Association for Professionals in Infection Control and Epidemiology

APIC CHAPTER RESEARCH TOOLKIT:

Research 101

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Section 1: Introduction

Welcome to the APIC Chapter Research Toolkit! Since you're reading this, you have some interest in research and may have questions about the path to making it a bit easier. You and your APIC chapter colleagues may be exploring the possibility of collaborating on a research project. Congratulations! You just took the hardest step—it gets easier from here.

In fact, infection preventionists (IPs) use data to make change happen every day. We're natural researchers, and we do research as part of our everyday work.

For example:

1. After reading up on the available literature (literature search), we are interested in reducing our infection rate using a new product "X" (research question).
2. We recruit two units for a trial of new product X (research proposal).
3. We implement a trial where the units use product X instead of the product Y for three months (data time frame).
4. We continue to track infection rate data as usual and compare those data to previous infection rates from the same units (methods).
5. We analyze the data to see what happened (data management and analysis).
6. We report our findings to the Infection Prevention Committee (publication) and discuss their implications, as well as pros and cons of local adoption of the product. Then, if the data indicate that product X is beneficial, we ask for approval to use product X in the units going forward (implementation science).
7. Next, we use these data to convince the administration to use product X for the whole facility (more implementation science).

This is research! However, most of time, we as IPs are caught up in the logistics and justification of implementing changes, rather than thoughtfully planning a specific intervention as a sound research project from the beginning.

Our goal is to help you elevate and transform your everyday work into a journey that develops your essential research competencies (benefiting you), generates publishable new knowledge that is shared with the rest of the IP and healthcare community (benefiting and promoting your organization), and advances the science of infection prevention to improve patient care (benefiting the field). In this toolkit, we provide you with a step-by-step process to become a competent IP researcher. We hope that using this toolkit will help you conduct a research project and submit a research-based abstract for a poster presentation either to APIC or another professional group (AORN, ASM, SHEA, etc.).

As in all things unknown, we need your input. Please share your comments with us at research@apic.org. We'll be tracking and trending the data, and you can help us make this toolkit better!

Key Takeaways:

- **Anyone can do research! Don't be too scared or overwhelmed to do it.**
- **Although seemingly a daunting task, research can be tackled in small steps.**
- **When the opportunity arises for you to do research, this toolkit can help set yourproject up for success by ensuring it's a study of strength.**

Section 2: Five *T*ips for Getting Started

You and your APIC chapter members are research enthusiasts! Now where do you start?

The key to success is planning and managing tasks to make research as easy, fun, and efficient as possible. Below, we include 5 Tips to move from idea to action: Topic, Team, Time, Tasks, Troubleshoot.

Topic

What are you interested in doing? All research starts with an idea and a question. From there, you can develop the proposal. For example:

- *Idea:* There's a new toolkit from APIC, and it's about research at the chapter level!
- *Question:* Can we implement a chapter research committee?
- *Proposal:* Propose to the chapter board that we form a chapter research group/committee. Get organized before the proposal is approved, and let others know this opportunity is being developed. Once the proposal is approved, you will be able to get started quickly and send out invitations to all members.

Team

Keep the mood light and fun.

- Remember, everyone is learning, and everyone learns and can attend differently. Everyone has their own strengths and weaknesses, and it may be helpful to pair a novice with an expert.
- That said, it is important to assign early on key roles such as principal investigator, coinvestigators, and research team members to establish accountability and facilitate movement from idea to action.

Time

Pick a time frame that will work for most of your teammates and decide how often you will meet.

- *Block out time on your calendar*! Reserving this spot may help you keep the work as a priority and avoid being overrun with other meetings.
- During the meetings with your research team, close your door, turn off your email, and silence your phone. The next hour is devoted to your research. This is usually the hardest part for all of us.
- Keep a consistent schedule.
    - It's a good idea to schedule meetings more often than once a month. In general, every other week is a long enough time frame to make progress but is not burdensome.
    - If you're getting close to a deadline, like abstract submission, meet once a week to check in with those that need some help.

Tasks

How will your team meet? Webinars are nice because you can pick someone to run the meeting and share screens, but phone conferences work, too.

- There are many webinar platforms to choose from: Webex, Zoom, GoToMeeting, GoogleHangout, EverWebinar, WebinarJam, etc.
- If your chapter already uses a particular webinar platform or someone in your group has access to one, use that. Free webinar platforms are out there.

For these meetings, designate a meeting facilitator (this can rotate) and a meeting scribe.

- As a facilitator, create an agenda and send it out early. It may be helpful to allocate specific amounts of time per agenda item. Also, highlight the decisions that will be made, in case people aren't able to attend the meeting. Make sure that people follow through with their action items.
- As a scribe, take the meeting minutes, noting action items and who's responsible for them. At meetings, go over the team's progress and the plan of action.

Once you are meeting and discussing work, be sure to have a way to share documents with multiple people.

- Try to have a central "bank" of your meeting minutes, documents, collected data, and drafts.
- Possible resources include Google Drive and Dropbox.

Set goals and deadlines.

- A regular and consistent schedule can help team members plan and make time for research.
- Ensure that everyone is assigned a job to foster a mutual sense of accountability and motivation.

Troubleshoot

Stumped with a problem or questions? Seek available resources through APIC!

- Did you know APIC has a Research Committee? If you're stuck, shoot them a question by emailing research@apic.org.
- APIC also has research education webinars:
    - Practical Tips for Understanding Research
    - Introduction to Research

Key Takeaways:

- **Although you may be super excited to dive into the work, addressing the logistics first will ensure a smoother research process.**
- **You have many resources to turn to, including your APIC Research Committee!**

Section 3: The Research Question—That Is the Question!

Before we discuss how to create a research question, let's first consider a key issue: does research differ from evidence-based practice (EBP)?

Steps of the two processes are somewhat parallel but differ in key ways that are important for the infection preventionist (IP) researcher to appreciate (Table 3.1). Research aims to generate *new* knowledge that describes, explains, and predicts through rigorous, systematic methods. Research cannot *prove* things; rather, research supports the probability of something. Once a lot of research is completed on a topic, EBP uses findings from all that research to generate best methods for providing patient care. Both research and EBP ultimately guide practice so we don't have to rely on trial and error, "old wives' tales," and intuition.

Table 3.1. Evidence-based practice process versus research process

EBP	Research
Formulate the EBP question	Formulate the research question
Search for best evidence in literature	Literature review
Select studies	Identify theory or conceptual model
Appraise the evidence	Select research design and method
Integrate the evidence	Implement the study
Evaluate the outcomes	Analyze the data
Disseminate the findings	Draw conclusions

A simpler way to think of the distinction between the two:

> *Research:* Does the temperature of the butter change the taste and texture of a cookie?
>
> *EBP:* Looking at all the food science, what's the exact recipe to make the perfect cookie?

Now, continuing with research, the research question is derived from the clinical problem of interest (Figure 3.1) and, importantly, addresses a specific knowledge gap based on review of the literature of why, how, what, when, or where (literature review is discussed in Section 5). There are four basic types of questions your research project can address: explanatory, descriptive, comparative, or causal (testing a relationship). The following are key points. Refer to Appendix 3A for examples.

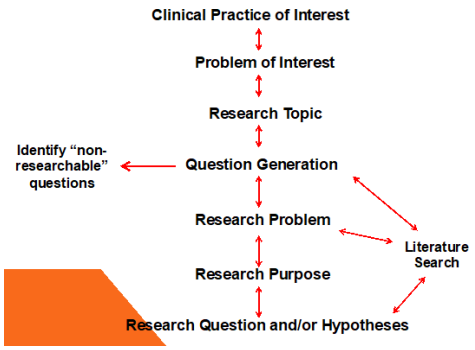


Figure 3.1. Deriving the research question. Adapted with permission from Schmidt NA, Brown JM. *Evidence-Based Practice for Nurses: Appraisal and Application of Research*, 4th ed. Sudbury, MA: Jones & Bartlett Learning; 2019.

What is a research question?

It's a question that you want to answer!

What is the purpose of the research? Why is the research important?

These seem like simple questions, right? Doing the research provides an answer! The problem is that you need to spend time on answering this specific question of "why." By answering the question "why is this important," you create the guiding pathway of your research project and highlight the significant issue your research will investigate.

Things to ponder about your research question

- What do you want to know?
- How are you going to best answer your question?
- What are the interesting ideas about the data?
- What data are needed to answer your question?
- Do you understand the data?
- Do the data answer the question?
- How do you analyze the data?
- Can you answer the question?

So, you and your colleagues are curious about something. How can you best formulate this curiosity into a great research question?

Characteristics of a great research question

- Relevant: Is the question an issue that can be investigated by research? How does this research contribute to the field?
- Measurable: Can you actually collect the proper data to answer your question?
- Specific: Is the question investigable? Can you actually research it?
- Clear and simple: Can readers of the question understand what you're hoping to find out?
- Interesting: Are readers interested? Is the question substantial?
- Answerable: Can you provide an answer to your question?

Finally, it is a *question* not a statement.

Summary

To summarize, the following are the main steps for creating your research question:

1. Identify a broad subject from the data you've already studied or read about.
2. Do a literature search. What is already known? What are the current gaps or challenges?
3. Narrow the topic: Ask how and why.
4. Find a specific, measurable question. For example, If we increase adherence to hand hygiene policy to 95%, will our healthcare-associated infection cases decrease?
5. Determine *why* this is an important question. Will the answer be significant? Will it make a difference? Determine the broad topic under investigation. Draft a purpose statement that states why you are investigating this question.
    a. The purpose of this study is to investigate/determine/establish the relationship between_____and_____and why_____.
6. Use simple and succinct language.
    a. What is the relationship between_____and_____?
    b. What factors affect_____?
    c. How do the effects of_____influence_____?
    d. How does_____relate to_____?
    e. Why is the_____an issue for_____?
    f. Does_____mean that_____?
    g. How many_____are still_____ over_____ [period of time]?

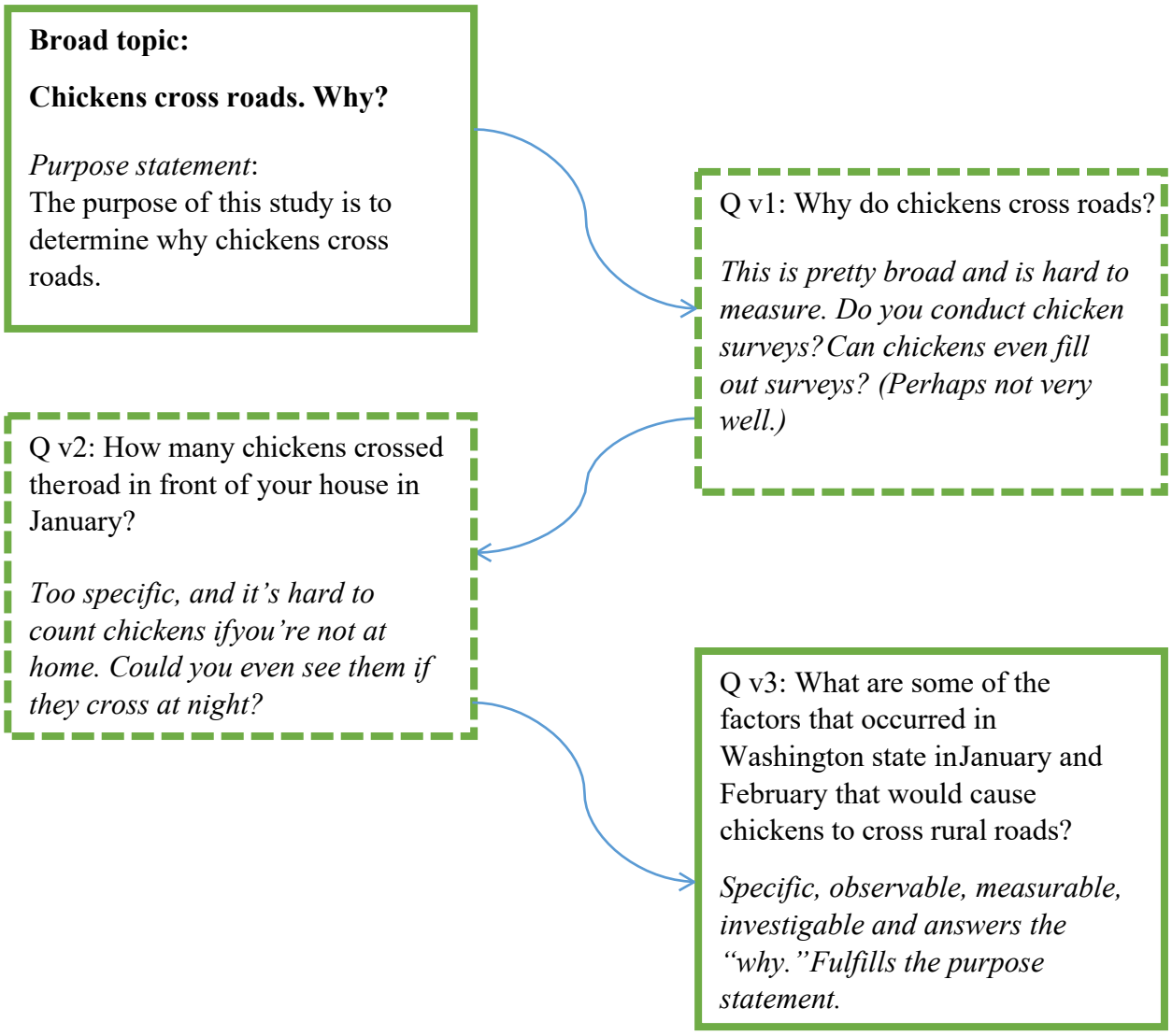
Once we have a question in mind, the next step is to investigate previous research related to it by performing a literature review. We'll cover literature reviews in depth in Section 5.

Key Takeaways:

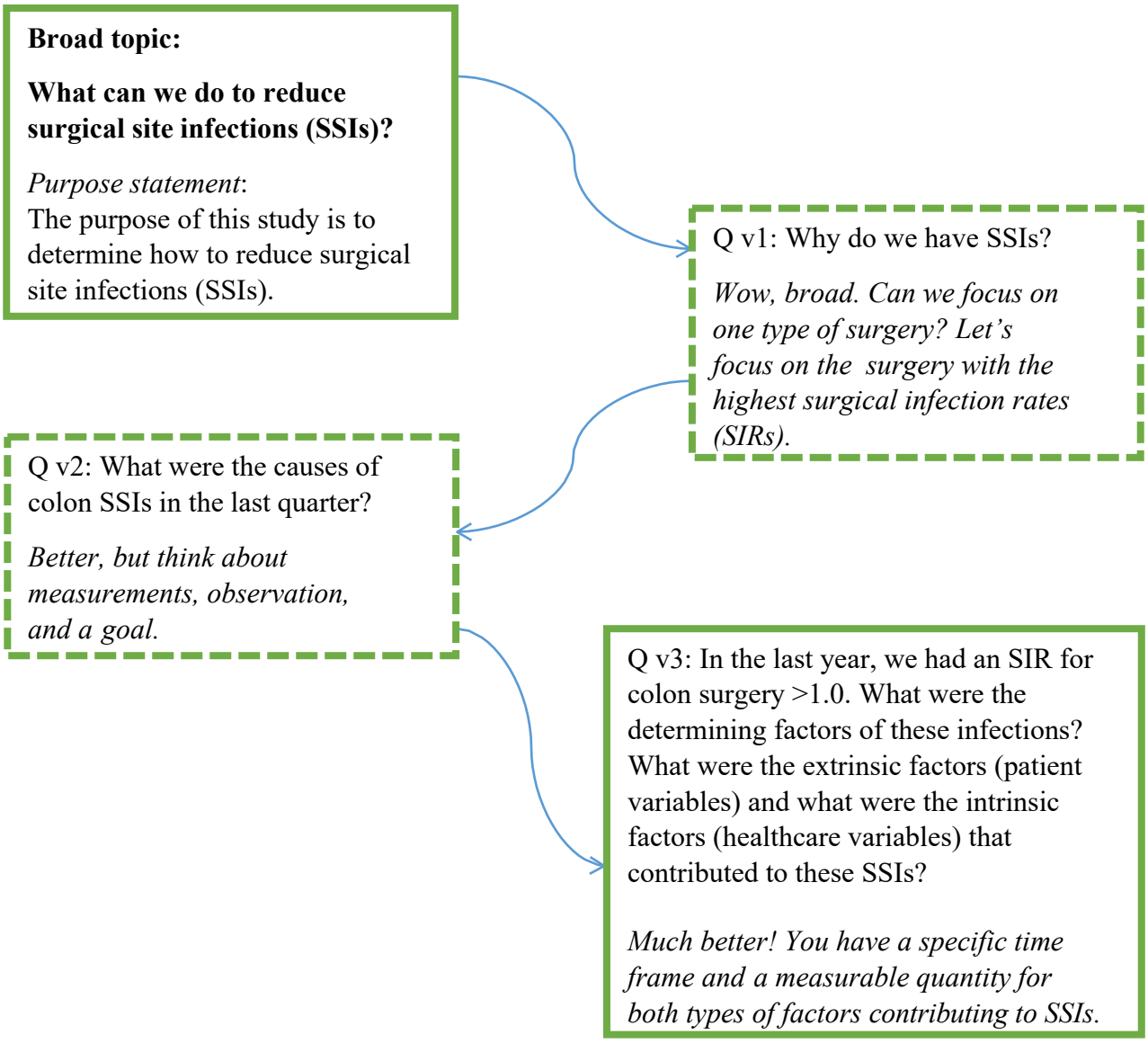
- **Research generates new knowledge that usually answers a question that youwant to solve.**
- **A purpose statement is the road map for your research process. Don't underestimate its importance!**
- **Great research questions are specific and measurable.**

Appendix 3A: Sample Research Questions

Time for an example! Let's make a research question together.



Let's try again, this time asking a question related to infection prevention:



Section 4: Building Your Research Team

What is a research team? The "team" is more than just you, and it's more than just one department. It might be more than one institution. It's made up of a group of people who work together on the same research project for a common goal. This section covers some things to think about when you are compiling your team.

Diversity

To make your research journey a smooth trip, you'll need buy-in and help from your infection preventionist (IP) team, as well as physicians, leadership, and auxiliary teams from many different backgrounds. Roles may change, but having a core group is very important.

- Deploy the persuasive skills that you use every day as an IP to recruit a diverse group of teammates.
- As you enlist help, make sure you tell people your intention is publication. That usually gets more attention and buy-in, especially from physicians and physician leaders.
- Balance your team. Don't have too many of one type of member.
- As you build your team, maintain an expansive understanding of diversity—it's more than mixing just career titles. Also look for diversity in research experience, educational backgrounds, and individual research strengths. For example, you may have teammates who excel at data management, project management, or writing.

Developing yourself as a principal investigator

Even if research is new to you, know and say out loud that *you can do it!* Expertise comes from grit and breaking a sweat. As a principal investigator (PI), you will also need to exercise these softer skills:

- *Opportunity awareness:* Gain a wider knowledge of the academic and professional sector to identify, create, investigate, and seize areas for personal and professional development. Identify possible sources of information and support within your institution and within your professional organization.
- *Decision-making:* Understand your personal priorities and constraints (internal and external) so that each research opportunity and project step is guided by an informed decision. You need to be able to match the decisions made to your core skills, knowledge, values, motives, and so on.
- *Networking:* Develop contact with others who do research. APIC has a Research Committee—volunteer with them! They're always looking for new people, and they love sharing what they do. You will be able to define, develop, and maintain a support network for advice and information.
- *Self-presentation and promotion:* Define and promote your own agenda, goal, or purpose. Promote your own strengths in a convincing way. Don't be afraid to share what you're working on.

- *Goal setting and action planning:* Move your research forward in a structured way by planning and implementing an effective course of action, organizing time effectively, and preparing contingency plans. You should be able to monitor and evaluate progress against specific objectives. Although time is always a scarce commodity, doing this research can further both your career and the field, and it is a key part of becoming an expert-level IP!

Management

As the PI, you have responsibilities, such as those listed below. Most infection prevention and control projects will not require all these elements, but it doesn't hurt to be aware of them. Even if you are *not* the PI, you can help your team achieve these basic elements of research management.

- Establish, agree, and communicate standards of performance and behavior.
- Establish the style, culture, and approach of the group (i.e., "soft" skill elements).
- Monitor and maintain discipline, ethics, integrity, and focus on objectives.
- Anticipate and resolve group conflicts, struggles, or disagreements.
- Assess and change as necessary the balance and composition of the group.
- Develop teamwork, cooperation, morale, and team spirit among all group members.
- Develop the collective maturity and capability of the group with the aim of progressively increasing group freedom and authority.
- Encourage the team toward objectives and aims by motivating the group and providing a collective sense of purpose.
- Identify, develop, and build consensus about team- and project-leadership roles within the group.
- Enable, facilitate, and ensure effective internal and external group communications.
- Identify and fulfill group training needs.
- Give feedback to the group on overall progress; consult with, and seek feedback and input from the group.

Key Takeaways:

- **It's corny but it's true: Teamwork makes the dream work.**
- **The PI is like a captain of the ship—use your motivation and enthusiasm to lead the group toward one common purpose.**
- **Have the confidence to identify yourself as the PI or research team member.**

Section 5: Time to Search the Literature!

The aim of doing a literature review is to find out what is already known about a specific topic. Why is this important? Knowledge doesn't exist in a vacuum. Your work and your findings will be meaningful to the extent that they're the same as, or different from, other people's work and findings.

Objectives

Specific objectives of a literature review are to:

- Summarize current knowledge.
- Generate and refine your own research ideas.
- Provide a critical review that demonstrates:
    - Awareness of the current state of knowledge in the subject area (description skills);
    - A synthesis of resources showing their strengths and limitations, omissions, and biases (critical skills); and
    - How the identified and reviewed research fits into this wider context (analytical skills).

Embarking on your search

How do you conduct a literature search? What resources do you use? First, you need access to content. Types of access to information can be classified as free access, access paid by an institution, and access paid by an individual.

These days, almost everyone will resort to the internet first. When you search online, make sure you know what you're looking at! There are online databases and internet search engines (aka "information vendors").

- Notable online databases include MEDLINE and CINAHL (refer to Appendix 4A for more examples).
- Search engines include Google Scholar, Ovid, EBSCOHOST, and Elsevier. In some cases, using different search engines can yield different results.

To achieve the best search results, if you are in an institution with a medical library, always seek professional assistance from your local/institutional librarian or informatician first.

Focusing your search

Once you start looking for scientific literature around your topic of interest, you will be surprised at how much you can find! However, it's important to know that some sources are more appropriate than others for inclusion in a literature review.

- Consider the hierarchy of evidence (Figure 5.1) when searching for literature. Different types of research will have varying levels of design, validity, and applicability that determine the study's methodological quality. Generally, meta-analyses and well designed systematic reviews are more scientifically rigorous than expert opinion and anecdotal experience.
- Try to avoid sources such as blog posts, newspaper or magazine articles, social media, or editorials where people publish their own opinions or unscientific evaluations of research findings.

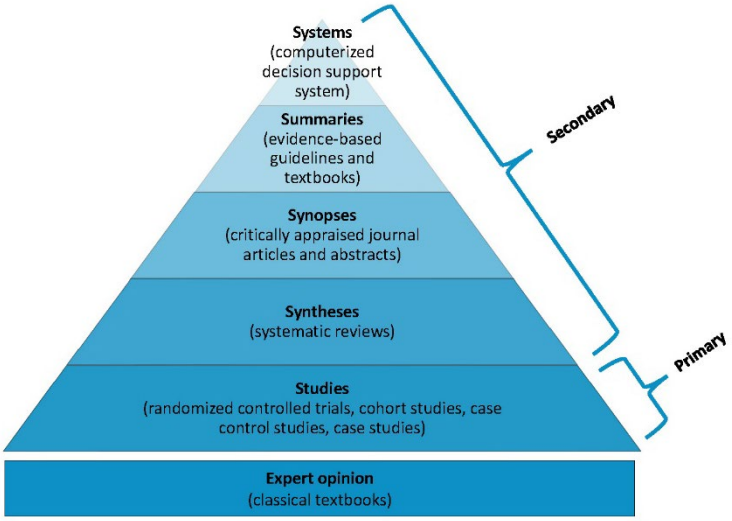


Figure 5.1. The 5S hierarchy of evidence. Adapted from Haynes RB. Of studies, syntheses, synopses, summaries and systems: the "5S" evolution of services for evidence-based health care decisions. *BMJ Evidence-Based Medicine*. 11(6):162-164. doi:10.1136/ebm.11.6.162-a

Recommended tools and techniques

Okay, here is the meat! The following are tips that will help guide this process.

General search strategies

- Design your search to find multiple relevant sources. This helps you avoid bias, identify methods used in studies exploring research questions similar to yours, and see a wide range of findings and conclusions.
- For each source, try to obtain the whole article—not just the abstract.

Formulating a search strategy

- Looking at your research question, identify key words, terms, and phrases.
  Tip: Brainstorming your main discussion points to create concept/mind maps can help with generating new themes and terms.
- Identify synonyms for your key words, using a thesaurus or subject headings.
- Identify a time frame for your literature review, if needed.
- Consider the types of materials you will include or exclude.
- Figure out which databases and online sources you will use for your search.
- Write all of this down and stick to your strategy!
- Keep track of your search strategies, including your search terms and which databases you use. This is your step-by-step guide of how you came to find all of your sources, and it will prove very helpful for jogging your memory for projects that you have to put on hold for months.

Hints for searching databases

- Start with basic searches using key words and index/subject terms.
    - **Key word search:** This a broader search that looks for your key words in the title, abstract, and sometimes the whole text.
    - **Index/subject term search:** This is a more focused search that looks for specific terms applied by an indexer or the authors. For example, some databases allow searches using a MeSH-controlled vocabulary.
- Try searching strings of key words using Boolean operators (Figure 5.2).
- Try citation searching, or look at articles cited in the publications that you have chosen to include in your literature review.

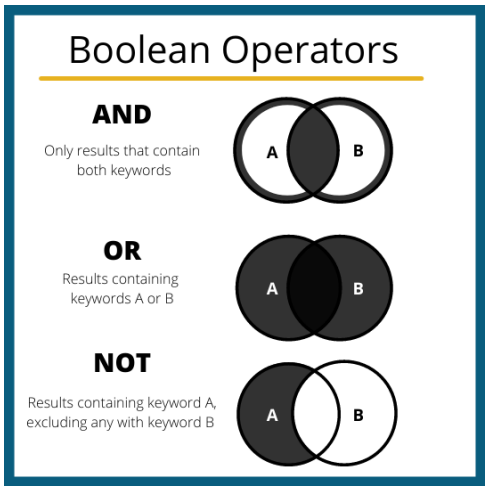


Figure 5.2. Boolean operators. Created by Cecelia Vetter. Reprinted under Creative Commons license (https://creativecommons.org/licenses/by-sa/4.0/deed.en) from https://commons.wikimedia.org/wiki/File:Diagram_Explaining_Boolean_Operators.png

Collating your sources and findings

The following are options to keep track of your sources:

- Use a reference manager. These are great tools for keeping track of all of your references and then generating your reference list in the correct format. Great examples are Mendeley, RefWorks, and EndNote.
- Manually track references in a word processing document or spreadsheet.

Tip: You can use Google Scholar to create the appropriate citation for you (Figure 5.3). By clicking on the quotation marks, it generates the citation in multiple formats.

Figure 5.3. Google Scholar citation tool.

Documenting your findings

Everyone has different methods of collating the data/evidence found during the literature search. Some people use specialized software for this, but you can also use a spreadsheet to list your sources, key findings, study types, results, implications, etc.

Key Takeaways:

- **Come up with a search strategy and stick with it!**
- **Remember, some sources are better than others.**
- **Keep track of all your search terms, references, and findings.**

Appendix 4A: Additional Literature Review Resources

Examples of databases used in literature review searches

Database	Description
National Guideline Clearinghouse (www.guideline.gov)	Summaries of best practice guidelines
DynaMed (www.dynamed.com)	Synthesis of the most recent medical information into evidence-based recommendations
Cochrane Library (www.cochranelibrary.com)	Database of Cochrane systematic reviews, plus quality assessments of other systematic reviews and database of randomized controlled trials
PubMed (www.ncbi.nlm.nih.gov/pubmed)	Free resource: Citations from MEDLINE (medical literature), life sciences publications, and online books
OVID MEDLINE (www.wolterskluwer.com/en/solutions/ovid)	Database of medical journal publications
EBSCO CINAHL (www.ebsco.com/products/research-databases/cinahl-database)	Database of nursing and allied health publications

Other resources

- National Library of Medicine: https://www.nlm.nih.gov
- PubMed online training: https://learn.nlm.nih.gov/documentation/training-packets/T0042010P
- Charles Sturt University. Literature review: developing a search strategy: https://libguides.csu.edu.au/c.php?g=476545&p=4949988
- Melnyk B, Fineout-Overholt E. *Evidence-Based Practice in Nursing and Healthcare: A Guide to Best Practice*. 4th ed. Philadelphia, PA: Wolters Kluwer; 2018.
- Schmidt, NA, Brown JM. *Evidence-Based Practice for Nurses: Appraisal and Application of Research.* 4th ed. Burlington, MA: Jones and Bartlett; 2017.

Section 6: Research Design for Infection Prevention and Control

Once you have your question at hand, it's important to know how you will design your research. The data that you will need to be able to answer your question depend on the type of study that you will do (Table 6.1). Let's start out with by asking, what's the purpose of your research?

Table 6.1. Research question types

Question Type	What You're Trying to Achieve	Best Study Design to Address Question Type
Intervention or therapy	Determine which treatment leads to the best outcome	Experimental studies
Etiology	Determine the greatest risk factor of a condition	Observational studies
Prognosis or prediction	Determine the progression of disease	Observational studies
Meaning	Explore or understand the meaning of an experience	Qualitative research
Process improvement	Determine changes that improve an overall process	Statistical process control

In general, research is broken up into two different study types: descriptive and analytical (Figure 6.1).

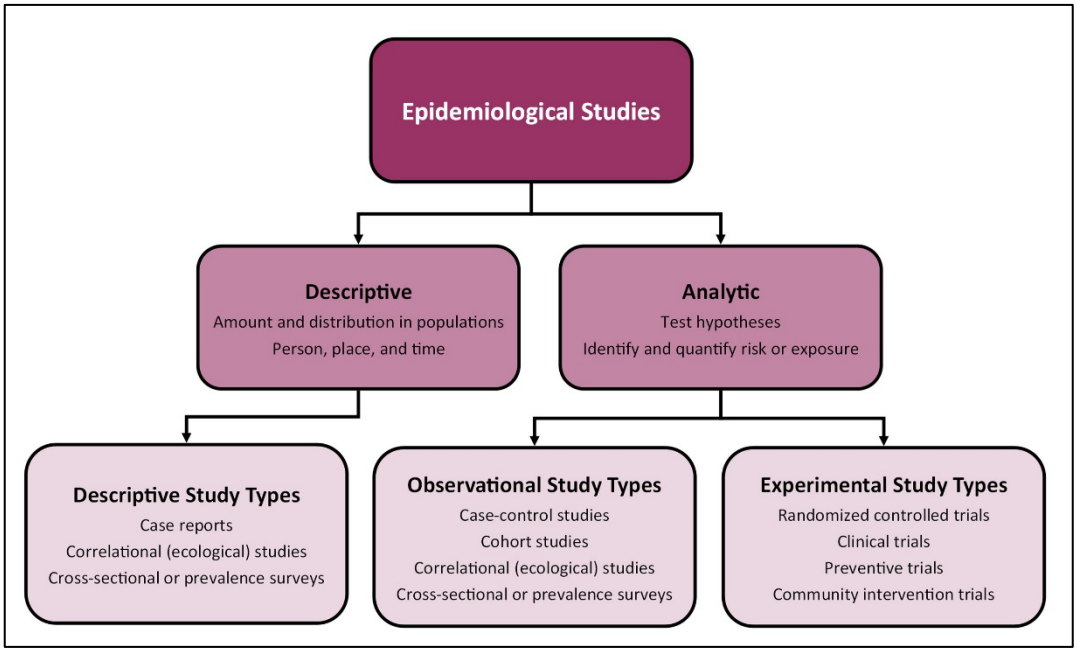


Figure 6.1. Types of epidemiological research studies.

Descriptive studies

Descriptive studies describe patterns or occurrences (Table 6.2). The researcher does not manipulate any variables or test any changes in technique or product. There are many types of descriptive studies: case studies, correlational (ecological) studies, and cross-sectional surveys.

- *Case studies* are detailed reports that highlight cases in areas where there is minimal published data. Examples include case reports of the first Ebola patient treated in the United States or how your facility managed a healthcare-associated outbreak of carbapenem-resistant Enterobacterales (CRE).
- *Correlational (ecological) studies* look at the relationship of disease and exposure in a population. These are higher overview studies that may look at different groups within the same time period or the same group over different time periods. These studies help with determining whether a relationship exists. For example, you could look at population-based prenatal exposure to influenza during an outbreak and compare it the later development of leukemia in children. A limitation of this method is that because you are analyzing population data, you do not capture individual exposure or outcome data; this limitation is known as ecological fallacy. This could lead to incorrect assumptions about the individuals in a group.
- C*ross-sectional studies* look a single snapshot of both an exposure and the outcome at a certain time. For example, you could look at reports of bloodborne pathogen exposures in an acute care setting over a year and whether the prevalence of exposures differ by healthcare worker type or department. These types of studies are good for investigating associations, but it's difficult to establish causal relationships between exposures and outcomes.

Table 6.2. Types of descriptive studies

Type of Study	Pros	Cons
Case study	Quick, easy Detailed reports of rare events/cases	No case comparisons or denominator; no ability to calculate rates
Correlational/ecological study	Relationship at a population level	Ecological fallacy—cannot extrapolate from population-level findings to an individual level
Cross-sectional study	Snapshot of both exposure and outcome	Hard to determine temporal relationship of exposure and outcome—which came first?

Analytical studies

While descriptive studies can help generate hypotheses, analytic experiments can go further. Analytic studies can either be observational or experimental.

- In observational studies, different groups are compared to investigate specific causes or outcomes.
- In experimental studies, individuals who are assigned to intervention group are compared to individuals in a control group. This intervention can be a procedure, a drug, or other treatment while the control group usually receives a placebo, a previously implemented procedure, or if appropriate, no treatment. Experimental studies are prospective, can be very big, and last for years.

There are various types of analytical studies (Table 6.3), such as case-control studies, cohort studies, and experimental trials. Most analytical study designs use a control group (a population that is not exposed to the intervention).

- *Case-control studies* are common in infection prevention and control research. They identify a group with the outcome of interest (cases) and compare that group to a group without the outcome of interest (controls) to figure out what risk factor(s) may have caused the outcome of interest. For example, a case-control study could compare people diagnosed with lung cancer (the outcome of interest) to those without lung cancer (the controls). In this study, investigators could analyze whether smoking, diet, and exercise were correlated with the outcome. Case-control studies generally occur retrospectively, and thus may be undertaken in a quicker and less-costly manner than many other study types.
- *Cohort studies* identify a group of study subjects and observe them over time to investigate specific outcomes. These prospective studies can evaluate historical data (if past exposure data are available) or watch for future data over time, measuring the incidence of disease or other outcome of choice. For example, in children diagnosed with low levels of lead poisoning, cohort studies may look at their behavior and medical outcomes during adolescence.
- *Experimental trials*, especially randomized controlled trials, provide the best evidence for testing a hypothesis because these studies control certain aspects of the study that might confound results while reducing potential biases. A confounder is a variable that influences both the study variables and results. For example, if researching a potential relationship between red meat consumption and the incidence of heart disease, potential confounders may include smoking and being overweight. In controlled trials, these confounding variables can be removed. While randomized controlled trials and experimental trials are reliable forms of scientific evidence, they are generally expensive and resource intensive. For the most part, experimental trials are not appropriate or feasible for IPs to perform unless assisted by a multidisciplinary team.

Table 6.3. Types of analytical studies

Type of Study	Pros	Cons
Case-control study	Strong design for investigating rare outcomes; good for evaluating multiple risk factors; quick and inexpensive; data often available	Not good for studying rare exposures; not population-based; difficult to measure if the exposure preceded the outcome
Cohort study	Strong design for investigating rare exposures; can measure temporality	Not good for studying rare diseases; can be expensive and time-consuming.
Randomized controlled trial	Best method for finding clinical evidence; reduces confounders.	Expensive, time-intensive; potential ethical concerns: Will control group be harmed by exclusion? Will intervention group be harmed by experiment?

Quality improvement research design

In addition to the epidemiological research designs we just reviewed, healthcare also benefits from quality improvement (QI) methodologies, which are used to find effective and quicker ways to improve outcomes. Unlike clinical research, QI initiatives do not attempt to "control" real-life variables; instead, QI projects measure outcomes before, during, and after an intervention. Popular process improvement techniques include Lean, Six Sigma, and plan-do-study-act (PDSA) cycles.

Most QI outcomes are measured by a process called statistical process control (SPC). In the SPC method, it is assumed that any process is relatively stable over time with slight variations from time to time. Once you know what's considered "normal variation" over a significant amount of time, you can identify your process's "control limits." These limits are thresholds that signal that something is happening due to factors other than just chance.

For example, Figure 6.2 is a control chart of a central line–associated blood infection (CLABSI) rate over time. In this control chart, the mean CLABSI rate and identified control limits are shown. If this were your hospital's CLABSI control chart, you might observe that one month's rate (February 2013) is significantly higher than the average monthly rate. This one data point could spur further investigation of potential causes of these infections, such as product contamination, practice changes, or staffing issues.

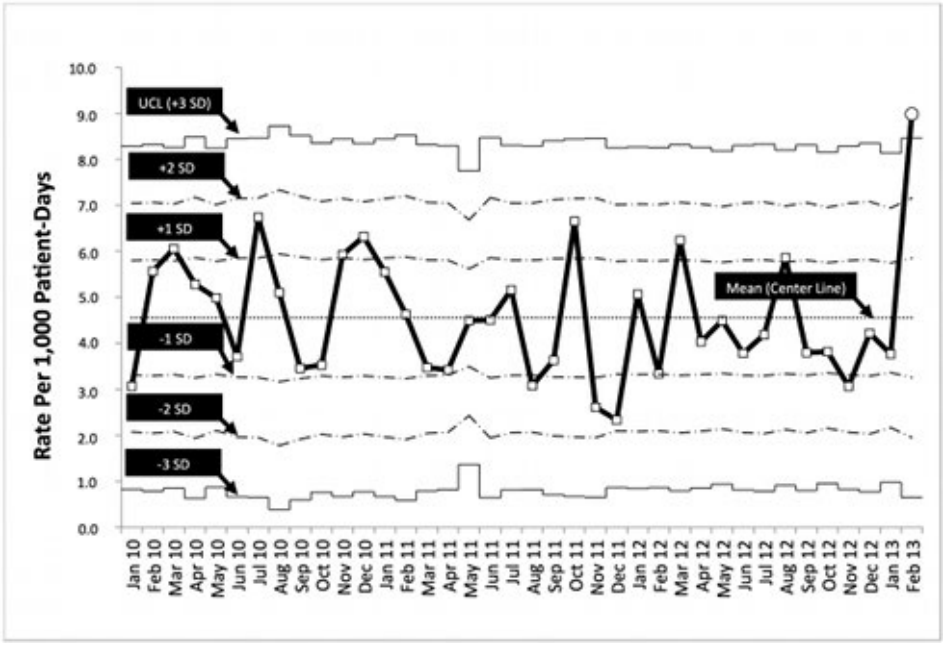


Figure 6.2. Control chart of central line–associated blood infection rate over time. Reprinted from Wiemken TL, Kelley RR. Process control charts. In *APIC Text Online*. 2014. https://text.apic.org

How to apply research design in infection prevention and control

In our field, we have the great ability to do both QI projects and research.

- QI projects are generally more local and self-evaluating than research, with the benefit of quickly fixing a specific problem.
- With analytical (observational and experimental) research, we are able to test hypotheses and generate new knowledge that contributes to our professional field. Even descriptive research, such as writing a case study, is valuable by describing a phenomenon and adding to a growing body of published work.
- As a caveat, if research is your ultimate goal, you may need extra time, planning, and assistance with writing and/or analysis depending on the type of study utilized.

Example scenario

An example scenario of a QI versus research approach is the effect of using chlorhexidine gluconate (CHG) on patients with a central line. Data from well-designed studies indicate that CHG bathing reduces bacterial skin colonization. As a result, the hospital decides CHG bathing will be an evidence-based standard practice for patients in the intensive care unit (ICU). Perhaps you want to explore the question, "Will using CHG daily skin disinfection on adult ICU patients with a central line reduce the number of central line infections?"

From a research perspective, it would be unethical to ignore the evidence of the benefits of CHG wipes by using them on some ICU patients but not others. Therefore, collecting prospective data (data moving forward from an implementation date) for an intervention group and a control group would be difficult.

Instead, you can approach this question from QI perspective, using a PDSA cycle to quickly implement the use of CHG wipes. You can identify a specific unit (or two) with higher central line days to receive this intervention. After a short period after implementation, you can use control charts to compare the unit's historical infection rates to the rates after using CHG wipes.

Once CHG wipes have become integrated into daily CLABSI-prevention practice, additional research can be performed. For example, a retrospective case-control study might compare patients with central lines who did not acquire a CLABSI (controls) with patients who did (cases). Over the study period, the daily use of CHG wipes could be analyzed to determine if it were a statistically significant protecting factor.

Multisite study opportunities

Prospective cohort studies can be difficult for individual IPs to perform without assistance. Multisite research projects are another opportunity for IPs to conduct research, especially for larger prospective studies. An example would be a multisite comparison of healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) colonization or infection between sites that do and do not use contact precautions for patients with identified histories of MRSA infections.

In large studies, you likely won't be the principal investigator (PI), but you can participate and learn from others with more research experience. IPs can actively contribute by helping with data collection and analysis as well as the writing and publication stages.

Key Takeaway:

- **There are many different ways to do research! Your question ultimately shapes the type of research study you will perform.**

Section 7: Data and Data Management

Collecting and using data are second nature for infection preventionists (IPs). We use data all the time because our jobs are data driven. However, very few of us use data that are intended for research. An essential part of the planning process for research is to have a robust plan for managing your data.

Recommended components of the data management plan include:

- Brief description of the project:
    - Project purpose and time frame.
    - Staff who will be involved.
    - Software that may be used for analysis or data collation (e.g., Excel, SAS).
- Description of the data to be collected:
    - Type of data (qualitative [text], quantitative [numbers], or both).
    - Data collection method (e.g., pulled from a database on a different server, qualitatively coded, collected via electronic survey).
    - Any secondary data on the topic. This could include numbers of infections, patient demographics, comorbidities, and other patient descriptors.
    - Data formats. IPs usually use line lists, but think about how you'll use the data before you start collecting and formatting it. Devise naming conventions for files and spreadsheet data at the beginning to help save time. For example, to manage version control of data and documents, you may wish to identify the file version by inserting "Content_Date_Author" into the file name each time a new version is created/saved, or by using some other consistent pattern to name file versions.
- Data dictionary:
    - A data dictionary is not necessary, but maintaining one is a recommended practice if you are investigating multiple variables.
    - Include each variable's name with a description and a definition.
    - For each variable, think of your analysis. If you already know the statistical platform (e.g., Excel, SAS, R) you will be using, you can also think about how you will code the data to suit that platform. Knowing your statistical platform is very helpful to plan, especially if you will be creating your own survey and/or database. For example, when asking "yes or no" questions, it could be more beneficial to code responses as 0/1 rather than Yes/No. Including statistical code in your data management plan may also be helpful. By thinking through your data analysis strategy, you can ensure that you are collecting cleaner data that are easier to analyze.

- Data storage: For healthcare, a key concern is how you will keep data such as protected health information (PHI) safe. Will you keep data on a secure server or on an encrypted thumb drive? Data security is very important.
- Legal and ethical issues: Top concerns for many projects include the confidentiality of the study participants and intellectual property rights. Who owns the data?
- Dissemination, access, and provisions:
    - What's your plan for sharing data with all of the members of your team?
    - Once your research paper is drafted, where will you submit your body of work?
    - Are there restrictions with the data that you will analyze? What can be shared? For example, if you are writing about a facility's successful intervention in decreasing infections, is the facility willing to have their procedures published? How long must information or data be kept private?
- Long-term data management:
    - Where will you store/archive the data in the future?
    - What is your plan for secure data destruction/disposal, if needed (e.g., as federally required for certain types of PHI)?
- Assigning data management: IPs typically manage their own data. However, if others help you with data management, ensure they are willing and able to assist until the project is complete.
    - For collaborative proposals, document roles and responsibilities for everyone involved, including contingency plans if key stakeholders leave during the project.
    - Be sure to identify who is collecting and/or collating the data, and who is analyzing it.
    - Ensure you have oversight of the data. Scheduling frequent check-ins with people involved in the data analysis and collection may help with keeping track of the data.

Although your data management plan and your research proposal will share some key elements, their purposes are distinct. Specifically, a data management plan is a detailed set of instructions that will help you get to your goal. Section 8 will provide more information on research proposals.

Additional resources

The National Institutes of Health (NIH) and National Science Foundation (NSF) have outlined requirements for data management plans:

- NIH: https://osp.od.nih.gov/scientific-sharing/nih-data-management-and-sharing-activities-related-to-public-access-and-open-science
- NSF: https://www.nsf.gov/bfa/dias/policy/dmp.jsp

Most IP researchers will not need all the information provided in these resources, but it's worthwhile to review them, as they provide a good foundation for your understanding of this important topic.

Most university libraries and research departments have checklists for data management. If your facility has a research department, it can help you access these lists and offer other assistance. *Tip:* Use your own facility's research department and institutional review board as resources before looking for external information.

If you don't have access to data management resources through your facility, perform an internet search for the phrase "research data management." You will find a long list of online resources available at your fingertips.

Don't get discouraged by the intricacies of some data management guidelines. The data management practices they describe are not required for every research project, and some details are only relevant to large, externally funded studies.

Key Takeaways:

- **Having a data management plan for your research is like providing a set of building blueprints.**
- **Keep current with your data management notes. This will help in the long run!**

Section 8: Writing the Proposal

Before you begin your research project, you usually must write a proposal to present to various senior administrators, committees, groups, or teams whose support is necessary to ensure that you can get your project off the ground. To enlist others to your cause, you need to convince them to devote time and invest in your project. The proposal serves both as a request and as a "heads up, I'd like to do this project and I need your help" message.

If proposal writing seems like a daunting task, consider starting with a brief one-page overview that covers why you are proposing this study, what you plan to do, how you will accomplish your plan, and what the findings may mean.

So, what is a research proposal? Here is a broad outline of the contents.

1. Statement of intent:
    a. A declaration of intention and ideas.
    b. Show your motivation.
2. Subject:
    a. A declaration of aims and objectives.
    b. Be specific.
3. Overview of your proposed research:
    a. Why is this important? Why are you motivated to answer your own question?
    b. Show that it's unique and how it contributes to the field.
    c. Emphasize how cool it is!

Remember, your facility may already have a proposal template for you to use. Once you have the general ideas written, other granular components include:

1. Title:
    a. Start title with an action. For example:
        i. Comparison of_____
        ii. Assessment of _____
        iii. Development of _____
        iv. Defining _____
        v. Identifying _____
        vi. Screening _____
    b. Be specific and accurate. Aim for a title that is brief and catchy and contains the main idea.
2. Background and rationale—This section covers:
    a. Background and issues.
    b. Short literature review.
    c. Synthesis of key questions and developments in the field.

3. Research question(s):
    a. Provide a clear explanation of what problems and issues you will explore and why they're worth exploring.
    b. Include specific study purpose, aims, and/or hypotheses.
4. Research methodology—In this section, provide an outline of:
    a. Research design and the approach appropriate for your research question.
    b. Study population or data needed.
    c. Study procedures—What exactly will you do and what resources will you use?
    d. Measurement of your intended outcome.
    e. Instrument development and use preparation, if applicable.
    f. Discussion of advantages as well as limits.
5. Human subjects rights protections—This section covers:
    a. What are risks and benefits to participants?
    b. Do you require institutional review board (IRB) approval?
    c. Will you collect anonymous or confidential data?
    d. Do you need documentation of consent?
6. Data analysis plan—Questions to answer include:
    a. Where will data be stored and how will it be protected?
    b. What analytic tests will be conducted? Why are they appropriate to the research question and study design?
    c. What types of tables and figures do you intend to show?
7. Plan of work and time schedule:
    a. Include an outline of various stages and corresponding timelines for development and implementation, including writing and submission.
    b. Consider a table showing activity to be completed per month or quarter.
8. Bibliography:
    a. Include a list of references to key articles discussed in the proposal.
    b. Focus on literature and resources appropriate to the project.

Review your entire proposal carefully to make sure you have demonstrated why you are proposing this study, what you plan to do, how you will accomplish this, and what the findings may mean.

Key Takeaways:

- **A research proposal is your statement of intent that you will use to persuade others as to why they should support and/or collaborate with you.**
- **The proposal is the best way to advocate for your work.**
- **Once completed, the research proposal guides the work in a focused and timely manner.**

Section 9: To IRB or Not to IRB?

Before you embark on any research, quality improvement (QI) or evidence-based practice (EBP) project, carefully consider whether institutional review board (IRB) approval is required before you get started.

Here are the basic facts:

- Federal regulations require that research projects involving human subjects be reviewed by an IRB.
- The IRB is tasked with protecting human subjects and/or their protected health information.
- The IRB must approve or determine the project to be exempt *before* you start any research activities.
- The IRB cannot provide approval or determinations for research that has already been concluded.

IRB review and approval is required for projects that:

- Meet the definition of research,
- Involve human subjects, and
- Include any interaction or intervention with human subjects or involve access to identifiable private information.

Does your project meet this definition of research?

Research is defined as a *systematic investigation*, including research development, testing, and evaluation, designed to develop or contribute to *generalizable knowledge*.

- A *systematic investigation* follows a predetermined plan for looking at a particular issue, testing a hypothesis or research question, or developing a new theory that may include any or all of the following:
    - Collection of quantitative or qualitative data
    - Collection of data using surveys, testing or evaluation procedures, interviews, or focus groups
    - Collection of data using experimental designs such as clinical trials
    - Observation of individual or group behavior
- *Generalizable knowledge* is defined as follows:
    - The purpose or intent of the project is to test or develop scientific theories or hypotheses, or to draw conclusions that are intended to be applicable and/or shared beyond the populations or situations being studied.
    - The knowledge contributes to an already established body of knowledge, and other investigators, scholars, and practitioners may benefit from this knowledge.

Methods for sharing generalizable knowledge may include presentation of the data at meetings, conferences, or seminars, in poster presentations, or in publications such as journals, papers, dissertations, and master's theses.

If the project does not meet the definition of research (i.e., it is not a systematic investigation or does not contribute to generalizable knowledge), the project does not require IRB review and an IRB application is not required under federal rules. As always, check the requirements in your local setting—internal policies may be more stringent.

The decision tree in Appendix 9A can help you get a *general* sense of whether IRB approval is necessary or not. Once again, *when in doubt, contact the IRB.* No research activities can be conducted without IRB approval.

Is publishing in your future?

If you have any inkling that you might want to publish, it's worth jumping through the hoops necessary for IRB review.

Keep in mind that IRB approval is not required for abstract submission to APIC. However, if someone sees your poster or oral presentation and says, "You should submit this for publication in *AJIC* or the *AORN Journal*," you may have a problem pursuing this suggestion if you didn't seek IRB review before you started.

Getting a retroactive IRB review or exemption is almost impossible, but dissemination of research, including in peer-reviewed journals, typically requires a statement of ethical considerations. This statement is required whether the project was IRB approved or deemed exempt from review. Therefore, it is best to address this matter early in the process.

Tip: Find and make friends with your IRB representative or coordinator, and ask for help! Remember, their job is to facilitate research, not to inhibit it.

Is your research exempt?

Not all IRB processes are the same. Depending on your proposed type of study, you may need an exempt review, expedited review, or full-board review.

Exempt research is considered to pose a low risk to participants.

- Although the category is called "exempt," this type of research *does* require IRB review and registration.
- However, the exempt registration process is often less daunting than an expedited or full-committee review.

Most QI projects and projects with an infection preventionist (IP) as the principal investigator meet the criteria for IRB exemption. So, before you throw up your hands and decide you won't move forward on your research project because you don't want to go through the IRB process, look to see if your project will meet exempt status.

To qualify as exempt, research must fall into one of six federally defined exempt categories. These categories present the lowest amount of risk to potential subjects because they involve either collection of anonymous or publicly available data, or conduct of the least potentially harmful research experiments.

Some examples of exempt research are:

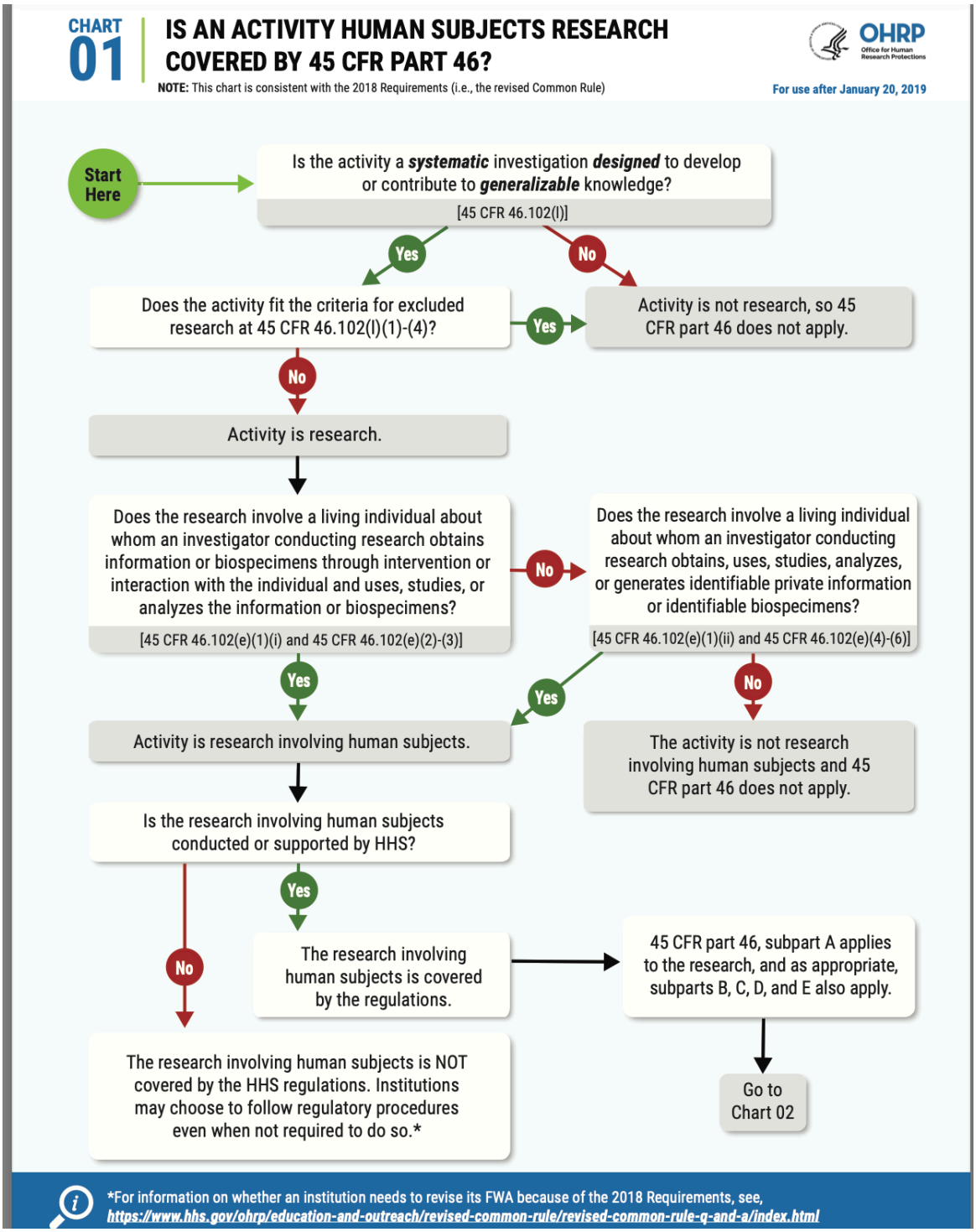
- Anonymous surveys or interviews
- Passive observation of public behavior without collection of identifiers
- Retrospective chart reviews
- Analyses of discarded pathological specimens without patient identifiers

IRB review may seem daunting but, as stated earlier, most IP-led research projects will be exempt. You can do it!

Key Takeaways:

- **When in doubt, contact your local IRB resource!**
- **Many research projects related to infection prevention or quality improvement fall under exempt review.**

Appendix 9A: IRB Decision Tree



Reprinted from Office for Human Research Protections. Human subject regulations decision charts: 2018 requirements. Published June 23, 2020. https://www.hhs.gov/ohrp/regulations-and-policy/decision-charts-2018/index.html#c1

Section 10: Research Project Management

Research project management is essential to success! Setting up your project properly will help the process run smoothly, ensure completion in a timely manner, generate new knowledge, and potentially change practice. This is not just about what you do; it's also about getting help from others to achieve your research goals.

To make sure things run smoothly and efficiently, your organization will probably have guidelines for you to follow and may provide a support infrastructure. Many project management steps are addressed when you put your proposal together, so you will already be familiar with key expectations.

Planning

- Put together a road map about the start (proposal and institutional review board [IRB] approval), implementation (data collection), middle (analysis), and ending of your project (written summary or presentation).
- Make sure you have specific targets with due dates and assignments to those accountable.
- Also, be prepared to share your progress! You may have to report on your work toward project milestones, and it's never a bad idea to let others know what you're doing. Plan on updates in your infection control committee meetings.

Here are some great planning tools that may help!

- **Microsoft OneNote:** A simple repository for notes, meeting minutes, drafts, and to-do lists
- **Gantt charts:** Visual representations of who's doing what, and by what time
- **Asana/Slack/Trello:** These are examples of project management software that may help keep people on track

Approvals

- Depending on your project, you may need approvals from boards, committees, or clinical leadership, as well as from your IRB (a topic we've already covered in Section 9).
- Make sure you build time into your project schedule to organize your proposal for all necessary approvals.

Staffing

- You might be responsible for making arrangements for any time needed from staff outside of your department.
- Most infection prevention and control projects are just managed by the infection preventionist (IP), but be aware of any other staffing needs. For example, are you recruiting nurses to assists with data collection? If so, are you able to negotiate with leadership their time to assist?

Legal conditions

- Make sure you review any contracts or terms if you deal with vendors for a new product.
- Partner with your materials or risk management department as needed.

Project finances

Most projects led by IPs do not have outside funding, but it's never a bad idea to quantify some of your "in kind" efforts—after all, your efforts are likely a "feather in the cap" for your entire organization as well as yourself and your department.

- Keep on top of documenting any expenses; your materials management or central services team can help if you need assistance.
- Depending on your project, it's possible there will be no expenses. However, to promote financial stewardship if you're trialing or instituting a new product, contact the sales people and departments that can help with costs or processes before you start.

Final reporting

All projects come to an end, and it's important to be prepared:

- How will you report on the outcomes?
- What committees will you report to?
- And, finally, who's going to help you with the presentation or publication?

If you have IRB approval, you'll have to notify them that you're done. They'll require a final report of both what data you've collected and what you plan to do with it.

Record keeping

At the end of the project, you'll have to make sure your data are complete and in order. It's possible your project might become part of an audit in the next few years. Having a complete set of records will save much time down the road.

Dissemination

Hooray! It's time to share what you learned with the rest of us!

- Consider the 3 "***P***s": Will you share via a *p*oster, podium *p*resentation, or *p*ublication?
- To make sure your data and hard work are recognized, write, submit, publish!

Key Take-aways:

- **Having a research management plan on top of your research proposal will help makeyour project a success!**
- **Keep track of who is responsible for what, by when, and for what reason!**

Section 11: Statistics and Calculations

As infection preventionists (IPs), we use data and statistics every day. Numbers and stats drive work and motivate people. This section will not be a statistics course; instead, we will note a few key concepts and list some of the resources available to you.

Why are statistics important?

- Statistics are a way to organize and describe data.
- From statistical testing, we can make conclusions about our data, such as associations and possibly causality.
- Statistics help us communicate findings to others though visual contexts. This part can be fun!

Back to the basics: A few essential points about statistical methods

Variables

Before you can choose your statistical method, it's important to know what type of variables you are working with.

- *Continuous* variables are numerical data that have an infinite number of values between a minimum and maximum value, such as age in years, weight, or date and time.
- *Discrete variables* are also numerical data but have a distinct number of values between two values, such as an amount of money or number of outbreaks in a year.
- *Categorical* variables are within distinct groupings that may or may not have a logical order, such as yes/no or distinct months of the year.

Descriptive statistics versus inferential (or analytical) statistics

Descriptive statistics are used for organization, presentation, and summarization of data, so that data may be easily understood.

- Common measures are central tendency (mean, median, mode), dispersion/spread (range, standard deviation, skew), proportions, rates, and ratios.
- Common tools include frequency tables, histograms, and graphs. (See Figure 11.1 [next page] for examples.)
- Variables are what is measured or manipulated in the study; they can be categorical data (such as some demographic data) or quantitative.

Use inferential statistics to decide whether findings from a sample can be applied to a population.

- Hypothesis testing usually uses statistical significance to evaluate whether your outcome is by chance.
- Important considerations are probability, sampling error, and tests of significance.

- Examples of methods to test for differences between groups include Chi-square (χ^2) statistic, *t* statistic and analysis of variance (ANOVA).
- Examples of methods to test for relationships among variables include Pearson *r* statistic (e.g., correlation coefficient between two variables) and multiple regression (e.g., relationship between multiple variables).
- For guidance on choosing your statistical test, check out the New York University Guide for Choosing a Statistical Test and Software Commands (https://guides.nyu.edu/quant/choose_test_1DV).

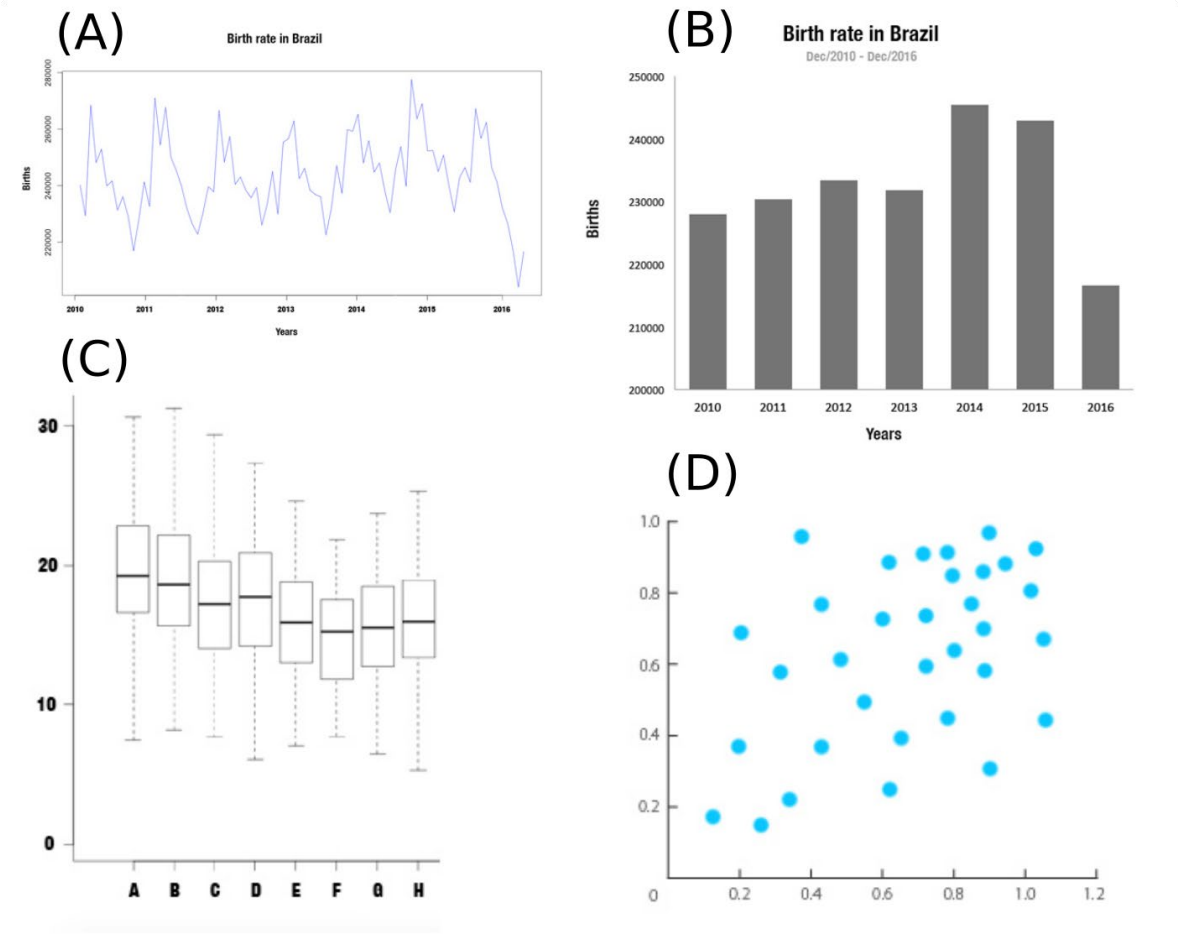


Figure 11.1. Graphical examples of descriptive statistics: (a) Line graph, the birth rate in Brazil (2010-2016); Figure B: Bar chart, birth rate in Brazil for the December months from 2010 to 2016; Figure C: Box plot, number of glycines in the proteome of eight different organisms (A-H); Figure D: Scatter plot example. Figures by Cthaynig and reproduced under a Creative Commons license (https://creativecommons.org/licenses/by-sa/4.0/deed.en) from https://commons.wikimedia.org/wiki/File:Examples_of_descriptive_tools.png.

How can statistical analysis be applied to infection prevention and control?

Going back to our example in Section 6, suppose you want to know if using daily chlorhexidine gluconate (CHG) wipes will reduce the number of central line–associated bloodstream infections (CLABSI). You trial daily CHG wipe use on one unit for three months before going hospital-wide. There are multiple ways of measuring and analyzing your data.

- You can show changes in the trial unit's pre- and postimplementation CLABSI rate over time. The infection rate can also be analyzed using statistical process control (SPC) methods within a control chart.
- You can measure statistical significance by performing a *t* test of the average (mean) CLABSI rate pre- and post-CHG implementation.
- You can also potentially measure success without the use of CLABSI rates through a Chi-square analysis. If you include a similar patient population/unit with central line days that were not part of the intervention, you can analyze the presence of CLABSI between patients who did and did not receive the intervention. Note that this is a type of exploratory analysis, and more analysis is needed to ensure that patient acuity, adherence to other CLABSI prevention bundles, and hand hygiene compliance are not potential confounders.

Key Takeaways:

- **Statistical analysis is a great way of organizing and communicating your results.**
- **There are many resources available to help along the way, but definitely start withyour institution's resources!**

Appendix 11A. Additional Resources on Statistics and Calculations

APIC

- APIC Research Committee: https://apic.org/Professional-Practice/Research
- APIC Research Webinar Series: https://apic.org/course/research-webinar-series
- APIC Text: Descriptive Statistics: https://text.apic.org/toc/epidemiology-surveillance-performance-and-patient-safety-measures/descriptive-statistics#book_section_437
- APIC Education: Effectively Using Data course: https://apic.org/course/effectively-using-data
- APIC Education: Tech Tools, Basics of Microsoft Excel course: https://apic.org/course/tech-tools-basics-of- microsoft-excel
- APIC Education: Basic Statistics for Infection Preventionists (slide presentation): https://apic.org/course/basic- statistics-for-infection-preventionists
- APIC Additional Resource: Using and Reporting Data Objectives (slide presentation): https://apic.org/Resource_/TinyMceFileManager/Academy/EPI_101_resources/Using_and_Reporting_Data.pdf

National Healthcare Safety Network

- Basic Statistics for NHSN Analysis (video presentation): https://www.youtube.com/watch?v=06Wr0_SBjwY
- NHSN Patient Safety Analysis Quick Reference Guides: https://www.cdc.gov/nhsn/ps-analysis-resources/reference-guides.html

Other resources

- Healthcentric Advisors: Calculations of Infection Rates: https://healthcentricadvisors.org/wp-content/uploads/2017/03/Cal_Inf_Rates.pdf
- UCLA Institute for Digital Research & Education: Choosing the Correct Statistical Test with Programming in SAS, STATA, SPSS, and R: https://stats.idre.ucla.edu/other/mult-pkg/whatstat

Section 12: How to Write Up Your Research

The last stage of the research process is the dissemination of your findings to your peers and colleagues. There are many reasons to publish your research or present it at professional meetings:

- To enhance the knowledge base of your profession
- To stimulate professional critical thinking
- To challenge views
- To reach a large audience
- To advance your career—publishing and public presentations may improve your career prospects, establish your reputation, and raise the profile of your organization
- To meet recertification criteria for the Certification in Infection Prevention and Control (CIC) credential through CBIC

Getting started

Would it surprise you to know that much of the work of writing up your research has already been done? Whether you decide to share your research as a publication in a peer-reviewed journal or as a presentation or poster at a professional conference, or both, the structure will include some components of your research proposal as covered in Section 8 of this toolkit.

First things first: Determine your *purpose*.

Questions to consider when planning your dissemination strategy include:

- What do I have to say?
- Is the paper or abstract worth writing? (The "So What" test.)
- Has such a paper already been written? (The "What's New" test.)
- Who is the audience? (The "Who Cares" test).

Refer back to the Five ***T***ips in Section 2:

- **Topic:** Is your topic best suited for a particular professional meeting or publication?
- **Team:** Who will be the primary author? This person generally does most of the writing for publication and/or serves as the presenter at meetings; they also decide who will be the other contributors to the work.
- **Time:** Block out time for writing to meet deadlines imposed for submissions to professional meetings.
- **Tasks:** Assign the writing of specific sections of the paper to coauthors. This is commonly done with publications. For example, someone writes the background and introduction, someone covers the methods, and so on.
- **Troubleshoot:** Reach out for help from the APIC Research Committee members. Writing improves with practice and becomes easier over time.

Start small with an abstract

Start small by developing an abstract for submission to an annual professional meeting, such as the APIC Annual Conference.

A word of caution: The deadline for these submissions will be several months prior to the meeting, and you must meet specific word limits for the title (such as 8 words) and presentation proposal (such as 300 words or less). Although it may seem very difficult to consolidate your work into so few words, it is possible with a few rounds (or more) of edits!

The abstract will have these key elements:

- Title
- Background: Brief explanation of the problem, your specific study purpose, and the aim/hypothesis
- Methodology: Scope of data and types of analyses performed
- Results of your work
- Discussion/implications: What changes can be implemented as a result of your findings? How does this work add to the body of knowledge on this topic?

Visual/graphical abstracts

A *visual (graphical) abstract* is a single schematic image that visually represents the primary findings of an article, allowing readers to easily identify the authors' main message. Depending on your topic, visual abstracts can be developed and submitted with your publication or used as a poster at a professional meeting.

For example, Kuhn and colleagues produced the visual design shown in Figure 12.1 to illustrate the elements of healthcare personnel communication at the start of a shift that were modified to address COVID-19 pandemic safety requirements.

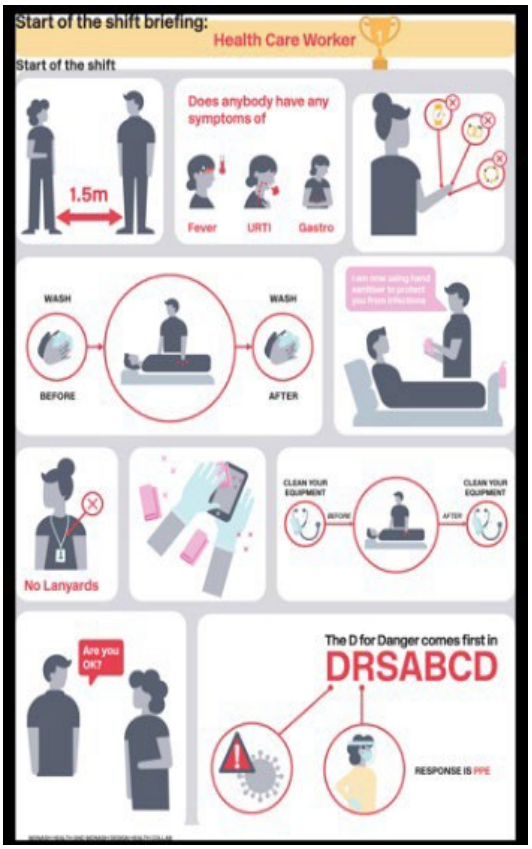


Figure 12.1. Example of healthcare personnel communication adjusted for COVID-19 safety requirements. Reprinted with permission from Kuhn L, Lim ZJ, Flynn D, Potter E, Egerton-Warburton D; COVID19AsOne Group. Safety briefing and visual design key to protecting health care personnel during the COVID-19 pandemic. *Am J Infect Control*. 2020;48(9):1122-1124. doi:10.1016/j.ajic.2020.06.186

Posters

Once your abstract is accepted, it's time to make a poster. The development of a poster is similar to creating a PowerPoint slide, with your key elements from the abstract positioned in a format that tells a story. Posters typically include the background, methods, results with figures, tables, or other graphic illustrations, and conclusions. Some posters will also show the abstract and the references used by the author(s).

Just like the visual abstract is made to quickly convey key findings, the poster should visually showcase your data and results in a prominent way. Although posters typically use the flow shown in Figure 2, you can have fun with how you choose to present your own data (as long as the poster meets the conference's minimum requirements).

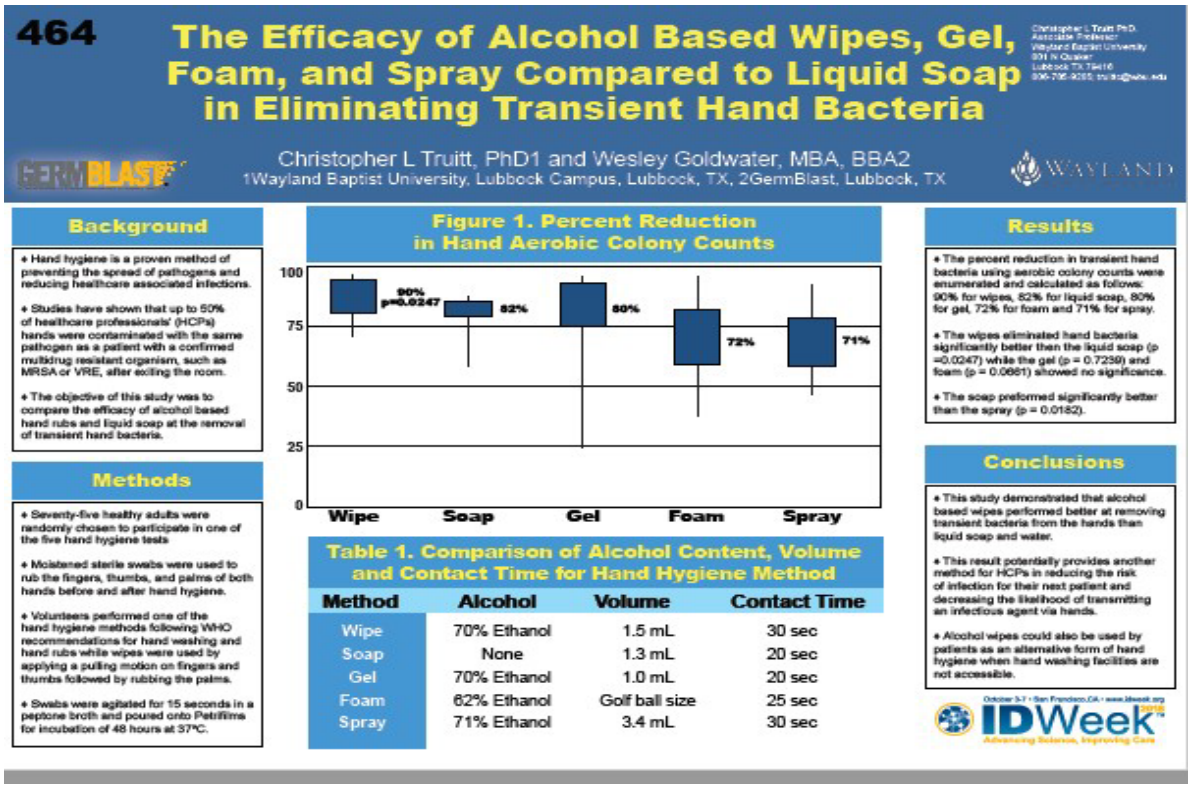


Figure 2. Example of a poster used to present research.

The ultimate goal—publication

Writing up your work and submitting a paper for publication in a peer-reviewed journal is the best way to share your hard work with your peers around the world! When choosing the journal to target for publication of your research, you should consider several factors, such as the journal's readership, whether your topic fits with the journal's scope, and the journal's guidelines.

Once you have picked your preferred journal, review the author guidelines on the journal's website to learn about the publisher's style and formatting requirements for manuscripts, the peer-review process, submission procedures, and other matters. By carefully following these guidelines, you improve the odds that your paper will be considered for publication. Another good practice is to peruse several copies of the journal to review the topics of recently published articles and the typical article length.

Finally, *get writing*! Tell your story: Why were you moved to do this research? How did you do it? What did you discover, and why is this discovery important? In general, the format of your manuscript will answer these questions, with four sections that follow the IMRaD format: *Introduction, Methods, Results, and Discussion.* And, of course, your paper should include an abstract and references.

You tackled your research project in small steps. Now, do the same thing with writing your paper. Again, no effort is wasted, as many of the elements included in a journal article can be found in your research proposal!

You may wish to start by writing the methods section first, rather than the introduction, or you could assign members of your team to tackle different sections. Just keep writing and keep editing until you have a final product you are proud of. Lastly, remember that help is available to you from the APIC Research Committee members!

Additional Resources

Bennett P. How to write a paper. *Int Emerg Nurs*. 2010;18:226-230. doi:10.1016/j.ienj.2010.04.003

Elsevier. Graphical abstracts. Accessed October 3, 2021. https://www.elsevier.com/authors/journal-authors/graphical-abstract

Gelling L. Stages in the research process. *Nurs Standard*. 2015;29(27):44-49. doi:10.7748/ns.29.27.44.e8745

Lewallen LP, Crane PB. Choosing a publication venue. *J Prof Nurs*. 2010;26(4):250-254.

Key Takeaways:

- **Publishing your work is beneficial to you, your organization, and the overall field of infection prevention and control.**
- **Use your research proposal to help craft your abstract or publication.**
- **When writing up your work for publication, divide the paper into smaller portions to make this task more manageable and less overwhelming.**