# Infection Prevention EpiNotes

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2010


**Epidemiology =** epi (upon) + demos (people) + logos (study).

**Descriptive epidemiology =** amount and distribution of disease within a population. Precedes analytic epidemiology. Uses numbers to tell a story.

**Analytic epidemiology =** reasons for frequency of disease.

**Inferential epidemiology =** makes an assumption about a population from a sample. Hypothesis testing.

**Prevalence** = existing cases at a given time.

**Incidence** = development of new disease over a certain time period.

**Incidence rate** = new disease cases divided by the population at risk.

**Incidence density** = new disease cases among persons at risk during a specific time.

**Attack rates** = ill ÷ ill + well x 100 during a time period; Noted as a %. Exposed and ill.

**Infectiousness** = # infected divided by the # susceptible.

**Pathogenicity** = # with disease divided by the # infected.

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2x2 table compares those with disease to those exposed. Can show odds ratio or relative risk.

**Odds Ratio** = a x d/ b x c= . Is the odds of exposure in cases divided by the odds of exposure in controls (no disease).

**Relative Risk** = a/a+b divided by c/c+d. Is the rate of disease in exposed divided by the rate of disease in unexposed.

**Rate Ratio** = Incidence density in exposed divided by the incidence density in the unexposed. Can use a 2 x 2 table and substitute person or time for the No Disease column.

| | Disease | No Disease | Total |
|---|---|---|---|
| Exposed | a | b | a + b |
| Not Exposed | c | d | c + d |
| Total | a + c | b + d | N |

**Case-Control**

- Retrospective
- Starts with disease cases
- Looks back for history of exposure
- Exposure odds among cases / Exposure odds among controls
- Compares frequency
- Measure of frequency= odds of exposure
- Measure of association= odds ratio

| | | |
|---|---|---|
| Disease Yes- | Exposed Y | |
| | Exposed N | |
| Disease No- | Exposed Y | |
| | Exposed N | |

**Cohort**

- Retrospective or prospective
- Starts with exposed cases
- Looks forward for disease
- Incidence of exposed / Incidence of unexposed
- Compares incidence rates
- Measure of frequency= incidence rate
- Measure of association= relative risk

| | | |
|---|---|---|
| Exposed Yes- | Disease Y | |
| | Disease N | |
| Exposed No- | Disease Y | |
| | Disease N | |

**Steps in an outbreak investigation:**

- Prepare for field work
- Verify diagnosis
- Confirm outbreak (compare present with baseline)
- Identify– count cases (case definition; line list)
- Tabulate and orient data (time, place, person)
- Take immediate control measures
- Formulate and test hypothesis
- Plan additional studies
- Implement and evaluate control measures
- Initiate new surveillance
- Communicate findings

**Sensitivity**= likelihood that someone with the disease/condition will test positive (greater sensitivity means fewer false negatives). a/a+c

**Specificity=** the likelihood that someone that does not have the disease or condition will have a negative test result (higher specificity means fewer false positives). d/b+d

**Positive Predictive Value**= the likelihood that someone who tests positive actually has the disease or condition. a/a+b

**Negative Predictive Value**= the likelihood that someone who tests negative actually does not have the disease or condition.

| True (+) | False (+) |
|---|---|
| c | d |
| False (-) | True (-) |

**Samples:**

**Biased**– some of the potential sample have no chance for selection.

**Unbiased**– everyone has a known probability of ≠ 0.

**Representative**– all groups will have equal opportunity of selection.

**Sample size–** calculated according to desired confidence level, precision, and proportion in the target.

**Hypothesis = Ho**

| Hypothesis/ Conclusion | True | False |
|---|---|---|
| Accept Ho | No error | Type II error (beta) |
| Reject Ho | Type I error (alpha) | No error POWER |

**Confounding**– effect a third variable has on the association between exposure and outcome. Must be associated with both disease and outcome. Prove by performing adjusted odds ratio.

**Independent variable**– the information you are given.

**Dependent variable**– what you are trying to predict.

Study Design: the procedure under which a study is carried out. 2 main categories:

- Observation (case series/case study, case-control, cohort (retrospective or prospective), cross-sectional or longitudinal, meta-analysis).
- Experiment (randomized controlled (double-blind, single-blind, non-blind), nonrandomized trial (quasi-experimental).

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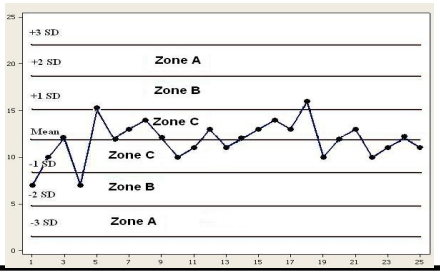
**Discrete data** counts (5 SSI cases). Categorical data counts events and non-events (20 SSIs and 80 without SSI out a 100 surgeries). Non-categorical data counts events only (10 VAP out of 1000 vent days) .
**Continuous data** measures (# of patient falls). Continuous data not commonly expressed in HAIs.

**Statistical Process Control:** can use discrete (categorical or non-categorical) data as well as continuous data.
**When to use p chart**– categorical data. Events and non events can be counted. Example is SSI rate (can count surgeries that got infected as well as surgeries that did not).
**When to use u chart**– non-categorical data. Can only count events so estimates potential at risk. Example is estimating post-discharge SSI rates.
**When to use c chart**– non-categorical data with stable denominator.
**Special cause variation** has an irregular or unnatural cause. Influenced by a cause outside the process system (unpredictable).
**Common cause variation** is the result of random variation in the process attributable to a regular cause. A stable process with predictable variation.
When viewing a control chart, evaluate **trend, shift and pattern**. Rules for evaluating an control chart for special cause variation include:

- Any point above the upper control limit or below the lower control limit
- 1 or 2 points above or below 2 standard deviations (Zone A)
- 4 of 5 points above or below 1 standard deviation (Zone B)
- 8 points in a row above or below the center line
- Trends of 6 points in a row increasing or decreasing
- 15 points in a row inside Zone C
- 14 points in a row alternating up and down
- 8 points in a row outside Zone C




**Run charts:**

- Are useful for process variation
- Looks at a situation over time
- Helps to analyze for patterns
- Good when < 25 data points

**Control charts:**

- More sensitive than a run chart
- Uses mean and standard deviation
- Provides upper and lower control limits
- Identifies special cause
- Need at least 25 data points

**Measures of Central Tendency:**

- Mean (average of all values)
- Median (half the values are greater and half are less)
- Mode (most frequent value)

**Correlation (r): direction and magnitude of a relationship between 2 variables**

- Positive correlation (+)r = as one variable increases, so does the other
- Negative correlation (-) r= as one variable increases, the other decreases
- No correlation (o)r= no association between the two variables

p value= Power. The probability of obtaining a statistic at least as large as what you would have gotten if the hull hypothesis (Ho) were true.

**Distribution:**

- Range– highest value minus the lowest
- Deviation– actual distance of each observation from the mean
- Standard deviation– measures the average spread around the mean
- Variance– standard deviation squared

**Parametric tests for association:** Normally distributed data

- More accurate– likely to reject Ho when it is false. Only valid with normal distribution.
- Z test– compares means between different samples
- Student's t test—compares means between 2 different samples
  - One-tailed or two-tailed
- ANOVA (comparing means between > 2 samples)
- Regression analysis

**Non Parametric tests for association:** Non-normally distributed data

- Chi square
  - Discrete data (observed against expected)
  - Measures observed against expected
  - Cannot use if one cell is 2 x 2 table is < 5
- Fischer's exact text used for small sample size
- Mann -Whitney U test (or Wilcoxon rank sum and Kendall's S ) compares median between 2 samples

**Confidence Interval**– Calculating a confidence interval identifies a "range" of values that the population value might be.

**Some behavior theories relevant to infection prevention:**

What people know and think affects how they act. Knowledge is necessary for, but not sufficient to produce, most behavior changes. Perceptions, motivations, skills, and the social environment are key influences on behavior.

**Health Belief Model** addresses individual's perception of the threat, benefits of avoiding threat, and factors influencing decision to act.

**Stages of Change Model (Transtheoretical)** describes individual's motivation and readiness to change a behavior

**Theory of Planned Behavior** examines relations between individual's beliefs, attitudes, intentions, behavior, and perceived control over that behavior.

**Precautions Adoption Process Model** names seven changes in an individual's journey from awareness to action.

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**Evaluating the Research Literature:** The following outline is to help you critique a research article. Use this as you review an article to help identify strengths and weaknesses. Note that not all of the questions in each section may apply to the type of research described in your article.

Title:

- Is the title clear and informative and does it accurately describe the nature of the research?

Abstract:

- Does the abstract provide a short summary of the entire research report and is it brief and clear?

Introduction:

- What is the purpose of the paper and is that purpose clearly stated?
- Is there a review of existing literature?
- Is it a balanced summary of existing work?
- Does the literature review highlight how the current research paper will build on earlier findings?
- Are conceptual variables discussed and operationally defined to become measured variables?
- Is the research question/hypothesis clearly stated? What is it?

Methods:

- What was the population and was it clearly identified?
- How was the sample selected and was that process described?
- Was the sample size reported and, if so, what was the size and were there enough subjects to detect significance?
- Did the authors justify the sample size?
- Who was included/excluded in the sample?
- If the sample used volunteers, was there a comparison with non-volunteers? What were the similarities and/or differences?
- Was there a comparison of people completing the study vs. those dropping out (for surveys, comparison of respondents vs. non-respondents What were the similarities and/or differences?
- What was the research design?
- Were the treatment and control groups comparable? If they differed, how?
- Did the authors create the treatment and control groups or did they use intact groups? If they created them, how were subjects assigned to groups?
- Did the subjects know which group they were in during the study?
- Did the examiners know which group was the treatment and which was the control?
- If new measures were used, were they validated? How?
- If examiners were used, were they trained and calibrated? How?
- If examiners were used, was interrater reliability assessed? How?
- If a questionnaire was used, was reliability assessed (test-retest, coefficient alpha)? How?
- Were the levels of the independent and dependent variables clearly defined? What were they?
- Was the manipulation process of the independent variable discussed?

Results

- Were the appropriate results of the tests of the hypothesis reported (e.g., means, standard deviations, p values, r, etc.)?
- Was the statistical analysis appropriate for the level of data collected? What analysis was used and why was it appropriate or inappropriate?
- Were the tables and figures clear and easy to read?
- Was there enough data included in the article that you could judge the appropriateness of the analysis?

Discussion/Conclusions

- Did the author review the major findings and provide an interpretation of their meaning?
- Did the author compare the findings with other research findings?
- Did the author note limitations of the research? What limitations were not addressed, if any?
- Did the author assess the generalizability of the research?
- Did the author suggest next research steps?
- Did the author distinguish between statistical significance and clinical importance? If not, do you think that there is a difference between statistical significance and clinical importance in this article?

References

- Does the reference section contain sufficient information for the reader to locate the article being referenced?
- Are all sources cited in the paper included in the reference section?

Your Critique

- In your opinion, what were the strengths and weaknesses of this research/article?