



History / origins

Hippocrates of Cos (460-370 BC) "On airs waters and places" discusses patterns, risk factors and epidemics (things which visit populations)

Routine data

London Bills of Mortality (17th C)
Censuses
Death certification by cause (E&W = 1837)
Morbidity notification and registries

John Snow (1813 – 1858) London GP analysed cholera death patterns to deduce waterborne source of agent

London Epidemiological Society formed 1850, interests in human, animal and plant disease

First textbook "Epidemics and Crowd Diseases" Greenwood 1935

Outcome measures

Case definition

Prevalence

number, "rate"
point or period

Incidence

number
risk (percentage)
rate (per person time)
incidence = prevalence / duration

Mortality (rate)

case fatality rate
excess mortality

Health of populations

Time trends
Inequalities
International differences
Disease burden
DALYs
QALYs

Infections

Infection versus disease

incubation period
pre-infectious period
infectious period
serial interval
generation time

Epidemic curves

point source
common extended source
propagative

Transmission

direct, indirect
horizontal, vertical
secondary attack rate
reproduction number
basic R_0
net (effective)
 $R_n = R_0 \times \text{prop. susceptible}$
vectorial capacity

Herd immunity

threshold = $(R_0 - 1) / R_0 = 1 - 1/R_0$
 $\approx 1 - A/L$

At least one logic

Reed Frost model
 $C_{t+1} = S_t(1 - q^{C_t})$

Heterogeneity

supershedders and superspreaders
networks and mixing patterns
WAIFW matrices

Outbreak investigation

Ethics / Regulatory

Declaration of Helsinki (1964 *et seq*)
Informed consent
Institutional Review Boards
GCP

Demography

Censuses
Life tables
Fertility
Age-specific mortality
maternal mortality ratio (rate)
infant mortality ratio (rate)
Life expectancy (at age x)
Migration

Types of studies

Surveillance

Observational

Descriptive

Ecological
Cross sectional
Longitudinal

Analytical

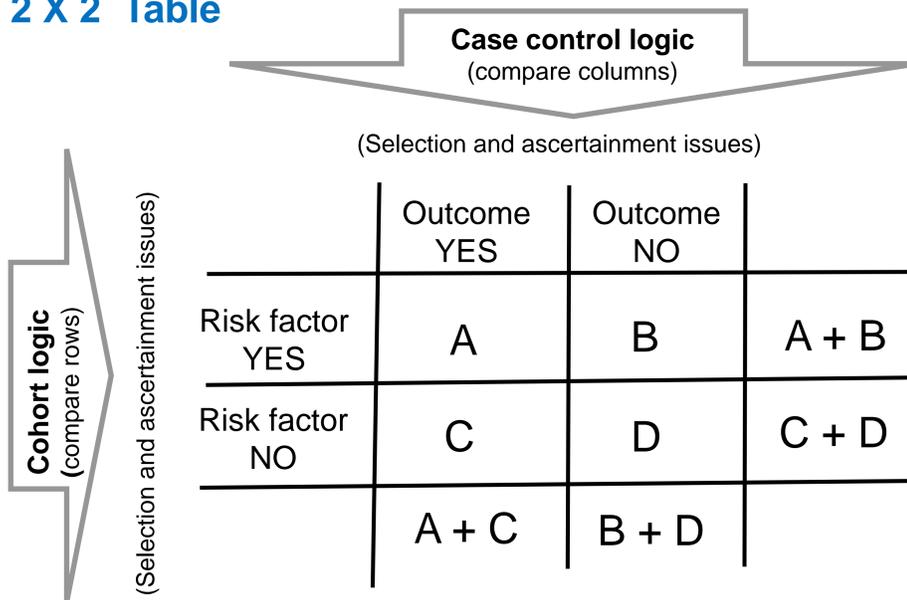
Cohort
prospective v historical
Case control
Self-controlled designs

Intervention

Before – after
Randomised Controlled Trial
individual versus cluster
blinding

Simulation

2 X 2 Table



Validity

	True YES	True NO	
Test YES	a	b	a + b
Test NO	c	d	c + d
	a + c	b + d	

Sensitivity = $a / (a + c)$

Specificity = $d / (b + d)$

Positive predictive value (PPV) = $a / (a + b)$

Agreement, $(a+d) / (a + b + c + d)$

Kappa

Analysis

Sample size

power

Distributions

Contingency tables

Hypothesis testing

statistical inference

Univariable

bivariate

multivariable

Correlation

Regression

linear

Poisson

logistic

Cox

Bayesian...

Danger !

Ecological fallacy

Random error

sampling error
confidence limits

Misclassification

differential
non-differential

Bias

systematic misrepresentation
selection, information, etc ...

Confounding

stratification
regression adjustment
propensity scores
matching
self-controlled designs
restriction
standardisation
randomisation

Interaction (effect modification)

Effect and impact measures

Attributable risk

risk difference $(r_1 - r_0)$
risk difference percent $(r_1 - r_0) / r_1$
population attributable risk (PAR)
 $r - r_0 = p(r_1 - r_0)$

Risk (or rate) ratio (RR)

$r_1 / r_0 = (A / (A+B)) / (C / (C+D))$
hazard ratio

Odds Ratio (OR)

$(A/C) / (B/D) = A \cdot D / B \cdot C$
rare disease assumption ...

Standardised mortality ratio (SMR)

observed / expected

Population attributable fraction (PAF)

$PAR / r = p(RR - 1) / [p(RR - 1) + 1]$

Protective efficacy

$(R_n - R_v) / R_n = 1 - R_v / R_n$
 $= (P_p - P_c) / [P_p(1 - P_c)]$

effectiveness versus efficacy
direct versus indirect effects
externalities

Big data

E-health and large-scale data linkage
-omics
genomics, transcriptomics, metabolomics...
GWAS

Genetics & mol. epi.

phylogenetic trees
clustering
gene-environment interaction
biomarkers

Causality

Koch's (Henle-Koch) postulates

presence..... isolation....induction

Bradford Hill "perspectives"

strength of effect
consistency
specificity
temporality
gradient
plausibility
coherence
experiment
analogy

Causal inference

potential outcomes / DAGS

Triangulation

Observational / RCT evidence /
Natural experiments
Mendelian randomisation

Synthesis

Systematic review

Meta-analysis
fixed effects
random effects

Applications

Health and disease
humans, animals, plants
Criminology
Education
Economics
Social sciences