Research
BASIC PRINCIPLES OF RESEARCH
Upon completion of this Lecture, the paramedic student will be able to:

- **Explain** Explain the importance of emergency medical services (EMS) research.
- **Describe** Describe the differences between types of EMS research.
- **Outline** Outline the 10 steps in performing research that are identified in this lecture.
- **Define** Define evidence-based practice.
- **Describe** Describe the criteria for evaluating a research paper.
10 basic steps for conducting research

1. Prepare a question.
2. Write a hypothesis.
3. Decide what to measure and the best way to measure it.
4. Define the population.
5. Identify study limitations.
6. Seek approval of the study.
7. Obtain informed consent.
8. Gather data after conducting pilot trials.
9. Analyze the data with an awareness of the pitfalls in interpreting the data.
10. Determine what to do with the research product (publish, present, perform follow-up studies).
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• EMS research begins with the posing of a specific problem or question.
  • What factors predict success for paramedic students on the National Registry of EMTs written examination?
  • Is the incidence of complications greater with prehospital peripheral vascular access than with hospital peripheral vascular access?
  • Does the paramedic uniform influence a patient’s satisfaction?
  • What is the incidence of violence in an EMS system?
  • Does the paramedic’s shift length influence the number of medical errors?
Write a Hypothesis

Problem or question to be studied has been identified, a statement (the hypothesis)

The hypothesis states the relationship between two or more variables.

Drug A

Drug B
Define the Population

- Any group of people (e.g., all patients with a diastolic blood pressure greater than 100 mm Hg), or any group of places or objects.
- If the population group is large, the researcher can use a sample (e.g., all patients over 50 years of age who have a diastolic blood pressure greater than 100 mmHg).
- The researcher should draw the sample randomly. That way, the patients in the study have an equal chance of being assigned to one group (drug A study) or the other (drug B study).
Identify Study Limitations

The researcher can ensure random sampling with computer software programs, random digits, and even with the flip of a coin.

Drawing a random sample prevents selection bias (placing the best or worst patients in a study group).
Another way to limit bias is with **systematic sampling**. With this method, patients are put into groups in the order in which they are encountered in the prehospital setting. For example, the first patient seen is put into group A, the second into group B, the third into group A, and so on.

The researcher also can use **alternative time sampling** to prevent bias by assigning a treatment group based on the day, week, or month in which patients are encountered in the study.
To lessen bias

- the researcher can use **blinding** (either single, double, or triple).
- In a *single blind* method, one party (the patient, the paramedic, or the person gathering the data) is unaware of (blinded to) the treatment at the time it is given. That party also is unaware of the effect to be measured during the study.
- In a *double blind* study, two parties are blinded.
- In a *triple blind* study, all parties are blinded.
- **Unblinding** refers to making all parties aware of the study, treatment, and outcome to be measured.
Seek Approval of the Study

• When planning for research involving human subjects, researchers use an institutional review board (IRB). IRBs (also known as independent ethics committees [IECs] or ethical review boards [ERBs]).
Obtain Informed Consent

With informed consent, the subject voluntarily agrees to take part in the research project.

The subject has decisional capacity and understands what is being presented.
Data from the research study should be gathered and analyzed using statistical methods.

The term statistics refers to numerical facts or data. These facts or data are classified and put into a chart to present key details about a subject.

Statistics can be descriptive or inferential.
Descriptive statistics does not try to conclude (infer) anything about a subject that goes beyond the data.

This type of statistics provides a description of the sample of objects or people being studied.

It does not infer anything from the data; it simply reports it.

Descriptive statistics can be qualitative or quantitative.
Qualitative analysis is nonnumerical; it is the organization and interpretation of observations. For example, it would show the age and gender of a sample. Qualitative analysis uses text and few numbers to describe the research findings.
Quantitative analysis • in descriptive statistics uses the mean, median, and mode to describe the most commonly occurring values in a sample.
Quantitative analysis

The **mean** is the arithmetic average of the group (e.g., the average age of the people in the sample).

The **median** is found first by arranging the measurement according to size from smallest to largest and then by choosing the one in the middle (or the mean of the two that are nearest to the middle). The median sometimes is referred to as the *50th percentile*.

The **mode** is the number that occurs more often than any other number in a set of data.
Your sample has 13 participants. Their ages are 53, 53, 53, 54, 55, 55, 56, 57, 59, 60, 64, 71, and 79.

The *mean* (average) age of the group is 59.15 years;

the *median* (middle) age is 56; a

the *mode* age is 53.
Inferential statistics is used to infer whether the relationships seen in a sample are likely to occur in the larger population.

The researcher can use these statistics to decide whether the results of the study support or contradict the initial hypothesis.
To do this, one must assume the opposite of what one may want to prove.

This is done by stating a null hypothesis.

A null hypothesis is a default position, such as that a specific treatment has no effect or that the results are a chance of variation (the opposite of what you expect to prove).
Significant?

• When a statistical test reveals that the probability is rare that a set of results is attributable to chance alone, this result is called **statistically significant**.

• *Statistically significant* means that the observed phenomenon represents a significant departure from what might be expected by chance alone.

• Researchers must set their level of significance before they begin their research.
Determine What to Do with the Results

• The final step in EMS research
• Several options are available, including publishing the results, presenting the results, and performing follow-up studies.
Publishing the Results

- The findings from research may be published in a professional journal for peer evaluation.
The format for writing a manuscript for scientific literature has five basic sections:

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>01</strong></td>
<td>The <em>introduction</em> provides a brief historical background of the research. It also relates any previously published research. The introduction provides both a rationale for the study and the research hypothesis.</td>
</tr>
<tr>
<td><strong>02</strong></td>
<td>The <em>methods section</em> describes how the experiment was done so that it can be replicated by others. This section should define the inclusion or exclusion criteria for the study (how patients were chosen). It also should contain the statistical methods used to analyze the data.</td>
</tr>
<tr>
<td><strong>03</strong></td>
<td>The <em>results section</em> provides answers to study questions and data (e.g., tables and figures). This information supports the research findings.</td>
</tr>
<tr>
<td><strong>04</strong></td>
<td>The <em>discussion section</em> lets the author interpret the research findings. Limitations of the project usually are also given here. This section frequently offers suggestions for improving the study through follow-up research.</td>
</tr>
<tr>
<td><strong>05</strong></td>
<td>The <em>conclusion</em> provides a succinct summary of the four preceding sections.</td>
</tr>
</tbody>
</table>
You also need to know your readers

**Methods**
- *What* did you do?

**Results**
- *What* did you find?

**Introduction**
- *Why* did you do the study?

**Discussion**
- *How* does the study advance the field?
The title

• The title is the most important part of the article because it connects your research with readers who might be interested in learning about it.

• Scientific articles usually have one of three types of titles: declarative, interrogative, and informative.
A declarative or headline title is a complete sentence that states the results

- Lactoferrin efficiently counteracts the inflammation-induced changes of the iron homeostasis system in macrophages.
- Vitamin D deficiency is common and associated with overweight in Mexican children.
- Declarative titles are often found in articles reporting basic research (the first example) but are discouraged in articles reporting clinical research (the second example).
“interrogative title”, which is phrased as a question

• Is mannitol the treatment of choice for patients with ciguatera fish poisoning?

• Is tea tree oil effective at eradicating methicillin-resistant *Staphylococcus aureus* colonization?

• Interrogative titles do not provide a lot of information—including the point of the article—they just call attention to the issue addressed in an article.

• As a result, they are not usually suitable for articles reporting research and are best limited to editorials.
“informative title”, which typically identifies the population, exposure, event, treatment, outcome, or relationship that was studied

- Serum lead concentrations in Jamaican children with and without autism spectrum disorder.
- Food insecurity as a predictor of domestic violence in Kazakhstan.
Consider including any or all of the following seven elements when writing a title

• (I) the study setting, location, or both;
• (II) the patients, organism, event, or relationship studied;
• (III) the intervention, treatment, or exposure;
• (IV) the comparator or control group(s);
• (V) the outcomes or end points;
• (VI) the study design, and sometimes
• (VII) the time period or duration of the study.
For example, suppose a study has the following characteristics:

- the setting and location: refugee settlements in Jordan;
- the patients or subjects: residents using public toilets;
- the intervention: self-disinfecting “smart toilets” using ultraviolet irradiation to kill bacteria;
- the control condition: regular manual toilet cleaning;
- the end point: *Escherichia coli* infections;
- the study design: randomized trial;
- the time period (probably not a factor in this study).
Now create a title

• starting with all the elements, and then edit for clarity and length. Many journals limit titles to about 80 characters and spaces. If so, remove the least important elements until you have met the character limit.

• Effectiveness of “Smart Toilets” Using Ultraviolet Germicidal Irradiation vs Regular Cleaning for Reducing *Escherichia coli* Infections in Refugee Settlements in Jordan: A Randomized Trial [187 characters and spaces]

• Effectiveness of “Smart Toilets” Using Ultraviolet Irradiation for Reducing *Escherichia coli* Infections in Refugee Settlements [127 characters and spaces]

• Effectiveness of Self-Disinfecting Toilets for Reducing *Escherichia coli* Infections in Refugee Settlements [107 characters and spaces]

• Effectiveness of Self-Disinfecting Toilets for Reducing *Escherichia coli* Infections [84 characters and spaces]
Titles – Get your reader’s attention

**Should include...**
- What’s important
- Keywords for indexing
- Study design
- Conciseness (<20 words)

**Should avoid...**
- Questions
- Describing methodology
- Abbreviations
- “New” or “novel”

*Your title should be a concise summary of what’s most important*
• **Original title:** Action of antibiotics on bacteria
• **Revised title:** Inhibition of growth of Mycobacterium tuberculosis by streptomycin
• **Comments:** Titles should be specific. Think about "how will I search for this piece of information" when you design the title.
• The title is the part of the article most often read and often the only part read. For these reasons, you should take the time to write a good title.
The abstract

• is the second most often read part of the article (after the title), but it should be the last part written.
introduction: why did you start?

- The introduction should prepare readers to understand why and how you did your research and tell them what to expect if they read your article.
- That is, a good introduction, especially after a good title and abstract, should let readers decide whether or not to read your article.
A good introduction should answer the following questions:

• What is the problem to be solved?
• Are there any existing solutions?
• Which is the best?
• What is its main limitation?
• What do you hope to achieve?
writing a four-part introduction

• In part 1, the background statement.
• In part 2, the problem statement.
• In part 3, the activity statement.
• In part 4, the forecasting statement.
• By the end of the introduction, readers should be able to determine whether your article is likely to interest them.
methods: what did you do?

• The purpose of the methods section is to tell readers how you went about answering your research question.
**What** do they need to know?

**Who/what was used in the study**
- Samples or participants
- Materials (where purchased)

**How you conducted the study**
- Methodology and techniques
- Discuss specific conditions and controls

**How you analyzed your data**
- Quantification methods/software
- Statistical tests (consult a statistician)
methods

• The methods section is usually the easiest part of the article to write simply because you describe what you did in your research. For this reason, many authors write this section first.
methods

• research design;
• location and setting of the study;
• patient or sample selection;
• group assignment or case definitions;
• the intervention or exposure studied;
• how variables were defined and measured;
• statistical methods.
results: what did you find?

*What* did you find?

You are very familiar with your findings

Your readers are *not*

Logically guide your readers
results: what did you find?

• In the results, report your data, but also tell readers what happened during the study. Explain if and why the research did not go as planned. In many studies, including a visual summary or flow chart of the sample selection process can be enormously useful.
Guide your readers through your findings

*Logical flow of information*

**Introduce** study design

**Efficacy** of the treatment

**Safety** of the treatment
Do not simply list your findings

Drug A reduced tumor volume by 32.7%, increased blood pressure by 12.3%, and increased the patient’s weight by 7.3 kg.

Drug B reduced tumor volume by 22.3%, increased blood pressure by 15.6%, and increased the patient’s weight by 2.4 kg.

Drug C reduced tumor volume by 38.1%, increased blood pressure by 6.9%, and increased the patient’s weight by 9.2 kg.

Describe relationships among your findings
Describe relationships among your findings

Patients treated with Drug C showed the **greatest reduction** in tumor volume (28.1%) compared with those treated with Drug A (32.7%) or Drug B (22.3%).

Drug C also had the **lowest increase** in blood pressure (6.9%) compared with that seen after treatment with Drug A (12.3%) or Drug B (15.65).

*However*, patients treated with Drug C had the **highest weight gain** among the three groups (Drug A, 7.3 kg; Drug B, 2.4 kg; Drug C, 9.2 kg).
• Present the results for the primary endpoint first, whether or not they are clinically important, statistically significant, or interesting. You designed the study to answer a specific question, and the results section should focus on that question. Other results can be presented, but only after the primary results have been reported.
• The discussion is usually the weakest part of the article because you have to determine the meaning and implications of your results and integrate them with what else is and is not known about the topic.
How your study contributes to the field

- **Summarize what you did**
  - Begin with research problem
  - Briefly describe study design
  - Summarize key findings

- **Interpret your findings**
  - Similarities & differences
  - Unexpected/negative results
  - Limitations

- **Why important to the field**
  - Main conclusion
  - Implications
a 7-part discussion

• (I) summarize;
• (II) interpret;
• (III) compare; and
• (IV) generalize your results;
• (V) speculate on their implications;
• (VI) critique your study; and
• (VII) and list your conclusions (5).
• A common error is to repeat the results rather than to give their implications:
**Strong conclusions**

*What do you want your readers to remember about your study?*

In conclusion, elevated arterial ammonia levels were almost exclusively found in critically ill patients with acute and acute-on-chronic liver disease. High arterial ammonia levels predicted poor outcome in our HH and ALF patients and were associated with advanced encephalopathy in those patients with acute and acute-on-chronic liver disease. Therefore, we recommend that arterial ammonia levels be used as a prognostic marker in both ALF and HH patients. Future studies should clarify whether targeted ammonia-lowering interventions may improve outcome in critically ill patients with acute hepatic injury.

Abstracts – First impression of your paper

- **Aims**: *Importance* of your topic
- **Results**: *Significance* of your study
- **Conclusions**: *Relevance* of your study

*Clarity of your writing*
## Abstracts – Good first impression

*What do you readers want to know?*

<table>
<thead>
<tr>
<th>Background</th>
<th>Why trial/case needs to be reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients/methods</td>
<td>Patient information Interventions</td>
</tr>
<tr>
<td>Results</td>
<td>Treatment outcomes Adverse events</td>
</tr>
<tr>
<td>Conclusion</td>
<td>Clinical relevance Learning points</td>
</tr>
</tbody>
</table>
Logically linking your ideas

Answer the **four key questions** for your reader

- **Why** this study needs to be done
- **What** you did
- **What** you found
- **How** your study will advance the field

**Logically link your ideas throughout your manuscript**
references
EVIDENCE-BASED PRACTICE

- Traditional medical practice has been based on medical knowledge, intuition, and judgment. With the emphasis moving toward evidence-based practice, many medical specialties have developed evidence-based guidelines for specific conditions, such as traumatic brain injury, spinal injury, and ST-segment elevation myocardial infarction.
• High-quality patient care should focus on procedures that have been proven useful in improving patient outcomes.
• Paramedics should participate in EMS research, data collection, and the sharing of information. These efforts aid in the design of a system-wide process for prehospital care that reflects the current state of scientific evidence.
Reviewing Research

• When reviewing research articles, paramedics should read the article critically to determine whether the findings are relevant to their practice.
Population

• Is the sample adequate and is it similar to your practice? For example, a study that
• evaluates response times without lights and sirens conducted in a rural setting may not be relevant
• to an urban EMS system. Another example is a study conducted in an area that has a significantly
• different ethnic makeup than your practice area. This could influence results if the study subject
• involves disease processes that are more prevalent in some ethnic communities.
Inclusion and exclusion criteria

- A study of patients with chest pain that did not include patients older than age 65, for example, would eliminate a key group at risk for heart disease and death.
Data collection

• Is there anything that could have influenced the data collection? If the study used
• the experimental method, how were the groups randomized? Was the method clearly described?
• Could the method have varied based on the person delivering care? Were the conditions in the
• control group and the experimental group the same?
**Results**

- Are the numbers presented clearly? When percentages are presented, are the underlying numbers reported? If a statistically significant difference was seen in the outcome, is it also clinically significant?
Discussion and conclusion

• Is the conclusion consistent with the results reported? Did the authors
• properly report correlations and relationships, rather than predictions? Did they link the research
• to relevant literature? Were the limitations of the study pointed out clearly? Did the researchers
• make specific suggestions for future research? Did you identify any major flaws in the conclusion?
• *How does this research relate to your practice?* Does the research suggest an area of

• improvement for your system? Does it suggest an area that should be monitored in your quality

• improvement program? Is there a reason to seek out more literature on the same subject to propose

• a change in your system?

2. After entering your topic, this example is “The Alamo” you can click on the + sign to add the topic to your Word document. A link is provided on your document so you can return to the information source again at a later time. Click on the article to learn more about it.
3. Select the text you would like to add to your research notes and then choose if you want to Add or Add and Cite. To avoid plagiarism, make sure you add quotation marks around the text so you know it came from the source.

4. The citation format will match the one you selected in the References tab. This citation is APA style, but you can change it to the one given by your teacher or instructor.
Vary Your Sources

• Refer to the notes section below for guidelines on this topic.
Evaluate Your Sources

• Refer to the notes section below for guidelines on this topic.
Narrow Your Topic

• Refer to the notes section below for guidelines on this topic.
Organize Your Research

• Refer to the notes section below for guidelines on this topic.
Present Your Research

• Refer to the notes section below for guidelines on this topic.