How to Read a Paper

EBCP Module #7
Outline of Module

- This module will introduce the following topics:
  - Format of primary literature
    - IMRaD
    - Structured abstracts
  - Getting your bearings
    - Question
    - Exposure and outcome
      - Primary versus secondary endpoints
    - Study population
Objectives of Module

- **Students who complete this module should be able to...**
  - Describe the general format of a scientific paper from the primary literature.
  - Identify from an article in the scientific literature:
    - Clinical question
    - Study design
    - Study population
    - Variables analyzed (exposure & outcome)
    - Study results
Putting It Together
Putting it together

- In the preceding modules, you have learned a good deal of vocabulary related to EBCP, including:
  - Study designs
  - Statistical tests
  - Types of variables
  - Types of error

- You have also learned about hypothesis testing, the specific process by which questions are asked and statistical tests are conducted to answer that question.

- In this module, you will combine this knowledge and apply it to a paper from the medical literature.
IMRaD Format
Many of you are probably familiar with the traditional layout of scientific studies. You may have observed that studies are often presented in the following four sections:

- **Introduction** – containing information on *why* the study was undertaken
- **Methods** – containing information on *how*, *when*, and *where* the study took place
- **Results** – containing information on *what* the study showed (and)
- **Discussion** – containing information on what the results of the study *mean*, and *limitations* of the study
In addition to the standard IMRaD sections, most medical research studies are published with a structured abstract. Structured abstracts often contain summary details of the IMRaD sections. They may also contain additional category headings, such as “study design” and “study population” that are useful to orient a reader.

These abstracts can be viewed through PubMed and can be used by clinicians to determine whether or not a study is worth reading in further depth.

However, it is important to remember: Reading an abstract is not equivalent to reading an entire article. Abstracts do not contain the nuance or detail of whole articles. Abstracts are insufficient guides to make informed decisions in clinical care.
Getting Your Bearings
Separating the Wheat and Chaff

- It may be a surprise to some students that many clinical articles are of little or no use to your clinical practice.
  - Certain studies may be misleading, wrong, or just a waste of time.
  - In fact, an uncritical reading of some may even be harmful.

- Such a point is not meant to discourage the student or to disparage clinical research.
  - Basic Research is of necessity a process of trial and error—and of testing and retesting—and there are bound to be mistakes in it.
  - Any student familiar with the history of medicine will recognize that medical knowledge is constantly being challenged and revised.

- For these reasons, it is crucial that clinicians learn to identify useful articles from the rest—to separate the wheat from the chaff.
Getting Your Bearings

- The best way to start in determining whether an article will be useful to clinical practice is to first determine:
  - What clinical question does this article attempt to answer?

- You should then consider:
  - In what context was the study conducted?
    - What population was studied? (Who)
    - Where and When did the study take place?
  - What was the basic study design?
    - Was it experimental or observational? Prospective or retrospective?
  - What was the “exposure” in the study? And the primary outcome of interest?
    - What kinds of variables were used to represent the exposure and outcome(s)?

- In this module, we fill focus on these questions, which are useful for getting your bearings.
  - In later modules, you will learn to critically appraise the results of a study—an important skill required to determine how what you read might apply to your own patients.
Example

- To illustrate the steps useful to get your bearings, we will refer to the following study, published in the September 21, 2012 issue of NEJM.

A Trial of Sugar-free or Sugar-Sweetened Beverages and Body Weight in Children

Janne C. de Ruyter, M.Sc., Margreet R. Olthof, Ph.D., Jacob C. Seidell, Ph.D., and Martijn B. Katan, Ph.D.
Example: Abstract

Abstract

BACKGROUND: The consumption of beverages that contain sugar is associated with overweight, possibly because liquid sugars do not lead to a sense of satiety, so the consumption of other foods is not reduced. However, data are lacking to show that the replacement of sugar-containing beverages with noncaloric beverages diminishes weight gain.

METHODS: We conducted an 18-month trial involving 641 primarily normal-weight children from 4 years 10 months to 11 years 11 months of age. Participants were randomly assigned to receive 250 ml (8 oz) per day of a sugar-free, artificially sweetened beverage (sugar-free group) or a similar sugar-containing beverage that provided 104 kcal (sugar group). Beverages were distributed through schools. At 18 months, 26% of the children had stopped consuming the beverages; the data from children who did not complete the study were imputed.

RESULTS: The z score for the body-mass index (BMI, the weight in kilograms divided by the square of the height in meters) increased on average by 0.02 SD units in the sugar-free group and by 0.15 SD units in the sugar group; the 95% confidence interval (CI) of the difference was -0.21 to -0.05. Weight increased by 6.35 kg in the sugar-free group as compared with 7.37 kg in the sugar group (95% CI for the difference, -1.54 to -0.48). The skinfold-thickness measurements, waist-to-height ratio, and fat mass also increased significantly less in the sugar-free group. Adverse events were minor. When we combined measurements at 18 months in 136 children who had discontinued the study with those in 477 children who completed the study, the BMI z score increased by 0.06 SD units in the sugar-free group and by 0.12 SD units in the sugar group (P=0.06).

CONCLUSIONS: Masked replacement of sugar-containing beverages with noncaloric beverages reduced weight gain and fat accumulation in normal-weight children. (Fund by the Netherlands Organization for Health Research and Development and others; DRINK ClinicalTrials.gov number, NCT00893529.)
What is the Question?

- First, always ask yourself: What is the question that the authors of this study were trying to answer?

- In this study, you might say that the researchers considered the effects of sugar-sweetened beverages.
  - However, this answer leaves open a number of important issues:
    - Effects compared to what? (e.g., to the equivalent of water?)
    - What effects? (e.g., weight gain or diabetes?)
    - Among whom? (e.g. children or elderly?)

- You may remember that a well-constructed clinical question may follow the PICO format:
  - Here, we should consider:
    - Patient/Population: Children
    - Intervention: Sugar-sweetened beverages
    - Comparison: Sugar-free beverages
    - Outcome: Body weight

- In a full sentence, the question asked by this study could be written:
  - Among children, what is the effect of sugar-sweetened beverages on body weight when compared to sugar-free beverages?
What is the Question?

- Using the PICO format helps us to see that this study does not answer a number of related questions that may be relevant to clinical practice.

- For example, the study does not answer whether sugar-sweetened beverages are healthier or less healthy than sugar-free ones.
  - The outcome matters. Sugar-free beverages may have other effects not considered by this study.
Beyond PICO: Context

- Beyond PICO, it is important to consider the context of a study.
  - **Who** participated?
    - We can read in the Methods section that the participants in this study were students aged 4 years 10 months to 11 years 11 months.

- **When** did the study take place?
  - We can also read in the Methods section that the study lasted from 2009 to 2011.

- **Where** did the study take place?
  - In the Methods section, it is stated that it took place in urban area elementary schools in Amsterdam.

- These questions help us to consider the *generalizability* (also called external validity) of the study results.
  - They should allow us to consider issues such as whether the study results might be relevant to our own clinical context.
  - Generalizability will be addressed in further depth in later modules.
Beyond PICO: Exposures and Outcomes

- You may remember the term “exposure” from a previous module.
  - Exposure often refers to an intervention, but may also refer to other factors such as a disease or genetic trait (as you would see in a prognosis domain question), or an environmental exposure or a lifestyle choice (as you might see in a risk/etiology domain question).

- It is important to understand exactly what exposure was assessed in a study.
  - What was the exposure?
    - Sugar-sweetened beverage.
  - How much?
    - An 8oz, 108 calorie, sugar-sweetened beverage given once per day.
  - How long?
    - Children received the beverages daily for 18 months.

- The answers to these questions also affect generalizability. For example, the average amount of weight gain associated with sugar-sweetened beverages in this study is not necessarily what you might find with one of your own patients who drinks multiple sugared sodas daily and has for many years.
Similarly, the outcome should be fully considered.
- In this study, the primary outcome is body-mass index (BMI).
  - The “z-score”—a statistical transformation—was used to allow simple comparisons between students’ BMI measurements.

It is useful to distinguish between primary and secondary outcomes where they exist.
- You may note that the authors of this study also considered weight, skinfold-thickness measurement, waist-to-height ratio, and fat mass as outcomes, as well as adverse events—these were secondary outcomes.

The primary outcome is usually identified by the authors of an article in order to both help with readability, as well as improve statistical efficiency.
- Remember the issue of multiple comparisons from Module 5. It is important to limit the number of comparisons made to reduce the overall likelihood of a type I error.
By now, you should be able to identify the *types of variables* used in both exposure and outcome assessments.

- Some may be *categorical*, such as the exposure measurement used here (sugar-sweetened group and sugar-free group).
- Some may be *continuous*, such as the primary outcome measurement used here (BMI).

You can imagine how modifying these variables and variable types might affect the outcomes of a study:

- Consider, for example, the possibility of using the outcome obese (BMI≥30) and non-obese (BMI<30). How do you think that this would have affected the study results?

*refer to Module 4 from CAPS-I for review of this concept.*
Further considerations

- Given what you have already learned, you should also be able to identify:
  - The type of study design used in this trial.
    - It was a clinical trial (an experimental study, as the beverage exposure was assigned by the investigators).
    - Refer back to the abstract – Was it randomized? Was there a control group? Was there blinding?
  - The null hypothesis.
    - Children drinking sugar-sweetened beverages will show no difference in average BMI compared to students drinking non-sugared beverages.
  - The alternative hypothesis.
    - Children drinking sugar-sweetened beverages will show a difference in average BMI compared to students drinking non-sugared beverages.
  - The allowed type I error.
    - Alpha was set at 5%.
Bearings ≠ Critical Appraisal

- The points raised in this module should be sufficient to help you to get a sense of what a paper is about and to consider whether it might have use in addressing a clinical question that you have.
  - But remember, nothing can compensate for good science. A study may be flawed, regardless of whether the question it addresses is incredibly interesting, its context perfectly relevant to your patient, or its results “statistically significant.”
    - These perks cannot make up for major design flaws.

- In future modules, you will learn to distinguish between studies based on their quality and to understand their strengths and limitations—in short, to appraise them critically.

- Clinicians have a responsibility to be “skeptics” and learn to read research studies critically in order to provide the best possible evidence-based care to patients. (Just because you find it in MEDLINE does not mean it’s true!)
Key Points for Module 7

- The IMRaD format provides a standard framework to communicate scientific research.

- To get your bearings on an article presenting clinical research, you should always ask first: What question does this article try to answer? The PICO format provides a useful way to structure the research question.

- Additionally, you should always consider the study’s context, exposure and outcome definitions, and study design.

- Given these facts, you should have enough information to determine whether a study is of interest to you. However, this is distinct from knowing whether or not the study is valid & useful. A study’s value can be better determined through further critical appraisal.
Please complete the online quiz.

Thank you!

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