

Research Process

An Overview ^{#1}

LAWRENCE L. GABEL, PhD*

It has been suggested that podiatric education, training, and practice too often are not well understood outside of the profession. If this is the case, a potential remedy is for more podiatric health professionals to publish work that has significance. Beginning with this article and continuing through a total of six articles, the research process is used as a paradigm for enhancing podiatric literature in the future.

Claim has been made that podiatric education, training, and practice are well kept secrets in the health care field. Few nonpodiatric health professionals have a true understanding of podiatrists' capabilities and scope of practice.^{1,2} One way to improve this situation would be for more podiatric health professionals to publish.³ Probably many gladly would accept this challenge if they could be assured of having something worthy of publishing and if guidance were available to assist in the process.

To this end, a series of six articles will be published in JAPMA. Beginning with the current issue and continuing in the next five issues, the series includes:

- Research Process: An Overview;
- Research Process: Planning the Research Project;
- Research Process: Preparing a Research Proposal;
- Research Process: Conducting the Research Project;
- Research Process: Concluding the Research Project; and
- Research Process: Reporting Results of Research.

Their collective purpose is to offer guidance regarding the spectrum of efforts required to produce quality research reports.

Even though the focus of the series will be on planning, conducting, and reporting quality research, many of the principles addressed will be found to be broadly applicable in other endeavors. Thus, even the reader who does not plan to do research now is encouraged to take advantage of the series. It may be found that research is not that difficult after all, and the choice may be made to undertake such an effort. Or, as suggested previously, the principles of sound research can be used to benefit in various activities, for example, conducting other types of projects or becoming a more critical consumer of the research literature.

In this article as well as the other five, please note that, at best, only the surface will be scratched. Each article, and, for that matter, most sections within each article, could be book length. Therefore, the interested reader is encouraged to pursue fully all bibliographic citations.

Reasons To Do Research

Answers to the question, "Why do research?" are many and varied, but always they must be meaningful to the person who chooses to engage in the research process. Generally, such answers can be categorized by levels, including society, profession, practice, and self.

* Associate Professor and Director of Graduate Education and Research, Department of Family Medicine, The Ohio State University, 1110 UHC, 456 W Tenth Ave, Columbus, OH 43210.

At the broadest level, Gibson⁴ used cost as a societal allegory to describe the importance of research. He argued that if medical research is thought to be expensive, consider the cost of disease. VandeCreek⁵ synthesized the many professional reasons for doing research, particularly in the helping professions, and explained that the primary reason for producing a scientific literature comparable to that of one's peer professionals is a moral obligation to do so. For him, the moral obligation was not only to discover whether one is helping patients, but also to determine whether some efforts are more helpful than others, whether interventions of one style or another are helpful or harmful.

At the practice level, reasons for doing research include improving the efficiency and effectiveness of methods of practice, altering or developing a technique or procedure, testing interventions and management plans, and evaluating new drugs and treatments. Any one of these reasons can result in healthier, happier patients. Additionally, such practice-related reasons contribute directly to personal reasons, many of which may be seen as rewards to self. These include enhanced skills, increased knowledge, and improved judgment and diagnostic acumen. Ultimately, these types of reasons yield heightened satisfaction, with both one's practice and self.

Potential of the Podiatric Environment for Meaningful Research

In what is now considered a landmark study regarding health care delivery, one of the underlying questions of the investigation was, "Is the burgeoning harvest of new knowledge fostered by immense public investments in medical research being delivered effectively to the consumer?"⁶ The findings led to the conclusion that, on the basis of monthly prevalence estimates of illness or injury for 1000 adults aged 16 years and older, 750 would experience one or more illnesses or injuries in a given month; 250 would see a physician one or more times; nine would be hospitalized at the community level; five would be referred to another physician; and one would be referred to a university medical center. If it is supposed that most research and most related scholarship, both periodic literature and textbooks, are undertaken in the university setting, the inference is that much medical knowledge and practice is based on experience with approximately 1/1000 of the population.

How would the research literature read and how would textbooks be written if the "burgeoning har-

vest of new knowledge" were generated at least in part on why 250 persons at risk for illness or injury do not experience one or the other in a month's time, or how 750 persons are treated successfully at the primary and secondary levels? Podiatric health professionals are in a prime position to respond to these challenging questions. Why? Because even though on the order of 70% of the nation's podiatrists have clinical privileges in one or more hospitals, and although approximately 60% of these can provide health care on an inpatient basis, still, 90% to 95% of all podiatric care in the US is provided outside the hospital setting.⁷ Thus, while podiatrists participate in the provision of secondary and even tertiary care, the collective discharge of podiatrists' responsibilities suggests that podiatric medicine functions as a primary care discipline in the vast majority of practice activities.⁸ Hence, the podiatric health care environment provides excellent opportunities for meaningful research, which could contribute greatly to improved health care for the bulk of the nation's population.

Need for Improvements Regarding Podiatric Research

Various statements have been made to support the notion that improvement can and should be made if the potential of the podiatric environment for meaningful research is to be realized. These include:

1. An extended, consistent call for colleges of podiatric medicine to be aggressive and creative in securing and dedicating greater fiscal, physical, and human resources for the conduct of significant research^{2,9,10};
2. The recommendation that postresidency podiatric fellowship programs be established, one purpose of which would be to develop the profession's research resources¹¹; and
3. The recommendation that a Department of Education be established as an autonomous agency of the American Podiatric Medical Association to encourage and facilitate quality research at all levels of podiatric education and training and by podiatric practitioners.¹²

Various factors underlie and provide a basis for the foregoing suggestions and recommendations. From an examination of the literature itself, two factors are immediately obvious. First, much of the podiatric literature, on the order of 85%, consists not of quantitative research studies but, instead, of position papers, case reports, review papers, and descriptions of techniques. Not surprising, then, is

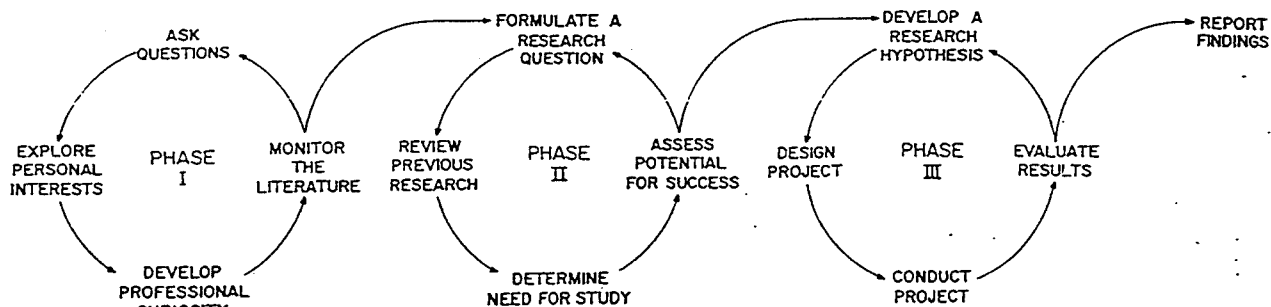


Figure 1. The research process.

the observation that only about 10% of the literature consists of reports of research studies in which statistical analyses were performed on data that were collected *via* a research protocol that was based on research questions and hypotheses.

Second, much of podiatric literature is generated at the residency level; a much smaller amount is generated at the college level; and some is generated by private practitioners. Given that the Council on Podiatric Medical Education of the American Podiatric Medical Association requires each resident, no matter what area of specialization, to complete and submit a manuscript for consideration of publication, the origin of much podiatric literature is not surprising. Neither is it surprising that much podiatric literature is not quantitative in nature, given that most residents lack formally developed research skills and also lack the time to pursue research seriously because of their many education and training responsibilities.

Research Process

As stated, this series of six articles is intended as a guide to the spectrum of efforts that are required to produce quality research reports. Convinced that the efforts are worthy to undertake because of personal desire, professional need, or societal obligation, where does one begin and how does one proceed? Beginning is in understanding what constitutes a quality research report; proceeding is in understanding the research process.

Huth¹³ suggests that research papers are built on the principles of critical argument. He lists the sequence of a critical argument as:

- Stating the problem;
- Marshalling evidence;
- Assuring credibility of the evidence;
- Examining implications of the evidence;
- Weighing conflicting evidence; and
- Determining the verdict.

Thus, quality research reports depend not only on writing skills but also on the ability to develop a critical argument regarding the research study that has been pursued. This requires a careful methodical process: the research process.

Figure 1 depicts the research process. Even though it is presented in fairly general terms, still one should see a parallel between its various aspects and the elements of the critical argument.

Concluding Remarks

Future articles will provide specificity to each phase of the research process and will provide guidance to undertaking research in a vigorous, comprehensive manner. The intent is to more greatly assure the interested and dedicated researcher that the research studies undertaken will be significant, will be suitable for publication, and will make a valuable contribution to the podiatric literature.

Acknowledgments. Conceptualization of the research process depicted in Figure 1 is credited to John S. Monk, PhD, Assistant Director of the Grant Family Practice Residency Program of the Grant Medical Center in Columbus, OH.

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SPECIAL COMMUNICATION

Research Process

Planning the Research Project #2

LAWRENCE L. GABEL, PhD*

This second article in a series of six on the research process provides a guide to planning a research project from start to finish. By description and illustration, 13 steps are outlined. Although the guide is comprehensive, advice is offered at strategic points regarding the value of consulting with a research specialist or a colleague experienced in research to gain assistance or insight into the planning process. Additionally, an admonition underlies the whole process: keep it simple and succinct.

This article, the second in a series of six, is intended as an aid to conceiving, designing, and planning a research project.¹ Even in its length and completeness it is a condensed version of a more comprehensive planning guide.² Although specific guidance is given here, planning research projects is complicated and must be done carefully if the previous challenges are to be met.¹ Therefore, any one planning guide is incomplete, and, for this reason, additional references are listed to provide greater guidance regarding the research process.

Even with a guide such as this, the novice researcher is encouraged to seek help from research specialists; for example, professionals trained in research design, statistical analysis, and scientific writing. Also, relationships should be established with colleagues who are already successful in research and who have published. Certainly, as skills are honed and as personal research patterns are developed, assistance will be less needed. However, it is the experience of most researchers that such associations always remain helpful, if not invaluable.

Another caveat should be considered seriously as this or other guides and assistance are used to pursue the first and additional research projects.

This is to keep constantly in mind the KISS principle: Keep It Simple and Succinct. If novice and experienced researchers alike would use this principle each time they design, conduct, and report research projects, valuable findings more often would be the rule rather than the exception.

What does the KISS principle imply? First, simple means the research should be singular in purpose and unadorned in design. Second, succinct means the research should be free of complex methodologies and not burdened with unnecessary analyses of data.

Be patient and do not expect too much from an individual research study. One project cannot provide all answers to all questions regarding a particular research problem or issue. More often than not, a single research project will not even provide a complete answer to a single question. Think of research in terms of studying a lake. It is recognized that a lake cannot be described and understood in a single visit. A cup of water may be studied today, a muddy bank tomorrow, the lily pads next week, and, over time, an understanding of the whole lake begins to emerge.

Finally, be willing to accept that answers to research questions will generate new questions. To continue the analogy of the lake, each visit to the lake certainly will bring new knowledge, but this new knowledge will be the basis for new questions. In the final analysis, the cup of knowledge is never full.

* Associate Professor and Director of Graduate Education and Research, Department of Family Medicine, The Ohio State University, 1110 UHC, 456 W Tenth Ave, Columbus, OH 43210.

Getting Started

Beginning with the following section, guidance is given to planning a research project. Once all has been read for the sake of interest, this article should be kept for ready reference as you begin to plan a research project. At that time, plenty of paper should be available, and each section should be treated as an assignment to complete. If pursued diligently, the end result will be a well developed outline of a research project. With very little additional work, the research project can be initiated and followed through to completion. The remaining four articles of this series of six will provide further guidance.

Before beginning, please keep in mind that a research project has three major components: 1) designing the research project, 2) implementing the research design, and 3) communicating the research results. As indicated, the following sections outline details of the first component. However, in providing a step-by-step approach to designing a research project, a degree of artificiality is introduced. As with most things, the whole is more than the sum of its parts. By delineating the steps in planning a research project, there is an implication that a set sequence exists that must be followed exactly. Such is not the case. But only by beginning in this way and by gaining personal experience will the fullness and richness of the whole process come to be understood and appreciated.

Identifying Research Interests

From your experiences and reading or from your interactions with colleagues, students, and patients, consider your mental lists of "I wonder why?" or "What if?" In written form, describe a few of these that you might like to investigate. Keep each idea simple and nontechnical.

Knowing that research requires time, effort, money, and other resources, identify the one idea you would most like to investigate, the one that really excites you. It is important to choose the one that enthralls you the most, because some portions of planning, conducting, and reporting research can be tedious and frustrating. Your enthusiasm will carry you through the difficult times. Besides assuring yourself that it is a topic of genuine interest, also consider if it can be studied within the confines of your work environment, your department, or your program. How much will it impose on associates? Can it be accomplished with available equipment and facilities; if not, can you secure what will

be needed? Can you pursue the study given your busy time schedule? If you can respond to these questions relatively easily and positively, you probably have identified an ideal project, an area of research.

Now, briefly write what you think you would like to discover from such an investigation, what you would like to present in the conclusion of a research report. What you think can be discovered through an investigation in your area of research is called your anticipated outcome.

Getting to Know the Literature

Although most persons generally stay abreast of their professional literature and many are well read in selected areas, starting a new research project usually requires a review of the literature characterized by both breadth and depth. At this point, the concern is more on breadth than depth. In this regard, please note that professional literature can be categorized generally in one of two ways. One is conceptual literature, which presents ideas, opinions, and reviews; conceptual literature can be found both in texts and in periodicals. The other is research literature, which reports completed research studies, usually in journals.

Both conceptual literature and research literature are useful in considering a new research project. This is because in your initial review of the literature you want to ascertain to what extent your area of research has been discussed. Have any studies already been reported regarding your area of research? Does there appear to be a general need for additional investigations? Have specific issues been identified as needing study?

In answering these and related questions, try to identify five or six pieces of literature that are most related to your area of research. Drawing upon them, develop a brief narrative that supports specific need to do work in your area of research. If you are successful in doing so, you have the beginning of a research project. If you cannot make a clear statement in support of a need to undertake a study in your area of research, it may be that the area you have selected has been so thoroughly researched that the answers to any questions you might have already are available. However, more often than not, it will mean that the area you have selected is too broad, and no specific needs are apparent. If this is the case, you should hone your area of research and continue the review of literature until you have a crisp statement of research need, a research problem.

Developing a Research Question

With a defined need for new or continued research in your area of interest, it is necessary to focus on specifics. This is done by developing one or more detailed questions that a research study potentially can answer. Recalling the KISS principle, it is preferable that one primary question be established. Any additional questions should be developed as secondary to the primary question. At most, there should be no more than two or three primary questions, with each having no more than two or three secondary questions. Whether primary or secondary, the research questions will take these forms: What if . . . ? Is there a difference . . . ? Is there a relationship . . . ? Does . . . affect . . . ?

With your research question(s) stated simply and succinctly, it is time to justify your research. To do this, respond carefully and convincingly to the following types of questions in such a way that you can convince yourself, and, ideally, others, that you should proceed. Does your research question truly interest you? Would others have a real interest in the answer to your research question? If there is more than one conceivable answer to the research question you have posed, can it be refined to allow for only one potential answer? Is your research question answerable with the resources available to you? Will the answer to your research question be meaningful; that is, will it be practical or will anyone benefit? If you cannot be convincing at this point, you should start over from the beginning. Not doing so will only create wasted effort and frustration if you continue.

Convinced that there is at least one worthwhile research question, it must be analyzed in detail to identify its components, and possibly refined to make it more explicit. The process must be repeated for each research question, whether primary or secondary.

First, every research question will refer to at least one group of subjects to be studied, for example, people. Identify the group(s). Second, every research question will have something that is to be observed or measured. These are variables. Identify them. Third, the variables will have implied relationships. Identify each set of relationships as, ". . . is related to . . ."

Once the variables have been identified, along with all possible relationships, each variable must be analyzed carefully. If each variable as stated is not specific, such that it can be counted, observed, or measured, it must be modified until it can be. With this done, classify each variable as an inde-

pendent variable or a dependent variable. Independent variables are those that can be manipulated by the researcher (for example, did or did not receive a drug or have a particular surgical technique) or can be used to classify subjects by group (for example, age, sex, race, or socioeconomic status). Dependent variables are observed, counted, or measured in order to determine an effect of treatment on subjects, or differences in subjects based on differentiating factors, such as age or sex.

Conducting a Thorough Literature Review

The review of the literature at this point will be focused; whereas before the intent was breadth, now it is depth. Both conceptual and research literature should be reviewed, but the latter will be emphasized. This second review of the literature must not be skipped and should not be taken lightly. It will serve you well, because the results can guide your development of methods and procedures, selection of measurement instruments, and determination of data analysis techniques. Remember that the literature has been established not only to report research findings but also to guide further investigations. After you have published your research study, you, too, will have added to the whole process, thereby enabling "the lake to be better understood."

There are basically four ways to proceed. These are: 1) the ancestry approach, 2) the descendancy approach, 3) the database approach, and 4) the invisible college approach.³ Advantages and disadvantages exist with each, but by using two or more according to your personal preferences, disadvantages can be minimized and advantages can be maximized. The ancestry approach begins with a recent article closely related to your area of research interest. Using the bibliography to find other significant articles and the bibliographies in these articles, trace an idea or technique backward in time. The descendancy approach is almost the opposite, in that you begin with a classic article and identify subsequently published articles that refer to the classic reference. The database approach cuts across the other two, in that sophisticated, computerized bibliographic databases are used to search for specified descriptors, which you supply. The invisible college approach is to talk to experts in your area of research interest and to your colleagues to determine what literature they find useful and would recommend to you, given your interests and needs.

Stating the Hypotheses

Each research question will suggest one of several possibilities. It may be that the need is to document a problem or to describe a situation; if so, a descriptive study is required. It may be that there is a need to study a relationship; if so, a correlational study is required. It may be that there is a need to study an effect; if so, an experimental study is required. In all of the types of studies, research hypotheses are appropriate; however, in the latter two they are necessary.

Hypotheses serve several purposes. First, in paralleling the research questions, they provide guidance to research design considerations. This includes selecting methods to generate the data, procedures to collect the data, and techniques to analyze the data. Second, the hypotheses, by the way they are ordered, provide a structure for subsequent written and oral reports of the research study. Because research hypotheses are so important to the overall success of your research study and because many researchers find them difficult to prepare, this is definitely a point in your planning where you should consider seeking help from a research expert or an experienced colleague.

The following example is offered to demonstrate 1) the form an effective research question would take, 2) the components of a research question, and 3) an appropriate research hypothesis.

Research Question: Does administering a steroid as a postoperative anti-inflammatory agent reduce pain experienced by surgical patients?

Independent Variable: Administration of a steroid.

Dependent Variable: Level of postoperative pain.

Groups of Subjects: Surgical patients who do or do not receive a steroidal postoperative anti-inflammatory agent.

Hypothesis: Surgical patients who receive a steroidal postoperative anti-inflammatory agent will experience significantly less pain than will surgical patients who do not receive a steroidal postoperative anti-inflammatory agent.

Designing the Research Study

Designing the research project has at least two implications, but many fears! First, research design implies planning methods and procedures by which data will be generated. Second, research design implies planning techniques by which the data will be analyzed. Fears come primarily from believing that a single correct design exists, which must be

determined and used for each research study. This is simply not the case; hypotheses can be studied with different methods using different designs. Any research design is, at best, a compromise that accounts for the many practical considerations with which you are confronted. Thus, the goal of research design is to plan the means that will allow the most valid data to be collected and to subject the data to the most appropriate analytic technique(s).

Many investigative techniques have been devised, all of which have been classified as standard research designs. Space does not permit a discussion of these, even for definitional purposes; however, several will be listed to suggest the many options with which you are faced. These include retrospective *versus* prospective, descriptive *versus* explanatory, and observational *versus* experimental. Within descriptive studies are surveys and case reports as examples. Cohort analytic, case control, correlational, and prevalence studies are but a few examples of observational studies. Experimental studies include the whole set of options available through randomized control studies. Each design has many appropriate uses, with attendant advantages and disadvantages.⁴⁻⁷ By all means, consult with research experts or experienced colleagues in finalizing the research design for your particular research questions and hypotheses.

In preparation for such consultations, there is some preliminary planning that you can do. This involves two things: 1) analyzing your research question for the number of groups of subjects from which data must be collected, and 2) estimating the minimum number of subjects to include in each group. The following examples are meant to guide your preliminary planning of the research design.

Does your hypothesis require that you compare data from groups that differ only in one factor? For instance, do you have a situation analogous to comparing data from a group of 10- to 14-year-olds with a group of 15- to 18-year-olds and, also, with a group of 19- to 22-year-olds? In this situation, there would be a three-group design:

AGE		
10-14	15-18	19-22

Or maybe the groups of subjects in your hypothesis are best diagrammed on more than one dimension. Is there more than one independent variable on which you wish to differentiate the groups, for example, age and sex?

		AGE		
		10-14	15-18	19-22
SEX	Male			
	Female			

		AGE		
		10-14	15-18	19-22
Height (20 subjects)				
Height (20 subjects)				
Height (20 subjects)				

Example 1
One Independent Variable
One Dependent Variable

In both preceding examples, each box of each diagram is referred to as a cell.

It may be that your hypothesis does not require more than one group of subjects. For example, in a correlational study, you may be interested in the relationship between two variables without regard to one or more independent grouping variables. Studying the relation of height to age is an easy example for a one-group, one-cell study.

By now you are probably recognizing that independent variables are used to define the parameters of the groups of subjects, with the values of the independent variables determining the total number of cells. Inside each cell are listed those variables for which you have an interest in studying an effect; these are the outcome variables or the dependent variables. From the last example of a correlational study the diagram would be:

			AGE		
			10-14	15-18	19-22
SEX	Male	Height (20 subjects)			
		Weight (10 subjects)			
	Female	Height (20 subjects)			
		Weight (10 subjects)			

Example 2
Two Independent Variables
Two Dependent Variables

Figure 1. Two examples of determining the number of subjects.

Height Age

Combining the various examples to this point, it is recognized that a researcher might be interested in comparing a dependent or outcome variable, such as weight, across three groups of an independent or factor variable and, at the same time, looking at the relation of the dependent variable to another dependent variable. A diagram of such would be as follows:

			AGE		
			10-14	15-18	19-22
Weight Height	Weight Height				
	Weight Height				

Before going on to consider how many subjects should be in each cell of a study, take some time to diagram the cells of your study. Label all independent dimensions, each value of each dimension, and all outcome or dependent variables within each cell.

Attention is now turned to how the subjects get into the cells, and how many subjects there should be in each cell. Although there are many ways to choose a group sample from the population or uni-

verse, some are better than others. You are advised to consult with a research expert or a colleague experienced in research, but you will always be safe by sampling randomly. This ensures that the probability is equal on all accounts that a particular subject will be placed in, or not placed in, a particular cell.

Once this has been ensured, how many subjects should be chosen for a given cell? Assuming that you have determined the number of independent cells for your study, a rule of thumb is to use at least 20 subjects for each cell, where each cell is defined within by only one dependent variable. For each additional dependent variable within each cell, the rule of thumb would be to add 10 subjects. This is illustrated in Figure 1.

Sometimes you will find that you have not only several related variables in a cell, but also several variables in each cell that you want to use in comparing groups. In this special case, you have multiple dependent variables and really should check with a research consultant before making a final decision on sample size. A research consultant also can help you adjust sample sizes, when necessary, to ensure that results will be within predetermined error limits or that enough power exists to detect significant differences between the groups of comparison should differences actually exist.

In summary, you can always estimate the number

of subjects you will need by applying the following rule of thumb:

- Start with: 20 subjects for the first variable in the cell;
Add: 10 subjects for each additional variable in the cell;
Multiply by: $\frac{X}{N}$ the number of cells;
 N total number of subjects you need.

The number of subjects you need can get large quickly! Remember, each subject you enroll increases the cost of your project and the time needed to complete your project. Therefore, again recall the KISS principle and apply it judiciously.

Take the time now to calculate the number of subjects you need for your study. It may help to make another copy of your study diagram and pencil in the number of subjects you need in each cell.

Determining How to Collect the Data

Based on your research question or hypothesis, you know from the independent and dependent variables what data you must collect for each subject of each cell. Now you must consider how you will collect the data.

Essentially, there are three means to accomplish this: 1) observing—you gather data by watching the subjects and recording the data needed; 2) measuring—you use some method or instrument to measure and record information about the subjects; and 3) questioning—you pose verbal or written questions or a series of questions and collect data by having the subjects respond to these questions. If your study is retrospective and the data already exist regarding the subjects, you will not collect the data directly from the subjects. However, the data you glean from existing records were obtained sometime in the past by using one of these three methods.

Sometimes it is not difficult to obtain needed data; the method for gathering the data is obvious, and no special preparations are needed. In other instances, instruments or equipment must be obtained or designed to allow for appropriate data collection. For example, you may wish to survey all persons in a given area to find out their attitudes toward an action you propose to take. In such an instance, generally, a questionnaire would have to be designed. A questionnaire is a survey instrument. In another instance, you will wish to measure the blood flow in the skin. In this case, you may need to obtain a specific instrument to measure blood flow.

Carefully consider each of your variables. Determine if the means to implement the data gathering methods are available or if you need to obtain or develop special methods or instruments to implement the necessary data gathering methods. Prepare a listing as follows for each variable:

Variable: Are special methods or instruments needed? If so, what are they, how may they be obtained, or how may they be developed? Be very detailed if the characteristics of a method or instrument are not obvious.

For each variable and the means of measurement you have identified, additional questions must be asked. These have to do with quality of the data your proposed data collection methods will yield. They are:

Will the methods proposed, using the means or instruments described, provide reliable results?

Reliability is an expression for the consistency of the data yielded by a given data collection technique. This consistency is reflected in how the data collection technique performs when applied repeatedly. Does the technique yield the same type of data when applied at different times to the same subject or when applied by other researchers?

Will the method proposed, using the means or instruments described, provide results that are valid?

Validity is the ability to measure the real state of affairs. An instrument or technique can yield the same results over and over, and yet not be a valid measure of a particular variable. With what assurance do you know that the instrument is measuring what you believe it is measuring?

Examine carefully each data collection method that you propose to use and estimate its reliability and validity. If you are using techniques described in the literature by others, such estimates should have been reported in the respective research reports and can serve as an initial guide. If you have any questions as to how to determine the validity and reliability of your data-gathering methods, you should seek consultative help. A common cause of research that is of little or no value is the use of invalid or unreliable data collection procedures.

Planning the Methods and Procedures

By now you have a well constructed research question and most likely a research hypothesis, you

have identified your independent and dependent variables, you have determined the number of subjects you will need and how they will be grouped, and you have decided on or designed your methods to collect the necessary data. You may be tempted to start your research study. Do not do it; you still have much additional planning to do before you enroll the first subject in the study or before you collect your first data. Specifically, you now must consider carefully the overall study plan to assure yourself that all will be done in a standard, consistent fashion. This includes planning the prestudy, the study, and the poststudy phases of your research project. A flow chart or timeline is helpful in doing this.

Regarding each phase, the following questions are only suggestive. You need to identify similar questions unique to your study.

Prestudy

- What must be done?
- Who is going to do it?
- What will be needed to accomplish each task?
- How long will it take?

Study

- What must happen with each subject?
- How are groups to be treated?
- Who is responsible for the treatment(s)?
- Who is responsible for data collection?
- Who will monitor and coordinate the study?
- Are contingency plans needed?
- How long will the study take?
- What is needed during the study?
- What is the schedule of events for the study?

Poststudy

- What is to be done once all data are collected?
- Who is responsible for which poststudy task?
- What is the poststudy timeline?
- What has to be done to close down the study?

The more carefully you plan each phase of the study, the easier and more automatic the actual conduct of the study will be. It will be unusual if problems do not arise in the course of your study, but careful planning ahead of time will allow you to modify and adjust your approach accordingly to minimize introducing contaminating biases.

Anticipating the Results

There are many ways to analyze data. What you wish to say about the data you plan to collect will determine how your data will be analyzed. The strongest statements or conclusions can be made only when what you want to say is planned in advance.

At this point, you know the variables you will be using to guide the data collection process, and you know how many cells are in your study and how these cells supposedly are related. Begin by sketching the tables, charts, and graphs you would like to use in the final report. Describe them in enough detail so that you can pencil in hypothetical results. This will require you to be familiar with data analysis techniques that are appropriate to your research question, research hypothesis, and data to be collected, because it is these techniques that will produce your results. You will probably want to seek consultative help to develop the data analysis plan and the best ways to present the results.

With this done, you will want to review your anticipated results. You will be looking for:

- Hidden ambiguities in your hypotheses;
- Potentially tragic omissions in your data collection methods;
- Potential multiple interpretations of your anticipated results;
- Clarifications of your anticipated results so that the actual results will be interesting, because they either confirm or refute your expectations; and
- Clues to additional literature to review to use in your discussion of the actual results.

Checking the Feasibility of the Study

The major planning of your research project has been completed. Now it is time to check on its feasibility. If it cannot be conducted as you have planned it because of a lack of resources, you will have to secure the resources or modify your plans. To this end, Table 1 presents factors that will impinge on the success of your study; make sure that you have considered each one adequately in your planning to this point. If you have not, go back and do so before you begin. Also, try to think of other factors that may be unique to your study that are not included in Table 1 and take them into account.

Assessing Limitations of the Study

Another potential problem not considered formally to this point is the fact that every study is limited. The fact that limitations exist is not necessarily bad; however, ignorance of the possible limitations of a study can lead to bias. Bias is the term applied to any of several factors that decrease the value of research. These are called invalidating factors be-

Table 1. Checklist of Resources Needed to Conduct Study

Personnel <input type="checkbox"/> Subjects <input type="checkbox"/> Project assistants <input type="checkbox"/> Consultants	Ethics and Compliance <input type="checkbox"/> Risks to subjects <input type="checkbox"/> Risks to researchers <input type="checkbox"/> Human subjects approval <input type="checkbox"/> Subject research compliance
Equipment and Supplies <input type="checkbox"/> Instruments <input type="checkbox"/> Equipment <input type="checkbox"/> Postage <input type="checkbox"/> Telephone <input type="checkbox"/> Copying	Institutional Cooperation <input type="checkbox"/> Administrators <input type="checkbox"/> Colleagues <input type="checkbox"/> Staff
Temporal Factors <input type="checkbox"/> Time required for researcher <input type="checkbox"/> Time required for assistants <input type="checkbox"/> Time required for subjects	Physical Facilities <input type="checkbox"/> Space acquisition <input type="checkbox"/> Space maintenance

cause they subtract from the generalizability of the findings of a research project. There are factors that reflect on the internal validity of a study and can prevent you from successfully testing your hypotheses. Comparably, there are factors that influence external validity of a study and can prevent you from generalizing your results to events and persons not specifically included in the study.⁷

The following are descriptions of factors that influence the internal and external validity of studies. Examine each factor and determine if your plans to this point are such that the factor is a threat to the validity of your study.

History. Can you think of specific events that may take place during your study which might affect the data you will be collecting? If there might be such events, what are they and how can you control for them?

Maturation. Will there be any processes operating within the subjects that are functions of time and might affect your study results? If there might be such processes, what are they and how can you control for them?

Testing. If you will be repeating measurements on the subjects, might the first measurement affect the second measurement? If there is the potential for this effect, what is the problem and how can you control for it?

Instrumentation. Are there potential problems with the instruments you will use or characteristics in those who collect the data for you that could cause error in the obtained measurements? If these instrument or measurement errors potentially exist, what are they and how can you control for them?

Statistical Regression. Will you be selecting subjects on the basis of extremes of a given condition? Changes in these conditions can occur for

purely natural reasons and may be confused with effects of your research variables. Identify them and describe how you can control for these effects.

Selection. Can the way in which you plan to obtain subjects to participate in the study, or the way you are assigning subjects to various groups, affect the outcome of the study? If so, what might these effects be and how can you control for them?

Mortality. Do you see any ways in which you might lose subjects from the various groups of your study that might affect the outcome of the study? If so, what might these be and how can you control for them?

Selection and Maturation Interaction. Is there the possibility that one or more of your groups would change because of natural processes, whereas one or more other groups would not? If so, how could these changes affect your study and what can you do to control for such changes?

Reactive or Interactive Effects of Testing. If you are using a pretest, will this increase or decrease a subject's sensitivity to one or more of your research variables? If this occurs, what is the possible effect of pretesting and how can you control for this problem?

Interaction of Selection Biases and the Research Variables. Will one or more of your research variables have an effect only on certain kinds or types of subjects? If so, how can you control for this effect and ensure representativeness?

Reactive Effects of Grouping. Are there specific differences between the real world and the ways in which you have formed your groups? If so, what are they and how could they affect the way in which the findings of the study can be applied? Also, how can you control for them?

Multiple Treatment Interaction. Will more than one treatment be applied to the same subjects,

either intentionally or inadvertently? If so, how can you control for the effects of multiple treatments?

Now that you have identified the potential threats to the validity of your study and ways of countering those threats, go back and modify your study design. You may find that for some threats there is no feasible way to modify the study to reduce the threat. Therefore, after struggling to achieve a design which is feasible and provides control of the most troublesome threats to validity, you may be left with inadequate controls over other threats. These represent limitations to your study and should be identified as such in your research report.

Finally, even unbiased studies have limitations in their generalizability. To what population, represented by your study sample, can you generalize your conclusions? In identifying this, it may be easier to identify the characteristics of populations to which you cannot generalize your conclusions. Comments regarding this issue must also be included in your research report.

Piloting the Research Study

You are now almost ready to begin your research project. However, at this point it may be necessary to conduct one or more pilot studies. If the study you plan to conduct is complicated, piloting is a must. It will allow you to refine the plan to ensure the best possible results. To this end, the pilot study has several purposes:

1. It is a trial run of the data collection approach;
2. It tests the data collection methods or instruments to see if revisions are needed;
3. It provides data to try out the planned data analysis techniques;
4. It allows you to determine if the data collection process is appropriate for the subjects you are going to use; and
5. It gives you experience in working with the subjects of your study, in administering the data collection methods, and in analyzing the type of data to be collected.

In general, a pilot study is a miniature of part or all of the actual study. Subjects for the pilot are drawn from the same population as the sample. Subjects from the pilot, however, should not be included in your final study.

Concluding Remarks

Quality research begins with careful planning. Hence, the importance of detailed planning cannot be emphasized too frequently nor too strongly. The planning guide outlined in this article will be invaluable in planning research that is meaningful, that can be conducted in a credible manner, and that can produce valid results and conclusions.

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SPECIAL COMMUNICATION

Research Process

Preparing a Research Proposal^{#3}

LAWRENCE L. GABEL, PhD *

The preparation of a research proposal is often a necessary step in the research process. Research proposals are used to secure permission to undertake a study, to ensure protection of subjects, to secure needed resources, and to achieve a refined perspective of the proposed study. This third article of a series of six on the research process describes the steps involved in preparing a research proposal, demonstrating a parallel to the research planning process.

In beginning the research process, there are several stages of planning that should be undertaken carefully and methodically.¹ This ensures that the researcher has been able to determine significant need for a research study, to posit justifiable research questions or hypotheses, to develop suitable methods and procedures for collecting and analyzing data, and to identify required resources.² This third article of a series of six describes the next important step in the research process: preparing a research proposal.

There are four reasons why the preparation of a research proposal is an essential step in the research process. In any given situation, one or more of these four will be applicable, whether the researcher is a student, resident, faculty member, or private practitioner. They are:

1. To get permission to undertake the research project;
2. To ensure proper protection of subjects, whether they are human or animal;
3. To secure needed resources that were not available at the outset; and
4. To achieve a refined description of the proposed study.

* Associate Professor and Director of Graduate Education and Research, Department of Family Medicine, The Ohio State University, Area 300, 1314 Kinnear Rd, Columbus, OH 43212.

The rationale for the first three reasons is probably obvious; however, for the fourth, it may not be. That is, after planning a research project in great detail and if circumstances do not require permission to conduct the study, approval for use of subjects, or additional resources, then why go to the bother of preparing a research proposal?

There are two major reasons for this. First, examining the results of the research planning process, it can be seen that, although sequential in nature, they are somewhat segmented.² Therefore, the preparation of a narrative description of the research project will provide further opportunity to ensure that all is logical, consistent, and comprehensive. No facets or factors have been overlooked. Second, although this may seem like redundant work, be assured that it is not, and that it will pay additional dividends in the end. This is because the research proposal, more likely than not, will become the first draft of the research report once the study is completed. If the study has been planned well, it will be conducted as planned. Hence, all that is required to convert the research proposal to the first draft of the research report is to change the verb tense from future to past; to complete the tables, charts, or graphs with actual data and results; to develop the discussion based on the previously stated implications of the study; and to finalize the conclusions according to the previously anticipated outcomes.

The focus of this article will be on the preparation

of a research proposal for the purpose of securing needed resources. This is because the development of a research proposal for one of the other three reasons, or a combination thereof, requires only slight modifications of the components and principles to be discussed forthwith. For the most part, these types of research proposals are simply shortened versions of the research proposal that is developed to secure needed resources. Therefore, this approach to the article allows another demonstration of the KISS principle: Keep It Simple and Succinct.

Seeking External Support

When a research project has been designed that requires resources not readily available to the researcher but necessary to successfully conduct the research project, the usual practice is to prepare a research proposal, sometimes called a grant proposal. As there is a research process, so, too, there is a grant-seeking process.

Like the research process, the grant-seeking process has identifiable phases and steps. The first phase is getting ready to prepare the grant proposal. The second phase is preparing the grant proposal. The third phase is submitting the grant proposal. Before the first and third phases of the grant-seeking process are described to provide a context for the second phase, preparing the grant proposal, a bit of advice is in order. Becoming successful in securing external funding is a craft in itself; it is often referred to as grantsmanship. Therefore, the novice is strongly encouraged to seek consultative help from professionals who specialize in securing funding and from colleagues who are experienced in securing external funding to support their research.

Getting Ready to Prepare the Grant Proposal

The first phase of the grant-seeking process is the preparation phase. Be ready to spend more time with this phase than it took to plan the research project or than it will take to prepare the grant proposal. Step one is determining potential funding sources. There are three basic types: 1) government, 2) philanthropic foundations, and 3) corporations. Step two is contacting all potential funding sources to secure information about their funding policies and past funding patterns. Step three is narrowing the potential funding sources to those which are most compatible with your research interests and

needs. Step four is analyzing the published guidelines of the potential funding source(s) you have determined to be most likely to be receptive to your grant proposal and to consider it favorably for a grant award. If allowed by the guidelines, establish a working relationship with each prospective funding source. Step five is developing a work schedule for completing the grant proposal in accordance with the published guidelines.

Submitting the Grant Proposal

After the grant proposal has been prepared in accordance with the components and principles discussed in the remainder of this article, it is submitted to the potential funding source(s). It is permissible to submit to more than one potential funding source, but it is extremely important that each be advised of an actual or intended submission to others. It follows, though, that multiple awards for the same project cannot be accepted.

For each potential funding source, prepare a cover letter on the letterhead of your organization, with the signature of the most appropriate official of your organization to show the potential funding source that your project is supported at the highest level. Include in the cover letter a description of what you are sending, a summary of your proposal, and a statement of your availability and desire to answer any questions about the proposal and, if appropriate, to arrange for a personal meeting. The proposal itself should be prepared in accordance with the specific guidelines of each potential funding source, should be visually attractive, and should be free of errors. However, it should not be overly elaborate in its presentation, eg, the visual aids, because this may suggest that you have been wasteful of resources or that you already have an overabundance of resources available to you.

Why Grant Proposals Are Unsuccessful

Before discussing the second phase of the grant-seeking process, preparing the grant proposal, it will be instructive to examine reasons why grant proposals are not funded. Federal agencies, such as the National Institutes of Health and the Health Resources and Services Administration, often provide listings of reasons why grant proposals are rejected; Table 1 is a partial listing of the many reasons, in descending order beginning with the most frequently cited reason.³ Generalizing from this listing, it can be seen that rejection is usually the result of questionable research design, inade-

Table 1. Most Often Cited Reasons in Descending Order of Why Grant Proposals are Unsuccessful

1. The overall design is unsound, having unrealistic techniques
2. The proposal is not explicit enough, lacks detail, or is too vague or general
3. The investigator does not have adequate experience
4. The investigator's knowledge or judgment of the literature is poor
5. Problems exist in the design that are not recognized or are not dealt with effectively
6. Methods and procedures are unsuited to the stated objectives
7. The overall application is poorly prepared or poorly formulated
8. Assumptions and evidence for procedures are questionable
9. The anticipated results will be confusing, difficult to interpret, or meaningless
10. The research design is too ambiguous or otherwise inappropriate
11. The approach lacks scientific imagination
12. The experimental purpose or hypothesis is vague
13. The problem is of insufficient importance
14. The approach is not rigorous enough, too naive
15. The overall proposal is repetitive of previous work
16. Results from previous work are inadequate
17. The investigator needs more liaison with colleagues
18. The research problem is premature and warrants, at most, a pilot study
19. The overall budget is too high
20. The methods and procedures are not well organized, coordinated, or planned
21. Controls are either inadequately conceived or inadequately described
22. The investigator has produced too few publications
23. The overall approach is poorly thought out
24. The emphasis is on data collection rather than data interpretation
25. The research study is based on hypotheses that are doubtful or unsound

quate explanation of the research approach, and lack of demonstrated competence of the researcher. Of interest is the observation that budgetary issues are low on the list.

Please note that serious attention to the research planning process would prevent any one of these reasons from being applicable to a research project. Therefore, it is imperative to complete some form of a research planning guide before expending efforts to develop a research proposal, if you want to maximize the odds that it will be funded.²

Preparing the Grant Proposal

Because securing external funding to support research has become more important in recent years, much has been written about the process involved.

*Grant Writing for Health Professionals*⁴ is recommended highly as a good single reference for an expanded discussion of the pertinent issues.

As suggested previously, most potential funding sources will have a specific set of guidelines to use in developing a grant proposal. These should be secured and followed explicitly. Although some differences exist in the various sets of guidelines, there are more commonalities than differences. For instructive purposes, the common features of the various guidelines will be discussed below in a sequence that is typical of most. This discussion will serve also as a guide to be used in preparing a grant proposal for a potential funding source that does not have a published set of guidelines.

Title. Starting with the title, going next to the abstract, and then to the body of the proposal, the development of the proposal can be viewed as an inverted funnel. As one proceeds from one to the other, each segment should say the same thing except in an expanded fashion. Thus, the title should be constructed so carefully that it, in essence, describes the full proposal. However, in doing so, keep the title short, on the order of ten words, more or less. Make it very descriptive. Prepare it last.

Abstract. Following the title should be an abstract. The abstract is prepared after the proposal has been developed. Positioned after the title and before the body of the proposal, the abstract must create a positive first impression, as it provides a summary of the entire proposal. Therefore, even though the abstract is relatively short, on the order of one to two paragraphs, considerable time and effort should be expended in preparing it.

The abstract's organization follows that of the body of the proposal. It should define the need for the study, hinting at the timeliness and importance of the problem being investigated. This is followed by a summary of the project's aim, suggesting the research questions or hypotheses that are to be answered or tested. Next comes a summary of the methods and procedures, including how the data will be analyzed. This leads naturally to a description of the anticipated results and the importance of the implications of the expected outcomes. When the abstract is finished, it should be a concise, coherent account of the whole project. It should be easy to read.

Purpose. The body of the proposal should begin with a concise statement of the purpose. Literally, the first sentence should complete the statement, "The purpose of this study is . . ." The well written statement of purpose will 1) communicate the general area of research, 2) provide a foundation for

the later statement of the research questions or hypotheses, and 3) suggest the methodological approach for the conduct of the study. Thus, the statement of purpose should be seen as a lengthened version of the title and a shortened version of the abstract.

Description of Need. This section of the proposal narrative presents a succinct analysis of the need for the study; it is sometimes referred to as a statement of the problem. It sets the preceding statement of purpose in context and serves as an introductory background for the remainder of the proposal. To use the funnel analogy again, if the title is seen as the small opening of the funnel and if the statement of purpose is seen as the narrow cylindrical tube, then the description of need is the beginning of the conical portion of the funnel.

Using on the order of five of the most relevant, pertinent literature citations that have direct bearing on the proposed study, the definition of need, or the statement of the problem, should be convincing regarding the importance of the study. It should be explicit in its quantification and qualification of the need, addressing issues such as significance, severity, extent, and timeliness of the problem to be investigated. Finally, even though the need may be great or the problem profound, this section should delimit the study to that which can be undertaken within a reasonable time and with reasonable additional resources. In limiting the study, the methodological approach is alluded to, so that the specific aim of the proposed study is obvious.

Review of the Literature. This section should present a cogent summary of related, relevant conceptual and research literature. It also should demonstrate scholarship. In attending to both purposes, the review of the literature should build upon and extend preceding sections of the proposal, providing breadth and depth to what already has been presented briefly or, in many cases, only implied. In the process, the review should be critical. There should be an element of evaluation of that which is reviewed.

To this end, the review of the literature allows two important opportunities. First, it prepares the way for the next section, the statement of the research questions or hypotheses. That is, when the research questions or hypotheses are stated, they should represent the logical next investigatory step in the particular area of research, almost demanding immediate attention. Second, and somewhat related to the first, the review of the literature places the proposed study in context so that, when reported, it will be seen as making an important

contribution to the growing body of professional literature.

Ideally, the review of the literature will incorporate three major components. It will 1) expand and elaborate on the need for the study; 2) tie the proposed study to existing theories or important constructs of the area of research; and 3) fit the proposed study into the broader scheme of other studies, both completed and ongoing.

Regarding the last component, attention should be given to methodological issues in addition to the contextual issues, as discussed previously. That is, there should be an analysis of previously used approaches to generate, collect, and analyze data. The discussion should evaluate strengths and weaknesses and suggest how the proposed study will guard against identified weaknesses that could bias the results. The discussion also should demonstrate how strengths of previously used methods and procedures will be incorporated into the proposed study. This serves to validate the proposed study's methodology.

It is advisable to complete the review of the literature with a concise summary. The summary should bring the area of research into sharp focus and should emphasize the value of the proposed study by delineating the most pertinent findings from the literature. Additionally, the summary should present an operational definition of all terms, constructs, and variables that are germane to the proposed study.

Research Questions. Basic to all research studies is the intention to seek answers to specific questions. The narrative of the proposal should have been developed to this point as a crescendo to the statement of the research questions. Assuming that this has been done, the only requirement for this section is to state the research questions simply and succinctly.

Because most research studies are conceived and planned with the expectation of specific findings or outcomes, these, too, are stated in this section, in the form of research hypotheses. The research hypotheses will parallel the statement of the research questions and should be listed in order of importance. They should be stated in the positive form *versus* the null form. This is done to make an explicit prediction of the expected outcomes and to provide a relationship to the preceding narrative of the proposal.

This section will not be long, in that it is primarily a listing of the research questions and, presumably, related hypotheses. However, it should be a logical extension of the statement of purpose and the description of need and should be grounded in

the review of literature. In anticipation of the methodological section to follow, the research questions should be answerable and the research hypotheses should be testable by specific methods and procedures.

Methodology. The way in which the methodology is developed will be influenced greatly by the research questions to be answered and the research hypotheses to be tested. In any case, the methodology section must provide a detailed description of the conduct of the proposed study: by whom, how, and in what sequence. This requires that the narrative account for 1) the groups of subjects to be studied; 2) the generation, collection, and analysis of the data for each variable; and 3) the differences, relationships, or effects to be determined.

The section on methodology is a narrative description of the detailed planning that already has been done.² This includes six major steps of the research planning process:

- Designing the research study;
- Determining how to collect the data;
- Planning the methods and procedures;
- Anticipating the results;
- Checking the feasibility of the study; and
- Assessing the limitations of the study.

In describing the results of the research planning process, it is mandatory in the methodological narrative to deal with each research question or hypothesis in a specific, organized, logical manner.

Various techniques can and should be used to communicate clearly what will be done. For example, judicious use of subject headings, outlines of activities, and time lines will demonstrate that the study has been carefully planned and potential problems have been anticipated. This serves to provide assurances that each research question can be answered as asked and that each research hypothesis can be tested as posited.

Personnel. In the preceding section on methodology, there will have been opportunity and, in fact, need to refer to the various types of persons required to conduct the study. Often this previous reference will have been made in terms of role, eg, principal investigator, research assistant, or statistician. This makes more sense than to refer to a person by name, because the role is more meaningful in describing the various activities of the study.

In this section on personnel, the respective roles are listed by title, the responsibilities of each role are delineated, and the person to fill each role is named, if such a person is available. Such a person may not be available, in that this may be a part of the requested resources to be described in the fol-

lowing section on budget. For all roles where a person is available, a summary statement should be given regarding each person's experience and training that uniquely qualifies that person to undertake the responsibilities of the respective position.

Budget. This section consists of two major components, a detailed listing of all resources needed to conduct the study and a justification of why each is needed. The level of difficulty experienced in preparing the budget and in justifying it will be an excellent test of how carefully the details of the methodology have been planned. This is because a study that has been designed and articulated carefully will be relatively easy to translate into monetary terms. Although the format of the budget and its justification will vary, depending on such things as requirements of the potential funding source(s) or personal preference, there are more similarities than differences in terms of what should be included.

Essentially, a budget is a two-way matrix. Horizontally, columnar divisions allow for a vertical listing of the various resources needed to successfully conduct the study, what portion of each resource's cost will be contributed, and what portion is being requested from the potential funding source. Vertically, categorical divisions allow for two major types of necessary resources, personnel and operational. Within each, there are usually additional subcategories to account for all that is required to successfully conduct the study.

Costs shown in the two-way budgetary matrix are referred to as direct costs. In addition, there are indirect costs associated with any study, eg, operational costs of facilities and maintenance costs of equipment. Usually, indirect costs are calculated as a percentage of direct costs. Whether or not they are costs that are allowed by the potential funding source, the indirect costs should be included in the final budget for the study. Preparation of the budget to accurately account for all items and all costs probably will require consultative help. The goal is to prepare a budget that is consistent with the methodology.

The justification of the budget is necessary and very important. First, its preparation forces a final, careful consideration of each item to ensure that it truly is needed and that its cost is neither underestimated nor overestimated. Second, the justification provides a definitive, relational link between each item in the budget and the various activities of the study. It is crucial that adequate resources are available to conduct the study but that no more are allocated or, especially, requested than absolutely necessary. In the final analysis, the budget

should be adequate in relation to the methods and procedures, not perceived as less than needed and not perceived as more than needed.

Summary. As a parallel to the abstract at the beginning of the proposal, a summary should be presented at the end of the proposal. Emphasis should be placed on the expected outcomes and their significance to the overall area of research. Also included as a part of the summary should be an indication of how and when the study will be reported. This will include a brief discussion of the final report, professional meetings to be identified for paper presentations, and journals to which manuscripts will be submitted for consideration of publication.

Attachments. The body of the proposal should be direct, to the point, and substantive. To protect against putting too much detail in the body of the proposal, which might be distracting, but to have it available for a complete understanding of the proposal, attachments to the proposal can be used. Detailed tables of data, comprehensive figures, related publications of the researcher, resumes, examples of data collection instruments, and letters of support or agreement are but a few examples of what may be presented as attachments. Take great care in choosing what to include, making sure that it is absolutely necessary. As the decision is made

to include an attachment, give it a title, number it for easy reference in the narrative, and make sure that it is visually attractive, comparable to the body of the proposal.

Concluding Remarks

Do not be surprised and do not become discouraged if your first, your second, or even your third research proposal does not get funded. There is as much skill and art involved in preparing fundable research proposals as there is in designing quality research. Even the most experienced researcher often will have a research proposal rejected. Perseverance is the key. Analyze the review of your proposal, modify and refine it accordingly, and submit it again. Keep trying, and before long you, too, will begin to realize a successful research career.

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SPECIAL COMMUNICATION

Research Process

Conducting the Research Project #4

LAWRENCE L. GABEL, PhD*

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Conducting the research study should be a methodical process in which the details of the planning process are executed. This fourth article in a series of six on the research process presents guidelines with supporting recommendations to increase the likelihood that the study indeed will be conducted as planned. The guidelines emphasize the importance of 1) record-keeping systems, 2) detailed work schedules, 3) communications, and 4) monitoring progress.

The last phase of the research process has been reached.¹ All planning is done, and the research proposal has been prepared.^{2,3} Although long awaited and cherished in anticipation, this moment must give way to action, to conducting the research project. This fourth article in a series of six focuses on the role of the researcher in this phase. Guidelines are given and recommendations are made to increase the likelihood that the project will be conducted as planned.

The perspective to be taken relative to conducting the research project is that of the researcher as administrator with other individuals carrying out most, if not all, aspects of the study. With this perspective, the large majority of situations will be taken into account. And for the small minority of situations that might best be described as singular in effort by the researcher, still the bulk of the guidelines set forth will be applicable.

Guideline 1: Maintain an Administrative Record-Keeping System

Being solely responsible for the successful conduct of the research project, it is imperative that the researcher develop and maintain an administrative

record-keeping system. This system should allow the means to account fully for the whole project. Although personal tastes will dictate the final form, either a large loose-leaf binder with tabulated sections and subsections or a series of file folders is recommended. Whatever method is chosen, the record-keeping system must be maintained religiously. This includes capturing all documents in a chronological order.

The record-keeping system should begin with the detailed notes generated during the planning process.² Even if in rough form, these should be available for ready reference as a reminder of all decisions that were made in conceptualizing the project. Assuming that a research proposal has been prepared to summarize the results of the planning process, this should be the next entry in the record-keeping system. Excluding the attachments to decrease bulk and because most will be included in the following section of the record-keeping system, this section provides access to a polished description of the research project. Besides serving as a reference, this section can be extracted easily and distributed to persons who have an interest in or who need to know about the project.

The next section of the record-keeping system should be for allocations of resources. This provides the means to track both efforts expended by personnel and financial transactions. It is important to monitor the allocation of resources in relation to

*Associate Professor and Director of Graduate Education and Research, Department of Family Medicine, The Ohio State University, 1110 UHC, 456 W. Tenth Ave, Columbus, OH 43210.

estimates made previously in the planning and budgeting processes to ensure that adequate resources are available at all times to continue the project to completion. Assuming that a grant was secured as a result of the research proposal, such a section also will allow for a full and accurate accounting of the financial aspects of the project in preparing the final report to the funding source.

The remainder of the record-keeping system should be sectioned in accordance with all major aspects of the project. The actual headings will be dictated by the specific methods and procedures of the particular study. Whatever is used, make sure to account fully and accurately for the progress of the work undertaken, by whom, and when. Examples of such sections might be instrumentation, subject recruitment and assignment, treatment protocols, data, and statistical analyses. Whether in these sections or in separate sections as deemed appropriate, include all minutes of meetings, memos, letters, or other forms of communication. This will further document activities or decisions made along the way regarding the conduct of the project.

Guideline 2: Prepare a Detailed Work Schedule

The methodology section of the research proposal is a narrative description of the planning that has gone into conceptualizing the project.^{2,3} It is a succinct summary of issues such as research design, number and assignment of subjects, instruments and techniques to generate and collect data, and how the data will be analyzed and the results reported. Even though it is comprehensive in breadth, the methodology section often will be lacking in depth because of space limitations in the preparation of the research proposal. Therefore, it is recommended that a detailed work schedule be prepared to guide the day-to-day conduct of the research project.

Figure 1 presents an example of how a work schedule can be developed, building on a project's purpose and hypotheses. This example is incomplete, going only far enough to demonstrate the use of goals, objectives, tasks, and milestones as one way to develop a detailed work schedule.

Note in Figure 1 that goals are comprehensive in nature and address major roles and functions within the project. Goals may support one or more hypotheses as they provide directions toward a desired outcome. Goals are management-oriented and indicate a need for concrete actions.

Title: A Study of Patients' Valuing of Continuity of Care

Purpose: The purpose of this study is to determine why some patients purposefully seek continuous care from one health care provider versus why some patients purposefully seek care from various health care providers.

Hypothesis I: Patients who seek continuity of care from one health care provider place significantly greater value on interpersonal factors versus technical factors associated with the patient-physician relationship.

Goal I.A: To design a strategy to elicit information from patients who purposefully seek continuity of care and from patients who purposefully avoid continuity of care regarding their attitudes and perceptions toward the delivery of health care.

Objective I.A.1: To develop an open-ended questionnaire that can be used to standardize interviews with patients who do or do not actively seek continuous care from one health care provider.

Task I.A.1.a: By 6/30/91, a valid and reliable questionnaire will be designed.

Milestone I.A.1.a.(1): By 3/31/91, researcher will select questions.

Milestone I.A.1.a.(2): By 4/15/91, researcher will construct list of prompts per each question.

Milestone I.A.1.a.(3): By 4/30/91, researcher will have identified those questions and prompts that are valid as per use of an expert panel.

Milestone I.A.1.a.(4): By 5/15/91, research assistant will pilot test all questions with patients of both types.

Milestone I.A.1.a.(5): By 6/15/91, statistician will apply psychometric techniques to produce a reliable questionnaire.

Milestone I.A.1.a.(6): By 6/30/91, research assistant will prepare 100 copies of questionnaire.

Figure 1. Detailed work schedule in context of a project's purpose and hypotheses.

Objectives are vehicles for implementing the goals; there will be two or more objectives for each goal. The objectives are outcome-oriented, are focused on singular rather than multiple outcomes, and are sufficient in scope to embrace a series of tasks.

The tasks include specific criteria to determine acceptable attainment of each objective, including factors such as verification of results, baselines of measurement, instruments to be developed or administered, and identification of subjects. There should be at least two tasks for each objective.

Milestones indicate an explicit strategy for pinpointing progress on the predetermined timetable or schedule. Milestones denote major events that are singular and discrete. They are developed in a logical sequence and collectively represent significant steps leading to the completion of tasks and, ultimately, the objectives of each goal.

Guideline 3: Communicate Regularly and Frequently

Seldom will a research project be undertaken that does not in some way involve a number of persons other than the subjects for its successful conduct. In many cases, these persons will be considered project staff members; in other cases, they may serve in advisory roles to the project; and in still other cases, they will support the project through consultative means. No matter what the role or level of involvement, all must be informed and motivated if they are to contribute their best. To this end, it is important that the researcher, as administrator, ensures regular and frequent communications.

One way to ensure appropriate communications is through well organized and well run meetings. This requires, minimally, a prepared agenda, a means for each person to provide input, a mechanism for making decisions, and a record of each meeting through timely developed and distributed minutes.

If possible, begin the project with all persons meeting at one time and in one place. If not possible, or if inappropriate, then hold separate organizational meetings with various groupings of persons in accordance with their major roles in the project. Organizational meetings are important for several reasons.

First, they should be used to familiarize all persons with all components of the project so that they know what will happen and when. Second, they should be used to establish the respective role of each person, making sure there is an understanding not only of what each person's role is but those of others as well and how all roles are interrelated. Third, they should be used to establish lines of communication so that the project can be documented fully, as all persons assume responsibility for keeping their colleagues informed. And fourth, they should be used to establish the tasks to be undertaken, both short- and long-range, so that work can be undertaken efficiently and efficaciously. Continue to meet with the various groups as the project progresses to provide a means to monitor the project closely.

Another way to ensure appropriate communications is through memos and letters; through graphic displays of progress, calling attention to milestones as they are passed; and through formal progress reports. No matter which means are used, make sure that a sense of accomplishment and appreciation is communicated.

Guideline 4: Monitor the Study Constantly

If the study has been planned meticulously and has been refined through a piloting process, it should go smoothly once it is begun. However, no matter how carefully plans and preparations have been made, there is the potential for difficulties that simply could not be foreseen. In fact, it will be the exceptional study in which no problems arise.¹ Therefore, it is mandatory that the researcher constantly monitors all phases of the study.

Be alert to whether each person is performing the tasks that were assigned in order to prevent invalidating biases from entering into the study.² Make sure the subjects are being recruited and enrolled in accordance with the criteria for inclusion and exclusion. Watch that interventions are applied as expected. Ensure that all data are being collected and recorded in a consistent manner. Random checks by the researcher regarding these and related issues are well advised.

As small problems arise, deal with them immediately, making sure that any minor midcourse corrections are duly noted. Inform all persons involved of any such changes so that uniformity is maintained. In making any changes, determine if biases have in any way entered into the process. Discard any and all data that are in question. However, if serious problems arise, it is much better to stop the study completely, redesign it, and start again. To do otherwise is to invite wasted effort and a flawed study that cannot be reported.

Concluding Remarks

The conduct of the research study itself is methodical and can be somewhat anticlimactic. Although much work is involved and careful attention must be given to many details, in retrospect, the creative and more exciting part to this point was probably in planning the study. Do not be surprised if you find yourself feeling somewhat let down. However, as you consider the analysis of the data and the preparation of the results, the excitement will return and, if anything, will intensify.

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Research Process

Concluding the Research Project #5

LAWRENCE L. GABEL, PhD*

This fifth article in a series of six on the research process provides guidelines for concluding a research project. Attention is directed toward a need for the researcher to be sensitive to the persons who supported the project. The other significant aspect of concluding a research project involves activities associated with analyzing the data, preparing the results, and finalizing the findings.

Elements of the three phases of the research process are said to parallel the six components of the critical argument.¹ To this end, planning a research study focuses primarily on developing a strategy to marshal credible evidence for the purpose of better understanding an identified problem.² The efforts of converting the results of planning activities to a research proposal are directed toward expressing clearly a researcher's thinking, such that the research study can be conducted with little deviation, if any, from what was planned.³⁻⁴ This fifth article in a series of six on the research process addresses issues related to concluding a research project. It focuses primarily on the last three components of the critical argument, namely: examining the implications of the evidence, weighing conflicting evidence, and determining a verdict.

Closing the Study

In that each study is unique, there is no standard set of rules for closing down a study. However, there are some general guidelines that will apply in most if not all cases. Some have to do with the human element. Others have to do with preparing

for the latter portion of the research process, evaluation of results.

Regarding the human element, be certain to inform all persons who have been integral to the conduct of the study that it is nearing completion or has been completed. This includes those who helped conduct the study as well as those who participated in it as subjects. Stop any interventions and call a halt to the collection of data; it is not ethical to continue generating and collecting data that will not be used. Provide the means for each person, no matter what role was played in the study, to normalize activities, whether to conditions prior to the study or to conditions as they have become as a result of the study. Indicate that the results of the study will be forthcoming and will be made available to those who are interested, as appropriate. Finally, express sincere appreciation for all support given to the study.

Regarding preparation for the latter portion of the research process, the data should be prepared for analysis. With computers being so available, it is advisable to analyze the data electronically. Computers are fast, do not make errors, and can present the results in tabular form as well as visually, for example, graphs and charts. Only for studies with few subjects and small amounts of data per subject should a researcher consider manipulating the data by hand.

* Associate Professor and Director of Graduate Education and Research, Department of Family Medicine, The Ohio State University, 1110 UHC, 456 W Tenth Ave, Columbus, OH 43210.

Although not stated previously, if at all possible, it is best to design the sheets on which data are recorded for each subject so that the data can be entered directly from them into the computer, excluding a middle step of transcribing the data. This saves time and, more importantly, eliminates the possibility that errors could be produced inadvertently as the data are transcribed.

With the data entered but before any analyses are made, it is important to clean up the data. This is necessary because in the process of recording the data, doing any necessary transcribing, or entering the data, it is always possible for errors to be introduced. First, secure a printout of the raw data and check all printed values one by one against the original data. Second, produce a frequencies printout and examine the results for any value of any variable that might be considered improbable or impossible. If any such values are found, go back to the original data and work through the transcription or entry processes until the errors are found and corrected in the computer files. Besides producing quality data, all of this work yields another major benefit. It causes the researcher to become intimately familiar with the data and to develop conscious and even subconscious understandings that will be very useful in later interpretive work of the results.

Analytic Perspectives

In that few clinically-oriented researchers have had formal training in statistical techniques, caution is the watchword at this point. Critical reviews of the medical literature consistently have shown that about half of the articles present unsatisfactory statistical analyses, and in some cases as high as two thirds!^{5,6} Hopefully not done intentionally, still it is easy to misuse statistics.⁷

Whether you plan to become directly involved in the statistical analysis of the data or to rely on a statistician, it is wise to do some study. On the one hand, you want to do everything possible to be correct in your analysis. On the other hand, you will be able to discuss the various issues more intelligently and be in a position to make informed decisions. One useful source for such study is medical journals themselves, in which review articles are published dealing with statistical analysis and interpretation in clinical research.⁸ Some medical journals regularly feature such articles in ongoing series; three that are particularly useful are the *New England Journal of Medicine*, the *American Journal of Diseases of Children*, and the *Family Practice Research Journal*. In all of these publica-

tions, the usefulness of the articles is in their treatment of statistical techniques using practical applications. Additionally, many excellent texts are available that are easily understood and can be used in almost a cookbook fashion to structure the statistical analyses of the data. Several that are particularly useful are presented as additional references.

It cannot be emphasized too frequently nor too strongly that great potential exists for not having a study to report if a researcher waits until after the data are collected to consider how the data will be analyzed and reported. At the very least, waiting will result in a reportable study that is much restricted in scope or much weakened in impact, compared to the study that could have been reported if planning were done in an appropriate sequence.² From the statistical consultant's perspective, there is little worse than a researcher appearing with a set of data and, in effect, saying, "I think there is a study here somewhere; please help me find it."

The primary methods of statistical analysis should have been determined during the planning phase in relation to the way the research questions were asked or the hypotheses were posited. A lengthy discussion would be required to present the technical rationale that supports the foregoing statement. Suffice it to say that intricate relationships exist between the way hypotheses are stated, the scales of measurement used to collect the data, and the statistical advantages available in the analysis stage of the research process.

During the planning phase of the research process, statistical considerations regarding anticipated results are complemented by conceptualizations of tables and figures to be used in presenting the actual results of the data analysis, such that the strongest case can be made for the expected outcomes. Therefore, the actual statistical analyses of the data are performed primarily for the purpose of determining what specific values will be presented in the tables and used as a basis for the figures, eg, charts, diagrams, and graphs.

Analyzing the Data

In most multifaceted activities, the usual practice is to begin with easier tasks and move progressively to more and more difficult or complex tasks. So it is with the process of analyzing data. Although the process will differ from study to study and from researcher to researcher, depending on individual circumstances and preferences, there is a sequence

Table 1. General Sequence of Steps in Analyzing Data

1. Check data for biases
2. Become intimately familiar with data
3. Find and examine any relationships between variables
4. Perform planned primary analyses of the data
5. Perform secondary analyses of the data

of steps that generally will be followed. These are listed in Table 1.

Biased data can weaken or invalidate the study. If bias exists, but not to such an extent that the study is invalidated, still it must be identified and discussed in the report of the study so as to qualify any conclusions that are made in relation to the biased aspect of the study. To identify biases, use one or more control variables to determine if the study groups represent the respective populations as expected; a control variable is one that is not intricately linked to a research question or hypothesis but which is easily collected, for example, age or sex. Compare or contrast the study groups to their respective populations on some discriminating factor, for example, differences, ratios, or percentages, using an appropriate statistical test.

Become intimately familiar with the data through the use of frequency distributions, descriptive statistics, and graphical presentations as available through the different options of the computerized statistical package, assuming one is being used. Look for trends in the values of each variable; visualize the data from various perspectives. Such efforts of familiarization will be complemented by preceding efforts exerted in the process of cleaning up the data, thereby enhancing your total understanding of all of the data.

If appropriate in the context of the research design, greater understanding of the data can be gained by studying relationships that exist. Using graphical techniques, such as graphing one variable against another variable, and statistical techniques, such as correlation between variables, relationships can be identified and characterized.

With a thorough understanding of the data, variable by variable, and of any meaningful relationships that exist between the variables, next perform the primary methods of analysis as deemed necessary and appropriate during the planning phase. These analyses will provide answers to the research questions or tests of the hypotheses. For the first time, it will be clear as to whether the results of the study are as they were anticipated and predicted.

If they are, it probably will be an exhilarating moment. If they are not, the first reaction likely will be surprise, disappointment, or another similar

emotion. These should be rejected quickly. If the study truly was logical and unbiased in design, was planned meticulously, and was conducted scrupulously, then much has been learned, and the study is worthy of being reported. Excellent examples of this latter situation exist in the literature.⁹ In science, "no" answers can be just as meaningful as "yes" answers.

Follow-up or secondary analyses of the data can be, and in many cases should be or must be, performed no matter what the results of the primary analyses. Depending on the design of the study, these may already have been planned in the context of specifying the primary methods of analysis during the planning phase. In some situations, the secondary analyses will be comparable to the primary analyses and will be used as a means to validate preceding analyses and results. In other situations, the secondary analyses will be used to answer secondary questions or test secondary hypotheses. In pursuing all follow-up analyses, caution is advised. Such analyses must be carefully determined and judiciously applied, because much opportunity exists for weakening the overall study by the use of multiple analytic techniques. Consultative help should be considered to prevent unforeseen problems and the potential for justifiable criticism of the study's final report.

Weighing the Evidence

With the analyses completed, construct tables and figures, first, in terms of what was planned originally and, second, in terms of new insights garnered as a result of the various analyses. Produce multiple variations of the tables and figures until the fewest and simplest are found that most clearly and succinctly present the results of the study. In a very real sense, be guided by the adage, "a picture is worth a thousand words."

Next, develop hierarchical levels of observations to ferret out obvious and cryptic meanings of the results. These should be germane to the purpose and need for the study as originally conceived. Cull and refine the observations until the basis exists for determining irrefutable answers to the research questions.

Using the finalized set of observations, compare and contrast each observation or appropriate combination of observations to that which is most pertinent from preceding reviews of the literature. This should be guided by the desire to identify any congruence or discordance in relation to what others have reported regarding the particular area of research. The upshot of these activities probably

will require an additional review of the literature. Highly targeted in focus, this review should result in the means to merge the findings of the research study with findings of previous research studies, such that a maximum of new knowledge is created.

Developing the Conclusions

As simply and succinctly as possible, conclusions are stated paralleling the research questions as originally asked. In summary fashion, the conclusions incorporate and account for the results and findings of the study. In the final analysis, the conclusions crisply answer the research questions and communicate the outcomes of the research study.

Concluding Remarks

Bringing a research project to an end involves two important but somewhat different activities. First, it requires that normalcy be returned to people's lives where disruption was created by their helping to conduct the research study or from their participating as subjects. This includes expressing sincere appreciation for their support and offering to share with them the results of the study once finalized. Second, it requires that the data be analyzed, the results prepared, the findings determined, and the conclusions drawn. The concluding portion of the research process provides considerable opportunity for creativity on the part of the researcher, much as did the planning portion. Both represent the intellectual aspects of the research process.

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Research Process

Reporting Results of the Research #6

LAWRENCE L. GABEL, PhD*

The preparation of a manuscript to report a research project is the final stage of the research process. Recommendations are made in this article related to preparing to write, getting started, guarding against problems and frustrations by making early decisions, and developing each component of the manuscript. This article is the last in a series of six on the research process, in which the collective purpose has been to offer guidance regarding the spectrum of skills required to produce quality research reports.

This article describes the final stage of the research process, reporting the results. It is the last article in a series of six, in which the collective purpose has been to offer guidance regarding the spectrum of skills required to produce quality research reports.¹⁻⁵

The first article argued the importance of doing research and presented an overview of the research process. The second and third articles detailed the steps in planning and preparing to undertake a research project. The fourth and fifth articles described the means whereby a research project can be conducted and completed in accordance with preceding preparatory work. This sixth article provides and supports recommendations on reporting the research project so that the process is efficient and is likely to be successful.

Research can be reported by verbal means and by written means. Verbal communication can be informal, as to one or more colleagues, or it can be formal, as in a scientific presentation at a professional meeting. Written communication can be in the form of a final report, as in reporting to an agency that supported the research, or in the form of a publication, as in a journal article or a book.

Of all forms of reporting the results of research, the journal article is the most valued in the scientific community. This is because the journal article can continue to be examined critically, is relatively widely available, and takes on a sense of permanence. Although other means of reporting research may meet one or even two of these criteria, seldom do they meet all three.

To this end, an underlying theme of this series of six articles is that a discipline's literature, at any point in time, represents both what has come to be its historical body of knowledge and what is currently being explored. Researchers have an obligation to contribute to this dynamic forum by publishing credible results of research projects that have addressed important subjects. Thus, publication in a respected journal, for example, one listed in *Index Medicus*, must be considered the final integral aspect of the research process.⁶

Be Prepared

Just because a research project has undergone meticulous planning, rigorous conduct, and scrupulous analysis, this does not guarantee that it will be reported in the literature. Too often, the preparation of scientific manuscripts is of such poor quality that journal editors find them unclear, verbose, confusing, and full of errors, both technical and

* Associate Professor and Director of Graduate Education and Research, Department of Family Medicine, The Ohio State University, 1110 UHC, 456 W Tenth Ave, Columbus, OH 43210.

grammatical.⁷ Such manuscripts risk immediate rejection. It is sad but true that unpublished research has never been undertaken as far as anybody is concerned other than the researcher and possibly a few colleagues.⁸ Therefore, when it comes time to prepare the manuscript to report a research project, there should be at least some cause for concern on the part of an author no matter what the level of previous experience.

Fortunately, help is available. Given the low quality of a high number of scientific manuscripts submitted for consideration of publication, over the last few years various writers and editors have published excellent guides to scientific writing. Selected examples are listed as additional references. It is recommended strongly that one or more of these be secured and studied carefully. Be assured that any efforts exerted in this regard will be compensated more than amply in benefits throughout the process of preparing and refining a manuscript.

Two Ways to Get Started

Even with the best of intentions and with the greatest of enthusiasm on completing the research project, it may be difficult to begin the process of preparing the manuscript. Many researchers face this reality and consciously or subconsciously find reasons not to get started. The reasons are many and varied, for example, bad experiences in writing while in school, lack of experience in writing since graduation, or the busyness associated with personal and professional obligations. Be careful. Put off too long, the manuscript will not be prepared. The completed research project will become unpublished research that, as described previously, has never been undertaken. To deal with this possibility, there are two ways to get started.

The Research Proposal. One way to get started preparing a manuscript is to go back to the research proposal.³ Recall that purposes for preparing the research proposal included securing permission to undertake the study, ensuring protection of subjects, achieving a refined perspective of the proposed study, and securing needed resources. No matter why the research proposal was prepared, it should be possible to modify it relatively easily to serve as the first draft of the research report.

As a side note, if the research proposal was prepared for the purpose of securing resources to conduct the study, more than likely the funding agency will require a final report. Therefore, it is advisable to complete this task immediately. Not to do so will probably make it difficult, if not impossible, to get support from the same source in the future.

Assuming that the study was conducted as planned, the first step is to modify the research proposal, from the statement of purpose through the methodology section, by changing the verb tense from future to past. Also, where differences exist between how the study was proposed and how it was conducted, the narrative must be modified appropriately. The next step is to develop three new sections of narrative to account for results, discussion, and conclusions, respectively. These new sections will be based on the work already performed in concluding the study, "weighing the evidence."⁵ The last step is to revise the abstract of the research proposal to reflect the actual research project as it was conducted.

The Conference Paper. Most journals will accept a written report of a research project to consider for publication even if a similar report has been given verbally at a professional meeting. Therefore, preparing and giving an oral presentation is an excellent way to get started on the preparation of the manuscript.

To have a paper accepted for presentation usually requires the submission of an abstract, if not a four-to-five page version of the paper itself. If a critique of this submission is offered by the program committee, this is an ideal way to perceive how a journal editor might subsequently react to the manuscript. On any account, producing these and preparing a presentation that can be given in 10 to 15 minutes require careful consideration of what is really important so that the full work can be presented efficiently and effectively.

In that the format of the presentation will parallel that of the manuscript, this will begin to force a structure that later will be useful in outlining the manuscript. Determining what visual aids, tables, and figures can be presented to the live audience so that understanding can be grasped quickly will help in considering the results section of the manuscript. In the question and answer period that follows the presentation, important clues can be acquired as to what might need amplification in the manuscript and how the discussion section might be focused most ideally. Finally, the verbal interaction with the audience will test the logic of the conclusions and generalizations regarding the research results in relation to the research questions.

Just as the research proposal can serve as a starting point for the journal manuscript, so too can the paper that is presented orally. Both are important and valid means to report the research project, but the qualities that characterize each are different from those that are applicable to the journal article. Therefore, much remains to be done to

prepare the manuscript; they serve only as good starting points.

Early Considerations

Before beginning the work of preparing a manuscript, there are three important decisions to be made. The first decision is determining to which journal the manuscript will be submitted. The second and third decisions are related. These are determining who will be cited as authors of the manuscript and in what order. In making all three decisions, several factors must be taken into account.

Choosing a Journal. The primary reason for choosing a journal before writing the manuscript is because the choice will greatly affect whether the manuscript, once submitted, will be published. Characteristics of journals to be considered in making a choice include: 1) type of audience, 2) level of circulation, 3) quality, 4) impact, and 5) scope and frequency of topics.⁹ Each characteristic has a respective set of advantages and disadvantages that can be determined only on a case-by-case basis. To make this determination, examine past issues; check publications that make comparisons; and, if in doubt, contact the editor of a particular journal to inquire in a diplomatic fashion about the appropriateness of the intended manuscript for the journal.^{10, 11}

With the choice of journal made, it is extremely important to secure the "Guidelines for Authors" of the particular journal. These will be published in each issue or at some regular interval of the journal's publishing cycle. Carefully study the guidelines and become totally familiar with the format and style of the journal. This can be facilitated by examining past issues of the journal to determine precisely how the guidelines are applied in the presentation of various articles.

It cannot be emphasized too strongly that not preparing the manuscript in accordance with the guidelines is a serious mistake. It can lead to the manuscript's immediate rejection by the editor. At the very least, it will cause great delays in getting the manuscript published because of the changes that will be necessary until the guidelines are met explicitly. This will create considerable frustration on the part of both the author and the editor. In all cases, such problems can be prevented by simply following the guidelines in the first place.¹²

Authorship Issues. One indicator of the stature of an individual's professional career is the quality and quantity of publications for which the individual is credited as an author. In reality, quantity

often takes precedence over quality. As a result, the trend in recent years has been for several persons to be cited as authors of a particular manuscript submitted for consideration of publication, whereas, in the past, only a few would have been cited. To counteract this trend, journals have begun to limit the number of authors for a given manuscript. This restriction usually is stated in the journal's instructions to authors.

To determine whom to include in the restricted number, detailed guidelines are available with illustrative examples of application to various types of manuscripts, including research reports, case-series analyses, case reports, topical reviews, and editorials. Regardless of the type of manuscript, the overall deciding factor to qualify an individual for authorship is substantial contribution to the work, such that public responsibility can be taken for the content. Substantial contribution is defined as: 1) conception or design of the work, analysis and interpretation of the data, or both; 2) drafting or revising the manuscript for critically important content; and 3) final approval of the version to be published.¹³

Note that the criteria regarding contributions are in an order similar to that of the sequential steps of the research process, that is, planning, conducting, and completing the research project.²⁻⁵ Generally, decisions regarding sequence of authorship are based on the amount and importance of each author's efforts in the overall process. This implies that the first author would have been integral to perceiving the need for the study, conceptualizing its design, and guiding the analyses and interpretation of the data; the subsequent sequence of authorship represents progressively lesser contributions.¹³ However, this general rule of thumb does not apply to all journals, in that selected journals have as a policy that all authors share equally in the authorship. Hence, the sequence of authorship is determined by other criteria established by the authors involved.

The Manuscript

Table 1 lists standard components of a manuscript for a research report. It is necessary to check the "Guidelines for Authors" of the chosen journal for specific guidance in preparing these various components. However, in general, manuscripts must be typed, double-spaced, with at least 1-inch margins. Illustrations must be of good quality; this can be achieved most easily by having them prepared professionally and submitting them as glossy prints.

Title and Abstract. Recommendations regard-

Table 1. Components of a Manuscript for a Research Report

Title page, includes authors and affiliations
Abstract, plus key words
Text
Introduction
Methods
Results
Discussion
Summary
Acknowledgments
References
Tables with complete titles and footnotes
Legends for illustrations
Illustrations

ing the preparation of the title and abstract for a research report differ little from those already given for a research proposal.³ The only difference is that the abstract of a research report ends with results and conclusions, whereas the abstract of a research proposal ends with anticipated results and expected outcomes.

Introduction. In much reduced fashion, the introduction of the research report incorporates four sections of the research proposal, including the purpose, description of need, literature review, and research questions.³ Using about three to five paragraphs, the introduction begins by describing the contextual problem or issue of the research study, why the research was pursued. Literature is cited only as necessary to describe previous closely related work and to demonstrate the logic and reasoning on which the study was based. Finally, the purpose of the study is stated in a way that the research questions, or hypotheses, can be inferred.

Methods. The methods must be in sufficient detail to allow independent replication of the study. This includes describing the research design, how the subjects were selected and assigned, what interventions were used, what measurements or observations were made, and what statistical procedures were used. Any methods, techniques, or procedures with which an informed researcher would not be expected to be familiar are described in appropriate detail. Likewise, any delimitations or limitations are discussed regarding selection of subjects or collection of data, either in methodology or instrumentation.

Results. Using the research questions, or hypotheses, as a guide, present only relevant data in the results. Data are not presented if they do not relate directly to answering the research questions. Tables can be used to present the data, and figures can be used to depict the data; if used, they should stand alone, meaning that no narrative is needed

to interpret them. The narrative is used to state results of the data analysis, for example, group statistics and related tests of significance. In stating the results, statements are made as facts with no interpretation or qualification. Thus, the narrative succinctly provides answers to the research questions to the extent the available data permit.

Discussion. In the discussion, facts presented previously as results are interpreted, along with any identified relationships. In the process, concise statements of findings, conclusions, are made. Consideration is then given to any biases, delimitations or limitations of the study, and if and how the conclusions must be modified. From the literature review done before, during, or after the study, the conclusions are compared and contrasted with research findings of others to highlight areas of support and conflict. This leads to a discussion of generalizations of the study, often in relation to future research that might reinforce or extend areas of agreement or resolve areas of conflict.

Summary. The last section of narrative presents a cogent summary of the report with emphasis on the ultimate outcomes of the study. As such, it parallels the abstract in form and substance. Hence, it provides a final opportunity to state succinctly what is important regarding the study's conceptualization, conduct, and findings.

Acknowledgments. Persons who made important contributions to the research are cited in the acknowledgments. However, be sure to secure their permission before doing so.

References. To provide a context for the study, references are cited that relate directly to determining a need for the study, structuring the methodology, and discussing the results. The balance between the number of citations and the closeness of their relationship to the study will be indicative of the researcher's scholarship. When citing other work, be sure to be accurate and complete and to use the journal's designated format.

Concluding Remarks

Since writing is not easy for most, there may be a tendency to procrastinate in preparing the manuscript or reporting the research study. One way to get started is to convert the research proposal into a final report, which, in turn, is used as a first draft of the manuscript. Another way to get started is to prepare and present a paper at a professional meeting to stimulate preparing the manuscript.

Before getting started, however, there are some basic decisions to make: for which journal to pre-

pare the manuscript, whom to include as authors, and in which sequence the authors will be listed. Making these decisions early will eliminate or at least decrease many problems and frustrations that can be experienced by authors and editors during the preparation, submission, and revision of the manuscript.

The importance of following a journal's "Guidelines for Authors" is emphasized. By doing so and by giving careful attention to developing each component of the manuscript, the probability is increased markedly that all preceding work will result in a quality research report.

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