Public Health, Epidemiology, and Clinical Research

100 Essential Concepts Made Easy

Flashcard Collection

A comprehensive study guide covering key concepts in public health, epidemiology, and clinical research.

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Public Health Foundations

1. Determinants of Health

Definition:

The range of personal, social, economic, and environmental factors that influence individual and population health outcomes.

Example:

Access to clean water (environmental determinant) and level of education (social determinant) both affect rates of communicable diseases.

Significance:

Understanding determinants guides interventions beyond clinical care—addressing root causes to improve public health equity.

2. Health Promotion

Definition:

The process of enabling people and communities to increase control over—and improve—their health, through policies, education, and community actions.

Example:

A city-wide campaign encouraging daily physical activity in parks to reduce obesity rates.

Significance:

Empowers individuals and systems to prevent disease proactively, reducing healthcare costs and improving quality of life.

3. Social–Ecological Model

Definition:

A framework recognizing that individual behavior is shaped by interactions across multiple levels: individual, interpersonal, organizational, community, and policy.

Example:

Designing an anti-smoking program that includes personal counseling, family support groups, smoke-free workplace policies, and national legislation.

Significance:

Ensures multi-level strategies that target not only individuals but also social and environmental influences, maximizing impact.

4. One Health

Definition:

An integrated approach recognizing that human health is connected to animal health and shared environments, aiming to prevent and control zoonotic diseases.

Example:

Joint surveillance of avian influenza in poultry farms and human clinics to detect spillover events early.

Significance:

Promotes cross-sector collaboration to manage emerging infectious diseases at the human–animal–environment interface.

5. Health Equity

Definition:

The absence of systematic disparities in health between social groups who have different levels of social advantage.

Example:

Implementing mobile clinics in underserved rural regions to close infant-mortality gaps.

Significance:

Frames health as a social justice issue—driving policies that ensure every population has fair health opportunities.

6. Health Literacy

Definition:

The capacity of individuals to obtain, process, and understand basic health information and services needed to make appropriate decisions.

Example:

Simplifying consent forms with infographics to help patients understand treatment risks and benefits.

Significance:

Critical for patient empowerment and adherence—low literacy is linked to poorer health outcomes and higher costs.

7. Universal Health Coverage

Definition:

A system goal where all individuals and communities receive needed health services—promotion, prevention, treatment, rehabilitation—without financial hardship.

Example:

A national insurance scheme covering antenatal care, immunizations, and essential surgeries.

Significance:

Ensures financial risk protection and equitable access—key to achieving global health targets like the SDGs.

8. Sustainable Development Goals (SDGs)

Definition:

A set of 17 global targets established by the UN to end poverty, protect the planet, and ensure prosperity for all by 2030.

Example:

SDG 3's aim to reduce global maternal mortality to below 70 per 100,000 live births.

Significance:

Provides a holistic framework linking health to broader social, economic, and environmental development objectives.

Prevention & Control

9. Primary Prevention

Definition:

Interventions applied before disease onset to prevent occurrence, by reducing exposure or increasing resistance.

Example:

HPV vaccination of adolescents to prevent cervical cancer.

Significance:

The most cost-effective approach—averting illness before it begins saves lives and healthcare resources.

10. Secondary Prevention (Screening)

Definition:

Early detection of asymptomatic disease through screening tests to enable prompt treatment and reduce complications.

Example:

Mammography for women over 50 to detect breast cancer at an early, treatable stage.

Significance:

Improves prognosis and reduces treatment intensity, but requires careful consideration of harms like false positives or overdiagnosis.

11. Tertiary Prevention

Definition:

Interventions to reduce the impact of established disease by restoring function and reducing complications or disability.

Example:

Cardiac rehabilitation programs for post-myocardial infarction patients to prevent recurrent events.

Significance:

Enhances quality of life and reduces long-term morbidity, critical for chronic disease management.

12. Disease Surveillance

Definition:

Continuous, systematic collection, analysis, and interpretation of health data to guide public health action.

Example:

Weekly reporting of influenza-like illness by sentinel clinics to detect seasonal trends.

Significance:

Enables timely outbreak detection and resource allocation, forming the backbone of epidemic control.

13. Outbreak Investigation

Definition:

A structured process to verify an outbreak, define and identify cases, generate and test hypotheses, implement control measures, and communicate findings.

Example:

Field team tracing a Salmonella foodborne outbreak to a contaminated restaurant batch.

Significance:

Rapid, systematic investigations limit spread and inform prevention strategies for future outbreaks.

14. Immunization Programs

Definition:

Coordinated efforts—policy, financing, logistics, cold-chain management, and community engagement—to deliver vaccines at scale.

Example:

National measles–rubella campaigns combining routine immunization with school-based catch-up days.

Significance:

Provide one of the most successful population-level disease prevention strategies, saving millions of lives annually.

15. Vector Control

Definition:

Strategies to reduce or eliminate disease transmission by controlling insect or animal vectors via environmental management, insecticides, or biological methods.

Example:

Distributing insecticide-treated bed nets to prevent malaria in endemic regions.

Significance:

Essential for controlling vector-borne diseases, often a cornerstone of integrated disease management.

16. Disease Control vs. Elimination vs. Eradication

Definition:

Control reduces disease incidence to acceptable levels; elimination interrupts transmission in a defined area; eradication permanently removes disease worldwide.

Example:

Polio eliminated in the Americas but not yet eradicated globally.

Significance:

Clarifies program goals and informs resource allocation; eradication demands highest commitment and coordination.

Epidemiologic Study Designs

17. Cross-Sectional Study

Definition:

A snapshot survey measuring exposure and outcome status simultaneously to estimate prevalence.

Example:

Surveying dietary habits and obesity status in adults during a community health fair.

Significance:

Quick and cost-effective for hypothesis generation and prevalence estimation, but cannot establish temporality.

18. Case-Control Study

Definition:

Retrospective comparison of exposure histories between individuals with disease (cases) and without (controls) to estimate odds of exposure.

Example:

Comparing past antibiotic use among patients hospitalized for C. difficile infection vs. matched healthy controls.

Significance:

Efficient for studying rare diseases and multiple exposures, but prone to recall and selection biases.

19. Cohort Study

Definition:

Prospective or retrospective design following exposed and unexposed groups over time to measure incidence of outcomes, yielding relative risks.

Example:

Following vaccinated vs. unvaccinated children for five years to compare rotavirus infection rates.

Significance:

Strong for causal inference with clear temporality, but resource-intensive and subject to loss to follow-up.

20. Ecologic Study

Definition:

Aggregate-level analysis exploring correlations between exposures and outcomes across groups or regions.

Example:

Correlating regional measles vaccination coverage with outbreak incidence across provinces.

Significance:

Useful for hypothesis generation and policy evaluation, but subject to ecological fallacy when inferring individual risk.

21. Nested Case–Control Study

Definition:

A case–control study drawn from an existing cohort: cases and matched controls sampled from under-follow-up participants.

Example:

Selecting rotavirus cases and matched controls from a birth cohort's biosample bank.

Significance:

Combines cohort temporality with case–control efficiency, reducing bias and cost when assays are limited.

22. Case–Crossover Study

Definition:

Each case serves as its own control by comparing exposure in a risk window before an event to other time windows.

Example:

Comparing NSAID use in the week before peptic-ulcer perforation versus one month earlier.

Significance:

Controls for fixed individual confounders, ideal for studying transient exposures and acute outcomes.

23. Randomized Controlled Trial (RCT)

Definition:

Experimental design randomly assigning participants to intervention or control to minimize confounding and establish causality.

Example:

Assigning infants to PCV13 vs. PCV10 and comparing pneumococcal disease incidence.

Significance:

Gold standard for evaluating intervention efficacy, informing clinical practice and regulatory approval.

24. Cluster RCT

Definition:

Randomizing groups (e.g., villages, clinics) rather than individuals to evaluate interventions delivered at community or institutional levels.

Example:

Randomizing health centers to electronic immunization registries vs. paper-based systems to assess coverage.

Significance:

Reflects real-world program delivery and prevents contamination between individuals.

25. Stepped-Wedge Trial

Definition:

Cluster RCT where all clusters sequentially cross over from control to intervention at randomized timepoints.

Example:

Phased implementation of a hand-hygiene campaign across hospital wards in random order.

Significance:

Balances ethical considerations with rigorous evaluation, ensuring all clusters receive intervention.

26. Adaptive Trial

Definition:

Trial design permitting preplanned modifications based on interim analyses (e.g., dropping arms, adjusting sample size).

Example:

Stopping the lowest-dose arm mid-trial to concentrate on more effective vaccine doses.

Significance:

Enhances efficiency, ethical allocation, and resource use by learning during the trial.

27. Non-Inferiority Trial

Definition:

Trial aiming to show a new treatment is not worse than the standard by more than a prespecified margin.

Example:

Comparing single-dose vs. two-dose vaccine schedules with a 5% non-inferiority margin.

Significance:

Enables adoption of simpler or safer regimens when placebo is unethical.

28. Case Series

Definition:

Descriptive report of clinical features and outcomes among a group of patients without a comparison group.

Example:

Describing symptom progression in the first 30 COVID-19 patients at an outbreak center.

Significance:

Useful for early outbreak characterization and hypothesis generation for further studies.

Bias & Confounding

29. Selection Bias

Definition:

Systematic differences between those selected for a study and the target population, leading to non-representative samples and distorted associations.

Example:

Recruiting only hospitalized patients to estimate community prevalence of diabetes may overestimate true rates.

Significance:

Threatens generalizability; recognizing and minimizing it ensures study findings apply to broader populations.

30. Information Bias

Definition:

Systematic error from misclassification of exposures or outcomes due to inaccurate measurement or data collection methods.

Example:

Self-reported alcohol intake often underestimates true consumption due to recall and social desirability.

Significance:

Undermines internal validity; standardized assessments and blinding improve measurement accuracy.

31. Recall Bias

Definition:

Error when participants do not accurately remember past exposures, causing differential misclassification between cases and controls.

Example:

Mothers of children with birth defects may overreport medication use compared to mothers of healthy children.

Significance:

Can exaggerate or mask associations; using medical records helps mitigate its effect.

32. Observer (Measurement) Bias

Definition:

Systematic differences in data recording by observers, influenced by knowledge of exposure or outcome status.

Example:

A clinician knowing a patient received the vaccine may overestimate symptom improvement.

Significance:

Maintaining blinding and training observers reduces this bias.

33. Confounding

Definition:

Distortion of an exposure–outcome relationship by a third variable associated with both but not on the causal path.

Example:

Age confounding the link between exercise and heart disease if older adults both exercise less and have higher risk.

Significance:

Controlling confounders via randomization or multivariate analysis is essential for valid inference.

34. Residual Confounding

Definition:

Remaining confounding after adjustment due to imperfect measurement or unmeasured variables.

Example:

Adjusting for smoking status (yes/no) leaves bias from pack-year differences.

Significance:

Recognizing residual confounding informs cautious interpretation and further sensitivity analyses.

35. Healthy-User Bias

Definition:

Bias where individuals engaging in preventive behaviors differ systematically in health status from non-users.

Example:

Vaccinated individuals may also have healthier lifestyles, skewing effectiveness estimates upward.

Significance:

Adjusting for health-seeking behavior reduces overestimation of intervention benefits.

36. Channeling Bias

Definition:

Systematic prescribing patterns where patients with different prognoses are channeled into specific treatments.

Example:

Sicker patients preferentially receiving second-line therapy, biasing outcome comparisons.

Significance:

Distinguishing channeling from confounding by indication is key for correct adjustment.

37. Lead-Time Bias

Definition:

Apparent survival benefit when early detection advances diagnosis date without actual extension of life.

Example:

Screen-detected cancers appear to increase survival time from diagnosis without changing mortality.

Significance:

Focusing on mortality rates rather than survival time avoids misleading screening benefits.

38. Ecological Fallacy

Definition:

Incorrect inference about individuals based on group-level data, because aggregate associations may not hold at individual level.

Example:

A country with high fat intake and low heart disease incidence does not imply individuals eating fat are protected.

Significance:

Highlights need for individual-level studies to guide clinical decisions.

Measures of Disease Frequency & Association

39. Incidence Rate

Definition:

The rate at which new cases occur in a population per unit of person-time at risk.

Example:

Reporting 5.2 new rotavirus cases per 1,000 child-years in a birth cohort.

Significance:

Allows comparison of disease risk accounting for varying follow-up durations.

40. Cumulative Incidence

Definition:

The proportion of an initially disease-free population that develops the disease over a specified time period.

Example:

Noting that 8% of participants develop type 2 diabetes over 10 years.

Significance:

Directly informs individual risk and aids in public-health planning.

41. Prevalence

Definition:

The proportion of a population with a disease or condition at a point or over a period, reflecting both incidence and duration.

Example:

Finding that 12% of surveyed adults have hypertension at a health fair.

Significance:

Guides healthcare service planning and resource allocation.

42. Risk Ratio (Relative Risk)

Definition:

The ratio of cumulative incidence in exposed vs. unexposed groups, quantifying relative likelihood of an outcome.

Example:

A RR of 3.0 for lung cancer among smokers vs. non-smokers indicates triple the risk.

Significance:

Provides an intuitive measure of association in cohort studies.

43. Odds Ratio

Definition:

The ratio of the odds of exposure among cases to odds among controls; approximates RR when outcome is rare.

Example:

An OR of 2.5 for high cholesterol among heart-attack survivors vs. controls.

Significance:

Widely used in case-control studies and logistic regression analysis.

44. Hazard Ratio

Definition:

The ratio of hazard rates between two groups in survival analysis, indicating relative risk at any time point.

Example:

A HR of 0.7 for mortality in vaccinated vs. unvaccinated indicates 30% reduction.

Significance:

Crucial for time-to-event analyses in clinical trials and cohort studies.

45. Rate Ratio

Definition:

The ratio of incidence rates between two groups, comparing new-case rates per person-time at risk.

Example:

A rate ratio of 1.8 for measles in unvaccinated vs. vaccinated children per 1,000 child-years.

Significance:

Enables comparison of dynamic rates across different populations or periods.

46. Risk Difference

Definition:

The absolute difference in cumulative incidence between exposed and unexposed groups.

Example:

If 15% of smokers and 5% of non-smokers develop COPD over 10 years, RD is 10%.

Significance:

Quantifies absolute effect for decision-making and NNT calculations.

47. Number Needed to Treat (NNT)

Definition:

The number of individuals who need the intervention for one additional beneficial outcome compared to control.

Example:

An NNT of 50 for a vaccine means vaccinating 50 children prevents one disease case.

Significance:

Simplifies communication of clinical benefit to practitioners and policy-makers.

48. Population Attributable Fraction

Definition:

Proportion of disease incidence in a population that would be prevented if an exposure were eliminated.

Example:

Calculating that eliminating smoking would prevent 30% of lung cancer cases.

Significance:

Informs prioritization of public-health interventions by highlighting high-impact exposures.

49. P-Value

Definition:

Probability of observing data as extreme as those observed, assuming the null hypothesis is true; not a measure of effect size.

Example:

p=0.02 in a vaccine trial suggests a 2% chance the efficacy difference occurred by random variation.

Significance:

Guides statistical hypothesis testing but should be interpreted alongside effect sizes and confidence intervals.

50. Confidence Interval (CI)

Definition:

Range of values derived from sample data within which the true population parameter is expected to lie with a specified probability (e.g., 95%).

Example:

A 95% CI of 0.8–1.2 for a risk ratio indicates the true effect likely falls in that range.

Significance:

Conveys precision and uncertainty; narrow intervals suggest more reliable estimates.

51. Statistical Power

Definition:

Probability that a study will detect a true effect of a specified size at the chosen significance level (1−β).

Example:

A trial with 80% power has an 80% chance to detect a 20% reduction in disease incidence if it exists.

Significance:

Ensures studies are adequately sized to avoid false negatives and wasted resources.

52. Type I & Type II Errors

Definition:

Type I (α): False positive—incorrectly rejecting a true null. Type II (β): False negative—failing to reject a false null.

Example:

Claiming a vaccine is effective when it isn't (Type I) vs. missing a real vaccine benefit (Type II).

Significance:

Balancing error rates is crucial in trial design to minimize misleading conclusions.

53. Multiple Testing & False Discovery Rate (FDR)

Definition:

When multiple hypotheses are tested, false positives increase; FDR controls the expected proportion of false discoveries among significant results.

Example:

Adjusting p-values across 1,000 gene tests to maintain FDR ≤ 5%.

Significance:

Protects against spurious findings in high-dimensional studies like genomics.

54. Alpha Spending

Definition:

Framework for allocating the overall Type I error budget across interim analyses to maintain the specified α level.

Example:

Using O'Brien–Fleming boundaries to allocate α in sequential looks of a clinical trial.

Significance:

Allows ethical interim assessments without inflating false positive rates.

55. Bayesian vs. Frequentist Inference

Definition:

Frequentist interprets probability as long-run frequency; Bayesian updates prior beliefs with data to yield posterior distributions.

Example:

Bayesian trial incorporates prior efficacy data to refine current vaccine effectiveness estimates.

Significance:

Bayesian methods offer flexibility and direct probability statements, while frequentist methods are widely established.

56. Fixed-Effects vs. Random-Effects Models

Definition:

Fixed-effects assume one true effect size; random-effects model variation across studies and incorporate between-study heterogeneity.

Example:

Random-effects meta-analysis of PCV trials accounts for differences in geography and study design.

Significance:

Choosing the correct model impacts generalizability and pooled estimate interpretation.

57. Meta-Analysis

Definition:

Statistical pooling of results from multiple studies to generate a combined effect estimate, enhancing precision and exploring heterogeneity.

Example:

Combining rotavirus vaccine RCTs to estimate overall efficacy of 85%.

Significance:

Strengthens evidence synthesis and informs clinical guidelines and policy.

58. Sensitivity Analysis

Definition:

Analyses under alternative assumptions (e.g., variable definitions, missing data methods) to assess robustness of main findings.

Example:

Re-running analyses excluding early dropouts to evaluate consistency of vaccine effectiveness.

Significance:

Demonstrates the stability of results, bolstering confidence in conclusions.

59. Allocation Concealment

Definition:

Ensuring recruiters cannot foresee upcoming assignments (e.g., sealed envelopes, centralized randomization) to prevent selection bias.

Example:

Using a web-based system that reveals treatment only after patient enrollment.

Significance:

Maintains trial integrity by preventing enrollment manipulation.

60. Blinding (Masking)

Definition:

Keeping participants, caregivers, and/or assessors unaware of allocated interventions to reduce performance and ascertainment biases.

Example:

Double-blind PCV trial where neither parents nor clinicians know the vaccine type administered.

Significance:

Enhances objectivity in outcome assessment and participant management.

61. Intention-to-Treat (ITT) Analysis

Definition:

Analyzing all randomized participants in their assigned groups regardless of adherence to preserve randomization benefits.

Example:

Including children who missed doses in their original group when assessing PCV efficacy.

Significance:

Reflects real-world application and avoids attrition bias.

62. Per-Protocol Analysis

Definition:

Analyzing only participants who fully adhere to the protocol, excluding major deviations and dropouts.

Example:

Evaluating vaccine efficacy among infants who received all scheduled doses on time.

Significance:

Estimates efficacy under ideal conditions but may overstate real-world effects.

63. Trial Registration & CONSORT

Definition:

Registering trials in public databases and reporting according to CONSORT guidelines for transparency and completeness.

Example:

Including a CONSORT flow diagram in the published PCV trial report.

Significance:

Reduces selective reporting and enhances replicability.

64. Data and Safety Monitoring Board (DSMB)

Definition:

An independent committee reviewing unblinded safety and efficacy data and advising on trial continuation or modification.

Example:

DSMB halts a vaccine trial after detecting serious adverse events at interim analysis.

Significance:

Protects participant safety and maintains trial validity.

65. Interim Analysis

Definition:

Preplanned assessment of accruing trial data at predefined points using statistical boundaries to control overall error rates.

Example:

Analyzing efficacy data after 50% of events in a rotavirus trial.

Significance:

Enables early stopping for efficacy or safety, optimizing resources and ethics.

66. Composite Endpoints

Definition:

Combining multiple outcomes into a single measure (e.g., death or hospitalization) to increase event rates and power.

Example:

Using 'heart attack, stroke, or cardiovascular death' as one endpoint.

Significance:

Improves efficiency but requires careful interpretation of component events.

67. Adaptive Design Features

Definition:

Preplanned trial modifications such as dose adjustments or arm dropping based on interim data.

Example:

Dropping ineffective vaccine arms mid-trial to focus on promising candidates.

Significance:

Enhances trial flexibility and participant welfare.

68. Equivalence & Non-Inferiority Margins

Definition:

Predefined thresholds for acceptable differences when demonstrating equivalence or non-inferiority.

Example:

A 5% margin for single-dose vaccine schedule comparison.

Significance:

Determines interpretation of trials without placebo arms.

69. Passive vs. Active Surveillance

Definition:

Passive relies on routine reporting by providers; active involves proactive case-finding by health authorities.

Example:

Clinic reports of measles (passive) vs. door-to-door case searches during an outbreak (active).

Significance:

Active surveillance detects more cases but requires more resources; choice impacts outbreak control efficacy.

70. Sentinel Surveillance

Definition:

Monitoring disease trends via selected reporting sites that represent larger populations, balancing cost and representativeness.

Example:

A network of pediatric hospitals reporting rotavirus hospitalizations seasonally.

Significance:

Provides timely data on disease trends without exhaustive data collection.

71. Case Definition & Line List

Definition:

Case definition sets standard criteria for identifying cases; line list is a table of individual case data.

Example:

Using WHO's Ebola suspect case definition and compiling dates, symptoms, and outcomes in a line list.

Significance:

Ensures consistent case identification and organized data for rapid outbreak analysis.

72. Attack Rate & Secondary Attack Rate

Definition:

Attack rate is the proportion of at-risk individuals who become ill; secondary attack rate is proportion of contacts who become ill.

Example:

20% attack rate in village cholera outbreak and 15% secondary rate among household contacts.

Significance:

Helps quantify transmissibility and target control measures during outbreaks.

73. Epidemic Curve

Definition:

Graphical display of case counts by onset time, revealing outbreak dynamics such as point-source or propagated spread.

Example:

A sharp peak two days post-exposure indicates a point-source salmonella outbreak.

Significance:

Aids hypothesis generation on exposure and guides control interventions timing.

74. Basic & Effective Reproductive Number (R0 & Re)

Definition:

R0 is average secondary cases in susceptible population; Re is reproduction number accounting for immunity/interventions.

Example:

Measles R0≈15; after 80% vaccination, Re falls below 1, halting transmission.

Significance:

Informs vaccination targets and outbreak potential assessments.

75. Contact Tracing

Definition:

Identifying, notifying, and monitoring individuals exposed to confirmed cases to interrupt transmission.

Example:

Tracing and quarantining contacts of a confirmed COVID-19 patient.

Significance:

Critical for containing infectious disease spread at early stages.

76. Ring Vaccination

Definition:

Vaccinating contacts and contacts-of-contacts around a case to create immunity buffer and contain spread.

Example:

Ring vaccination strategy used successfully in Ebola outbreaks.

Significance:

Efficiently targets limited vaccine resources to achieve rapid outbreak control.

Diagnostics & Screening

77. Sensitivity & Specificity

Definition:

Sensitivity: True-positive rate—proportion of diseased individuals correctly identified.
Specificity: True-negative rate—proportion of healthy individuals correctly excluded.

Example:

A rotavirus test with 95% sensitivity and 90% specificity accurately identifies most infected and excludes most healthy children.

Significance:

Fundamental metrics for evaluating diagnostic tests and guiding interpretation of results.

78. Positive & Negative Predictive Values

Definition:

PPV: Proportion of test-positive individuals who truly have the disease. NPV: Proportion of test-negative individuals who are disease-free.

Example:

In a high-prevalence flu season, a rapid test PPV of 85% indicates 85% of positives are true cases.

Significance:

Reflect real-world test performance based on disease prevalence, informing clinical decisions.

79. Receiver-Operating Characteristic (ROC) Curve

Definition:

Plot of sensitivity vs. 1–specificity across thresholds, illustrating a test's discriminative ability.

Example:

Using ROC analysis to select optimal viral-load cutoff for HIV diagnosis.

Significance:

Helps choose test thresholds balancing true- and false-positive rates.

80. Area Under the Curve (AUC)

Definition:

The area under the ROC curve, summarizing overall test accuracy; ranges from 0.5 (no discrimination) to 1.0 (perfect).

Example:

An AUC of 0.88 indicates excellent performance for a cancer biomarker.

Significance:

Provides a single measure to compare diagnostic tests and assess improvements.

81. Likelihood Ratios

Definition:

Metrics combining sensitivity and specificity to update disease odds: LR+ = Sensitivity/(1−Specificity), LR- = (1−Sensitivity)/Specificity.

Example:

A test with LR+=9.5 and LR-=0.06 greatly shifts disease probability.

Significance:

Facilitates accurate application of Bayes' theorem in clinical diagnosis.

82. Kappa Statistic (Inter-rater Agreement)

Definition:

Chance-corrected measure of agreement between observers classifying categorical outcomes; ranges from –1 to 1.

Example:

A kappa of 0.80 for X-ray readings indicates substantial agreement among radiologists.

Significance:

Assesses reliability of diagnostic or observational measures.

83. Diagnostic Odds Ratio

Definition:

Ratio of odds of a positive test in diseased vs. non-diseased: (sensitivity/(1–sensitivity)) ÷ ((1–specificity)/specificity).

Example:

A DOR of 50 indicates strong discrimination by a tuberculosis assay.

Significance:

Offers a single performance metric combining sensitivity and specificity.

84. Lead-Time & Length-Time Bias in Screening

Definition:

Lead-time: Early detection advances diagnosis date without extending life. Length-time: Screening picks slower-progressing cases, overstating benefit.

Example:

PSA screening may detect indolent prostate cancers, inflating survival statistics.

Significance:

Crucial to interpret screening benefits accurately and avoid overestimation.

85. Vaccine Efficacy

Definition:

The relative reduction in disease incidence under ideal (trial) conditions: (1 – RR) × 100%.

Example:

A PCV trial demonstrating 90% efficacy means vaccinated children had 90% fewer pneumococcal cases.

Significance:

Establishes baseline protection level for regulatory approval and public-health recommendations.

86. Vaccine Effectiveness

Definition:

Observed reduction in disease incidence in real-world settings, accounting for programmatic factors like cold chain and adherence.

Example:

A rotavirus program showing 80% effectiveness in routine use, lower than its 90% trial efficacy.

Significance:

Reflects true public-health impact, guiding resource allocation and program improvements.

87. Vaccine Impact

Definition:

The overall reduction in disease burden at the population level, including both direct and indirect (herd) effects.

Example:

After PCV introduction, under-five pneumonia hospitalizations fell by 40% nationwide.

Significance:

Demonstrates broader benefits of vaccination programs beyond individual protection.

88. Herd Immunity

Definition:

Indirect protection of susceptible individuals when a critical proportion of the population is immune, halting transmission chains.

Example:

Non-vaccinated infants gain protection when >90% of community members are immunized against measles.

Significance:

Informs vaccination coverage targets necessary to prevent outbreaks.

89. Herd Immunity Threshold

Definition:

The proportion of immune individuals required to reduce the effective reproductive number (R■) below 1: 1 – 1/R■.

Example:

For measles with R■≈15, the threshold is ~93%.

Significance:

Guides policy on minimum vaccine coverage to achieve community protection.

90. Leaky Vaccine

Definition:

A vaccine that reduces the probability of infection per exposure but does not confer full immunity to any individual.

Example:

A malaria vaccine that halves the risk of infection per mosquito bite.

Significance:

Affects modeling of vaccine impact and design of immunization strategies.

91. All-or-Nothing Vaccine

Definition:

A vaccine where a proportion of recipients gains complete protection while the rest receive no benefit.

Example:

An adenovirus-vectored vaccine fully protects 70% of recipients, with 30% unprotected.

Significance:

Influences interpretation of efficacy and informs booster or alternative strategies.

92. Waning Immunity

Definition:

The gradual decline of protective immunity over time post-vaccination or infection, necessitating booster doses.

Example:

Pertussis immunity decreases after 5–10 years, prompting adolescent booster recommendations.

Significance:

Shapes vaccination schedules and booster policies to maintain long-term protection.

93. Antibody-Dependent Enhancement (ADE)

Definition:

A phenomenon where non-neutralizing antibodies facilitate viral entry into cells or enhance inflammation, worsening disease.

Example:

ADE concerns in dengue vaccine development where prior antibodies exacerbated subsequent infections.

Significance:

Essential consideration in vaccine design to prevent unintended exacerbation of disease.

94. Vaccine Hesitancy

Definition:

Delay in acceptance or refusal of vaccination despite availability, driven by complacency, convenience, and confidence factors.

Example:

Community dialogues addressing COVID-19 vaccine safety to reduce hesitancy.

Significance:

A major barrier to achieving coverage targets; understanding drivers informs communication strategies.

95. Cold Chain

Definition:

The temperature-controlled vaccine supply chain (typically 2–8°C) from manufacturer to administration point, preserving potency.

Example:

Solar-powered refrigerators in off-grid clinics maintain measles vaccine cold-chain.

Significance:

Critical for vaccine efficacy; breaks can lead to reduced effectiveness or wastage.

96. Vaccine Coverage

Definition:

The percentage of a target population that has received a specific vaccine dose or complete schedule.

Example:

An 85% DTP3 coverage rate indicates three-dose completion in 85% of infants.

Significance:

Key metric for program performance and identifying coverage gaps.

97. Booster Dose

Definition:

An additional vaccine dose given after the primary series to counter waning immunity and prolong protection.

Example:

Tetanus boosters recommended every 10 years to sustain immunity.

Significance:

Ensures long-term disease prevention and informs revaccination policies.

98. Multi-Dose Vial Policy

Definition:

WHO guidelines on safely using opened vaccine vials for multiple sessions (up to 28 days), balancing wastage reduction with contamination risk.

Example:

Using BCG vials across several immunization days under controlled cold-chain and hygiene measures.

Significance:

Improves vaccine access and cost-efficiency in resource-limited settings.

99. Vaccine Vial Monitor (VVM)

Definition:

A heat-sensitive label on vaccine vials that changes color as cumulative heat exposure increases, indicating when vials should be discarded.

Example:

Discarding OPV vials once the VVM's inner square matches the outer circle in color.

Significance:

Provides a simple, visual check to maintain vaccine quality at point of use.

100. Thermostability

Definition:

The ability of a vaccine formulation to withstand temperature variations without significant loss of potency.

Example:

A rotavirus vaccine stable for up to 14 days at 40 °C enables outreach in remote areas.

Significance:

Enables controlled temperature chain approaches, expanding immunization in challenging environments.

References and Further Reading

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