International Pharmaceutical Students' Federation

IPSF RESEARCH 101 BOOKLET

RESEARCH MADE EASY FOR BEGINNER AND INTERMEDIATE PHARMACEUTICAL RESEARCHERS.

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Sama Ghozlan - Pharmaceutical Sciences Initiatives Coordinator 2023-2024

First edition

THIS BOOKLET

This booklet, led by the Pharmaceutical Sciences Initiatives Team 2023-2024 under the guidance of Sama Ghozlan and her team, aims to be a valuable resource for undergraduate and graduate pharmacy students, as well as professionals in the field. With a focus on scientific research, the content of this booklet provides a comprehensive guide that covers various aspects of the research process. From methodologies and data analysis techniques to ethical considerations, readers will gain a deep understanding of how to conduct rigorous and impactful research in the field of pharmacy and related disciplines. The expertise and dedication of the team behind this booklet ensure that readers will be equipped with the necessary tools and knowledge to excel in their research endeavors.

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Andries Bickerweg 5, 2517 JP - The Hague, Netherlands
ipsf@ipsf.org
Tel +31-703021992 | **Fax** +31-703021999

TABLE OF CONTENT

CHAPTER 1

INTRODUCTION TO RESEARCH

1.1. Definition and significance of research in pharmaceutical sciences

When it comes to science, the key is "research." Science is all about discovering new things, and to confirm these discoveries, we need to establish a solid foundation. This involves presenting our findings systematically and understandably for people to grasp. In Pharmaceutical Sciences, creativity, new ideas, and a systematic thought process are crucial for effective work and expanding our understanding of drug development and new medicines.

Let's be real—the research process is **tough**. And it's probably going to stay that way, especially if we're not using fancy artificial intelligence. This booklet is not made to "make research easy", it is to "make research **easier**". We hope that this can set as a baseline for young researchers to understand how to kickstart their research journey.

1.2. Explanation of research and the scientific method

Before we start, it is important to first understand what the word "research" really means. Research is the search for new knowledge. Research is the gathering or investigation of factual information that can arrive at some sort of a conclusion or finding. When one conducts research, that means you are attempting to discover something new, to make sense of this void of things yet to be explained.

Of course, when put that way, it *might* sound a little bit intimidating, but one doesn't have to achieve scientific breakthroughs for one's initiative to be called a 'research'. It can start with small steps, like, backing up an existing idea, going against what people already think, or taking a theory to the next level. If you're ticking off one or more of these boxes, congratulations—you've just done some research of your own!

1.3. Overview of research types: qualitative and quantitative

In general, there are two types of research:

Qualitative Method: Method of inquiry that focuses on the in-depth exploration of underlying

reasons, motivations, and meanings behind a particular phenomenon. A qualitative study is prone to subjectivity and acquires data in the form of interviews, focus groups, observations, and open-ended surveys.

Quantitative Method: Method of inquiry that uses statistical, mathematical, or computational techniques to acquire data. This study uses variables as a way to draw conclusions, and it strives for objectivity through predefined data. The quantitative method is expected to be replicable and supports large sample sizes.

Exercise 1.1: *Is this research qualitative or quantitative?*

1. A statistical approach to the efficacy of an Antimicrobial Resistance Program in Hospitals
2. Dissecting the importance of ethnopharmacology through interviews with relevant experts
3. Quantifying the amount of contaminants through UV-Vis Spectrophotometry
4. Identifying the chemical compound through UV-Vis Spectrophotometry
5. Aseptic Method Quality Control by enumerating the amount of particles in the room

1.4. Key stages of the research process: problem identification, literature review, research design, data collection, data analysis, interpretation and dissemination of findings

Before we start, you must also familiarise yourself with the **key stages of the research process:**

1. **Problem Identification:** Start off with a research question, one that you will find the answer to by the end of the research. The research question can be based by an existing problem that requires further investigation.
2. **Literature Review:** Do a 'recap' of all the available research that has already been conducted related to your research question, and reorganize them properly for clarity and ease of dissemination.
3. **Research Design:** Choosing the right research design is important so that one can know what kind of data they are about to collect and in what way they will interpret it. A research design can briefly consist of the type of research (qualitative or quantitative), the way of acquiring data (interview, instrumental analysis, descriptive experiments), the required sample, and the expected results.
4. **Data Collection:** This step is rather technical, and it consists of the content and results that were obtained from the research that has been conducted. Collected data must be approved to be accurate and based on reliable sources.
5. **Data Analysis:** Analyse the data by looking for patterns and removing anything that doesn't fit. This step refines your information and prepares it for interpretation.

6. **Interpretation:** The polished data must be able to be interpreted in a way people can understand. Interpretation can be in the form of written explanations, pie charts or tables so that people can get the bigger picture.
7. **Dissemination of Findings:** Connect your findings back to your original question. Answer the question based on what you found, and suggest new questions for future research. Sharing your results helps others learn from your work and encourages more research in the same area.

Answers for Exercise 1.1

1. Quantitative
2. Qualitative
3. Quantitative
4. Qualitative
5. Quantitative

CHAPTER 2

FORMULATING RESEARCH QUESTIONS

2.1. Importance of well-defined research questions that are specific, measurable, achievable, relevant, and time-bound (SMART)

The first stage in any research project is to formulate a research question. A carefully constructed research topic serves as both a guide for your research and an indication of its success.

All research questions should be:

Specific (S):

A precise research question is unambiguous, succinct, and leaves no space for doubt.
It is simpler to handle because it focuses on a specific subject or problem

Tips:

The five "W" questions must be considered:

Who: Who is contributing to this endeavor?

What: What goals do I have in mind?

Where: Where do we want to accomplish this goal?

When: When do I hope to accomplish this objective?

Why: What motivates me to accomplish my goal?

Measurable (M):

Research questions that are measurable facilitate the gathering of quantifiable data and supporting documentation. This helps researchers to evaluate the success and advancement of their work.

Tips:

How much or how many?

How can I tell if I've accomplished my objective?

What is my progress indicator?

Achievable (A):

Objective is realistic given the realities faced in the community. Setting reasonable objectives helps set the project up for success.

Tips:

Do I possess the tools and abilities necessary to accomplish the goal? What am I missing, if not?

Has anyone else done it effectively before?

Relevant (R):

An appropriate research question supports the aims and objectives of the research. It needs to tackle a remarkable problem in the research area.

Tips:

Is the objective reasonable and feasible?

Given the time and resources available, is the goal achievable?

Can you make a commitment to finishing the task?

Time-bound (T):

A SMART objective needs to have a start and end date in order to be considered time-oriented Without a time limit, there won't be any sense of urgency and, consequently, less incentive to c omplete the task.

Tips:

Does my objective have a timeframe?

When do you hope to accomplish your objective?

2.2. Guidelines and examples for formulating clear and focused research questions.

A. Before selecting a topic, familiarize yourself with the subject by widely reading it. Consider

that topic would be interdisciplinary perspective, meaning there is sufficient published material or articles pertaining to the subject.

B. Developing research questions:

1. **Clarity:** The study question needs to be precise and unmistakable. It should clearly communicate the questions or topics you are attempting to research or explore. Keep your wording simple and straightforward to avoid confusing readers.
   Example: "How does regular physical exercise impact cognitive function in adults aged 50 and above, as measured by standardized memory and attention tests?"
2. **Specificity:** Rather than being too general, the question should be focused. Reduce your attention to a single interesting variable or facet. A well-defined research question facilitates unambiguous study direction and enables more targeted data gathering and examination.
   Example: "What are the environmental and economic implications of implementing a plastic waste recycling program in urban areas?
3. **Relevance:** Make sure the research question you've chosen is pertinent to your discipline or area of study. It ought to fill a vacuum in the literature, close a knowledge gap, or have applications. Think about the importance and possible consequences of your research question.
   Example: "What is the impact of social media usage on the mental well-being of adolescents, and how does this vary across different socio-economic backgrounds?
4. **Feasibility:** Evaluate the feasibility of your research question. Consider the available resources, time constraints, and ethical considerations. Make sure that the question is realistic and can be addressed within the limitations of your study.
   Example: "What are the factors influencing the adoption of telehealth services among elderly populations, and how can potential barriers be addressed to improve accessibility?"
5. **Measurability:** The study question ought to be observable or quantifiable. This implies that gathering and analyzing data need to be feasible in order to offer a response or bolster findings. Ensure that the pertinent data can be collected and that your query can be operationalized.
   Example: "What is the relationship between daily screen time duration and sleep quality in adolescents, as measured by the Pittsburgh Sleep Quality Index (PSQI)?"
6. **Relation to research design:** Take into account the methodology and research design you intend to employ. Make sure that the research topic is compatible with the strategy of choice and can be satisfactorily addressed using the tools of choice.

Example: "What are the most effective interventions for reducing anxiety symptoms in college students, and how do these interventions compare in terms of accessibility and cost-effectiveness?"

7. **Open-endedness:** Try to formulate research questions with as much room for interpretation, analysis, and investigation as possible. A simple "yes" or "no" response to a question should be avoided as it may restrict the breadth and complexity of your research.
   Example: "To what extent do leadership styles influence employee job satisfaction and retention rates in the technology industry?"
8. **Prevent bias by being aware of any bias that might exist in your research question.** Aim to ask a neutral, objective question so as not to influence the results or guide participants in any certain direction.
9. **Iterative refinement:** Keep in mind that as the research process progresses, research questions can be adjusted and changed. Be willing to make revisions and adjustments to your inquiry as you get new information to make sure it stays pertinent and useful.

2.3. Emphasis on aligning research questions with the research objectives and hypotheses

1. Clear Articulation of Objectives:
   Start by outlining your study goals precisely. These are the precise, quantifiable objectives you hope to accomplish with your research. As an example:
   objective: "To assess the impact of [intervention] on [outcome] among [target population].
2. Translate Objectives into Research Questions:
   Divide each goal into the related research topics. These questions should directly address the specific parts of the objectives. As an illustration:
   The Question of the Study: "How does [intervention] influence [specific aspect of outcome] in [target population]?"
3. Formulating Hypotheses:
   Create conjectures in response to your research questions. A clear statement of what you hope to discover in your research is provided by your hypotheses. As an illustration:
   It is predicted that among [target group], [intervention] will result in a notable improvement in [particular outcome].
4. Consistency in Terminology:
   Make sure the language you use in your objectives, hypotheses, and study questions is consistent. This keeps everything clear and prevents confusion.

5. Prioritizing Key Research Questions:
   Determine which research questions are most important and directly related to your main goals. Reaching the goal of the study should be largely dependent on these questions.
6. Testing Hypotheses Through Questions:
   Formulate research questions that will help you evaluate your theories. Every research question needs to touch on some aspect of your hypotheses.
7. Avoiding Redundancy:
   Ensure that each research question brings distinct value to the study. Don't ask the same questions over and over again in an attempt to save repetition.
8. Pilot Testing:
   To make sure your research questions are gathering the data necessary to meet the goals, think about conducting a pilot study. Modify the questions in light of comments and initial findings.
9. Feedback Loop:
   Create a feedback loop involving the objectives, hypotheses, and research questions. Throughout the course of the research process, periodically review if your research questions are consistent with the changing goals and theories.

CHAPTER 3

LITERATURE REVIEW

3.1. Introduction

The literature review is a type of academic writing that searches and evaluates the literature "sources" in your topic or area. In a literature review, you recap the important information from the sources and then re-organise them. A literature review depends on 2 large steps the first is summary "recap" and the second is synthesis "reorganization"

3.2. But why is it important?

Provides a foundation and comprehensive knowledge of your topic as it covers a large of sources so it is considered a handy guide to keep you up to date with what is current in the field

Identify the need for additional research when you know what is the latest news and the progress related to your topic then you will be able to identify what remains unknown "the knowledge deficit or gap" and show readers why your research needed to be done "justify your research"

Inform the methodology, the literature review summarizes a large number of papers and this means it contains a lot of ideas and methods that you can study and learn from which is known as "knowledge claims "

3.3. How to review the literature?

Before you go and search for papers to review you must do steps, first is to identify your topic and the second is to know the sources you will search

3.3.1. Identify Your Topic

It should narrow the scope of the literature review and avoid wasting time, to do this you need to go through 4 steps:

- ✔ Reflecting the scope of the literature and this means knowing the coverage that defines the knowledge you will present and the organization that builds your sequence of argument and the audience in which the paper is written.

- ✔ Writing headings and subheadings, increase the level of depth of your reflection and stimulate the argument.
- ✔ Identify the keywords, they are the main keywords in your topic and will guide your literature and guide the reader throughout it.
- ✔ Time interval and language, involving all the recently published documents and classic documents in the field can be included. Decide if you want all your papers in English or not and you must pay extra attention to translating if there are different languages included.

Exercise 3.1:
One of the common problems is that Citations "papers included" are too old (ie, more than 10 years), search how you can overcome this problem

3.3.2. Scientific sources (literature)

There are 3 types of sources: primary, secondary, and tertiary.

a. **Primary sources:** are original materials. It is authored by researchers, contains original research data, and is usually published in a peer-reviewed journal. They have advantages as they provide the most current knowledge "cutting edge" and provide the ability to evaluate the results by yourself also have detailed information related to the topic. But be careful because misleading conclusions based on one trial, require good skills to evaluate the results and time-consuming. The quality of the journal can be evaluated by the impact factor and peer-reviewing process.

   Impact factor: Is the ratio between the number of citations received in that year for publications in a journal that was published in the two preceding years and the total number of "citable items" published in the journal during the two preceding years. Journals with higher impact factor values are more important, or carry more prestige in their respective fields, than those with lower values.

   2-year Impact Factor: Metric calculated by Clarivate Analytics. The 2-year journal Impact Factor is the average number of times articles from the journal published in the past two years have been cited in that year. It is calculated by dividing the number of citations in the year by the total number of articles published in the two previous years.
   SJR = Scimago journal rank
   The higher the SJR, the higher the quality of the journal

   Peer-reviewing process: the scientists send their paper to the journal and then the journal editor receives it and sends it for peer review and the editor may reject it when does not

maintain high scientific standards. Peer reviewers read and evaluate the papers and send comments to the editor if the paper meets the editorial standards it is published in the journal. Examples of journals are the LANCET, JAMA (the Journal of the American Medical Association), BMJ (British Medical Journal) and The Journal of Pharmacy and Pharmacology

Exercise 3.2:
Evaluate the following journal regarding impact factor, SJR, and peer-reviewing
CA: A Cancer Journal for Clinicians

b. **Secondary sources (databases):** are resources that are used to identify primary references and Provide a Pathway to the primary literature "primary sources".
Papers < peer-reviewed journals < indexed database.
Common indexed databases are Google Scholar, Scopus, Embase, PubMed, and Clarivate analytics.

c. **Tertiary sources (Tertiary references/databases)** are those that contain a collection of information from primary and secondary literature, and they add value by summarizing or interpreting original works. Textbooks, reference books, databases, monographs, and review articles are types of tertiary literature. (Do not contain original information)
Why do we use tertiary sources?
The most appropriate and efficient first step to finding information is to consult tertiary resources before searching for other types of resources as it adds value by summarizing or interpreting original works.
    - The information is filtered and summarized
    - The initial place to identify information
    - More easy and convenient when compared with other sources
      But tertiary sources still have some limitations like the lag time between writing and publishing original papers and publishing the tertiary source, and also the author biases (misleading, inaccurate, and incomplete information) a problem that you may face.

Examples of General drug tertiary sources that are important for pharmacists
- American Hospital Formulary Service (AHFS®) Drug Information. AHFS DI is available in paper format (updated annually) and online version alone or as a part of the subscription in databases such as Lexicomp or free as Drugs.com.
- Drugs.com
- Lexicomp®
- Martindale: The Complete Drug Reference

Specific drug sources:
- Meyler's Side Effects of Drugs: The International Encyclopedia Of Adverse Drug Reactions and Interactions

- Comprehensive Toxicology Information (TOXNET)
- Drugs and Lactation Database (LactMed)

Exercise 3.3:

Concerning the use of drugs during pregnancy, is Furosemide under FDA pregnancy category A OR C?

3.3.3. Review the literature

Here we go to start our literature.

Searching the literature, define which databases, official documents, and books will be searched. Determine and define Keywords, syntax, and MeSH (for Pubmed) to search effectively.

Search strategy

You must write a good search strategy before starting to search the literature;

The most important step in formulating your search strategy is to formulate your research question. A good research question should have some standards such as being specific and clear and also should answer some issues to make sure you are on the right way like who is the patient or the disease and which drug your research will answer gaps related to it. There are methods to help in this and one of the methods that are used is the PICO method. Each letter in PICO refers to an issue.

- **P in PICO** refers to **POPULATION** and it means the patient or the problem you will address and you are interested in it.
- **I in PICO** stands for **INTERVENTION** and this means the exposure in your study, can be a drug, treatment, surgery and tests.
- **C in PICO** is for **COMPARISON**. In many clinical research, there are always another group to help in extracting accurate results and to make sure that these results are because of your intervention. For example, if you used a diabetes mellitus drug (x) which lowers blood glucose level (lower blood glucose level means good drug for diabetes mellitus),you may have any bias or other conditions that also lowering blood glucose level and this will affect your accuracy because we don't know is the effect of lowering blood glucose level is a result for your drug or these conditions .so to make sure that it is your drug which made the effect you can use other drug or placebo (tablet with no drug in it) .and now we know that C in PICO means to have a control group and it can be another drug, placebo, treatment, standard for care or comparison intervention.

- **O in PICO** is for **OUTCOMES.** In your research, you should determine which outcome you will measure and this outcome must be the best for your research study because it is the way that will be used to measure your results and work. In the diabetes mellitus example, we used blood glucose to measure the effect of the drug but WHY? It is because when you need to control diabetes mellitus you need to lower the blood glucose level it is a must and the lower blood glucose level is good proof for your controlled diabetes mellitus. So, you need to choose your outcomes that are related to the disease and will measure and show your results accurately.

✔ First, keywords

Identify and extract the Main Words in your research question (PICO).
Research question = the effect of insulin in decreasing blood glucose levels in patients with type 1 diabetes mellitus.

What are the keywords?

Here we go…

P= Type 1 diabetes mellitus

I= insulin

C= none

O= decreasing blood glucose

Keywords = (Type 1 diabetes mellitus, insulin, blood glucose)

✔ Second, find out synonyms

Start to search your browser to find out the different words that describe each single keyword may also search PubMed and collect these words

✔ Third, the MeSH term is used when you search Pubmed.

It is a controlled and organized vocabulary produced by the National Library of Medicine.

Go to toMeSH term through the hyperlink, write your keyword, and add it to the search builder then copy it

✔ Fourth, Boolean operators

They are words AND, OR, NOT. They are written between your keywords to "precise" your search and save time.

- AND is used to narrow the search, it means that the paper must contain the two words before and after AND. Usually used to connect the synonyms of different keywords.
- OR is used to widen your search as it means that the paper should contain one of the words before and after OR. Usually used to connect the synonyms of the same keyword.
- NOT is used to exclude a certain word from the search and means that the papers must not contain the word after NOT

✔ Fifth, wildcards, are symbols to ease your search and maximize your search results in the database.
(?) Is used to replace any character (letter) or zero character (letter).
E.g.; colo?r will retrieve color or colour.
($) is used to replace one character; Ex wom$n will retrieve woman or women.
Asterisk (*), broadens the search by finding words that start with the same letters.
E.g.; student* will retrieve student or students.
Notice, asterisk must be used with words more than 3 letters
Use* (not applicable)

✔ Sixth, write the strategy, in this step, we use quotation marks to specify the synonym consisting of 2 words

E.g.; diabetes mellitus should be "Diabetes Mellitus"

And use rounded brackets to connect the whole synonyms together

E.g.; (Diabetes OR "Diabetes Mellitus")

Exercise 3.4

Build a search strategy for the following research question:

The effect of insulin in decreasing blood glucose levels in patients with type 1 diabetes mellitus explaining the sixth steps.

- Snowballing library, choose a paper related to your topic go to its reference list identify the relevant publications, and include them in your literature review, this also enables you to reference the original studies and contact the leading authors

- Selecting documents, in this step, you choose the documents that will be included in your research paper so select the recent peer-reviewed published papers, conference abstracts, and gray literature.

Now how to select the document?
First, read the title, and it must fulfil you inclusion criteria that you identified depending on your PICO, if the title meets your PICO include the paper, and if not exclude the paper. Then, these included papers need to be reviewed again and, in this step, you will read the abstract if meet your PICO include it and if not exclude it, then go to the full text of the included papers and include if meet or exclude when not.

Setting your inclusion criteria right:
- Does the article cover the right population?
- Does it cover the intervention set out in the review question?
- Is the outcome the one being examined in your review?

- Gray literature is the information published outside of the traditional way, it is like academic texts, working papers, and government documents.

3.3.4. logging, cataloging, and synthesizing the literature

i. Logging, the use of reference software programs to save the included papers. In this step, we will just insert the included papers into the program but it will help us in organizing the papers and ease the coming steps. References software programs are Mendeley, EndNote, Zetero, and paperline.
ii. Cataloging, after we insert the reference software programs, we will write a short sentence explaining why we have chosen each paper to include. And also, we can use Excel sheet
iii. synthesizing, to write the expected part in which you will use the paper while writing your research. For example, I included paper X because of the outcomes. The outcomes are expected to be in the results section so I write beside the paper "results section ". This step will help you when you start to write because, after it, everything is organized and collected together.

Logging	Cataloging	synthesizing
Paper title	Outcomes are the ones in my PICO	Results

Answers to Exercise

Exercise 3.1:

- Use filters in PubMed to narrow your research
- Cite old references only in the rare case that relevant contemporary studies are unavailable
- State the reference age and indicate the reason for citing
- Cite contemporary work and discuss how older and newer studies together inform current research

Exercise 3.2:

- Search SJR ranking
  CA: A Cancer Journal for Clinicians Journal impact factor is 254.7
  SJR IS 86.091
  The journal is peer-reviewed

Exercise 3.3:

Search drugs.com and LactMed, Furosemide is FDA pregnancy category C

Exercise 3.4:

Keywords

P=Type 1 diabetes mellitus

I=Insulin

C= none

O=Blood glucose

Synonyms

Type 1 Diabetes = type 1 diabetes mellitus = T1DM =hyperglycemia syndrome = insulin dependant diabetes mellitus =juvenile diabetes=IDDM=Autoimmune Diabetes=Brittle Diabetes Mellitus=Ketosis-Prone Diabetes Mellitus=Juvenile-Onset Diabetes Mellitus=Sudden-Onset Diabetes Mellitus

Insulin = Novolin = Sodium Insulin= Iletin

Blood glucose = blood sugar = plasma glucose = glucose = glycemia

MeSH

"Diabetes Mellitus, Type 1"[Mesh]

"Insulin"[Mesh]

"Blood Glucose"[Mesh]

Boolean operators

Type 1 Diabetes OR type 1 diabetes mellitus OR T1DM OR hyperglycemia syndrome OR insulin-dependant diabetes mellitus OR juvenile diabetes OR IDDM OR Autoimmune Diabetes OR Brittle Diabetes Mellitus OR Ketosis-Prone Diabetes Mellitus OR Juvenile-Onset Diabetes Mellitus OR Sudden-Onset Diabetes Mellitus OR "Diabetes Mellitus, Type 1"[Mesh]

Insulin OR Novolin OR Sodium Insulin OR Iletin OR "Insulin"[Mesh]

Blood glucose OR blood sugar OR plasma glucose OR glucose OR glycemia OR "Blood Glucose" [Mesh]

Write the search term

((“Type 1 Diabetes” OR “type 1 diabetes mellitus” OR “T1DM” OR “hyperglycemia syndrome” OR “insulin-dependent diabetes mellitus” OR “juvenile diabetes” OR “IDDM” OR “Autoimmune Diabetes” OR “Brittle Diabetes Mellitus” OR “Ketosis-Prone Diabetes Mellitus” OR “Juvenile-Onset Diabetes Mellitus” OR “Sudden-Onset Diabetes Mellitus” OR "Diabetes Mellitus, Type 1"[Mesh]) AND (Insulin OR Novolin OR “Sodium Insulin” OR Iletin OR "Insulin"[Mesh])) AND (“Blood glucose” OR “blood sugar” OR “plasma glucose” OR glucose OR glycemia OR "Blood Glucose"[Mesh])

CHAPTER 4

RESEARCH DESIGN AND METHODOLOGY

4.1. Research Design:

Research Design is the overall plan or strategy that answers your research question and guides your research project.

Why is a research design important?

- Provides a firm foundation for the researcher
- Ensures high-quality data and reduces inaccuracy
- Reduces bias
- Minimizes time

Research design includes experimental, observational, and qualitative designs

4.1.1. Experimental study

It is a method where the researcher systematically manipulates/changes one or more variables to determine their effect on a specific outcome

Randomized control trials (RCT)

These are prospective studies that determine the effectiveness of an intervention or treatment. Prospective data are data collected forward in time from the start of the study.

A random assignment of a sample occurs where one group receives the intervention (for example the tested drug) and the other does not (control/Reference group), outcomes are then compared between the two groups to check if the drug was effective.

Blinding:

is an important feature of RCTs because it ensures a high validity of results and reduces bias.

Types of blinding:

- Single: Only the participants are blinded (participants do not know which group they are in)
- Double: The participant and the Researchers are blinded
- Triple: The participant, researcher, support staff, and data analysts are all blinded.

Selection Criteria:

Inclusion Criteria: Refers to the qualifications that individuals must possess to be a part of the study.

Exclusion criteria: Refers to the factors that disqualify the individual from participating in a study.

Advantages:

- Demonstrates Causality
- Reduces Bias
- Eliminates the influence of confounding variables

Disadvantages:

- Expensive
- Ethical Limitations
- Time-consuming

4.1.2. Observational study:

It is a method where the researcher observes or records events without direct intervention or altering the subjects or environment.

It includes:

1. Cohort Study
2. Case-control study
3. Cross-sectional Studies

1. Cohort Study:

A type of observational study design where participants are selected based on their exposure status and then followed over time to evaluate the occurrence of an event.

Advantages

Can assess causality

Ability to establish a temporal sequence between exposure and outcome

Disadvantages

- Inefficient for rare outcomes or outcomes that take long periods
- They require a large sample size

2. Case-Control:

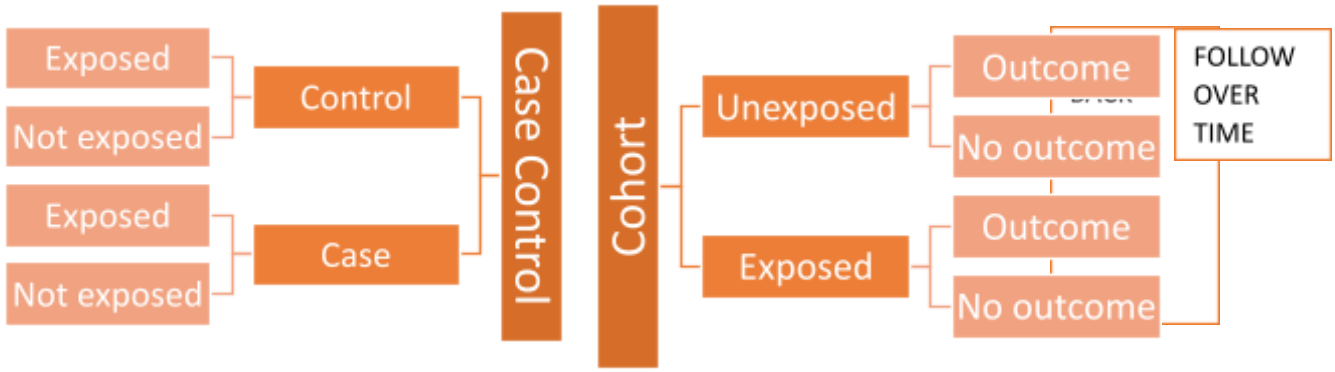
A type of observational study design that compares a group having an outcome/disease with a group without the outcome and then checks retrospectively if they were exposed to a certain factor to determine an association between the risk factor and the outcome.

Advantages

- Cheap
- Quick
- Good for rare diseases
- Good for diseases with a long latency period

Disadvantages

- Subjected to bias
- Recall Bias (inability of participants to remember events accurately)
- Selection bias
- Inability to find causation



3. Cross-sectional studies:

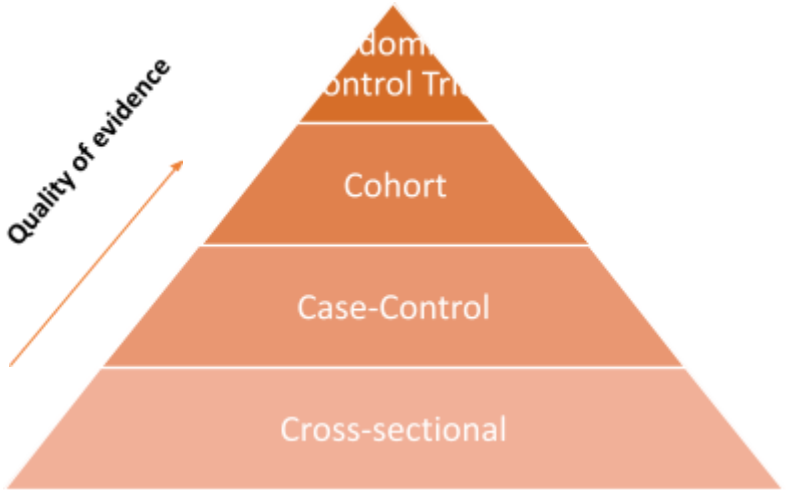
Type of observational studies that measure the cause and effect by collecting information/data from different individuals at the same time.

Advantages:

- Easy to conduct
- Inexpensive
- Can study associations of multiple exposures and outcomes

Disadvantages:

- Inability to measure the incidence
- No direct estimate of risk possible



4.1.3. Qualitative studies:

It is a type of research design that involves collecting and analyzing non-numerical data

i. **Phenomenological Research Design:** an approach that focuses on the meaning of lived experiences and how people perceive them.
Example: A phenomenological study was done on Nurse's experience caring for COVID-19 patients.

ii. **Grounded Theory:** is a strong inductive method for discovering new theories.
Example: your research aims to understand how people cope with chronic pain from a specific medical condition to develop a theory.
iii. **Ethnographic Research Design:** is the study of human societies and cultures
iv. **Case studies** (Most common qualitative studies): a detailed examination of a subject such as individuals, groups, events, or situations.

Exercise 4.1:

Choose the best answer

Case 1:

A study took a random sample of adults and asked them about their social media habits. The researcher looked at which group had a higher risk of depression

The study is:

A. Observational study
B. Experimental Study

Case 2:

A study randomly assigned group of adult volunteers into two groups

- One group was asked to use social media as they usually do
- One group was blocked from using the social media platform

The researcher looked at which group had a higher risk of depression.

The study is:

A. Observational study
B. Experimental study

Case 3:

You are interested in examining the impact of a new drug on a specific disease. You randomly assigned the participants to either the control group or the group receiving the drug. Which type of study design are you using?

A. Randomized Control Trial
B. Cohort study
C. Case-control study

Case 4:

A researcher is interested in examining the association between sun exposure and the development of skin cancer. He recruited a large sample of participants with varying sun exposure levels and aimed to follow them over the years. What is the best study design in this case?

A. Randomized control trial
B. Cohort study
C. Case-control study

4.2. Data collection:

The methodological process of obtaining information or observations is known as **data collection.**

How can you collect data?

1. **Surveys:** the collection of information from a sample of individuals through asking questions.
2. **Experiments:** It involves the manipulation of one or more variables to observe the effect of this manipulation.

   Variables:

   i. **Independent variable:** the variable that the researchers manipulate or change=cause
   ii. **Dependent variable:** the variable that is observed or measured in response to the manipulation of the independent variable =outcome
3. **Interviews:** A structured or unstructured conversation between two or more people to collect data by asking questions.

Types of interviews	Structured Interviews	Semi-Structured Interviews (Best of both)	Unstructured Interviews
	They have predetermined questions in a specified order. Closed-ended (yes/no) or multiple-choice questions.	Combination of structured and unstructured interview The interviewer has a general plan for what he wants to ask but the questions do not necessarily follow any particular wording or order	No predetermined questions Open-ended questions
Advantages	• allows you to compare responses across participants while keeping other factors constant. • minimize study bias • Easy to conduct • Less Time • greater reliability and validity.	• More flexible than structured • Comparable data • Reliable	• Flexibility • Building rapport

Disadvantages	• too formal • limited in scope and flexibility.	• Hard to conduct • Risk of bias	• Lower reliability • more biased responses
Example	How often do you exercise? Daily Weekly Monthly Rarely	Do you enjoy exercising? And why?	Why did you choose to start exercising?

4.3. Ethical considerations in research:

Ethical considerations are a set of principles that guide your research design.

It includes:

a. Informed consent
b. Privacy
c. Confidentiality
d. Anonymity

a. Informed consent:

It is when the patient/participant confirms to start a certain intervention (For example: to participate in a study or to undergo surgery) only after he is given all the needed information including the process, benefits, and risks.

b. Privacy:

It is a personal choice to restrict the public from accessing personal information

c. Confidentiality:

It is a professional obligation where an agreement between two parties (researcher and participant) occurs which restricts unauthorized people from accessing confidential data.

d. Anonymity:

No one can access the personal data of the participant, not even the researcher. It is usually used in surveys

Answers to Exercise 4.1:

Case 1: A

Case 2: B

Case 3: A

Case 4: B

CHAPTER 5

DATA COLLECTION AND ANALYSIS

5.1. Importance of collecting reliable and valid data through careful measurement and observation.

Why should you use the correct and authentic ingredients when cooking?

Why should you pay attention to the amount of ingredients you use?

Maybe you aren't interested in cooking but please flow with me here.

Getting these things mentioned above right is as equally important as collecting a reliable and valid data set. This makes sure that our findings and interpretation are reliable and credible. More on this at the end of the chapter.

Let us look at the importance of collecting reliable and valid data through careful measurement and observation.

- ✔ It helps us avoid wasting time and resources.
- ✔ It helps us make the right and informed decisions.
- ✔ It ensures the credibility of the research

As you continue to read, please pay attention to the following questions:

A. *What data collection method would you use for a qualitative data analysis?*
B. *What data collection methods would you use for a quantitative data analysis?*
C. *What is the purpose of the test of significance in research?*
D. *What type of data analysis requires the use of randomized trials data sets?*

5.2. Techniques and considerations for data collection, including data recording, organization and management

5.2.1. Consideration for Data Collection

Before starting the process of collecting data, there are certain factors to be considered in order to collect the right data for the research. Collecting the right data is essential for successful research. The following below are factors to be considered for data collection.

1. **Research Goal:** Selecting the best research instrument for gathering data requires careful consideration of the study objective. While observational methods are useful for studying the traits or actions of subjects, interviews aid in understanding the experiences of respondents and further knowledge of issues under research. Numerical values are produced via questionnaires in order to establish correlations between variables. Compatibility between research goals and data collection methods is critical because failure to take the research goal into account can result in the set goal not being achieved. (Mwita,2022)
2. **Scope of the study:** The geographic coverage and scope of the investigation are important considerations when selecting data collection techniques. Semi-structured interviews and focus groups were used in one organization-based study. Questionnaires are the best option for higher response rates in greater geographic areas. Interviews can be utilized for more limited areas with fewer participants. For long-distance interviews, telephone interviews could be appropriate. Another crucial factor is the study's duration. The best approach is document analysis if the investigation includes data from several sources.
3. **Types of data:** Prior to choosing a data collection technique, it is important to ascertain the kind of data required for the project. Data is information that is expressed as facts or figures and is categorized into quantitative and qualitative methods for analysis and hypothesis testing.
4. **Sample size:** Sample size is the number of people or subjects a study collects data from, which influences the selection of data collection tools. Small sample sizes are suitable for interviews and focus groups, while large sample sizes may require questionnaires for efficient reach. Sample sizes also impact cost, with smaller sample sizes being less expensive to cover.
5. **Time factor:** Both the length of the activity and the necessity of data collecting must be taken into account by researchers. Interviews are frequently utilized for urgent work, including diagnosing a recently discovered illness. Because they take longer to respond to, questionnaires might be less effective. The length and aim of the investigation have an impact on the methodology as well. The best technique for examining data gathered and recorded throughout a given time frame, like the study's five years, is document analysis.
6. **Research approach:** Researchers can use qualitative, quantitative, or a mixed research approach, with data collection methods varying depending on the method. Quantitative approaches often use questionnaires for numerical results, while qualitative approaches involve interviews, focus group discussions, and observation. Document analysis can be used in both approaches depending on the data nature. For mixed approaches, researchers may use both qualitative and quantitative data collection methods simultaneously.

5.2.2. Data Collection Method

Primary data collection method:

Primary data collection involves self-collecting data for study purposes, using both qualitative and quantitative approaches. Common types include questionnaires, interviews, focus groups, observations, surveys, and case studies.

a. **Questionnaires:**

A questionnaire is a common tool for collecting information from a specific population, including questions and answers. It is suitable for both qualitative and quantitative data collection, especially when dealing with large samples. Designed by Sir Francis Galton, questionnaires measure variables like behaviours, preferences, and facts. They are useful when personal discussions are not possible, and can be categorized based on question types and administration modes.

Steps In Designing A Questionnaire

Step 1: Decide on the method.

Step 2: Calculate the feasibility

Step 3: Prepare the instruments needed

Step4: Select your samples

Step 5: Conduct pilot tests

Step 6: Revise the prepared instruments

General Rules In Constructing A Questionnaire

- Use simple and short questions when possible.
- Use positive sentences.
- Add an open-answer option after providing the listed answers.
- Avoid making assumptions for the respondents.
- Let your statements be understandable simple and clear.

b. Interviews:

Interview is a social interaction method where data is collected through provided answers, allowing for confidential information collection. Researchers can conduct interviews in individual or group face-to-face settings, using methods like telephone or computer.

Types of Interviews

i. **Structured Interview:** Pre-planned questions with constrained response options are used in standardized interviews. You can utilize open-ended inquiries to help you comprehend the subject of the investigation. When a less organized approach or a thorough literature review are available, questionnaires or interview guides can be used.
ii. **Semi-structured Interview:** Semi-structured interviews are formal, guided conversations where interviewers ask questions based on guidance. They are suitable for gathering qualitative data in the first meeting, as they require training and open-ended questions. They can also be used to develop ununderstood subjects or as an initial step for more structured methods like surveys or interviews.
iii. **Unstructured Interview:** Unstructured interviews are informal, casual conversations without a structured structure, often used in field observation. Researchers collect data using brief notes and try to memorize responses. These methods can enhance trust and understanding of others' experiences, making them a crucial step in preparing structured interviews. They allow for direct participation and quick approval of notes, ensuring the final data is obtained quickly after observation.

Process of Conducting an Interview

1. Specify entry requirements.
2. Introduce yourself and your organization for 20-30 seconds max.
3. Explain the concept of the study.
4. Ask the provided questions in the order given.
5. Get enough responses and record them.
6. Conclude the interview and thank the participants.

c. Surveys:

Surveys are an effective way to collect information from a big target group and reveal attitudes, beliefs, and thoughts. They can be carried out nationally or internationally, and they can use techniques like phone calls, emails, or in-person interviews. Surveys can also be used to gauge social behaviors of professionals at educational institutions and political candidates. However, because they necessitate studying the entire population, they are inappropriate for use in government projects.

The Survey Process:

1. Planning and Designing

✔ Define the aim of the study.

✔ Design the methods for data collection and sampling.

- ✔ Design the test questionnaire

2. Testing and Modifying
   - ✔ Pilot tests
   - ✔ Analyze the tests
   - ✔ Modify the processes
3. Conducting
   - ✔ Finalize processes and forms
   - ✔ Select samples
   - ✔ Train interviews
   - ✔ Conduct the survey procedures
   - ✔ Analyze the gathered data

d. Experiments:

Experiments are a key method for data collection, allowing researchers to create research situations, select participants, and manipulate independent variables to influence dependent variables.

Secondary data collection method:

The information obtained from published sources is referred to as secondary data. Examples of secondary sources includes Journals, websites, books, newspapers or magazines, government records, census data etc.

Exercise 5.1:

What data collection methods are suitable for studying the impact of social media usage on adolescent mental health?

5.3. Basic statistical concepts and analysis techniques.

5.3.1. Basic Statistical Concepts

What Is Statistics?

Statistics is the methodology developed by scientists and mathematicians for collecting, analyzing, interpreting, and drawing conclusions from data, including all aspects of data collection, processing, interpretation, and presentation.

Some Common Terms Associated With Statistics

1. Population: A population is a collection of all individuals or items included in a statistical study.
2. Sample: A sample is a subset of the population from which information is gathered.
3. Variable: Variables are characteristics that vary from one person or thing to another, such as height, weight, number of siblings, sex, marital status, and eye color. Quantitative variables yield numerical measurements, while qualitative variables yield non-numerical measurements.

Types of Statistics

1. Descriptive Statistics: Descriptive statistics are strategies for organizing and summarizing data. It involves creating graphs, charts, and tables, and calculating descriptive measures like averages, measures of variation, and percentiles.
2. Inferential Statistics: Inferential statistics are methods for drawing and testing the trustworthiness of population conclusions based on data from a sample of the population. It includes methods based on probability theory such as point estimate, interval estimation, and hypothesis testing.

Important Statistical Concepts

1. Measures of Center Tendency:

Measures of center are descriptive measures that indicate where the center or most usual value of a variable falls in a series of measurements. Examples are the Mean, Median and Mode.

2. Measures of Variation:

This can be determined with Sample Range and Standard Deviation. The sample range is calculated by subtracting the biggest observed value of a variable in a data collection from the lowest while standard deviation can be defined as a kind of average of the absolute deviations of observed values from the variable's mean.

3. ScatterPlot:
A scatterplot is a useful tool for displaying the relationship between two quantitative variables, with one variable's values on the horizontal axis and the other on the vertical, focusing on the same individual.

4. Correlation Co-efficient:
The sample correlation coefficient (r) (or, in some situations, rxy) measures the strength of the linear relationship between the x and y variables.

5. Test of Significance:
A significance test is a statistical method of testing a hypothesis by comparing data to the values predicted by the hypothesis. Data that deviates significantly from the projected values gives evidence against the hypothesis. All significance tests have five components: assumptions, hypotheses, test statistic, p-value, and significance level.

Other statistical concepts include: Estimation, Sampling Distribution, Probability Distribution, Regression Modelling, Confidence Intervals, Linear Regression, and Logistic Regression.

5.3.2. Data analysis techniques

What Is Data Analysis?

Data analysis is a process that involves goals, relationships, decision making, and ideas, as well as working with data itself, to support the work, goals, and plans of a program or agency.

Types of Data Analysis

1. Descriptive Analysis:
This strategy summarizes the facts to produce a straightforward presentation. This method is divided into two categories: univariate and bivariate analysis. Univariate and Bivariate analyses are statistical methods used to summarize data into a simple presentation. Univariate analyses use Frequency, Central Tendency, and Dispersion techniques to identify characteristics and general properties of a variable. Frequency disruption determines the frequency of values for a specific variable, while Dispersion spreads variables around the central tendency using tools like range, variance, and standard deviation. Bivariate correlation calculates correlation using sample mean values and standard deviations and can be solved using software like SPSS. Central tendency methods include mean, median, and mode, which represent the average, median, and mode values in the data set

2. Explanatory Analysis:
Explanatory analysis aims to answer research questions about variables' connections, relations, and patterns using Dependence and Interdependence methods. Dependence examines the impact of predictor variables on outcomes, while Interdependence focuses on multivariate analyses.

3. Inferential Analysis:
The inferential analysis approach employs a small sample to draw conclusions about a larger population. It means that data from a subset of the world is utilized to evaluate a broad theory about its nature.

4. Predictive Analysis:
Predictive analysis employs past and present data to make predictions about the future. It can also use data from one subject to forecast the values of another. There are various predictive models; nevertheless, in general, a basic model with more data can function better.

5. Mechanistic Analysis: Using randomized trial data sets, this strategy requires the greatest amount of work to pinpoint the precise changes in the factors that can influence changes in other variables. Furthermore, it might be said that inferential mechanistic analysis is scarce. Thus, if you require a high level of precision in your output and you want to reduce the amount of mistakes you make, you should consider this type of analysis.

Data Analysis Tools

Depending on the type of data analysis being carried out, there are different tools to use. This includes:

- ✔ Excel: Excel Data Analysis, 2nd Edition.pdf - Free download books
- ✔ R programming language: usingR (r-project.org)
- ✔ STATA: practical_introduction_to_stata.pdf (harvard.edu)
- ✔ SAS: crop.pdf (cambridge.org)
- ✔ XLSTAT: XLSTAT_HELP_EN.pdf
- ✔ Python: Free PDF Download - Python Data Science Handbook : OnlineProgrammingBooks.com
- ✔ Tableau: PowerPoint Presentation (wmich.edu)
- ✔ Power BI (Check recommended text)

Exercise 5.2:

How can statistical analysis be utilized to determine the effectiveness of a new drug in treating a specific medical condition?

5.4. Interpreting research findings and drawing conclusions based on the data analysis.

Interpretation is the process of making sense of findings by answering "why?" and "why not?" questions. It requires more conceptual and integrative thinking than data analysis, as it involves abstracting important understanding from the detail and complexity of the findings. Interpretation moves the analytical process to a higher level, bringing meaning beyond the specifics of the data. Wrong interpretation of your research findings can be misleading and this would have dire consequences, especially in the sciences. When interpreting your research findings, please pay attention to the following.

1. First you ask yourself the following questions:
   - ✔ How consistent and reliable are your findings?
   - ✔ To what extent, and in what ways, do your findings contribute to a better understanding of the study?
   - ✔ How well do your findings fit into the existing body of knowledge?
   - ✔ How relevant are the findings in terms of contributing to theory, informing policy, or informing practice?
2. Seek Patterns.

The first round of analysis involves identifying emergent patterns among findings and examining across different dimensions and subsets. A second round of analysis can uncover new insights and uncover unnoticed patterns. Cross-case classification matrices are created by moving between findings and connecting themes or patterns into a storyline. However, it's crucial not to manipulate the data or force it to fit cross-classification. Identifying patterns and themes is one result, but ambiguities and inconsistencies are another. To explain patterns, draw on personal experience and consult literature. Consider whether the findings confirm similar research or contradict previous studies, and how to explain these differences or similarities.

3. Your Interpretations should be:
   - ✔ Clear
   - ✔ Logical

- ✔ Relevant
- ✔ Credible

Exercise 5.3:

In a study investigating the impact of teaching methods on student performance in mathematics, what statistical tests would be appropriate for analyzing the data collected from pre- and post-tests?

Answers to the Exercises:

5.1

Question: What data collection methods are suitable for studying the impact of social media usage on adolescent mental health?

Answer: Various data collection methods such as surveys, interviews, and observational studies can be employed. Surveys allow for large-scale data collection, while interviews provide in-depth insights. Observational studies can offer real-time behavioural observations.

5.2

Question: How can statistical analysis be utilized to determine the effectiveness of a new drug in treating a specific medical condition?

Answer: Statistical analysis can involve techniques such as hypothesis testing and regression analysis. By comparing the outcomes of patients receiving the new drug versus a control group, statistical tests can assess whether the drug leads to significant improvements in the medical condition.

5.3

Question: In a study investigating the impact of teaching methods on student performance in mathematics, what statistical tests would be appropriate for analyzing the data collected from pre- and post-tests?

Answer: Paired t-tests or ANCOVA (Analysis of Covariance) could be suitable for comparing the mean performance scores of students before and after the implementation of different teaching methods, while controlling for any pre-existing differences among the groups.

CHAPTER 6

SCIENTIFIC WRITING AND PUBLISHING

6.1. Significance of effective scientific writing to communicate research findings.

Scientific writing is a critical means of communicating the outcomes of a systematic research process. It involves presenting the evidence and interpretations acquired through a thorough collection, analysis, interpretation, and evaluation of data to solve problems reliably. Effective scientific writing is crucial in conveying research findings. Expressing complex information clearly helps colleagues, students, and the public understand study objectives, methods, results, and implications. Well-written scientific texts support the foundational element of reproducibility, facilitating the replication of the study by other researchers.

Additionally, transparent documentation of research methods and results upholds ethical research practices, prevents data manipulation, and ensures accountability within the scientific community. Effective scientific writing also promotes collaboration on an international scale, contributing to the advancement of knowledge and the broader impact of scientific research by accurately, transparently, and comprehensibly conveying research findings.

6.2. Guidance on structuring a research manuscript, including the title, abstract, introduction, methods, results, discussion, and conclusion sections.

Main components of the scientific article

When writing an academic article, following a specific structure to ensure clear and concise content is crucial. The main template of an article is based on IMRAD. This abbreviation consists of the first letters of the words Introduction, Methods, Results, And, Discussion. This format is now a universal way of presenting a scientific article.

IMRAD

Introduction- Methods-Results-And-Discussion

I	Introduction	Which problem was examined?
M	Methods	How was the problem examined?
R	Results	What was found?
A	And	
D	Discussion	What do these mean?

Although the IMRAD format is recommended for scientific articles, there should be an abstract first. Therefore, this format also includes Abstract and AIMRaD (Abstract, Introduction, Materials and Methods, Results, and Discussion) structure.

1. **Title**

First, choose a short and interesting title that includes relevant keywords. The title should neither be too short nor too long. It should give an idea about the whole article. It is important to craft the title of an article with care, as it is the first thing a reader sees. The title is also the section that can be accessed for free. Therefore, the title should be chosen thoughtfully, and should accurately reflect the content of the article.

– Example short title: Polypharmacy

– Sample long title: On additions to microscopic research by a new way of producing colour between an object and its environment, or between certain parts of the object.

2. **Abstract**

This is the section where basic information about the article should be given. The purpose of this section is to provide a summary of the entire article, including any inventions that were mentioned. It should be easy to understand without having to read the entire article. Each section of the article should be briefly summarized, and the information in the abstract should also be in the article. The abstract should be written last and should not repeat any information from the title. It should be written in the past tense, with no abbreviations, figures, tables, or references. The abstract should focus on defining the problem and reason for the study, outlining the goals and objectives, explaining how the research was conducted, and highlighting the key findings and their implications. A well-written abstract is important because it helps readers quickly understand the content of the article and decide if they want to read it in full.

3. Introduction

The first section of IMRAD is the Introduction, which logically should be the starting point of any article. In the Introduction, the problem under investigation is introduced, along with basic sources of information to help readers understand the topic. Regardless of existing publications on the subject, the research is presented in enough detail to enable readers to evaluate the results. The Introduction emphasizes the importance of the research and clearly states the purpose of the article.

A good Introduction should do the following:

(i) Clearly present the nature and content of the problem,

(ii) Evaluate previous articles to inform readers,

(iii) Summarize the study method and explain the reasons for choosing it.

The previous studies and the chosen method should be presented in a way that helps readers understand the problem and its proposed solution.

4. Methods

This is the second part of the IMRAD article. The purpose of this section is to define the experimental plan and provide adequate details of the methodology. For the article to have scientific value, this section must be carefully written in the past tense. In this section, it is important to clearly state what needs to be done and how it should be done to achieve the purpose stated in the "Introduction" section. Failure to provide critical points in the method may cause the referee to reject the article. However, in some cases, reference can be made to previous studies for a more detailed method. It is also worth noting that materials and methods can be presented in tables or figures. For example, to demonstrate the analytical procedure, a process flow chart can be created to summarize the method.

The subheadings for the details in the materials and methods section are presented as follows:

- Design of the research,
- The population and sample of the research,
- Place and time of the research,
- Data collection tools Vehicles,
- Data collection methods,
- Evaluation of Data (Statistical analysis),
- Ethical aspect of the research

5. Results

This is the third section of the IMRAD article which aims to present the information gathered in the study. The results should be presented in the same order as specified in the Materials and Methods section. It is important to avoid repeating any information from the method in this section. Since comments and analysis should be reserved for the discussion section, the presentation of the data should be kept neutral. Firstly, a brief description of the experiments should be given without repeating the details in the Materials and Methods section. Then the data and findings should be presented using the past tense. It is important to avoid presenting data in tables and figures in the text, as this can be confusing. Only important emphasis should be made in the text, and it is incorrect to present the same information both in tables and figures.

6. Discussion

This is the final section of an IMRAD article which discusses the study results and compares them to existing literature findings. The purpose of the discussion is to reveal the main findings, highlight any limitations in the method, compare the results to other scientific articles, and discuss their implications. The reasons behind any differences between the results and other sources should be interpreted, especially by looking at the material and method sections. The compatibility of the results and interpretations with previously published research should be explained with reasons. Any unexpected findings that are not consistent with the discussion should not be hidden. The conclusions should be clearly stated, and the theoretical and practical implications of the research should be discussed. Literature information and basic information should be given in the present tense, while findings should be given in the past tense. The discussion should begin with a summary that highlights the importance of the research and end with a concluding paragraph.

7. Conclusions

The Conclusions section summarizes important findings and highlights the practical implications of the study.

6.3. Importance of clear and concise writing, logical flow, and appropriate use of tables, figures, and citations.

The primary objective of scientific writing is to create easily understandable and engaging content for readers. To achieve this, authors need to use clear and concise language, avoid embellishments, and ensure that every paragraph is focused on a specific topic. An effectively written scientific article should flow seamlessly, preserving the integrity of the topic and paragraphs while supporting its development with evidence.

In academic and scientific writing, using clear and concise language and having a logical flow are essential. Clear writing ensures that the content is easily understood, while conciseness enhances readability. A logical flow connects ideas seamlessly, offering coherence and guiding readers through the content. Clear and concise writing, logical flow, and appropriate use of tables, figures, and citations are crucial in academic and scientific writing. Clear writing ensures understanding and effective communication, while conciseness enhances readability. Well-designed tables and figures visually represent complex information, making it more accessible.

Example:

• It is clearly seen in Table 1 that smoking causes lung cancer (WRONG EXPRESSION)

• Smoking caused lung cancer (Table 1) (CORRECT EXPRESSION)

All information and findings in the text, tables and figures should not be repeated, only the points that need attention should be emphasized. For this reason, care should be taken to prepare tables and figures simply and understandably. Table and figure descriptions should be written as short as possible. It is crucial to emphasize only the points that require attention and avoid repeating all the information and findings in the text, tables, and figures.

6.4. Referencing and Guidelines for Citing Sources

6.4.1. Introduction to Referencing in Research Writing

You will agree with me that no researcher can boast of writing a scientific article without checking or including some data or information from other sources, right? Right! That's because new knowledge in the science world is built on the foundation of previous or existing knowledge. The whole concept of referencing is to give due credit to the sources you use or obtain information or data from in your research work. In other words, referencing is the

means of acknowledging the contributions of other authors or researchers in your work. Now, this is why it is important to ensure proper referencing in your research work.

Significance of Proper Referencing in Research & Academic Writing

1. Gives proper acknowledgement to authors of sources used, avoiding plagiarism and assuring the integrity of one's work.
2. Referencing helps other researchers reading your work to trace and verify information from sources you provide in your work, which assures the accuracy and reliability of your research work.
3. In-text citation brings credibility to your research work indicating that information/data included are based on published and established research findings.
4. Proper referencing shows thoroughness in your research work, indicating that it is founded on established previous and existing knowledge, thereby also boosting your work's credibility.
5. Citation of sources also helps carve out a pathway for others to explore related literature

Now read this very attentively. Referencing in research is not only important, it is mandatory, and, the absence of, or poor referencing is against the professional ethics of research. Why is this so? What exactly makes referencing compulsory in research? – *To avoid PLAGIARISM!* What is plagiarism? Let's find out!

6.4.2. Plagiarism

Let me give you a simple analysis. Imagine you are a songwriter, and wrote down a beautiful piece of lyrics. Then, a friend of yours went through your space, found the book in which you wrote your song lyrics, *stole it,* and went ahead to compose a song with it without giving you any credit for it and published it. Surprisingly, it became a hit song! How would you feel knowing that you were the original writer of the song, yet your permission wasn't sought before the lyrics were used in a song, neither were you acknowledged? Wroth, betrayed, and sad, I guess, right? The same concept applies in research/academic writing. Using data, information or resources from a particular source, without properly acknowledging or referencing the original authors or researchers, is against research ethics, and it simply means you "stole" their intellectual property. This sounds awry, isn't it? That's why you must do your very best to avoid plagiarism at all costs.

You should also know that plagiarism (whether intentional or not) attracts penalties. Firstly, most journals have strict screening processes before publishing articles on them, hence, your research work can be rejected. Also, there could be legal implications for plagiarism, and you could tarnish your reputation as a researcher. Now, listen, you read it right! Plagiarism can be unintentional.

Types of Plagiarism:

1. Complete Plagiarism: Labeling others' entirely research work as your own.
2. Direct Plagiarism: Extracting part of a research work and adding to yours without proper referencing.
3. Self-plagiarism: Not properly referencing one's own earlier work when used in current work whether entirely or partially
4. Intentional Plagiarism: This is simply when plagiarism is done intentionally to falsely use other authors' intellectual property without referencing or acknowledging them.
5. Accidental Plagiarism: This is when plagiarism is not done intentionally. Accidental plagiarism can occur when the proper citation guidelines are not followed and hence resorts to plagiarism without the intention of fraud.

Examples of plagiarism:

1. Copying and pasting words from another literature into your work WITHOUT paraphrasing or quotation marks, AND with or without acknowledging the source.
2. Paraphrasing words or ideas from a literature into yours without acknowledging the source.
3. Duplicating materials or utilizing ideas, resources or concepts from articles, books, arts, presentations, etc., without appropriate acknowledgement.
4. Copying tables, graphs, illustrations, etc., from a research paper into your work without requesting permission from the original author(s), with OR without proper acknowledgement.

It's high time you learnt about referencing types and the guidelines for proper referencing, to help you avoid plagiarism.

6.4.3. Referencing Types, Guidelines and Anatomy

There are two types of referencing. The in-text citation and the bibliography. They're both necessary in research work. In this section, we will be addressing these referencing types, and go through their anatomy (i.e., structure) and some necessary guidelines. But before that, let us address some important points.

- When to cite sources:

In most cases, you do not need to give credit for knowledge you already had before beginning your research work. Furthermore, since dates and other well-known information may be found in many encyclopedias, you are not required to credit them. In your works, all other information, including methods, statistics, and ideas, must always be cited.

- Citing scientific literature:

When citing from scientific papers do not copy and paste into your work. Instead, paraphrase the main ideas from the article. If you must copy and paste points from a paper, such as definitions, then put them in quotations. All ideas obtained from other sources, whether paraphrased or in quotations must be acknowledged and cited. Also, avoid using words such as "one study found," or "a recent study showed." State the main point of the study and be concise.

Now to the types of references:

a. In-text Citation: In-text citations, also referred to as parenthesis referencing are short references included within and at the end of sentences in your research article that refer to ideas obtained from sources, and acknowledging their authors. They are usually made up of the author(s)' last name(s) and the year of publishing, or numbers that correspond to a numbered list of references in the bibliography, depending on the referencing style used.

   General Guidelines on In-text Citation (for non-numbering referencing systems):

   ✔ If a source has only one or two authors, their last names must be included in the in-text citation. For example; "Jones, 2017" where there is only one author, "Andela and Ayomide, 2008" where there are two authors.
   ✔ If a source has more than two authors, the lead author's last name is written with "et. al." before writing the date. For example, "Khadijah et. al., 2014".
   ✔ For in-text citations on multiple sources, it is arranged in correspondence to how they appear in your reference list, depending on the referencing style used.
   ✔ When the author is an organization, use the name of the organization as the author. Where the organization is not so popular yet, at the first appearance, write the organization in full at its first appearance, and you can abbreviate it at other

- ✔ appearances. For example, "Future Pharmacy Initiative, 2022", at the first appearance, then "FPI, 2022" at other appearances. However, for very popular organizations, their abbreviations can be used even from the first appearance. For example, "WHO, 2009".
- ✔ Where there is no identifiable author, the title or first few parts of the title can be used in place of the author.
- ✔ For direct quotations or when citing specific parts of a source, you can include the page or chapter number after the date, e.g., "Arthur et. al., 1998, p. 43" or "Fatimah 2005, chap. 6", or "Johnson and Grace, 2019, para. 6" (which can be used for online sources that don't exactly have pages).

For Numbering systems, rather than names and dates, numbers are used for in-text citations which corresponds to the order in which they appear in the reference list or bibliography. Usually, in numbering systems, references are arranged according to the order in which they are used in the research work, i.e., the first source used will be number 1 on the list, and the last source on its first appearance in the research project will be last on the list. Sources used more than once in the research work are not given a new number at every time they appear, rather, they retain the number given on their first appearance.

b. Bibliography: Simply put, a bibliography is a list of all the papers or sources you used in your research work. Please understand that while a reference list is a list of all sources you cited (in-text) in your work, a bibliography goes beyond that also to include sources you didn't cite but used for your research work. For example, you can get some concepts, methods or ideas to guide your research work, but did not necessarily write them in your work, and hence, didn't need to cite them in between your texts. Such works should be added to your bibliography.

Anatomy of References in the Bibliography:
Different referencing styles have varying features required for referencing sources in the bibliography, the following, however, are generally features found in the bibliography.

- ✔ Authors' names (consisting of their last names and initials of their first name and/or one other name) or even an organization's name.
- ✔ Title of the work
- ✔ Publication details such as name of journal, book or publisher.
- ✔ Publishing date
- ✔ Volume & Issue Number
- ✔ Page(s), chapter(s) and edition for books
- ✔ URLs and DOIs (for easier access to online sources)

6.4.4. Referencing Styles

Referencing styles are standard formats or methods established by various institutions for citing sources you used in your research work. These referencing styles differ in formatting, arrangement of information, punctuation, etc., both in the in-text citation and in the bibliography. The choice of referencing style to use can depend on the discipline you are writing on, and the guidelines of the journal or publisher you want to use for your work or that of your academic institution.

While there are several referencing styles, the FIVE (5) major referencing styles are;

- ✔ Harvard
- ✔ APA (American Psychological Association)
- ✔ Vancouver
- ✔ MLA (Modern Language Association)
- ✔ Chicago

Guidelines on in-text citation and bibliography for these referencing styles can be found in *A Manual for Referencing Styles in Research by Mohsin Hassan Alvi (Pakistan Institute of Living and Learning)*.

However, technology has made things quite easier, so that you do not have to memorize the guidelines of these referencing styles. There are software and referencing tools that help you reference (in-text or in the reference list) your sources in the referencing style you choose. Isn't that amazing?

6.4.5. Referencing and Writing Tools

Tools in research writing are software that enhances your writing efficiency, saves time, greatly reduces the possibility of error and makes writing enjoyable and seamless. Let's go over some research tools.

a. Referencing tools: Reference management tools help you easily manage the references or sources you used in your research work. They make in-text citation and reference listing much easier, reducing the chances of error, and making you worry less about the technicalities of referencing while focusing on the intellectual part of the research project. These reference management tools help with collecting, organizing, and in some tools, formatting references. Usually, these referencing tools have features like browser extensions and integration with word processors that make it smooth and easy to cite sources while writing. Examples of reference management tools are Zotero, Mendeley, EndNote, EasyBib.com, ReadCube, Citavi, RefWorks, etc. These tools usually have guides

b. or directions on how to use their software. However, if unavailable on the software, check YouTube for a tutorial video on the referencing tool of your choice.
c. Writing Tools: These include standard writing tools like Google Docs and Microsoft Word, however, other tools like Scrivener and LivingWriter, can help you to better structure and organize your writeups. Other tools can help with needs like grammar and spelling checking, paraphrasing, etc., such as Grammarly and QuillBot.
d. Plagiarism Checker: We have already discussed the weight of the offence of plagiarism and also explained that plagiarism can occur unintentionally. The good news is that there are tools that can help you check your work to identify plagiarism. Examples include Turnitin, Grammarly, QuillBot, Scribbr, etc.

Exercise 6.1:

Here is an excerpt from the review by Anu Maria Sebastian and David Peter in the Year 2022 on "Artificial Intelligence in Cancer Research: Trends, Challenges and Future Directions":

Since the field's inception, experts have predicted the potential of highly tailored oncology care employing AI technologies. This promise is being realised as a result of cumulative advancements in the sciences, including the improvement of ML and deep learning (DL) algorithms, the expansion of the breadth and variety of databases, including multi-omics, and the decline in the price of massively parallelized computing power.

The following are in-text citations from the above excerpt. Which of these in-text citations are ideal using APA in-text referencing style? Justify your answer, explaining why your choice is correct and other options wrong.

1. Since the field's inception, experts have predicted the potential of highly tailored oncology care employing AI technologies (Sebastian and Peter, 2022).
2. "Since the field's inception, experts have predicted the potential of highly tailored oncology care employing AI technologies"
3. A review by Sebastian and Peter, 2022, revealed that since the field's inception, experts have predicted the potential of highly tailored oncology care employing AI technologies.
4. A review by Sebastian and Peter, 2022, revealed that from the dawn of artificial intelligence use, experts have anticipated its application in treating people suffering from cancer.
5. From the dawn of artificial intelligence use, experts have anticipated its application in treating people suffering from cancer[1]

Options:

A. 1, 2 & 3
B. 4 only
C. 4 & 5
D. 5 only
E. 3 & 4

6.5. Overview of the Publication Process

The goal of research or engaging in scientific writing, is to add to existing knowledge. However, for other researchers and the world at large to benefit from your work, you must release your article for publication. The process of research from conception to publishing is an important part of academia and scientific advancement. Researchers who hope to contribute their work to scholarly debate and dissemination must understand the publication process, which includes manuscript submission, peer review, and revisions.

The process, however, can be complex and intimidating for researchers, especially if you are new to the field. In this section, we will explore the key steps involved in publishing scientific papers, from selecting a journal to performing final edits and reviews in a way that will be easy to understand.

The steps to publishing in a scholarly journal include;

1. Journal selection
2. Preparing the paper
3. Manuscript submission
4. Peer review
5. Responding to peer reviews
6. Acceptance of the manuscript and signing a copyright agreement if applicable
7. Final edits and Publication.

Let us take a closer look at each step.

1. Journal selection:

An important initial step in the publication process is selecting the appropriate journal. As a researcher, you should take into account variables like the journal's scope, audience, and reputation within their field. To increase the chances of acceptance and impact, it is crucial to choose a journal that closely matches the topic, methodology, and significance of your research findings. Also, you should consider the journal's level metrics, like, impact factor, or its copyright and open access policies. (To calculate the impact factor of a journal, refer to Chapter 3, section 3.3.2.).

You should also consider the payment policies of the journal. While some journals accept papers from all authors or authors from certain regions of the world for free, others require you to pay to publish your work. Also, for journals requiring payments for publishing articles, such payments may be for all articles or for specific articles whose authors desire to have open access.

Open-access publishing means that readers can view your article without having to pay to access your article or access it through their university or institution with an active subscription to the journal. Benefits of open-access publishing include more exposure for your work, especially researchers from developing countries who would otherwise, be unable to pay to access your work and more access to your work means more possibility for citations. Also, open-access publishing is compliant with grant rules. With open-access publishing, practitioners can apply your findings, and your research can influence policies.

It is therefore important to review the payment policies of journals and the type of open-access publishing methods available, considering your preferences and financial capacity, before selecting the journal to use.

2. Preparing the Paper:

Once an appropriate journal has been chosen, you need to carefully prepare the manuscript or article following the formatting and guidelines specified by the journal. This entails structuring the paper into sections such as introduction, methodology, results, discussion, and conclusion in addition to making sure the writing is accurate, coherent, and clear. These formatting and submission guidelines are usually under the "For Authors" section of a journal's website. Additionally, the journal's website should specify the kind of peer-review approach it employs and if the manuscript should be blinded, meaning all identifying information (name, institution, etc.) is redacted.

3. Manuscript submission:

Once the article satisfies the requirements of the journal, you can submit it, either by email or using the publication's online submission system, by following the guidelines the journal provides. Any supplementary materials, declarations of conflict of interest, and, if appropriate, recommendations for preferred reviewers, should also be included. The journal's editorial team reviews the paper once it is submitted to see whether it is appropriate for peer review. At this stage, the editor will decide whether to accept the submission for further review or to reject it. Rejection is a normal step of the publication process, so choose a journal that is more in line with the manuscript if rejected.

4. Peer Review:

Peer review is a fundamental component of scholarly publishing, which ensures the quality and integrity of research articles. If the manuscript has been accepted by the editor after the initial screening, the paper goes through a rigorous peer review procedure, where it is assessed by peer reviewers who are experts in the field. Usually, the editor will select 2-3 reviewers. Peer reviewers evaluate the research paper's quality, methodology, originality, significance, validity, and adherence to ethical standards. They also provide constructive feedback, questions, and comments and recommend the journal either rejects, revises or accepts the paper. Peer review involves putting scholarly research through a rigorous evaluation by peers with relevant knowledge to maintain the research's rigour and credibility.

There are different peer review models, regarding the disclosure of the reviewers' and/or authors' identity. Peer reviews are typically blinded, which means the author is unaware of the reviewer's identity. Double-blinded peer reviews are another option, in which the identities of the reviewer and the author are kept secret from one another.

- Single-blind peer review – A single-blind review means the reviewer's identity isn't disclosed to the author, but the author's identity is known to the reviewer.
- Double-blind peer review – A double-blind peer review means the identity of the reviewers and the authors aren't disclosed to each other.
- Open review – An open review means both the author and reviewer identities are disclosed.

Following their evaluation, the editor will receive the reviews from peer reviewers and offer any additional feedback before forwarding the reviews to the author.

5. Responding to Peer Reviews (i.e., Revisions):

You should carefully consider all reviewer's comments and suggestions after receiving feedback from peer reviewers and the journal's editorial team. This feedback may include requests for clarifications, revisions, or additional information. Then, you should revise the manuscript to address any issues that were brought up during the review process. At this point, you are to review the requested revisions, decide to make the amendments and re-submit the paper. Revisions may involve clarifying methodology, addressing limitations, revising interpretations, or providing additional evidence to support the research findings. Making sure your updated article satisfies the journal's requirements for publication requires that you give serious thought to each reviewer's criticism and answer them clearly and comprehensively.

At times, it can be frustrating and time-consuming to reply to reviews and make improvements. Take some time to consider the reviews, comments, and requests before you start to reply. Even while you don't have to comply with every request, you should always provide a valid explanation of why you can't comply or fulfil such requests. Consider requests that are necessary and unnecessary, how you will record modifications, and how you will reply to requests that you do not fulfil.

After making all necessary edits, re-submit your revised manuscript. Upon resubmission, the revised manuscript undergoes further assessment by the editorial team and reviewers to assess the adequacy or quality of the revisions and determine its suitability for publication.

6. Acceptance of Manuscript and Signing a Copyright Agreement if Applicable:

After your paper has been reviewed and the manuscript is complete, the journal then decides to accept it for publication. An author agreement will typically be sent by the journal once your work has been approved for publication. This agreement usually describes the conditions of publication, such as copyright ownership, distribution rights, and reuse permits, depending on the kind of journal. Thus, be sure to carefully read the agreement, go over it again, and keep a copy for your records. Sign the agreement if you agree with it so that publication can continue.

7. Final Edits and Publication:

Authors are permitted to make final revisions and edit their manuscripts to make sure they are accurate, clear, and comprehensive before publishing. This could entail checking for consistency in layout, typographical errors, and adherence to journal requirements during proofreading. At this stage, some journals will submit the manuscript to you for a final review to make sure all the details—including the author(s) and institution(s)—are accurate. The author and editor typically work together during this last round of review and editing, communicating frequently. The manuscript is ready for publishing and will be released after the final changes are completed.

Answer to Exercise 6.1:

Here is an excerpt from the review by Anu Maria Sebastian and David Peter in the Year 2022 on "Artificial Intelligence in Cancer Research: Trends, Challenges and Future Directions":

Since the field's inception, experts have predicted the potential of highly tailored oncology care employing AI technologies. This promise is being realised as a result of cumulative advancements in the sciences, including the improvement of ML and deep learning (DL) algorithms, the expansion of the breadth and variety of databases, including multi-omics, and the decline in the price of massively parallelized computing power.

The following are in-text citations from the above excerpt. Which of these in-text citations are ideal using APA in-text referencing style? Justify your answer, explaining why your choice is correct and other options wrong.

1. Since the field's inception, experts have predicted the potential of highly tailored oncology care employing AI technologies (Sebastian and Peter, 2022).
2. "Since the field's inception, experts have predicted the potential of highly tailored oncology care employing AI technologies"
3. A review by Sebastian and Peter, 2022, revealed that since the field's inception, experts have predicted the potential of highly tailored oncology care employing AI technologies.
4. A review by Sebastian and Peter, 2022, revealed that from the dawn of artificial intelligence use, experts have anticipated its application in treating people suffering from cancer.
5. From the dawn of artificial intelligence use, experts have anticipated its application in treating people suffering from cancer[1]

Options:

A. 1, 2 & 3

B. 4 only

C. 4 & 5

D. 5 only

E. 3 & 4

The correct answer is option B (i.e., no. 4 only).

Justification:

No. 1: Although, the authors were cited, nevertheless, the texts obtained were not paraphrased, neither were they put in quotation. This is plagiarism. Hence, Option A is wrong.

No. 2: The obtained texts were placed in quotations but the authors were not cited. This is plagiarism; hence Option A is false.

No. 3: Same condition as No. 1. Hence, Options A & E are false.

No. 4: The texts obtained were paraphrased and the authors were cited using APA in-text referencing style as instructed. This passes the plagiarism test and also follows the required referencing style. No. 4 passes; hence, Option B may be correct. Let us not review No. 5, before concluding.

No. 5: The texts obtained were paraphrased and the authors were cited, however, it was done using Vancouver or numbering system in-text referencing style, instead of the required APA in-text referencing style. No. 5 therefore passes the plagiarism test, but it fails the in-text citation or referencing test. Hence, Options C & D are false.

This affirms that Option B (i.e., No. 4 only) is the correct answer.