ASET Research Task Force

RESEARCH TOOLKIT

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RESEARCH TOOLKIT

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PREFACE

Research is the cornerstone of advancement in science and medicine. While many technologists and clinicians may not have formal training in research methodology, this toolkit is designed to empower those with an interest in research—regardless of background—to conduct meaningful, methodologically sound studies. Whether you're exploring research for the first time or seeking to enhance your understanding, this guide serves as a practical resource for beginners, helping to drive progress within your respective field.

Justin W. Silverstein, DHSc, CNIM, FASET, FASNM (Editor) – Chair of ASET's Research Task Force

SECTION I: PLANNING

LITERATURE REVIEW AND INFORMATION GATHERING

David Fortson, BS; Jacob Myers, BS, R. EEG T., CLTM; Hannah LeBlanc, BA, R. EEG T., CLTM

Every research project begins with an idea, which soon develops into a testable hypothesis. One of the first essential steps in conducting meaningful research is to explore existing literature to understand what has already been discovered in the field. This process begins with a comprehensive literature review and the collection of predicate information. This section will guide you through the initial stages of information gathering and help you build a strong foundation for your research.

PUBMED

1. One of the most reliable and widely used resources for accessing peer-reviewed research articles is **PubMed**, available at pubmed.ncbi.nlm.nih.gov. The following steps will guide you through how to effectively navigate and utilize this platform for your literature search. Type keywords, the name of the article you are searching for, or the DOI in the search bar. Click "Search" or press Enter.
    a. If you have access to your institution's library, you can use **PubMed** to locate the article of interest. Once you find the citation, use the **DOI** (digital object identifier) or **PMID** (PubMed ID) to retrieve the full text through your library's online database or journal subscriptions.

2. On the left side of the page, check the filter box that says "Free full text."
    a. Access to your institution's library provides full access to a wide range of research articles, including those behind paywalls—not just the freely available ones.

3. Sort through the articles and find the ones helpful to your research. Click the link to the article.

4. When this new page opens, you should see a hyperlinked DOI for the article. Click that link to be taken to a new page with the full-text PDF.

PubMed is an excellent resource for reviewing abstracts of relevant papers before committing to a full read. Abstracts offer a concise summary of a study's purpose, methods, and findings, helping you quickly determine whether a paper is likely to support or challenge your working hypothesis.

THE NEURODIAGNOSTIC JOURNAL

The Neurodiagnostic Journal is another option to review papers relevant to your working hypothesis and is available free to ASET members. Take the following steps to gain full access to articles:

1. Log into aset.org.
2. Click "The Neurodiagnostic Journal" from the member dashboard.
3. Use the search bar to find articles on your topic.
4. To limit your search to recent articles, click "publication date" in the left-hand menu and choose a date range for your search.
5. After clicking on the title to expand the article, you can click the green "View PDF" button to download a PDF version of the article.

GOOGLE

Search engines like Google and Google Scholar can also be valuable tools for locating articles related to your topic. They often link directly to PubMed entries or journal websites, making them a useful starting point for broader literature exploration.

1. Google: If you have access to the article's DOI, you can type that in Google and search the results to find a site that grants free access to the full PDF of the article. Be careful not to access sites with suspicious web addresses and domains.

2. Google Scholar: Search Google Scholar using keywords. Once the results are displayed, find the appropriate article with a "PDF Full View" hyperlink listed beside the search results. Most of these will allow access to the PDF, some will ask you to pay. Google Scholar can also be accessed by just typing your keyword into Google, followed by "peer-reviewed articles." Once the results populate, follow the steps detailed above to access the appropriate article.

OTHER RESOURCES

- Many schools, institutions, and employers allow free research database access for their students and employees via a network or on-site computers. Check with your supervisor, professor, campus librarian, or HR department to see if this is a possibility.

- Sci-hub.se is a free-to-access database for research articles, but you must have the article's DOI to search (You can obtain the DOI for an article through PubMed).

- If you find an article that cites studies that correspond with your topic, use the references section to identify these articles and search for them via the above methods to locate full PDFs.

- If you locate an abstract of an article but cannot find free access to the full version, you can find the contact info for the author and request they send you a copy of the article. Many authors are happy to do this as they usually do not receive monetary compensation from pay-to-view research databases.

STUDY PURPOSE, DESIGN, AND WORKFLOW

Shakira Lenosky, BS, R. EEG T., CNIM, CNMT, CHCA

After a cursory literature review is complete, the next step is to design the study itself.

The purpose of research design is to provide a clear, concise plan for the research project based on independent and dependent variables. The researcher should also have a full understanding of the chosen topic and consider the cause and effect evoked by the variables selected.

A research design serves as the blueprint for your study, outlining the overall workflow and structure. It defines the variables you aim to examine and establishes the methods by which your research will be conducted. These methods may include observations, surveys, interviews, experiments, or other data collection approaches. A well-constructed research design ensures clarity, consistency, and reliability throughout the research process.

Additional Resources

Scribbr. What Is a Research Design? Types, Guide, and Examples.

Reference

Ranganathan, P., & Aggarwal, R. (2018). Study designs: Part 1 - An overview and classification. *Perspectives in Clinical Research*, 9(4), 184–186. https://doi.org/10.4103/picr.PICR_124_18

TYPES OF RESEARCH

Justin W. Silverstein, DHSc, CNIM, FASET, FASNM

There are numerous types of research methodologies, each with unique advantages and limitations. Choosing the appropriate method depends on the research question and objectives. Below is an overview of common research types:

1. Case Studies

- Definition: Focused evaluations of a single individual, group, or event.
- Pros: Excellent for exploring rare or novel phenomena that have not been studied before.
- Cons: Findings may not be generalizable, as single events could represent anomalies rather than broader trends.

2. Experimental Control Studies

- Definition: Research designed to test hypotheses by manipulating variables to establish cause-and-effect relationships.
- Pros: Provides strong evidence for causation.
- Cons: Requires rigorous control of variables, which can limit applicability to real-world scenarios.

3. Observational Studies

- Definition: Studies where researchers observe subjects without intervening, aiming to identify patterns or associations.
- Pros: Useful for studying natural behaviors or phenomena.
- Cons: Cannot establish causation.

4. Correlation Studies

- Definition: Examines the relationship between two or more variables.
- Pros: Identifies associations and trends between variables.
- Cons: Does not prove causation; relationships may be coincidental.

5. Clinical Trials

- Definition: Research involving human participants to test new treatments or interventions.
- Pros: Directly assesses the efficacy and safety of treatments.
- Cons: Can be expensive, time-consuming, and ethically complex.

6. Cross-Sectional Studies

- Definition: Collects data from a group of participants at a single point in time.
- Pros: Quick and cost-effective.
- Cons: Provides a snapshot rather than insights into long-term trends or changes.

7. Descriptive Studies

- Definition: Uses surveys, interviews, or observations to describe phenomena.
- Pros: Provides foundational insights and context for future research.
- Cons: Limited in explaining causation or underlying mechanisms.

8. Survey Methodology

- Definition: Collects data from a sample population using questionnaires or interviews.
- Pros: Efficient for gathering large amounts of data.
- Cons: Results may be influenced by response bias or poorly designed questions.

9. Epidemiological Studies

- Definition: Investigates patterns, causes, and effects of health conditions in populations.
- Pros: Helps identify risk factors and informs public health strategies.
- Cons: Relies on observational data, making causation difficult to establish.

10. Cohort Studies

- Definition: Follows a group of individuals with shared characteristics over time to study changes in health outcomes.
- Pros: Provides insights into long-term effects and relationships.
- Cons: Time-intensive and may require significant resources.

11. Diagnostic Studies

- Definition: Focuses on developing or improving methods for diagnosing diseases or conditions.
- Pros: Enhances the accuracy and reliability of diagnostic tools.
- Cons: This may be limited to specific diseases or clinical settings.

12. Qualitative Research

- Definition: Analyzes non-numerical data, such as text or observations, to understand meanings and interpretations.
- Pros: Captures rich, detailed insights into human experiences.

- Cons: Subjective interpretations may introduce bias.

13. Meta-Analysis

- Definition: Combines quantitative data from multiple previous studies to identify overarching trends.
- Pros: Increases statistical power and generalizability of findings.
- Cons: Dependent on the quality and consistency of included studies.

14. Systematic Reviews

- Definition: Synthesizes all relevant literature on a specific research question using standardized methods.
- Pros: Provides a comprehensive and organized summary of existing research.
- Cons: Requires significant effort and may be limited by the availability of high-quality studies.

LEVELS OF EVIDENCE

Justin W. Silverstein, DHSc, CNIM, FASET, FASNM

Research fundamentally has a hierarchy of quality which is categorized by "levels of evidence". Levels of evidence provide a benchmark to the strength and quality of the research. Below is a table describing each level of evidence.

Level of Evidence	Type of Study
Level 1a	Systematic review of randomized controlled trials (RCT)
Level 1b	Individual RCT
Level 2a	Systematic review of cohort studies
Level 2b	Individual cohort study/low-quality RCT
Level 3a	Systematic review of case-control studies
Level 3b	Individual case-control studies
Level 4	Case series, case study, low-quality cohort, or case-control studies
Level 5	Expert opinions based on non-systematic reviews of results or mechanistic studies

DEFINITIONS

Randomized Control Trial = Controlled comparison of an experimental intervention and a placebo

Systematic Review = A comprehensive literature analysis on a particular topic

Cohort Study = Research that follows a group of individuals together over time (e.g. following the residents of a particular community to see if they develop the same disorders over time)

Case-Control Study = The retrospective investigation and comparison of groups of individuals who either have (case) or do not have (control) a specific disorder.

Case Study = The description of an interesting, new, or unique finding for a single individual.

Case Series = An evaluation of a series of individuals undergoing the same treatment

Expert Opinion = Opinion by an expert (usually conducted when there is poor empirical evidence)

Mechanistic Studies or Bench research = This is basic science research, which provides a foundation of fundamental principles.

Resources

Burns et al. (2012). The Levels of Evidence and their role in Evidence-Based Medicine

OpenMD.com. Levels of Evidence.

Elsevier Author Services. Levels of Evidence in Research.

HYPOTHESIS DEVELOPMENT

Shakira Lenosky, BS, R, EEG T., CNIM, CNMT, CHCA

Developing a hypothesis will state a prediction about a new phenomenon that "should" be observed if a particular theory is accurate. A hypothesis is developed by considering existing available evidence and using reasoning to infer what will happen.

- A hypothesis is a prediction grounded in theory. In some cases, the theory itself may still be evolving, and you may not fully recognize or develop it until after a series of observations have been made. This iterative process is a natural part of

scientific inquiry.This means you may need to make some observations and collect data before you can develop a broader theory. Hypotheses should always be in an if-then statement. For example, If my theory is correct, then my hypothesis can be developed and assessed.

A strong hypothesis should be testable and falsifiable, grounded in logic, and framed in a clear, positive statement that can be evaluated through observation or experimentation.

Additional Resource

Scribbr. How to Write a Strong Hypothesis | Steps & Examples

Reference

Price, P.C., Jhangiani, R., Chiang, I-C.A., Leighton, D.C., & Cuttler, C. (n.d.). Developing a hypothesis. *Research Methods in Psychology*. Pressbooks. https://opentext.wsu.edu/carriecuttler/chapter/developing-a-hypothesis/

COLLABORATORS AND AUTHORSHIP

Justin W. Silverstein, DHSc, CNIM, FASET, FASNM

While research can be conducted individually, collaborating with a team often makes the process more efficient and manageable. However, when working as part of a team, it's crucial to establish the order of authorship early in the process to avoid misunderstandings or conflicts later.

Authorship should reflect the level of contribution each collaborator made to the research. Here's a common framework for determining authorship order:

First Author:

The first author is typically the individual who carried out the majority of the research, including its conception, design, and execution.

This person also takes primary responsibility for drafting the manuscript and integrating feedback from other team members.

Last Author:

The last author is usually the senior author or principal investigator (PI) who supervised the research.

They are responsible for overseeing the project from start to finish, providing guidance, and ensuring the research meets high standards of quality and integrity.

Middle Authors:

Authors listed between the first and last positions are ranked based on their specific contributions to the study.

These contributions might include conducting experiments, analyzing data, or contributing sections to the manuscript.

By clarifying authorship roles and expectations at the outset, teams can foster collaboration and ensure credit is distributed fairly based on contributions.

FUNDED AND UNFUNDED RESEARCH

Margie Dieter-Murphy, BS, R. EEG/EP T. & Justin W. Silverstein, DHSc, CNIM, FASET, FASNM

Research can be categorized as either **funded** or **unfunded**, depending on whether financial support is provided.

- **Funded research** involves financial backing from an external source—such as a government agency, foundation, institution, or private sponsor—to support various aspects of the project (e.g., personnel, equipment, data collection, publication fees).
- **Unfunded research** is conducted without external financial support. In these cases, researchers may rely on existing institutional resources or volunteer their time and effort. While unfunded studies may have budgetary limitations, they can still yield valuable findings and often serve as pilots for future grant-funded work.

FUNDED RESEARCH

Securing funding is a critical part of conducting research. Whether you're pursuing a small pilot study or a large, multi-center trial, understanding the landscape of funding sources is essential. Below are the most common ways research projects are funded:

1. Government Grants

Government agencies offer structured, competitive funding programs to support research across disciplines.

- Examples (U.S.-based):

    - NIH (National Institutes of Health)
    - NSF (National Science Foundation)
    - DoD (Department of Defense)
    - CDC (Centers for Disease Control and Prevention)
- Common Grant Types:
    - R-series: Research project grants (e.g., R01 for major research, R21 for exploratory work)
    - K-series: Career development awards
    - T-series: Training grants
    - U-series: Cooperative agreements (more agency involvement)

Government funding is highly competitive and requires well-developed proposals and clear demonstration of impact and feasibility.

2. Institutional or Internal Funding

Universities, hospitals, and research institutes often provide internal support for early-career researchers or innovative pilot projects.

- Types of Institutional Support:
    - Seed grants
    - Bridge funding (between grants)
    - Pilot project awards
    - Departmental discretionary funds

These funds are ideal for gathering preliminary data to support future external grant submissions.

3. Private Foundations and Nonprofits

Many foundations and nonprofit organizations fund research aligned with their mission, often targeting specific diseases, populations, or societal needs.

- Examples:
    - American Cancer Society

    - American Heart Association
    - Michael J. Fox Foundation
    - Bill & Melinda Gates Foundation

These organizations may support high-risk, high-reward ideas and offer both small and large-scale grant opportunities.

4. Industry or Corporate Sponsorship

Companies, particularly in biotech, pharmaceuticals, and medical devices, may fund research that aligns with their commercial goals.

- Applications:
    - Clinical trials
    - Product or device testing
    - Market-driven innovations

Researchers must maintain transparency and address potential conflicts of interest when collaborating with industry sponsors.

5. Collaborative and Consortium Funding

Large-scale projects involving multiple institutions or disciplines may be supported by pooled resources from several funders.

- Often includes:
    - Academic-industry partnerships
    - International or inter-university collaborations
    - Shared research initiatives across disciplines

These models promote innovation through shared expertise and infrastructure.

6. Crowdfunding and Philanthropy

For smaller or highly novel projects, crowdfunding and private donations offer alternative sources of funding.

- Platforms:
    - Experiment.com

    - Kickstarter or GoFundMe (less common for academic research)

This is a growing area, especially for community-focused or public engagement research projects.

7. Contracts

Unlike grants, research contracts are formal agreements to complete predefined work, often with deliverables and milestones.

- Typically issued by:
    - Government agencies
    - Private companies

Contracts are less flexible than grants but can be a stable source of funding for applied research.

8. International Agencies and NGOs

Global research projects—especially those focused on public health, development, or humanitarian work—can be funded through international agencies.

- Examples:
    - World Health Organization (WHO)
    - United Nations (UN)
    - USAID
    - Horizon Europe (European Commission)

These sources often emphasize global collaboration, sustainability, and impact in under-resourced settings.

References

National Institutes of Health (NIH). (n.d.). Office of Extramural Research. NIH Grants & Funding. https://grants.nih.gov

National Science Foundation (NSF). (n.d.). Funding. U.S. National Science Foundation. https://www.nsf.gov/funding/

Philanthropy News Digest. Requests for Proposals (RFPs). (n.d.). Candid. https://philanthropynewsdigest.org/rfps

Association of American Medical Colleges (AAMC). (n.d.). Understanding Research Funding. https://www.aamc.org

European Commission. Research and Innovation. https://commission.europa.eu/research-and-innovation_en

FUNDING SOURCES

David Allison, Ph.D., CNIM

The primary source of biomedical research funding in the United States is the National Institutes of Health (NIH). NIH differentiates grant types with activity codes such as (R01, PO1, K, etc.). An explanation of these grants is found at Types of Grant Programs | grants.nih.gov. The RO3 grant is an example of a small short-term (2-year) award supporting pilot or preliminary studies, data gathering, and initial analysis, as well as the development of new research technology.

Secondary funding sources include existing grants (such as those with a surgeon serving as the principal investigator), hospital or health care systems (supported by endowments and large research grants), neurodiagnostics hardware manufacturers, and private neurodiagnostic provider companies that allocate funds to support research.

In addition to direct financial support, a company or institution can grant resources in the form of protected research time away from clinical duties to conduct experimental design, data analysis, and manuscript preparation. These non-financial resources can often be sufficient to carry out meaningful biomedical neurodiagnostic research.

NAVIGATING GRANT WRITING

Margie Dieter-Murphy, BS, R. EEG/EP T.

A grant request is defined as a request for funds explaining why monies are needed for a project or research. Successful grant writing takes time, preparation, and planning.

Steps

1. Identify what you need and why it is important.
2. Read and follow any guidelines that might be needed for specific grants.
3. Include a budget with actual costs and any other financial assistance you are getting for this project.
4. Write a short and concise cover letter. Include ideas/ thoughts on how this research will be beneficial and how it will be conducted.
5. Proofread and review. Make the proposal neat and clear.

5. Know the deadline and make sure everything is complete and accurate.
6. Research the foundation or business organization you are requesting the grant from to have a good understanding of the source.
6. Take your time to collect the data above and present the data in an educated, professional proposal package.

Reference

Gray, K. (2017, Sep 26). How to Write a Grant Request. Bizfluent.com. https://bizfluent.com/how-4547929-write-grant-request.html

CONFLICTS OF INTEREST AND DISCLOSURE

Andrew Ehrenberg, BS, R. EEG T., CNIM, FASET

In research, conflicts of interest are most commonly understood to be financial in nature. These may arise when individuals involved in the study—either directly (e.g., researchers) or indirectly (e.g., family members, business associates)—have financial relationships that could potentially influence, or appear to influence, the integrity or outcomes of the research.

Examples of financial conflicts of interest include:

- Ownership or equity interest in a company (e.g., stocks, bonds, partnerships)
- Employment or consulting arrangements with entities that could benefit from the research outcomes
- Grants, contracts, or sponsored research from interested parties
- Leadership roles (e.g., officer, director, trustee) in organizations that could be impacted by the study

It is essential that all potential conflicts—real or perceived—are disclosed and managed appropriately to maintain transparency and trust in the research process.

Financial interest does not always prohibit involvement but must always be disclosed.

PURPOSE OF DISCLOSURE

The purpose of disclosure is not to prohibit researchers from engaging in outside activities or relationships. Rather, it is to establish clear guidelines and expectations for what must be disclosed and how. This process ensures that all relevant interests are transparently reviewed by an independent authority, helping to identify and manage any

potential conflicts. Ultimately, disclosure promotes accountability, objectivity, and public trust in the integrity of the research.

TYPES OF DISCLOSURES

Disclosures related to research are typically submitted at the outset of the study to the appropriate review bodies (such as Institutional Review Boards or ethics committees) and are also included in the final publication to ensure transparency.

Conflicts of interest are not limited to principal investigators or lead researchers—they apply to all individuals involved in the research process. This includes research assistants, data collectors, data entry personnel, study coordinators, monitors, and any other contributors. Full disclosure from all participants helps maintain the integrity of the study and ensures transparency at every level of the research effort.

To prevent conflicts of interest, thoroughly weigh any involvements to ask yourself the following:

- Could my other involvements influence the results of this study?
- Could my other involvements influence the oversight authorities?
- Could my involvement be perceived as possibly influencing the results?

If the answer to any of these questions is yes, arrange controls to avoid even the perception of influence and ensure the controls are adequately documented.

References

U.S. Food and Drug Administration. (n.d.). What is a conflict of interest? Fda.gov. https://www.fda.gov/about-fda/fda-basics/what-conflict-interest

U.S. Food and Drug Administration. (n.d.). FDA Advisory Committees: Financial Conflicts of Interest Overview.fda.gov. https://www.fda.gov/media/87421/download

U.S. Food and Drug Administration. (2024, Dec. 24). Code of Federal Regulations Title 21 – Part 19: Standards of Conduct and Conflict of Interest. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=19.10&SearchTerm=financial%20conflict

RESEARCH ETHICS

David Allison, Ph.D., CNIM

Prompted by previous failures to protect human research subjects, the United States Government commissioned a report on ethical biomedical research in 1978 which resulted in the Belmont Report. The Belmont Report describes the three core ethical principles of ethical human research and guidelines for human subject research. The three core principles: respect for persons, beneficence, and justice. The core domains under these core principles are informed consent, assessment of risks and benefits, and selection of human subjects in research.

The regulations that govern human research today are founded upon the principles of ethical research in the Belmont Report. Today, biomedical research in the United States is overseen and regulated by the U.S. Department of Health and Human Services (HHS) and the U.S. Food and Drug Administration (FDA). The Office of Human Research Protections (OHRP) under HHS provides regulations and policy guidance to institutions and researchers. Each institution that sponsors human research must have an Institutional Review Board (IRB) that approves and oversees all research.

Researchers should recognize that most peer-reviewed biomedical journals require human research submitted for publication to be conducted with IRB approval. In-house neurodiagnostic programs will have access to an institutional IRB, while private companies lacking the resources to create their own IRB can contract with a private IRB. There are misconceptions that retrospective studies, or research involving the standard of care the researcher does not consider experimental, do not require IRB approval. Whether research meets IRB approval criteria should be addressed by an IRB, not by the investigator. It is typically accepted that case reports with three or fewer cases presenting the standard of care do not require IRB approval.

Part of the IRB approval process includes training on ethical human research. All researchers are encouraged to obtain this training.

INSTITUTIONAL REVIEW BOARDS AND HUMAN INVESTIGATION COMMITTEES

Rebecca Khozein, MBA, MS, R. EEG/EP T., RNCST, CSSGB, FASET, FACHE

The Institutional Review Board (IRB) is a committee established to review and approve applications for research projects involving human subjects with its primary purpose to protect the rights and welfare of human subjects.

Types of IRB review include the following:

- **Convened IRB Review:** involves greater than minimal risk, including studies with vulnerable populations or sensitive questions; requires full committee review.

- **Expedited IRB Review:** presents no more than minimal risk to the subjects and does not require full IRB committee review.
- **Exempt from continuing IRB:** at the committee's discretion and deemed a very minimal risk to human subjects.

HUMAN INVESTIGATIONAL COMMITTEES

Issues relating to research, investigational studies, or clinical trials are referred to the Hospital System, Institution, or Medical Center Human Investigation Committee, which functions as the hospital's IRB and complies with regulatory requirements.

All patients participating in investigational studies or clinical trials must be fully informed of the nature and purpose of the study, potential risks and benefits, available alternatives, and their right to decline or withdraw from participation at any time without penalty.

The patient is also informed that refusal to participate will not affect his or her access to medical care.

WAIVERS

The IRB may grant waivers for certain aspects of the research protocol that would otherwise require informed consent.

WAIVERS OF WRITTEN DOCUMENTATION OF THE CONSENT PROCESS

IRB relinquishes the requirement of an investigator to obtain a participant's signature as part of the consent process.

FDA-REGULATED RESEARCH

A waiver of documentation of consent may only be granted when the research presents no more than minimal risk of harm to participants and involves no procedures for which written consent is normally required.

Please note that even when waiving the documentation requirement, all other required consent elements must still be addressed.

NOT FDA-REGULATED RESEARCH

Not FDA-regulated research includes three circumstances for waivers:

1. The only record linking the participants and the research is the consent document, and the principal risk is loss of confidentiality.

2. Minimal risk and involves no procedures for which written consent is normally required.
3. Minimal risk and participants are members of a distinct cultural group in which signing forms is not the norm.

Resources

Yale University. IRB submission documents (protocol templates, submission forms, consent templates). Your.yale.edu. https://your.yale.edu/research-support/human-research-protection-program/policies-procedures-guidance-and-related-0

Johns Hopkins Medicine. Guidelines & policies: Johns Hopkins Institutional Review Boards. Hopkinsmedicine.org. https://www.hopkinsmedicine.org/institutional-review-board/guidelines-policies

Yale University. IRB Checklists and worksheets. Your.yale,edu. https://your.yale.edu/research-support/human-research-protection-program/policies-procedures-guidance-and-related-5

INSTITUTIONAL REVIEW BOARD TRAINING

Rebecca Khozein, MBA, MS, R. EEG/EP T., RNCST, CSSGB, FASET, FACHE

INTRODUCTION

- Prior to involvement with research, there are key items that must be learned, and the learning must be documented.
- Usually, this is through the CITI program (Collaborative Institutional Training Initiative)
- Training is dependent on the type of research and the individual's involvement.
- Quizzes and a "grade book" ensure documentation that requirements are met
- Must also be associated/affiliated with the institution overseeing the research

PURPOSE

- To ensure that comprehensive and up-to-date knowledge is held by all researchers on:
    - Regulatory rules and requirements
    - Considerations and practices to ensure ethical research
    - Standardized processes established for good research and documentation
    - Compliance

Types: the main types applicable for neurodiagnostic professionals

- Good clinical practice

- Human subjects research
- Animal care and use
- Biomedical research
- Medication clinical trials
- Behavioral research

DECIDING WHICH ONE

- Good clinical practice applies to almost all investigators.
- Humans vs. animals, adult versus protected populations (children, prisoners, etc.)

Biomedical/technology in nature versus medication versus behavioral/psychological research

- There could be more than one above, ie biomedical and behavioral

Periodic update

- To ensure knowledge is up to date, typically the education requires yearly updates

References

CITI Program. (n.d.). https://about.citiprogram.org

U.S. Food and Drug Administration. (n.d.). FDA Training and Resources. Fda.gov. https://www.fda.gov/international-programs/fda-training-and-resources

SECTION II: DATA GATHERING

QUALITATIVE RESEARCH

David Fortson, BS

Qualitative data is data that can be observed with your senses and recorded vs. quantitative data which is countable and measurable. Qualitative data leaves room for interpretation and is not exactly measurable. An example of this would be saying that a person has black hair and blue eyes.

Qualitative data collection can be completed as interviews, focus groups, direct observation, surveys, etc. The data is subjective since researchers are the ones gathering the data via the methods mentioned above. An example of this subjectivity is me as the researcher, observing that a patient has brown hair, while another researcher describes the hair as dirty blonde.

Qualitative data plays a vital role in research by capturing rich, nuanced insights into patients' experiences, perceptions, and behaviors. Unlike quantitative data, which focuses on measurable variables, qualitative methods—such as interviews and open-ended surveys—allow researchers to explore the depth and complexity of individual perspectives. For example, one patient might describe a negative experience with a medication, while another shares a positive one. These narratives offer valuable context that would be difficult to fully capture through numerical coding alone, as emotions, thoughts, and subjective responses often resist simple categorization without losing essential meaning. There are two approaches to conducting qualitative research – the deductive approach and the inductive approach. The deductive approach is arranged and organized by the researcher, allowing them more control over the type of data gathered and how they want patients to respond (think more specific questions to all the patients). An inductive approach is not organized and is usually utilized for case studies and direct observations where the researcher has not come up with specific standards that they are looking to observe.

Advantages over quantitative data collection include more in-depth data, different perspectives from the different patients, a chance of more authentic answers from patients as they can answer the way they want vs. just checking yes or no on a questionnaire. With these advantages, qualitative data collection is often utilized in social research.

QUANTITATIVE RESEARCH

David Allison, Ph.D., CNIM

NIH's National Library of Medicine defines quantitative data as "data represented numerically, including anything that can be counted, measured, or given a numerical value" (NIH, 2022). The NIH has a brief YouTube video explaining the differences between qualitative and quantitative data (Deakin Library, 2020).

Examples of quantitative data in neurodiagnostic medicine include waveform latency, slope, and amplitude, frequency of EMG or EEG activity, train-of-four ratio, testing and mapping stimulation and response values, and area under the curve (AUC). Other quantitative data that may be applicable when conducting neurodiagnostic research include anesthesia care data such as time, blood pressure, blood loss, heart rate, temperature, and drug dosage. Patient demographic and diagnostic data may include sex, height, and weight, as well as grading systems such as the Meyerding grading system for spondylolisthesis (grade 1-5) or scoliosis degrees and angles.

Two important considerations when designing a study are how quantitative data will be analyzed and presented.

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MIXED METHODS

Shakira Lenosky, BS, R, EEG T., CNIM, CNMT, CHCA

Mixed methods research combines qualitative and quantitative research methods in one single study. It permits a more synergistic use of data than just using separate quantitative and qualitative data sets.

- Collect and analyze both quantitative and qualitative data; ensure proper sample size for each.

  Statisticians are often consulted to ensure that the sample size is sufficient to achieve adequate statistical power, thereby increasing the reliability and validity of the study's results. Most academic institutions have access to statisticians if needed.

- Integrate data during collection, analysis, and discussion
- Use procedures that implement mixed components with the same sample.

This is mostly for use on models in which you are seeking to understand multiple perspectives on a single issue; for example, what is characterized as a "high quality procedure" in healthcare as determined by patients and clinicians.

SECTION III: DATA ANALYSIS

CRITICAL ANALYSIS

Margie Dieter-Murphy, BS, R. EEG/EP T.

Critical analysis involves examining a piece of work or an idea in an analytical fashion. This is a form of literature review that is essential for the advancement of current, correct knowledge. This process involves breaking the data into smaller pieces and reviewing the content. A literature review is a form of research; one must look at content

accuracy in the review—the source of the data and the references used. The outcome must advance the field studied with new knowledge or an extensive addition to knowledge. The analysis is done with a methodical review, and time is needed to perform the task properly.

There are three phases to the analysis.

1. Deconstruction
2. Analysis
3. Reconstruction

Deconstruction is the phase in which the data is broken down into variables. Analysis is the phase in which the data is reviewed and explained in more detail. Reconstruction is the phase that looks at any potential bias of data and creates meaningful, publishable data.

The quality of the analysis is essential; the analyzer needs to know what data should be included and what data is essential to the paper. This process also involves making sure everything is understood and easily read. This is much more than a summary of the information. It is a review of a body of work being studied.

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TYPES OF STATISTICAL ANALYSIS

Justin W. Silverstein, DHSc, CNIM, FASET, FASNM

There are a variety of statistical methods available for analyzing research data, each suited to different types of study designs and variables. If you are unsure which statistical test is appropriate for your data, it is highly recommended to consult with a qualified statistician—either through your institution or an external expert—to ensure your analysis is accurate, valid, and aligned with the goals of your study.

1. Descriptive Statistics

Used to summarize and describe the basic features of a dataset.

- Measures of central tendency: Mean, median, mode
- Measures of variability: Standard deviation, variance, range

- Frequencies and percentages: For categorical data
- Visuals: Histograms, bar charts, pie charts

2. Inferential Statistics

Used to draw conclusions or make predictions about a population based on a sample.

- T-tests: Compare the means of two groups
    - Independent samples t-test
    - Paired samples t-test
- ANOVA (Analysis of Variance): Compare means across three or more groups
    - One-way ANOVA
    - Repeated measures ANOVA

3. Regression Analysis

Explores the relationship between variables and is useful for prediction.

- Linear regression: Continuous outcome predicted by one or more independent variables
- Logistic regression: Categorical (usually binary) outcome (e.g., yes/no, success/failure)
- Multivariate regression: Includes multiple predictors and/or outcomes

4. Correlation Analysis

Measures the strength and direction of a relationship between two variables.

- Pearson correlation: For continuous, normally distributed variables
- Spearman's rank correlation: For ordinal or non-normally distributed variables

5. Chi-Square Test

Used to assess relationships between categorical variables (e.g., gender and treatment response).

- Chi-square goodness-of-fit
- Chi-square test of independence

6. Nonparametric Tests

Used when data do not meet assumptions of parametric tests (e.g., normality, equal variances).

- Mann-Whitney U test: Nonparametric alternative to independent t-test
- Wilcoxon signed-rank test: Alternative to paired t-test
- Kruskal-Wallis test: Nonparametric version of ANOVA

7. Survival Analysis

Used to analyze time-to-event data, common in clinical trials.

- Kaplan-Meier curves: Estimate survival probabilities
- Cox proportional hazards model: Assess impact of variables on survival

8. Factor Analysis

Used to identify underlying patterns or constructs in large datasets, common in survey or psychometric data.

- Exploratory Factor Analysis (EFA)
- Confirmatory Factor Analysis (CFA)

9. Meta-Analysis

A statistical technique for combining results from multiple studies to reach a general conclusion.

- Commonly used in systematic reviews
- Involves effect sizes, confidence intervals, and heterogeneity measures

DATA VISUALIZATION

Rebecca Khozein, MBA, MS, R. EEG/EP T., RNCST, CSSGB, FASET, FACHE

As a critical component of data analysis, data visualization in clinical research allows for the clear and effective communication of research findings. Visual tools—such as graphs,

figures, images, and tables—not only help convey complex data but also enhance understanding and foster decision-making. This guide offers high-level insights into each type of visualization commonly used in clinical research to support new researchers embarking on their careers.

GRAPHS

Graphs are essential tools for visualizing relationships, trends, and patterns within datasets. In clinical neurophysiology and other medical fields, various types of graphs are commonly used, each with distinct applications:

- **Line Graphs** show changes over time or continuous data, such as EEG signal analysis or tracking symptom progression. They are particularly valuable for depicting trends in longitudinal studies. Line graphs can display EEG changes over time, such as tracking brain wave fluctuations or changes in spectral power in video EEG monitoring. In critical care EEG, line graphs help visualize seizure burden or trends in cerebral activity, providing real-time insights into patient status.

- **Bar Graphs and Histograms** are effective for comparing categories, such as the frequency of specific outcomes in a patient population. Bar graphs typically represent discrete categories, whereas histograms illustrate distributions of continuous data. Bar graphs and histograms may be used in quantitative EEG (QEEG) analysis to display frequency distributions of different frequency bands (e.g., delta, theta, alpha, beta). In IONM, bar graphs can compare amplitudes and latencies of evoked potentials across time or specific surgical phases, helping identify intraoperative changes that may signal neurological risk. In polysomnography, histograms represent sleep stage data throughout the polysomnogram. Pulse oximetry is also displayed in condensed arrays to align and correlate with body position and sleep stage data.

- **Scatter Plots** are useful for showing correlations between variables, such as age versus symptom severity. They can provide insight into relationships that may warrant further exploration. Scatter plots effectively visualize relationships between EEG metrics and patient outcomes, such as the correlation between spectral power and cognitive recovery in post-critical care EEG monitoring. Scatter plots can also explore associations between seizure frequency and treatment efficacy.

- **Box Plots** are used to present data distributions and identify outliers, especially helpful in studies with variability among patients, such as neurological test scores or treatment response rates. Box plots provide data on distributions and

variability, which is essential in studies where EEG metrics vary significantly across patients or sessions. In QEEG, box plots display the variability in relative power ratios of brain waves, identifying outliers that may correlate with specific pathologies.

Each graph type allows researchers to communicate data trends visually, making it easier for stakeholders and peers to interpret results. These graph types make EEG research data more interpretable, enabling clinicians and researchers to recognize trends and correlations quickly.

FIGURES AND IMAGES

Figures and images play a unique role in clinical research by providing visual context that might not be captured through numerical data alone. Figures and images are crucial for visual context in EEG research, helping capture details that raw data may not convey. Key applications in research and EEG include:

- Medical Imaging (e.g., MRI, CT, PET scans): Often used in clinical neurophysiology to visualize anatomical and functional aspects of the brain, aiding in identifying conditions such as tumors, lesions, or neural degeneration.

- EEG Waveforms and Spectrograms: For video EEG, these provide a visual representation of brain wave patterns over time, facilitating seizure detection and classification. In critical care EEG, spectrograms help display power changes across frequencies, identifying trends associated with worsening or improving cerebral function.

- Intraoperative Evoked Potentials (IONM): In IONM, waveform figures are essential for tracking somatosensory evoked potentials (SSEPs) or motor evoked potentials (MEPs) during surgery. This provides real-time feedback on the patient's neurological status and helps prevent postoperative deficits.

- Workflow or Process Diagrams: These are useful for outlining research processes or protocols, and they help readers understand study design or complex procedures such as signal acquisition in EEG studies.

- Heatmaps and Color-coded Maps: Effective for displaying brain activity or metabolic data, highlighting areas of interest in neurophysiological studies, or comparing group results within different brain regions.

- Heatmaps in QEEG: Color-coded brain maps show the spatial distribution of power in various EEG frequency bands, offering insights into areas of cortical activity or dysfunction. These maps are instrumental in identifying focal abnormalities or monitoring responses to interventions.

Visual figures and images enable researchers to communicate specific observations that support quantitative data, often improving accessibility for non-specialist audiences. Visual figures and images also add depth to EEG data interpretation, helping researchers and clinicians identify patterns specific to brain function or pathology.

TABLES

Tables are fundamental for organizing data in a structured format, allowing for quick reference and detailed comparison of study findings. Tables organize EEG data for quick reference and thorough comparison, essential in clinical studies:

- **Data Tables:** Summarize statistical outcomes, demographic characteristics, and other essential data points. In clinical neurophysiology, these may include measures of brain wave frequencies, patient characteristics, and treatment outcomes. In EEG, data tables summarize statistical metrics (e.g., mean spectral power, seizure counts, latency/amplitude of evoked potentials) for patient groups or sessions. In critical care EEG, tables may display daily trends in seizure activity or EEG reactivity to track neurological status.

- **Comparison Tables:** Useful for contrasting different treatments, interventions, or patient groups, highlighting key differences in a straightforward format. Comparison tables are also valuable for contrasting EEG findings across conditions or interventions, such as comparing EEG features in different seizure types in video EEG studies. In IONM, comparison tables help document evoked potential changes across surgical stages, providing data for postoperative analysis.

- **Descriptive Summary Tables:** Employed for summarizing key metrics (mean, median, standard deviation). These tables provide a compact overview of research findings and are essential for interpreting the statistical significance of results. These tables outline key EEG metrics like frequency, amplitude, and coherence across different brain regions, aiding in quantitative comparisons. In qEEG, descriptive tables summarize group-level changes, which are valuable for understanding trends in treatment responses.

Tables are especially valuable in medical research, where precise numerical values must be communicated with accuracy and clarity.

BEST PRACTICES IN DATA VISUALIZATION

Regardless of the visualization type, adhering to best practices in data visualization enhances the clarity and effectiveness of research findings. Applying best practices in EEG data visualization enhances clarity and supports accurate interpretation:

- Simplicity and Relevance: Only include visual elements that directly support the study's findings. Avoid clutter; use clean lines, clear labels, and descriptive legends. Only include visual elements that directly illustrate study findings. For instance, simplify EEG spectrograms by focusing on key frequency bands or adjusting color scales in heatmaps for optimal visibility.

- Standardization: Use consistent color schemes, fonts, and scales across all visuals to facilitate more straightforward interpretation and comparison. Use consistent color schemes, axes, and scales across visualizations, facilitating easier interpretation, especially when comparing multiple EEG sessions or studies.

- Clear Labeling and Titles: Ensure that all graphs, tables, and figures have clear titles, labels, and units of measurement where applicable. Legends should be precise, allowing viewers to understand data without ambiguity. Ensure all graphs, tables, and figures have descriptive titles and legends. Clearly label EEG channels, frequencies, and time intervals to enhance comprehension.

- Compliance with Ethical Standards: In clinical research, ensure patient confidentiality, especially when using medical images. Moreover, patient confidentiality must be maintained when displaying clinical EEG data. Adhere to all ethical guidelines regarding data representation.

CONCLUSION

Effective data visualization is an essential skill in clinical research, particularly in clinical neurophysiology. By choosing the right type of visual representation and adhering to best practices, researchers can enhance understanding, promote collaboration, and contribute to the broader scientific community. In EEG research, data visualization is an indispensable tool. From video EEG and critical care monitoring to IONM and QEEG analysis, tailored visual tools enable clinicians and researchers to interpret complex data with clarity and precision. By selecting appropriate visual formats and adhering to best practices, EEG researchers can effectively communicate findings, foster collaboration, and contribute to advancements in clinical neurophysiology. This toolkit aims to empower researchers with foundational knowledge in data visualization, encouraging clarity and rigor in communicating research outcomes.

SECTION IV: REPORTING

PUBLICATION

JOURNAL SELECTION

Justin W. Silverstein, DHSc, CNIM, FASET, FASNM

After collecting and analyzing all the data, the next step is deciding where to submit the manuscript. Researchers and academics approach this decision in various ways. Some focus exclusively on a journal's impact factor, while others may target journals with less rigorous peer review processes to expedite publication and increase their output. While I strongly advise against the latter, selecting a journal based on impact factor can be a reasonable strategy. A journal's impact factor reflects how frequently its articles are cited, which correlates with readership and influence within a field.

Our research team uses a systematic approach for journal selection:

IDENTIFYING THE TARGET AUDIENCE

We start by determining the intended audience for the manuscript:

- Example 1: For a technically complex paper, such as one introducing a new IONM modality, we target neurodiagnostic or neurophysiology journals. These journals cater to neurophysiologists and technologists, not surgeons.
- Example 2: For an outcomes study assessing the prognostic value of MEPs in brain surgery, we prioritize neurosurgery journals where the audience consists of surgeons.

Once we identify the audience, we compile a list of 4–5 potential journals, starting with those that have the highest impact factor. This provides backup options if the manuscript is rejected. High-impact journals often have lower acceptance rates, so having alternatives saves time and effort.

If the manuscript passes the initial peer review, the likelihood of acceptance increases. Following the reviewers' recommendations carefully can greatly facilitate publication.

MANUSCRIPT FORMATTING

Each journal has specific formatting requirements outlined in its "Author Guidelines". It is essential to review and follow these guidelines meticulously:

- They dictate everything from abstract structure and manuscript layout to in-text citations and bibliography formatting.
- Non-compliance with these guidelines is a common reason for rejection.
- Formatting requirements differ across journals, so if the manuscript is rejected, you will need to reformat it according to the next journal's guidelines.

MASTERING SELF-EDITING

Effective self-editing is one of the most critical tools an author can employ. Every word should serve a purpose, and filler or unnecessary words should be avoided. Manuscripts must be clear, concise, and succinct.

Here is our typical editing process:

- Step 1: We begin with a stream-of-consciousness draft to outline ideas.
- Step 2: We edit meticulously, ensuring each sentence conveys information clearly and effectively.
- Step 3: We present research objectively, minimizing bias. Research manuscripts are intended to present evidence, not advocate for a particular perspective or discipline. Advocacy language should be avoided.

USING ARTIFICIAL INTELLIGENCE RESPONSIBLY

Generative AI tools, such as chatbots, are increasingly sophisticated and can aid in editing. However, most journals have specific policies regarding AI use. While AI can streamline editing, avoid using it to write the manuscript entirely, as:

- The output may contain inaccuracies.
- It could flag compliance issues with the journal.

If AI is used in any capacity, disclose its use according to the journal's "Author Guidelines." Proper adherence to these policies helps maintain the manuscript's integrity and ensures compliance.

THE PEER REVIEW PROCESS FOR SCHOLARLY JOURNALS

Rebecca Khozein, MBA, MS, R. EEG/EP T., RNCST, CSSGB, FASET, FACHE

INTRODUCTION

The peer-review process is the cornerstone of academic and scholarly publishing. It ensures that published work meets rigorous quality, validity, and originality standards. Understanding the peer-review process is essential for students and early-career neurophysiology technologists to successfully publish research in peer-reviewed journals. This guide provides an overview of the process, key stages, best practices, and practical tips for navigating this critical component of scholarly publishing.

WHAT IS PEER REVIEW?

Peer review is a quality control mechanism in which experts (peers) in the same field critically evaluate a manuscript before it is published in an academic or scholarly journal. The primary goals are to:

- Ensure the validity and reliability of the research.
- Assess the manuscript's contribution to the field.
- Identify any methodological, ethical, or interpretative issues.

TYPES OF PEER REVIEW

Single-Blind Review

- Reviewers know the authors' identity, but authors do not know the reviewers.
- Common in many journals but may introduce bias.

Double-Blind Review

- Both authors and reviewers are anonymous.
- Reduces bias and is widely used in academic publishing.

Open Review

- Both authors and reviewers are aware of each other's identities.
- Promotes transparency and accountability but may deter honest feedback.

Post-Publication Peer Review

- Manuscripts are published online, and reviewers or the academic community provide feedback.
- Encourages ongoing dialogue and critique.

THE PEER REVIEW PROCESS: A STEP-BY-STEP BREAKDOWN

Step 1: Manuscript Submission

Authors submit their manuscripts to a journal via its online submission system. Key components include the following:

- Manuscript text (including abstract, introduction, methods, results, discussion, and references).
- Figures, tables, and supplementary materials.
- A cover letter outlining the study's significance and fit for the journal.

Tip: Carefully review and adhere to the journal's author guidelines to avoid desk rejection.

Step 2: Initial Editorial Assessment

The journal's editorial team conducts a preliminary review to assess:

- Scope: Does the manuscript align with the journal's focus and readership?
- Quality: Are the writing, data presentation, and formatting adequate?
- Originality: Does the manuscript offer new insights or findings?

Manuscripts that do not meet these criteria are rejected at this stage (desk rejection), often within a few weeks.

Step 3: Assignment to Reviewers

If the manuscript passes the initial assessment, the editor assigns it to 2-3 reviewers with expertise in the subject area. Reviewers evaluate:

- Scientific rigor.
- Methodological soundness.
- Relevance and significance of findings.
- Ethical considerations.

Tip: Editors may consider author-suggested reviewers but ultimately select reviewers to ensure impartiality.

Step 4: Reviewer Evaluation

Reviewers critically examine the manuscript and provide feedback on the following:

1. Strengths: Novelty, clarity, and scientific contribution.
2. Weaknesses: Methodological flaws, unsupported claims, or ethical concerns.
3. Recommendations:
    - Accept: The manuscript is ready for publication.
    - Minor Revisions: Small improvements are required.
    - Major Revisions: Substantial revisions are needed.
    - Reject: The manuscript is unsuitable for publication.

Reviewers submit detailed comments to the editor and, sometimes, separate confidential comments.

Step 5: Editor Decision

The editor reviews the feedback and decides the manuscript's fate:

1. Accept: Rare in the first round; most manuscripts require revisions.
2. Revise and Resubmit: Authors address reviewer comments and resubmit.

3. Reject: The manuscript is returned to the authors with feedback.

Tip: Even if rejected, reviewer comments can help refine the manuscript for submission to another journal.

Step 6: Revisions and Resubmission

Authors revise their manuscript based on reviewer feedback, addressing:

- Specific comments and concerns.
- Errors or omissions.
- Clarity and presentation.

A response letter should accompany the revised manuscript, detailing:

- How each comment was addressed.
- Justifications for not incorporating specific suggestions.

Step 7: Secondary Review

The revised manuscript may be returned to the original or new reviewers for further evaluation.

- Minor revisions typically undergo editorial review.
- Major revisions are more likely to be reassessed by reviewers.

Step 8: Final Decision and Publication

The editor makes a final decision based on reviewer feedback and revisions:

Accept: The manuscript is prepared for publication.

Reject: Rare at this stage unless major issues remain unresolved.

Accepted manuscripts undergo copyediting, formatting, and proofreading before publication online or in print.

BEST PRACTICES FOR AUTHORS IN THE PEER REVIEW PROCESS

Before Submission

1) Choose the Right Journal: Review the journal's scope, impact factor, and readership.
2) Prepare a Polished Manuscript: Follow the journal's guidelines meticulously and use clear, concise language; avoid jargon.
3) Conduct a Pre-Submission Review: Seek feedback from colleagues or mentors. Use plagiarism detection tools to ensure originality.

During Peer Review

1) Respond Professionally to Feedback:
   a) Thank the reviewers for their comments.
   b) Address feedback comprehensively and respectfully.
2) Be Transparent:
   a) Clearly explain revisions and justify decisions in the response letter.

After Peer Review

1) Learn from Rejection:
   a) Use reviewer feedback to strengthen your manuscript.
   b) Consider alternative journals that may be a better fit.
2) Promote Your Work:
   a) Share your publication with colleagues, on social media, and in conferences to increase visibility.

ETHICAL CONSIDERATIONS IN PEER REVIEW

For Authors

- Avoid duplicate submissions (submitting the same manuscript to multiple journals simultaneously).
- Disclose conflicts of interest.
- Ensure the accuracy and integrity of data.

For Reviewers

- Maintain confidentiality of the manuscript.
- Avoid conflicts of interest.
- Provide constructive and unbiased feedback.

COMMON CHALLENGES AND HOW TO ADDRESS THEM

Long Review Times

- Proactively choose journals with clear timelines for review.
- Politely inquire about delays if you have not received a decision within the stated timeframe.

Conflicting Reviewer Feedback

- Seek clarification from the editor if feedback is contradictory.
- Address common themes and prioritize the editor's guidance.

Rejection

- Understand that rejection is part of the process.
- Use feedback to improve the manuscript for resubmission elsewhere.

THE ROLE OF PEER REVIEW IN ADVANCING NEUROPHYSIOLOGY

Peer-reviewed publications are critical for advancing clinical neurophysiology by:

- Disseminating new knowledge and innovations.
- Establishing standards for practice and research.
- Supporting evidence-based decision-making in clinical care.

By engaging in the peer-review process, students and neurophysiology technologists contribute to the growth of the field while developing their skills as researchers and practitioners.

CONCLUSION

Understanding the peer-review process is essential for aspiring authors in clinical neurophysiology. By following best practices, maintaining professionalism, and embracing feedback, you can navigate this process effectively and contribute meaningful research to the scientific community. Peer review is not just a hurdle to overcome—it is a valuable opportunity to refine your work and advance the field.

STUDY LIMITATIONS AND FUTURE DIRECTIONS

Margie Dieter-Murphy, BS, R. EEG/EP T.

The art of Research is to have a snapshot of life around the research and of the topic. Sampling is the process of selecting the participants, cases, and/or population based on their relevance to the project. The issue with this is the sample size may be too small or too large for the research needed. It may also create a bias in the research data if the group has certain criteria prior to the research. Sampling should be reviewed prior to the selection. Keeping in mind any obstacles to the sample group. Time is needed to review the purpose of the research and to select a clear, unbiased approach. The sampling selection will need to be described within the research, including who, why, and how the sampling was selected. The methodology can be a limitation in that the process will need to follow what the topic is asking. For example, the researcher will need to understand what needs to be answered and the best way to achieve that answer. Incorrect methods may not answer the question. Data collection should be set in an organized, efficient manner. The record-keeping of the data should be in an easily understood format.

Research design can be a limitation. The plan is to structure the process of outlining the design of the project. This needs to be thought out with a purpose statement and possible objections to this research.

The language of the research should relay the exact purpose of the research, the method of the data collection, and the desired outcome. The data will need to support this statement. All limitations will need to be stated and the reasons these limitations occurred. Any prior research done on the topic should be added to the research. Any new data and research on the topic can be compared. If any questions remain regarding data unanswered, all efforts should be made to explain how this will be resolved.

Including a limitations section (typically in the discussion) in a manuscript is essential for maintaining transparency and avoiding overgeneralization or overinterpretation of the results. In fields like intraoperative neurophysiological monitoring (IONM), much of the existing research is retrospective in nature. This design inherently carries certain limitations, such as the potential for selection bias, incomplete data, or lack of control over variables—all of which should be clearly acknowledged.

It is the responsibility of the authors to clearly communicate any limitations related to the study design, sample size, population characteristics, data collection methods, or analytical approach. By doing so, readers can more accurately interpret the findings, assess the validity of the conclusions, and understand the appropriate context for applying the results.

PRESENTATIONS AND POSTERS

Grace Huang, Ph.D., CNIM, D.ABNM

INTRODUCTION

Presenting research at conferences and symposia is crucial in the medical/neurodiagnostic field. It provides networking opportunities to connect with peers, experts, and potential collaborators, which can lead to future research partnerships. Additionally, it fosters professional growth and collaboration through skill development in areas like public speaking, technical writing, and critical thinking.

Moreover, conference presentations enhance the visibility of one's work. The selection of the right conference, development of a compelling abstract, creation of PowerPoint slides or posters, and delivering effective presentations are all essential elements that have contributed to the success of these scholarly endeavors.

CONFERENCE SELECTION

Carefully selecting the right conference is the first step in successfully disseminating one's research. Much like the systematic approach used for choosing journals to publish in, our research team employs a similar strategy for conference selection: We start by identifying conferences that align with our research interests, specialization, and intended audience. Several key factors warrant consideration.

- Conference Scope and Prestige: Among international, national, regional, and specialized conferences, the ASNM and ASET Meetings are highly recommended for vigorously representing intraoperative neuromonitoring research, given their stellar reputation and notable impact factors. However, alternative multidisciplinary options such as Congress of Neurological Surgeons (CNS), American Association of Neurological Surgeons (AANS), American Clinical Neurophysiology Society (ACNS), or the North American Spine Society (NASS) may also be suitable.
- Relevance of the Conference Program: It is essential to ensure that the conference program and sessions encompass topics directly relevant to one's research. A thorough examination of the conference website, past programs, and speaker lists can help assess the suitability of the conference.
- Opportunities for Engagement: Identifying conferences that offer opportunities for active participation, such as panel discussions and networking opportunities, can be invaluable, as they can provide valuable knowledge and facilitate professional connections within the neurodiagnostic community or related fields.

ABSTRACT DEVELOPMENT AND FORMATTING

Upon selection of an appropriate conference, the subsequent critical step involves the development of an abstract that effectively communicates the research objectives, methodology, and key findings. The abstract serves as the primary means of securing a presentation or poster slot at a conference. The following strategies are implemented to create an effective abstract:

Initially, carefully evaluate the Conference Call for Abstracts (CFA). This involves:

- Analyze the themes, topics, and specific submission requirements outlined in the CFA.

- Ensure a strong alignment between your research and the CFA's expectations.
- Consider the available presentation formats, such as oral presentations, posters, or workshops, and determine the format most suitable for your research and your presentation style.
- Most major society conferences allow researchers to select multiple presentation formats (e.g., platform, poster, e-poster) when submitting their work. Opting for all available formats can significantly increase the likelihood of acceptance.
- Pay close attention to submission deadlines and acceptance rates, as this can provide practical guidance on managing the timeline and understanding the competitive nature of the conference selection process.

Subsequently, focus on writing a compelling abstract. Clearly define the research objectives by providing a concise and succinct statement that highlights the key research questions, hypotheses, or goals. Outline the methodology by summarizing the study design, data collection, and analytical approaches employed in the research. Communicate the key findings by succinctly presenting the salient results and conclusions derived from the study. Finally, emphasize the significance and implications by elucidating the potential impact and relevance of the research to the field, clinical practice, or the broader scientific community.

It is vital to adhere to the conference's abstract formatting guidelines, such as word count limitations, section structure, and specific requirements for the content. By following these strategies, one can craft a compelling abstract that effectively conveys the research objectives, methodology, key findings, and significance, ultimately increasing the likelihood of securing a presentation or poster slot at the desired conference.

PRESENTATION AND POSTER FORMATTING

PAPER VS. POSTER PRESENTATION AND FORMATTING

Based on the acceptance of the abstract, the conference committee will inform the author whether to deliver a paper or poster presentation. A paper presentation primarily involves using PowerPoint slides and speaking before the audience. A poster presentation, conversely, requires the creation of a single-slide visual display for exhibitions at the conference or for print distribution. Similarly to abstract submissions, adherence to conference-specific guidelines is essential, as each conference may have distinct requirements. We have employed the following strategies for both paper and poster presentations.

CREATING EFFECTIVE PAPER PRESENTATIONS

- Visual Storytelling: Engage the audience with visuals that complement the message.
- Slide Structure and Content: Organize information per slide, using bullet points effectively and choosing appropriate visuals (graphs, charts, images). Less is more.
- Design Principles: Consistency, color palettes, font choices, minimizing text. Accessibility considerations (font size, color contrast).
- Presenting with Confidence: Delivery, body language, handling questions, time management, and using notes effectively. Practice, practice, practice!

DESIGNING ENGAGING POSTERS

- Adapt research for a poster format, use concise language, and key findings.
- Design the poster Layout and Organization: Clear visual flow, using headings and subheadings effectively, balancing text and visuals. Standard poster sizes and dimensions.
- Visual Elements: Choosing appropriate charts, graphs, and images. High-resolution images are essential.
- Depending on the conference requirement, the presenter can send a PDF file for monitor display at the conference. Alternatively, the presenter may have to print posters and use poster tubes or carrying cases for poster transportation.
- During the poster presentation session, anticipating key questions, and being ready to interact and engage the attendees.

Effective research dissemination involves strategic conference selection, the development of compelling abstracts, and the preparation of engaging presentations or posters. We have successfully implemented these strategies, leading to impactful research presentations at leading national and international societal symposiums.

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SECTION V: POST PUBLICATION

GUIDE TO CITATIONS IN CLINICAL NEUROPHYSIOLOGY RESEARCH

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INTRODUCTION

Citations play a pivotal role in academic and clinical research, serving as a bridge that connects your work to the broader scientific community. Proper citation practices acknowledge the contributions of others, establishes the credibility of your work, and guides readers to additional resources. For students and professionals in clinical neurophysiology, understanding the principles, structure, and formatting of citations is essential for ethical and effective scholarly communication. This guide outlines foundational knowledge, the function of citations, structure, formatting options, and best practices for citing in clinical neurophysiology research.

FOUNDATIONAL KNOWLEDGE: WHAT ARE CITATIONS?

A citation refers to a published or unpublished source that provides the information necessary to identify and locate it. Citations appear in the text of a document (in-text citations), concisely identifying the source of information or ideas and helping readers

find the corresponding entry in the reference list at the end (reference list or bibliography).

WHY ARE CITATIONS IMPORTANT?

1) Attribution and Acknowledgment: Recognize the contributions of others whose work informed your research.
2) Credibility: Support your arguments with evidence from reputable sources.
3) Reproducibility: Enable others to trace your research process and validate your findings.
4) Avoiding Plagiarism: Properly citing sources demonstrates academic integrity and avoids ethical violations.

FUNCTIONS OF CITATIONS IN RESEARCH

1) Support for Claims:
   a) Citations provide evidence for your hypotheses, methods, and conclusions.
   b) Example: Referencing a gold-standard protocol for performing neurodiagnostic studies.
2) Contextualization:
   a) Place your work within the framework of existing research.
   b) Example: Citing foundational studies on neurophysiological markers of epilepsy.
3) Encouraging Further Reading:
   a) Guide readers to resources for deeper understanding.
   b) Example: Linking to studies that explain advanced neurodiagnostic techniques.
4) Demonstrating Impact:
   a) Citations show your familiarity with the field and highlight how your research builds on prior work.

CITATION STRUCTURE

A typical citation consists of the following components:

1. Author(s): Name(s) of the individual(s) or organization(s) responsible for the work.
2. Title: Title of the article, book, or source.
3. Publication Information:
    a. Journal: Name, volume, issue, pages, and DOI (if applicable).
    b. Book: Publisher, year of publication, and edition.
4. Date: Year of publication.
5. Identifier: DOI, ISBN, or URL (for online sources).

Example (Journal Article):

Brizio, A., Faure, V., & Baudino, F. (2022). Medical semiotics in the telemedicine era: The birth of telesemiotics. International Journal of Medical Informatics, 157, 104573-104573. https://doi.org/10.1016/j.ijmedinf.2021.104573

CITATION STYLES AND FORMATTING OPTIONS

Different journals and disciplines require specific citation formats. Commonly used styles in clinical neurophysiology include:

1. AMA (American Medical Association)

- Widely used in medical and clinical journals.
- Key Features:
  - Author names (no first names, initials only).
  - Title capitalization: Sentence case.
  - Journal Title in Title Case (abbreviated)
  - Numbered references in order of appearance.
- Example:

  1. Brizio A, Faure V, Baudino F. Medical semiotics in the telemedicine era: The birth of telesemiotics. Int J Clin Med Inf. 2022; (157): 104573-104573. https://doi.org/10.1016/j.ijmedinf.2021.104573

2. APA (American Psychological Association)

- Common in psychology and neuroscience research.
- Key Features:
  - Author's last name followed by initials.
  - Title capitalization: Sentence case.
  - In-text citations: parenthetical (López et al., 2023) or narrative citation López et al. (2023)
- Example:

  López, J. R., Ahn-Ewing, J., Emerson, R., Ford, C., Gale, C., Gertsch, J. H., Hewitt, L., Husain, A., Kelly, L., Kincaid, J., Kise, M., Kornegay, A., Moreira, J. J., Nuwer, M., Schneider, A., Stecker, M., Sullivan, L. R., Toleikis, J. R., Wall, L., & Herman, S. (2023). Guidelines for qualifications of neurodiagnostic personnel: A joint position statement of the American Clinical Neurophysiology Society, the American Association of Neuromuscular & Electrodiagnostic Medicine, the American Society of Neurophysiological Monitoring, and ASET – The Neurodiagnostic Society. Neurodiagnostic Journal, 63(1), 14-46. https://doi.org/10.1080/21646821.2023.2183008

3. Vancouver Style

- Frequently used in medicine and biomedical sciences.
- Key Features:
    - Numbered references.
    - Abbreviated journal names.
- Example:

    1. López JR, Ahn-Ewing J, Emerson R, Ford C, Gale C, Gertsch JH, et al. Guidelines for qualifications of neurodiagnostic personnel: A joint position statement of the American Clinical Neurophysiology Society, the American Association of Neuromuscular & Electrodiagnostic Medicine, the American Society of Neurophysiological Monitoring, and ASET – the Neurodiagnostic Society. Neurodiag. J. 2023; 63(1):14-46. https://doi.org/10.1080/21646821.2023.2183008

4. MLA (Modern Language Association)

- Rarely used in clinical fields but may appear in humanities-related content.
- Key Features:
    - Focus on author and publication details.
- Example:

    López, Jaime R. et al. "Guidelines for Qualifications of Neurodiagnostic Personnel: A Joint Position Statement of the American Clinical Neurophysiology Society, the American Association of Neuromuscular & Electrodiagnostic Medicine, the American Society of Neurophysiological Monitoring, and ASET – the Neurodiagnostic Society." Neurodiagnostic Journal, vol. 63, no. 1, 2023, pp. 14-46, https://doi.org/10.1080/21646821.2023.2183008

CITING GRAY LITERATURE: DISSERTATIONS AND THESES

What is Gray Literature?

- Refers to research produced outside traditional publishing channels, such as dissertations, theses, technical reports, conference proceedings, and government documents.
- It is often not peer-reviewed, but it can provide valuable insights and data.

Citing a Published Dissertation or Thesis:

- Treat it as a formally published work. Include the author, year, title (italicized), publication type, and source.
- Example (APA):

    Smith, J. (2023). Neurophysiological markers in pediatric epilepsy (Doctoral dissertation, Yale University). ProQuest Dissertations & Theses Global.

Citing an Unpublished Dissertation or Thesis:

- Specify the unpublished status and include the institution where it was completed.
- Example (APA):

  Doe, A. (2022). Innovative EEG techniques for seizure detection (Unpublished master's thesis). University of California, Los Angeles.

Best Practices for Using Gray Literature:

- Verify the credibility of the source.
- Clearly indicate the unpublished or non-peer-reviewed status in your citation.
- Use gray literature judiciously, supplementing it with peer-reviewed sources when possible.

BEST PRACTICES FOR CITATIONS

1. Organize References Early

- Use citation management tools like EndNote, Zotero, or Mendeley to track and organize sources.
- Create a consistent reference list as you draft your manuscript.

2. Follow Journal-Specific Guidelines

- Always consult the journal's author instructions for preferred citation style and formatting.

3. Cite Primary Sources

- Prioritize original research articles over reviews or secondary sources.

4. Avoid Overcitation or Undercitation

- Strike a balance by citing relevant foundational and recent studies while avoiding excessive references.

5. Use DOIs and Persistent Links

- Ensure online sources are accessible and up to date by including DOIs or stable URLs.

6. Acknowledge All Contributors

- Cite all authors and contributors involved in the referenced work.

TOOLS FOR MANAGING CITATIONS

1. Reference Management Software

- Automate citation formatting and organize references:
- EndNote
- Mendeley
- Zotero

2. Online Citation Generators

- Quickly create citations in a range of styles:
- Citation Machine
- BibMe

3. Journal Abbreviation Resources

- Use databases like PubMed to find official abbreviations for journal names.

COMMON CITATION CHALLENGES AND SOLUTIONS

Challenge: Formatting Errors

- Solution: Double-check formatting guidelines and use citation tools to minimize errors.

Challenge: Missing Information

- Solution: Search library catalogs, PubMed, or the publisher's website for complete citation details.

Challenge: Inconsistent Style

- Solution: Use one citation style throughout the manuscript unless otherwise required.

Challenge: Citing Unpublished Data

- Solution: Label unpublished work as "unpublished data" or "personal communication" with the author's permission.

THE ETHICAL USE OF CITATIONS

Plagiarism

- Failing to attribute sources properly is a serious ethical violation.

- Use plagiarism detection tools (e.g., Turnitin, Grammarly) to ensure originality.

Self-Citation

- Cite your previous work sparingly and only when directly relevant.

Predatory Journals

- Avoid citing works from predatory journals that lack rigorous peer review.

CONCLUSION

Citations are a critical component of scholarly writing in clinical neurophysiology. They provide credibility, enable reproducibility, and connect your research to the broader scientific community. By mastering citation formats, tools, and best practices, students and neurophysiology technologists can contribute ethically and effectively to academic discourse. Remember, accurate and thorough citations not only strengthen your work but also respect the intellectual contributions of others in advancing the field.

LETTER TO THE EDITOR

Margie Dieter-Murphy, BS, R. EEG/EP T.

Letters to the Editor offer a concise and focused platform to present a direct viewpoint, raise important questions, or provide thoughtful commentary related to a recently published article—particularly within the field of medicine (or other relevant disciplines, as applicable). These letters should remain highly relevant to the topic in question and contribute meaningfully to the ongoing scholarly dialogue

Three types of letters:

1. **Stand-alone letters**
    - Stand-alone is a letter to the editor in which a complaint is issued in the form of an area of neglect or insufficient attention given to the topic.
2. **Written in response to a published journal article or published letter.**
    - Letters to the editor in response to a published journal or published letter. This letter should be sent after the publication is written. The response to the editor could be in the form of a question to better understand the topic. A full citation of the article in question will need to be entered. The main viewpoint will need to be entered in the letter.
3. **Letters to discuss methodological concerns to seek clarification.**
    - Letters to discuss methodological and or concerns are letters about the method of research. And of the data results themselves. These type letters will provide a concise summary of what is written in the journal and or

paper and what the issue may be with the method. In all three types a discussion that is significant to the paper and or article will be stated. An analysis of any issues and a forward-looking recommendation.

The format of a letter to the editor:

- Salutation
- Opening statement
- Opinion/ hypothesis
- Argument
- Conclusion
- Personal data/ name, email, and/or contact information.

The overall point of a letter to the editor is to comment on the paper and article in the form of a formal argument and verified with data. Or to comment on the article with other issues that the article may have brought to light.

Reference

Academic Medicine. Editorial policy, publication, ethics and complete infrastructure for authors. https: journals. Academic medicine/pages/infrastructure for authors.aspx

SOCIAL MEDIA

Shakira Lenosky, BS, R, EEG T., CNIM, CNMT, CHCA

Social media is utilized as a tool to target a larger audience. Be selective of the platforms utilized to reach the target audience for readership. Announce your published work along with a link to the article. Tag co-authors, publishers, institutions, etc; this will help engage a large audience of potential interest. Include hashtags that are relevant. Include an image or video in your submission that represents your article to make it more appealing. Keep your post simple, use minimal words and 1-2 sentences that are easy to understand and digest. This is all done to promote the frontier of knowledge and make it readily available in as many channels as possible.