NIEBP - Network Italiano Evidence Based Prevention

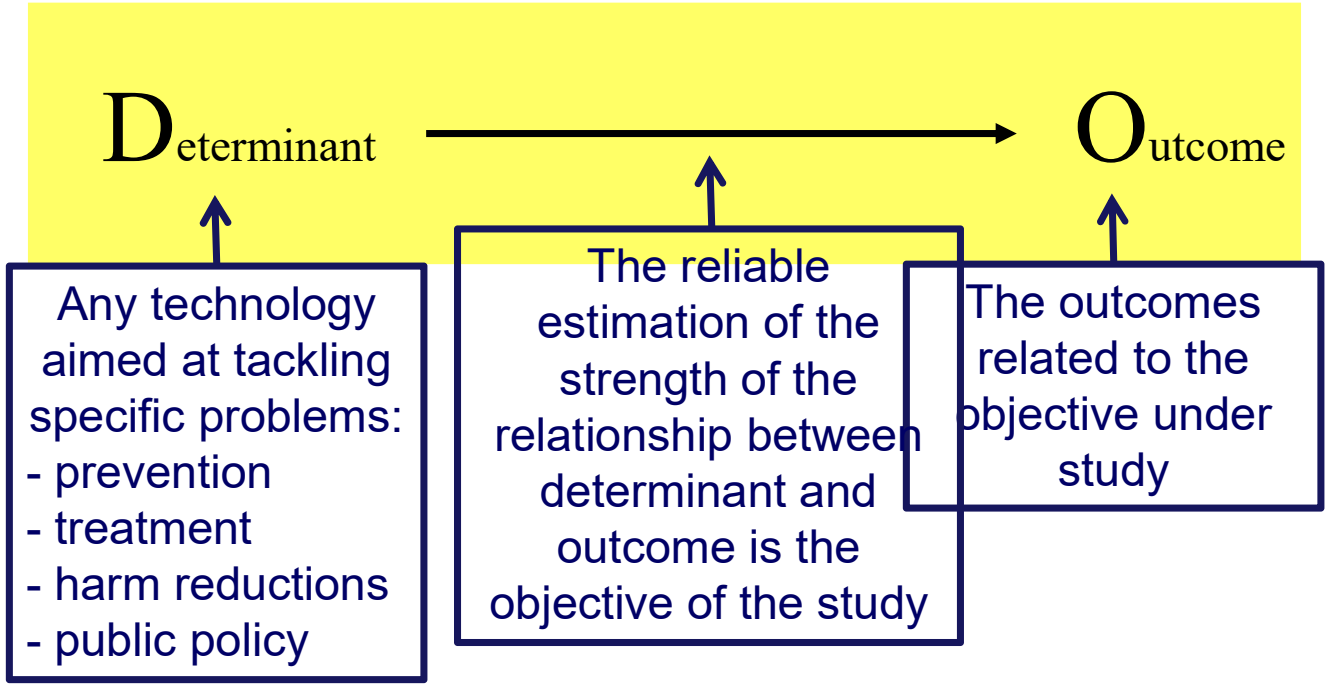
Formazione per le Antenne del NIEBP

Modulo 3
Le basi metodologiche della Evidence-based Prevention

Firenze, 18 maggio 2023

I NODI METODOLOGICI DELLA VALUTAZIONE DI EFFICACIA

Causal relationship



Characteristics of our domains

- Several scientific domains (biology, medicine, sociology, psychology…) share 2 common characteristics that determine the basic model of any scientific research:
  - the probabilistic paradigm
  - the variability of the natural development of the phenomena

Probabilistic paradigm

- Biologic, sociologic, psychological phenomena share a model of causation that is far to be deterministic.
- To explain a deterministic phenomenon, theoretically, one single experiment would be enough (Newton principles, for example) because any other repeated experiment will reproduce the first result

Probabilistic paradigm

- In our domains this is not the case:
  - tobacco, the stronger carcinogenic substance in commerce, does not cause a cancer in every smoker, but only increase the probability to get it (by 30 times!)
  - the experimentation of tobacco or heroin does not make dependent every user, even if 30% of experimenters will became
- In our domains we can have only ***probabilistic associations***
- …and such associations must be measured with ***samples of population of adequate size***

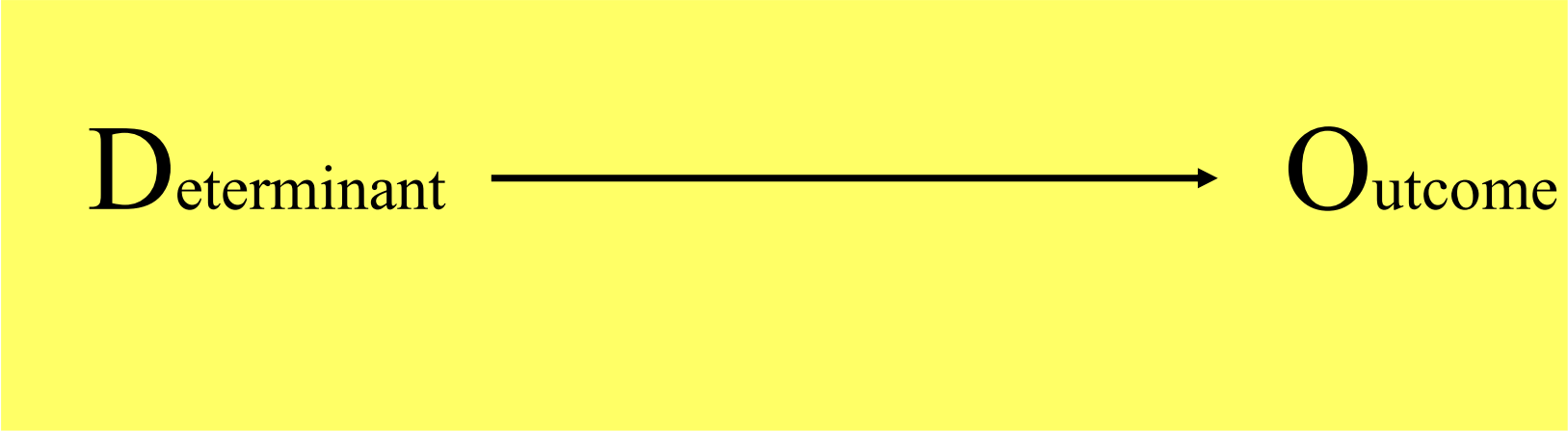
Variability of the natural development of the phenomena

- Follow this example:
  - 100 addicted to heroin are treatment with a new “Lourdes” ointment for 1 year
  - At the end of the observation period, 30 study participants have shown a prolonged period of abstinence and are considered recovered by researchers.
  - In a press release, they claimed: “The *Lourdes* ointment is effective because it is able to recover 30% of heroin addicted”.
  - Can you agree with them? And why?

Variability of the natural development of the phenomena

- No, we can’t agree.
- Addiction, like many other conditions (depression, headache), has a variable individual course. Many addicted to heroin are able to stop alone, to stay week or months or even years abstinent, and then have a relapse again
- What happened to the group of treated with the “Lourdes” ointment could be a “natural” course of the problem under study

Causal relationship



1st problem: Information bias

- Any error in the measurement of the elements under study (determinant and/or outcome) can bias the estimation of the effect. This is called ***misclassification***. Misclassification can be
  - ***unconditional***
  - ***conditional***

1st problem: Information bias

- The information can be misclassified
  - at the same extend in all study groups (***unconditional misclassification***)
  - may vary between groups (***conditional misclassification***)

1st problem: Information bias

UNCONDITIONAL MISCLASSIFICATION

Example
D = *school-based intervention*
O = tobacco use (interview)

TRUTH

	D+	D-	
O+	30	91	121
O-	270	609	879
	300	700	1000
	RR=	0,8	

1st problem: Information bias

Exposed to determinant

INSTRUMENT VALIDITY

instrument	TRUTH O+	TRUTH O-	
O+	24	54	78
O-	6	216	222
	30	270	300
P	*0,10*	*Sens*	*0,80*
n	*300*	*Spec*	*0,80*

Unexposed to determinant

INSTRUMENT VALIDITY

instrument	TRUTH O+	TRUTH O-	
O+	73	122	195
O-	18	487	505
	91	609	700
P	*0,13*	*Sens*	*0,80*
n	*700*	*Spec*	*0,80*

1st problem: Information bias

UNCONDITIONAL MISCLASSIFICATION

TRUTH

	D+	D-	
O+	30	91	121
O-	270	609	879
	300	700	1000
	RR=	0,8	

STUDY

	D+	D-	
O+	78	195	273
O-	222	505	727
	300	700	1000
	RR=	0,9	

1st problem: Information bias

CONDITIONAL MISCLASSIFICATION

D = *school-based intervention*
O = tobacco use (interview)

TRUTH

	D+	D-	
O+	30	91	121
O-	270	609	879
	300	700	1000
	RR=	0,8	

1st problem: Information bias

Exposed to determinant

INSTRUMENT VALIDITY	TRUTH		
instrument	O+	O-	
O+	21	14	35
O-	9	257	266
	30	270	300
P	*0,10*	*Sens*	*0,70*
n	*300*	*Spec*	*0,95*

Not exposed to determinant

INSTRUMENT VALIDITY	TRUTH		
instrument	O+	O-	
O+	86	183	269
O-	5	426	431
	91	609	700
P	*0,13*	*Sens*	*0,95*
n	*700*	*Spec*	*0,70*

1st problem: Information bias

CONDITIONAL MISCLASSIFICATION

TRUTH

	D+	D-	
O+	30	91	121
O-	270	609	879
	300	700	1000
	RR=	0,8	

STUDY

	D+	D-	
O+	35	269	304
O-	266	431	696
	300	700	1000
	RR=	0,3	

1° Information bias

- Unconditional misclassification can reduce the effect size
- Conditional misclassification conduct to an information bias
- The risk of bias is also a function of the “objectivity” of the outcome:
  - lower for “hard” outcomes: mortality, incarceration etc
  - higher for “soft” outcomes: scales of quality of life, depression

2nd problem: Confounding

Results from a longitudinal evaluation study

Effect of a school-based antidrug program

		exposed to program	
		yes	no
use of drug in last month	yes	15	45
	no	985	955
	tot	1000	1000

Re+= 0,02

Re- = 0,05

RR = 0,33

2nd problem: Confounding

High social status

	exposed to program			
	yes	no		
use of drug in last month: yes	9	3	Re+=	0,01
use of drug in last month: no	891	297	Re- =	0,01
tot	900	300	RR =	1,00

Low social status

	exposed to program			
	yes	no		
use of drug in last month: yes	6	42	Re+=	0,06
use of drug in last month: no	94	658	Re- =	0,06
tot	100	700	RR =	1,00

2nd problem: Confounding

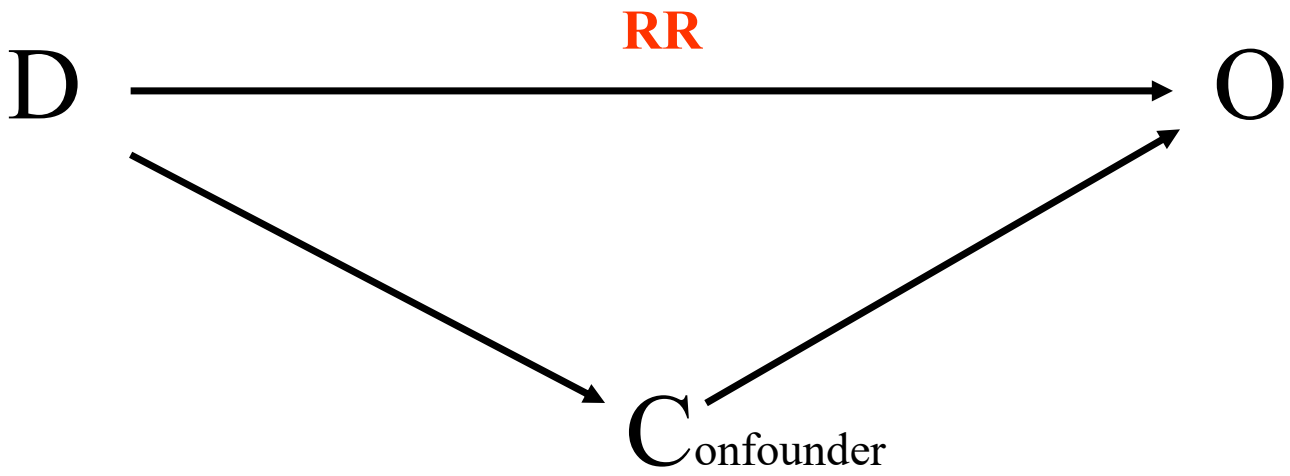
What's happened?

- schools were selected on voluntary base
- voluntary schools usually belong to higher social status areas
- higher social status is usually associated to a low level of drug involvement

Effect of social status

	social status			
	high	low		
use of drug in last month: yes	12	48	Re+=	0,01
use of drug in last month: no	1188	752	Re- =	0,06
tot	1200	800	RR =	0,17

2nd problem: Confounding



The confounder is a concurrent cause of the outcome, that correlates with the determinant. Confounding is also called spurious association.

2nd problem: Confounding

- Confounding is a major threat to the validity of inferences made about cause and effect (***internal validity***), as the observed effects should be attributed to the independent variable rather than the confounder.

Other problems

- Other possible problems that can bias the estimation of the association
  1. ***suggestion***: in some cases, if the subjects exposed to intervention, can perceive in a different way the outcome than those not exposed
  2. ***attrition bias***: a differential attrition can arise between exposed and not exposed, and when this is associated to the outcome, wil produce the attrition bias

Other players of the causality

- ***effect modifier***: it's a factor modulating the effect of a determinant:
  - it can be a biological factor, as for example a gene for susceptibility of addiction
- ***concurrent causes***: are all the other factors that can determine the outcome (for example air pollution in the study of the relationship between smoking and lung cancer). Whether they are not associated to the determinant, they didn't distort the association estimate

Other players of the causality

- ***mechanisms*** (intermediate stages of the causal chain), as for example:
  - knowledge of risk for the prevention of tobacco use, perception of the messages in a mass media campaign against drinking&driving, tasso ematico di fattori tossici, mutations in oncogenes for the study of the relationship between tobacco and lung cancer

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