy
- More models & estimates than actual data
- Deliberate misinformation campaigns

Research concerns during this pandemic

- All research is 'Covidised' – 23,000 papers+ papers on COVID-19!
- Deluge of pre-prints, fast-tracked, preliminary, no fact-checking
- Most are not peer reviewed
- Many by researchers with no background/expertise
- Lowering of normal scientific standards
- Tons of correlations based on cross-country comparisons
- Uncontrolled drug studies
- Not enough studies on any given topic
- Single and/or small studies get too much importance
- Policy makers jumping the gun before research is settled

CONTRIBUTOR



1% COVID RESEARCHERS

FUNDERS & UNIVERSITIES

99% OF ACADEMICS

IN THE NEWS, CORONAVIRUSES: PAST,...
'Covidisation' of academic research: opportunities a...



Madhukar Pai
Apr 10, 2020

BCG Against Coronavirus: Less Hype And More Evidence, Please



Madhukar Pai Contributor @
Healthcare
I write about global health, infectious diseases, and equity.



Close up of reaction of Bacillus Calmette Guerin or BCG vaccination infants. ©GETTY

A Skeptic's Guide To Ecologic Studies During A Pandemic



Madhukar Pai Contributor @
Healthcare
I write about global health, infectious diseases, and equity.



24 January 2020, Bavaria, Munich: A face mask and protective goggles are displayed in front of a map ... [+] DPAPICTURE ALLIANCE VIA GETTY IMAGES

Media reporting during this pandemic

- Media is also 'Covidised'
- In some areas, media is muzzled
- Sensationalized, hyped coverage (to increase clicks)
- Social media can amplify misinformation easily
- Everyone wants to report 'breakthroughs' (want 'new content')
- Correlations are presented as causation
- Preliminary findings presented as 'facts' (not enough fact checking)
- Uncritical, for most part (lack of epi training)
- Want certainty, when everything is uncertain
- Assumptions underlying models are rarely challenged
- Not able to interview the right experts
- Focused on numerators
- 'News is bad at communicating risk'
- All types of studies are given similar weightage

EDITORIALS

Promoting Healthy Skepticism in the News: Helping Journalists Get It Right

Steven Woloshin, Lisa M. Schwartz, Barnett S. Kramer

Table 1. A recent medical journal article and excerpts of subsequent media coverage

The Study Inhibition of Poly(ADP-Ribose) Polymerase in Tumors from BRCA Mutation Carriers (1)

Phase I study of olaparib in which 60 patients were enrolled with a variety of treatment refractory solid tumors. All were given the drug at various doses (to establish dosing and safety).

Response (improvement or no progression according to radiologic or tumor markers) was only seen in 12 of the 19 patients with BRCA1 or 2 mutations and ovarian, breast or prostate cancer.

Olaparib had fewer of the adverse effects typically seen with conventional chemotherapy.

Television Covered by three national television news programs: ABC, CBS, NBC

New cancer medicine might provide new era in treatment (NBC Nightly News) (2)

... [NBC's anchor]: "Now we turn to what some are calling the most important cancer treatment breakthrough in a decade. While we caution this is a small study, the New England Journal of Medicine tonight is saying it shows so much promise this could mean a whole new direction for cancer drugs, especially for those patients vulnerable to breast, ovarian and prostate cancer.

... [NBC's chief medical correspondent]: Patricia Buckles is a 29-year veteran of the battle with breast cancer, with all the suffering that surgeries and chemotherapy can bring. Almost out of options, she joined a trial of a new class of drugs, pills called PARP inhibitors.

Ms. PATRICIA BUCKLES: I went up there with growing cancer, measurable cancer, and I'm to the point now where the CAT scans show no evidence of disease.

... [NBC's chief medical correspondent]: Julian Lewis had prostate cancer that had resisted all treatments and spread throughout his body, until he got into a PARP inhibitor trial.

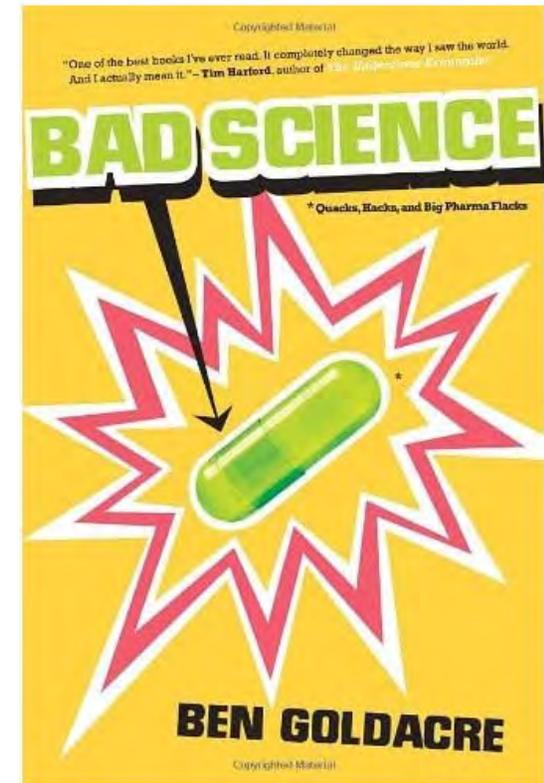
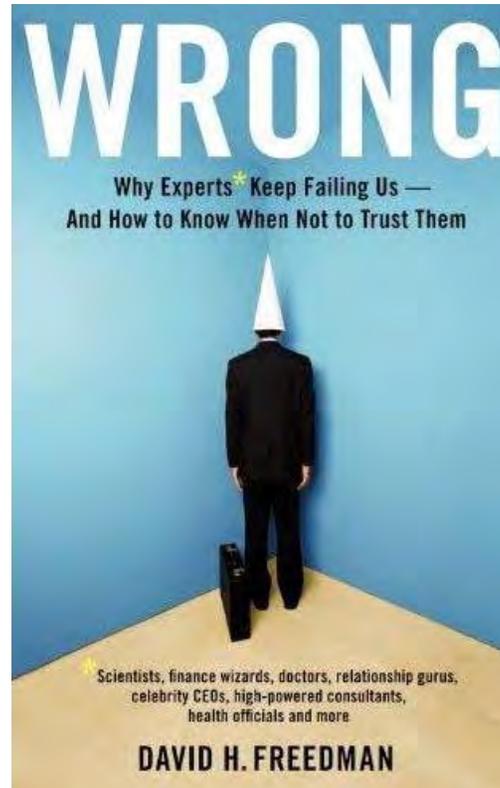
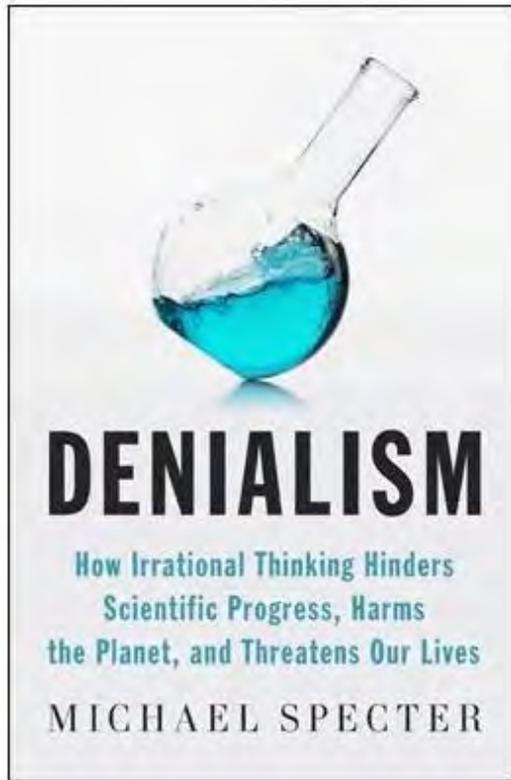
Mr. JULIAN LEWIS: My PSA level, which is a marker of the tumor, went right down to a very low level and it stayed low. And my bone metastases also seemed to have almost disappeared, judged from MRI scans.

... [NBC's chief medical correspondent]: As I said, many scientists believe these drugs could treat some people who don't have the genetic mutations, especially for ovarian cancer. Those studies are under way. But whatever else happens, these drugs look like they will eventually save thousand of lives."

Hence, this course!

Epi concepts that journalists need to understand

- R_0
- Epidemic curve, doubling time, attack rate, etc
- Risk vs Rate vs Odds
- Correlation vs. causation
- Need for randomization & control group
- Sensitivity, specificity, predictive values
- Herd immunity
- Exposure vs infection vs disease
- Incubation period
- Isolation vs quarantine
- Hierarchy of evidence
- Absence of evidence is not evidence of absence
- Statistical vs public health or clinical significance
- Prevalence vs incidence
- Mortality vs case fatality rate vs infection fatality rate
- Confounding & bias
- Relative vs absolute risk
- P-values & confidence intervals
- Vaccine efficacy
- Outbreak, epidemic, endemic, pandemic
- Crude vs adjusted rates
- Importance of denominators
- Mathematical models & their limitations
- Explaining uncertainty



Books worth reading!

