Research in Physical Medicine and Rehabilitation

VI. Research Project Management

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This article on research project management is written primarily for the researcher who has started a project, has collected data on a few subjects and has now realized that the project is more involved than anticipated. Although discussion of the many different styles of management is beyond the scope of this article, it addresses some common problems faced by the researcher, including finding subjects, obtaining project approval from the institutional review board, identifying and training staff, establishing a work plan, pilot testing, recording data, identifying problems, using computer software for project management and budgeting. Specific examples and exercises are included.

The complexity of management may seem daunting to the novice, who will often skip the fundamental organizational steps in designing a project. On the other hand, the person who has been able to successfully complete all the exercises in the previous articles in this series has, most likely, mastered project management and is now at the point of data analysis. This article on research project management is written primarily for the researcher who has started a project, has collected data on a few subjects and has now realized that the project is more complex than was expected. To successfully complete it with the available resources of personnel, equipment and funds, very careful project management will be necessary. For those of you struggling with selection of methods in exercise 4 of article 1, much of this information will seem foreign until you actually start to gather data. This review of project management will be most useful for those who had a research assistant who just quit/got sick/ moved, had the budget cut by 50% when the project was funded, are halfway through the projected time period for the study with only 5 out of 30 subjects entered, just got a major new clinical assignment that occupies all free time or (poor soul) all of the above.

The time to consider what is needed to manage your project is before embarking on the venture. What may appear, at first, as an easy and rapidly executed study, may in actuality abound with many difficulties. If you identify many of these hindrances before you begin, you will prevent obstacles and anxieties later on. Furthermore, a well-designed plan to deal with potential difficulties will not only make the project easier, but will increase the likelihood of funding as your project will be perceived by any granting agency as having a greater chance of success. Although the many different styles of management are beyond the scope of this paper, this article will address some common problems faced by the researcher, including finding subjects, obtaining project approval from the institutional review board, identifying and training staff, establishing a work plan, pilot testing, recording data, identifying problems, using computer software for project management and budgeting.

SUBJECTS

The biggest problem encountered in research utilizing human subjects is obtaining a sample population large enough to meet all your inclusion and exclusion criteria. It often appears, at first glance, that this will not be difficult. For example, a clinician treating patients with spinal cord injuries (SCI) may feel certain that he/she sees enough individuals with pressure sores for a 1-yr study. Unless you have performed a retrospective chart (or other records) review to confirm this, you may receive an unpleasant surprise when actually trying to recruit subjects. What subjectively seems to the practicing clinician as 'many' may, in reality, be only a reflection of the impact of a few dramatic cases. As an example of how actual recruitment time often takes far longer than initially estimated, we obtained a list of 148 members of an amputee support organization to...
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Recruit subjects for a research project at the National Institutes of Health (NIH). Approximately 18 hours were spent: 1) screening the list for appropriate subjects who met the inclusion criteria, 2) tracking down inaccurate telephone numbers, 3) leaving messages for those not at home and 4) answering returned telephone calls. A total of seven subjects were recruited. Hence, it took ~2.5 h to recruit each individual!

Determining a Reasonably Achievable Sample Size

Once you have decided on the sample size desired (see article III'), you must begin by estimating the largest number of subjects you could possibly find given your resources. For example, if you see 100 patients a year with below knee amputations, then this is the maximum number of such patients you could ever include in a 1-yr study unless you enlist the help of other facilities. If, however, you planned a study requiring 90 patients, you would be courting disaster as it is unlikely you would get all of your subjects into one study.

To estimate precisely the number of subjects you will get, you need to very carefully specify your inclusion and exclusion criteria. If a patient meets any of your exclusion criteria, he is not in your study. Although this may seem to belabor the point, clinicians often view exclusionary criteria as relative contraindications, not absolute criteria. Good research requires that you be very specific in your definitions so that 1) another person will be able to duplicate your experiment if they so desire, 2) experimenter bias is removed from subject selection and 3) you can reasonably estimate how many subjects you can actually find. You estimate this by subtracting the number of subjects you think will meet your exclusion criteria from the total (Table 1). In this example, the largest number of subjects you could enter is 72, based on your estimate of the number meeting each exclusion criterion. Although you may not know beforehand exactly how many subjects you will actually recruit, when possible, base your estimate on actual data. For example, numbers of patients living too far away for followup visits can be estimated from county of origin information that is often kept by the marketing department of your facility. If you just don't know, just make your best guess. However, it is very important to make some guess for each exclusion criteria, so that, if you are having trouble getting subjects, you can figure out why. If it is too much work to go through each of these calculations for every exclusion criterion you list, then you have probably listed too many.

Moreover, although you expect to ask 72 people to enter your study, by no means will 72 actually complete it. You must also take into account patients who do not wish to be subjects, those who may drop out and those who, for varied reasons, may not complete your study (for example, because of equipment malfunction on testing day). The very best investigators may have only 5% refusals and 5% dropouts, but it is more realistic to plan for 10% refusals and 10% dropouts. Refusal and dropout rates higher than that would greatly limit the conclusions that could be drawn from your study, as your experimental group would be likely to differ in important ways from the population as a whole. However, because you have not been able to study many of the eligible subjects, you do not know in what way the entire group differs from those you contacted. Although there are statistical methods to compensate for this, they are approximations at best and are not widely used techniques.

If doing all these calculations bothers you, there is another very simple method. Write your consent form and, before you start your project, locate potential subjects, see who meets your criteria and ask them to sign the consent form as if you were actually going to start the study. How many names did you have to start with to get two signed consent forms? If it took three, you are doing well; four, you are average; ten, you are in trouble. The length of time this exercise took can also be used as a guide to how long your entire project will take. By keeping good records throughout

<table>
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<tr>
<th>Criteria</th>
<th>Percent</th>
<th>Number</th>
<th>Number Remaining</th>
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<tbody>
<tr>
<td>Slow knee amputation &lt;18 yr</td>
<td>100</td>
<td>99</td>
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<tr>
<td>Congestive heart failure</td>
<td>9.9</td>
<td>89.1</td>
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<tr>
<td>Living more than 50 miles from</td>
<td>12.7</td>
<td>71.9</td>
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<td>Refusal to participate rop out</td>
<td>7.2</td>
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<td>6.5</td>
<td>58.3</td>
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<td>42</td>
<td>58</td>
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This study is based on a total of 100 subjects. Please note that, although these factors individually add up to 51%, you can still expect to have 58 subjects complete your study because each factor must be multiplied sequentially.
your study, you can keep track of the participation rate and, each month, make sure that you are making satisfactory progress. If you are not, the time to take action is early on. For example, in a study of family education, we found that no family would enter the study during the 1st wk of rehabilitation hospitalization, but almost all would do so at the initial evaluation conference at 1 wk after admission. The timing of approaching a potential subject in this case proved crucial. It would therefore be well worth your while to explore at which point(s) an individual was most likely to be receptive and amenable to inclusion in your proposed study. Not only will you save valuable time, but you may also achieve a higher rate of participation.

If you informally describe your protocol to a number of potential candidates, you can get valuable responses and feedback to your basic design. If there is a specific element in your protocol that appears to cause difficulty, you may be able to modify that factor without compromising the scientific quality of your study. An example of this is subjects’ objection to the frequency of test procedures such as blood drawing. With close and careful scrutiny, you may be able to reduce the total number of samples and/or modify the intervals to minimize discomfort and gain additional subjects.

Initial Screening of Potential Subjects

After you have completed the above estimation of subjects, you will usually find that what seemed to be a large number of subjects has turned out to be barely sufficient. Therefore, you will need to be certain that you do not miss any potential subjects, and you will have to develop very thorough screening procedures to identify as many promising individuals as possible. Even if you do have a surplus of candidates, this screening will allow you to enter the subjects into your study more rapidly. Because the major cost of a study is personnel time, this will allow you to complete your project with less time and expense.

Depending on the complexity and nature of the study, initial screening for potential subjects may be very time consuming for the investigator. To avoid missing potential subjects, a hierarchy of screening procedures can minimize time spent by the investigator, yet maximize participation. Subjects who seem skeptical at early stages may need extra attention later on; those who are enthusiastic from the start may need very little explanation later. However, it is important for the subject to feel close rapport with someone on the research staff, to decrease chances of subsequent dropout. Besides, the subjects’ comments may help you to perform a better study. We have found the following sequence of steps helpful in screening for possible research subjects in an in-patient setting:

1. Notification to the investigator of potential subjects by a nurse or attending physician or by screening of patient admission lists by research staff.
2. Screening for inclusion/exclusion criteria by research staff.
3. Initial presentation of the project to the patient by a resident and/or the attending physician. This step is particularly important, as subjects feel much more comfortable about a study if their physician appears favorable toward it.
4. A detailed explanation of the project to the patient by the research staff.
5. A discussion of the project by the investigator. Providing the patient with an opportunity to talk to "the boss" stresses the importance placed by the investigator on this subject’s participation in his/her research project.
6. A discussion of the project with an IRB member, if requested by the patient.
7. Signature of the consent form obtained by the investigator and witnessed by a member of the research staff.

It is particularly important to familiarize the attending physicians and residents with your study goals and protocol so they can provide an adequate and appropriate explanation to their patients. Almost invariably, a patient will appeal to the doctor caring for them with the question "Do you think I should enter this study?" Without sufficient information, the physician is unable to answer that question honestly and ethically. Any reservations about your study by staff will be quickly perceived by potential subjects, and once one refuses others will be more hesitant.

When subjects are being recruited from the general public, via special newsletters (e.g., The Multiple Sclerosis Newsletter), regular newspaper advertisements and the like, other screening techniques are needed. 1) A telephone input form with initial information is filled out by any staff member answering the phone. 2) These forms are reviewed by the investigator or research assistant and potential candidates are contacted by phone for a more detailed assessment of eligibility into the study as well as to explain the project. 3) Because potential subjects may call at any time, every person in your office who might answer the phone should know about your project and the location of the screening forms.

Background Work-up
After the subjects sign the consent form, there may be specific testing required before they can be entered into the study. Certain exclusion criteria may be based on measures not taken routinely in the clinical setting. Furthermore, this testing serves to establish base-line values to compare with subsequent findings. Prestudy testing may include specific items in the medical history, physical examination or laboratory tests. Because so much effort goes into obtaining informed consent, it is better to include as many of these factors as possible in the initial screening phase (step 2 above) so that subjects do not have to be dropped at this later stage. For example, if your study required that subjects be free of urinary tract infection (as evidenced by a catheter specimen), you would include questions about urinary symptoms in your initial screening to establish a high probability that there is no infection, even though the catheterization might not be done until after consent was signed.

**ETHICAL AND MORAL CONSIDERATIONS**

*Background and General Principles*

Ethical concerns about experimentation were originally brought to the forefront by reports of abuse to human subjects of biomedical research during the Second World War. During the Nuremberg War Crime Trials, public attention became more clearly focused on the need to define basic moral and ethical principles to govern the conduct of any research involving human beings. Consequently, the 'Nuremberg Code' was drawn up to establish a set of standards by which to judge the physicians and scientists who had been responsible for the abusive experiments carried out on prisoners of war. This code of ethics became the prototype of other important documents such as the Declaration of Helsinki (1964), 'the Belmont Report (1979),' the American Medical Association (AMA) code and the US Public Health Service Code of Federal Regulations (45 CFR 46) for the Protection of Human Subjects (1981, revised in 1983). These codes all embody rules and guidelines that direct researchers in the conduct of biomedical and behavioral research of the highest possible ethical standards.

These documents can be very dry and appear complicated to the novice. To save you from long hours of drearily pouring over these official documents, we will present a short summary of the most important concepts to help you understand why institutions impose such strict requirements before research with human subjects is allowed to be undertaken. The Belmont Report is the most readable reference and outlines three principles most relevant to ethical research: the principles of respect for persons, beneficence and justice. Respect for persons encompasses at least two choices but that specific actions are taken to assure their well-being. The Hippocratic Oath, "do no harm' becomes an obligatory rule within the ethics of research while a second, complementary rule dictates that possible benefits be maximized and possible harms be minimized. Justice is the principle whereby the burdens and benefits of research are equitably distributed. It requires that all persons be treated fairly and that each person be given what is due or owed to him/her. The question of justice can be understood when one considers an unjust practice common during the late 19th and early 20th centuries. In those times, it was generally the poorer class in large hospital wards who bore the burden of serving as research subjects for medical experiments although most of the benefits of improved medical care went to the richer class ensconced in the private rooms. Another terrible injustice took place in the 1930's during the Tuskegee syphilis study. In this study, disadvantaged, rural black men were deprived of effective treatment for their disease so that the untreated course of the disease could be determined. With such an historical backdrop, it is easy to see how justice demands an equitable distribution of the advantages and benefits resulting from research.

Specifically, to assure the ethical soundness of a research project, the investigator must ascertain that 1) a person volunteers to participate only after having been given all necessary information to make a knowledgeable, informed decision. This does not mean overwhelming the subject with information; you must select the most relevant and understandable facts; 2) a subject be allowed to withdraw from the study at any time without loss of benefits to which he is otherwise entitled; 3) the researcher has taken steps to preclude all unnecessary risks to the participants of the project through proper design of the protocol as well as through previous animal studies (if feasible, such as with drug studies); 4) the risks to the subjects are far outweighed by the potential benefits that could be of importance to the subject himself, to future patients or to science as a whole; and 5) the study will be conducted only by scientifically competent individuals highly skilled in the medical area in which they are undertaking the research.

If you examine your project carefully in view of these concepts, it will be easier to properly complete the application forms for your Institutional Review Board (IRB). Moreover, while you have a certain legal obligation to inform your subjects about your study, the concomitant benefit is that well informed enthusiastic subjects are also more cooperative and make your study easier.
Federal law requires IRB approval of any research project involving human subjects before its initiation, and provides for severe penalties to your institution if this is not done. Although the reporting requirements to your institution's IRB may seem onerous, the federal guidelines are rather explicit about what is required. In the case of studies involving new drugs and/or medical devices, additional approval may be required by the FDA. The saving grace is that, because of the specificity of the federal guidelines, most IRB review is the same from institution to institution. Therefore, once you learn the process and develop a standard consent and report form, you can use this for subsequent projects with minor modifications. Your responsibilities as researcher include the following: to provide the IRB with a copy of your entire research proposal, including the consent form; to provide the IRB with sufficient background information to assure a clear, complete understanding of the project including pertinent review of the literature, goals, purpose, procedures and potential adverse effects and/or hazards; to provide the IRB with periodic updates concerning the latest information in the literature, subjects already entered into the study, preliminary results and findings, any adverse/unexpected events, as well as any changes in the protocol; and to assure the availability of appropriate IRB members to serve as contact persons for any study subject requesting to speak with such an individual. If these numerous requirements appear bothersome, consider that they do force you to think your project through in detail, with all its ramifications, enabling you to present it clearly to the IRB. In this process, you may, albeit 'by force,' detect some potential problems and remedy them before the actual onset of your study.

Informed Consent

Informed consent must be obtained from study subjects before performing any research-related activity. Although this may sound quick and simple, it is actually a procedure that requires patience, tact and sound judgement. When the potential subjects are patients, sometimes severely ill and disabled, they are particularly vulnerable in the face of any medical interventions being suggested and must therefore be approached with understanding and sensitivity.

The consent form itself should be easily understandable. You need to concisely express the key elements of your project in language understandable to a lay person. The same language will be helpful in writing the abstract of any grant proposal you may submit. Care should be taken to keep the language of the consent form at a 9th to 10th grade level and to avoid using unnecessary technical terminology (translate your medical jargon!). If you anticipate that your target population will require a more simplified version, you must provide this for them. It may prove helpful to "test" your consent form on individuals at a similar reading/comprehension level as your anticipated subjects. One computer software package that will estimate the reading comprehension necessary for your consent form is Grammatik III (Reference Software, Inc., San Francisco, CA). A written consent form is no substitute for verbal explanation. Both must be provided, as well as adequate opportunity for the individual and/or family members to ask questions. Remember that you are required to obtain INFORMED consent!

If you wish to include subjects who are not English speaking, you must have your consent form translated into the appropriate language and provide someone who speaks that language to discuss it with your potential subject. Consent forms must be kept in a safe, designated place, known to the IRB. Although there are no specific rules about how long you must keep them, hold them at a minimum until your results appear in print in case any questions arise.

Other decisions to be made regarding obtaining informed consent are who will be involved in approaching the patient to obtain consent (resident, attending physician, investigator, research staff), in what sequence these individuals will approach the subject, others to whom patient may have access (other staff, IRB members), whether or not to provide a copy of the protocol to the patient and any other written material to provide to the patient (a copy of the signed informed consent form must be given to each subject).

STAFFING

Some studies require the interaction and cooperation of multiple departments and staff members to assure their success. Providing colleagues with copies of your proposed protocol and obtaining their feedback will therefore prove valuable, if not crucial. There are several important items that should be examined and addressed.

Task List

Although you have, by now, laid out each step of your project, it is only by enumerating in detail each and every task involved in each step that you can be certain that you have covered everything. These tasks should be listed according to the sequence in which they are to be performed. With this schematic overview, you can, on paper, assign each task to the appropriate staff member. In this way you can determine what type of staff and how many individuals you need to fill each role. A specific job description, including an individualized task list can be designed for each
member of your research team, as well as a clear designation of study-related responsibilities for clinical staff who are not part of the research team, for example, nurses, laboratory personnel and attending physicians. Figure 1 shows tasks assigned to 5 of the 12 persons involved in a sample project.

**Identification of Staff Participants**

**Appropriate Staffing**

The importance of selecting appropriate key personnel cannot be underestimated. Some tasks may be legally performed only by certified and/or licensed practitioners. Other functions, although not similarly restricted, require skill and experience. Of equal importance is the tact, sensitivity and understanding necessary in dealing with human subjects, some of whom may be anxious and fearful. In addition, members of a research team must be particularly efficient, conscientious and reliable because most study protocols require the precise timing and sequencing of events. It would therefore be foolish (given a choice) to select staff not interested in research, who are participating only because they have been thus assigned.

Staff members can be selected from those already present in your facility or can be hired from external sources to fit the specific needs of your study. Students, at various levels of training, can prove to be valuable resources. They are usually eager to learn and to gain experience and may even provide some worthwhile input gleaned from their own professional education. In addition, they are available because a portion of their professional training is usually designated as research/elective time.

Figure 1 shows tasks assigned to 5 of the 12 persons involved in a sample project.

**1. Principal Investigator/Co-Principal Investigator:**
   a. Review all diabetic admissions into Kessler Institute for Rehabilitation West facility for potential inclusion into study.
   b. Assign subject to study or control group, per randomization table.
   c. Issue appropriate device and equipment to patient.
   d. Administer psychological testing.
   e. Conduct 1 and 3 month follow-up home visits.
   f. Assist in data collection, entry and analysis.
   g. Prepare first draft of manuscript for publication.

**2. Primary Nurse:**
   a. Make sure all lab slips marked as part of study.
   b. Mark patient charts to identify patients participating in study.
   c. Teach study subjects use of designated insulin device.
   d. Record data in subject data book and return it to specified location.

**3. Coordinator:**
   a. Coordinate data collection and review same.
   b. Assist in data analysis.
   c. Assist in manuscript preparation for publication.
   d. Serve as backup for specified tasks of other study staff.
   e. Administer Jebson Hand Function and Stereognosis tests when not routinely performed by occupational Therapy department.
   f. Assure correct timing of all study phases.

**4. Laboratory:**
   a. Draw blood samples during subjects' inpatient stay as specified in study protocol.
   b. Process blood samples during subjects' inpatient stay and those from follow-up home visits.
   c. Provide copy of blood analysis results to coordinator or principal investigator.

**5. Accounting:**
   a. Maintain updated account of study expenditures.
   b. Provide monthly report of financial status to principal investigator.

Figure 1. Roles of study staff members.
Adequate Staffing

The previous paragraphs addressed quality of staff. This section addresses quantity. Even the most qualified members of your team have only two hands. In the real world of your facility, there are a number of factors you must consider. Some segments of your study may be critically timed, requiring many hands interacting smoothly and simultaneously. An insufficient number of staff members can result in an incomplete and sloppy study.

Back-up Staffing

If your handpicked staff members have concomitant clinical duties, back-ups should be arranged either to free them from their clinical tasks when necessary or to substitute for them in research activities when clinical and research schedules conflict. In addition, you must remember that sickness, vacation and unexpected emergencies are a fact of life. When research study timing is critical, assure adequate back-ups ready to step in immediately. These back-ups should be adequately prepared and familiar with their roles (similar to an understudy ready to step in for the injured prima ballerina).

In situations where routine clinical activities are incorporated within your research protocol (e.g., topical drug applications with wound dressing changes, oral medication dosing with simultaneous monitoring of vital signs), you must consider the scheduling of nurses performing these tasks, especially when timing of the activity is critical to the protocol (e.g., pulse rate and blood pressure 3 min after a daily 7 AM oral medication dose). Change of shifts, coffee/lunch breaks, a clinical emergency with another patient, even a shortage of nonresearch staff are contingencies for which the investigator must be prepared. Early discussion with nursing supervisors can determine the likelihood of having an adequate number of staff members for your research needs and can help in establishing contingency plans.

Now that you have orchestrated the ideal quality and quantity of your research activities, you realize that the total number of man-hours required is far in excess of your budget. You have to decide which of those activities you must pay for and which activities people will be willing to contribute either by doing them in addition to their normal clinical activities or by spending time after working hours. You are excited about your project or you wouldn't have waded through six articles so far. Can you pass some of that enthusiasm on to your colleagues? Finally, try to get active administrative support for your staffing plan. Clearly allocating tasks between research, clinical and outside time will facilitate this process (see sample of administrative approval form (Fig. 2).
Feedback to Staff

Don’t forget to share your research plans and results with the nonresearch staff at your facility. In the short term, your research protocol will be better and easier to carry out. In the long term, your research results will be put to clinical use sooner and more efficiently.

An initial staff presentation before the onset of your pilot study will familiarize staff with your purpose and proposed protocol. They can, at that point, provide feedback to you from their clinical perspective. In addition, short intensive training sessions should be provided to staff members who will be directly involved in your study (e.g., nurses assigned to a subject who will require topical dosing of an experimental drug followed by precise dressing applications). These sessions would focus on the specific tasks of the staff member as well as more detailed information about the study itself because this individual will be closely interacting clinically with the subject.

After your pilot study, you can present initial results, outline a definitive study and again request clinical feedback and input from your facility’s clinical staff. Updates of the project as it progresses can be incorporated in regular clinical staff meetings. Final results can be presented to all interested staff in your facility. Reviewing the experience you gained in this project, including dealing with unforeseen errors, can provide a valuable learning experience for those attending (as well as a valuable teaching and learning experience for you!). When your findings result in a change or addition to a clinical protocol, additional training sessions will be needed to assure optimal implementation of these changes.

ESTABLISHING THE WORK PLAN

Many research projects are complex and expensive, allowing little leeway for error. Scheduling for the various components is therefore of great importance. Before the actual initiation of study activities, many details must be considered.

Time Frames

Establishing a work plan involves the creation of a short- and long-term time frame for your entire project from cradle to grave (yours, if you don't plan well). You start with a projected plan and end with an account of the actual time spent on each phase of your project. As you become more experienced (and/or lucky), the "actual" times become closer to "projected” times. A Gantt chart clearly shows time allotment for each project phase. This diagram is one in which project activities are listed vertically along the left-hand side with the times for completion of each activity illustrated as horizontal bars extending toward the right. The timeline (in days, weeks, months or years) is positioned at the top of the chart. The Gantt chart (originally designed for use in shipbuilding) becomes more valuable the larger the project you are building. Further information on Gantt charts can be found in Time Management for Health Professionals by Applebaum and Rohrs.

At regular intervals in your study, compare your projected schedule with your actual schedule. If you find differences early on, you will have adequate opportunity to identify and rectify the problem(s). The novice researcher must build in small cushions of time to allow for unexpected delays; the experienced researcher learns to expect the unexpected. Establishing contingency plans whenever possible can minimize unanticipated departure from projected schedules. Become a temporary worrier and pessimist-use your imagination to predict any potential hitch that might occur (regarding staff, equipment, subjects, funding, labs, administrative decisions, inclement weather, biorhythms, nuclear disasters, etc.) and develop back-ups and alternate routes to achieve your goals. Use your pilot study as a testing ground for your ultimate work plan.

Integration into Clinical Routine

When a research project is performed within a clinical facility, study activities must be timed within normal, clinical routine to minimize disruption of the subjects’ medical care. For example, if the study protocol includes examination and debridement of a pressure sore, this should be timed to coincide with the subjects’ usual schedule of dressing changes and/or showers. If this is not possible, the principal investigator should arrange with the clinical staff to modify the schedule of dressing changes and/or showers, so the patient will not be subjected to unnecessary repetitive procedures. In addition, your care and consideration regarding the disruption of interdepartmental routine will be most appreciated by all facility members as well as your subjects. This includes scheduled time for therapies, meals, bedtime and wake-up. Cold meals make for lukewarm subjects! In an outpatient setting, a case of soft drinks in your lab can be very conducive to good will and cooperation.
Planning around Holidays and Weekends

When scheduling critical events in your protocol, consider any holidays that would interfere with your carefully planned sequence of events and modify accordingly. Although you may be a workaholic or so enthused over the progress of your project that holidays, weekends and nights cease to exist, you must realize that the rest of the world does still observe these occurrences. This includes your staff as well as staff of other departments, facilities or organizations whose participation you require (e.g., outside laboratories). In addition, believe it or not, your subject may wish to spend a holiday with someone other than you. If you insist on forging ahead and you have convinced your subject to do likewise, make sure that you 1) bribe your staff to come in or arrange for staff substitutes and 2) determine which of the other services that you require will be available (for example, laboratories). In the case of perishable organic specimens, schedule pickup and delivery carefully so your package will not be left in an unattended laboratory or holding area, over a holiday or weekend.

When your studies involve laboratory analysis of specimens, allow for adequate transportation, processing and reporting intervals. Delays do occur at any of these stages and must be planned for in any phase of your study that depends on earlier laboratory results. Otherwise, losing days awaiting laboratory results may throw off your entire schedule thereafter.

PILOT TESTING AND EQUIPMENT SETUP

Obtaining Crucial Information from the Pilot Test

Pilot testing is the dress rehearsal for the opening of your definitive research study. As in a dress rehearsal, the pilot study includes every procedure exactly as you are going to do it in the study. It therefore gives you the opportunity to answer the following questions: Can the experiment, as currently designed, proceed smoothly and safely? If not, what are the difficulties and how can they be remedied? Is the data easily obtainable? Does it yield the desired information? Does initial data appear to confirm or refute your hypothesis? If it appears to contradict your expected results, what are the possible reasons? Is your hypothesis incorrect or is your technique faulty? In beginning to pose and (if you are lucky) answer some of these questions, a pilot study can save you much time, money, frustration and embarrassment. Your first few subjects might as well be pilot subjects (not in your projected sample) because you will probably make a few mistake and have to discard the data anyway. As a rule of thumb, try to find a group of pilot subjects equal to 10% of your total sample size.

When feasible, members of the research team should themselves go through the activities of the study to assure that what is being requested of the subjects is, indeed, realistic. An example of this is an exercise study in which a subject is required to undergo strenuous physical activity while attached to various pieces of equipment. The only way for a researcher to become fully aware of what the subject is being asked to do is to experience it personally. It is in this way that difficulties can be identified early and the necessary changes made.

Equipment and Supplies

Even new equipment from a reputable manufacturer cannot be assumed to be accurate and dependable until so proven. The time to discover the actual imperfections is not during a carefully timed research run. All equipment should be adequately calibrated and tested well in advance of your experiments, allowing ample time for any necessary repair or modifications. Even if individual pieces of equipment function correctly, they may not interact harmoniously and with correct timing. Similarly, adequacy of supplies should be checked well in advance to avoid unpleasant surprises at strategic points, even for items as routine as computer paper and printer ribbons or cartridges.

RECORDING DATA AND OTHER INFORMATION

Labels and Forms

Few experiments proceed smoothly the first time. There is no shame in that; however, there is serious research shame in repeating your errors. The prudent researcher learns from mistakes; the best way of identifying, examining and remembering those mistakes is to record all activities and events as they occur (or as soon as possible thereafter). A specially designated bound notebook should be used for this purpose, which serves also for recording data. In this way, any questionable or suspicious data can be correlated with concomitant events that may have been associated with them.
Color-coded labels (of a designer color to reflect the spirit of your project) affixed to input data notebooks, patient charts, charge slips related to your study, specimen containers, etc. will alert all facility staff that your subjects and/or items related to them are involved in a research project, thus minimizing error. A list of subjects’ names and addresses should be kept on file in the event of having to contact them for any reason, either while in the study, during follow-up or after completion of the study. If you also have an address and phone number for a relative of your subject, you can find your subjects much more easily if they should move or are rarely at home. Duplicate the signed consent form and keep it in two separate locations, either in the respective subject data notebook or in a separate file. IRB forms must also be kept in a safe place, rapidly accessible when necessary.

Communication of Research-related Information to Appropriate Individuals

When patients become study subjects, it is not merely a courtesy to inform their primary physicians of their participation and the nature of the study. If the study intervention and/or outcome may, in any way, affect their medical status, it is of prime importance to transmit this information to the physicians who continue to diagnose and treat them (or who will resume diagnosis and treatment on the patients’ discharge from the rehabilitation facility). Patients doing well with a research technique while in the rehabilitation facility may, on discharge, be transferred back onto standard treatment techniques (less beneficial to those patients) by their primary physicians and/or homecare visiting nurses, who are unfamiliar with the study. These situations may be avoided by a phone call and/or letter to the respective medical professionals, describing the purpose and protocol of the research project, including the anticipated benefits to the patient from use of the experimental technique.

Documentation of Patient Participation in the Medical Chart

When your study subjects are patients (inpatients or outpatients), you must document their inclusion in a research study in their patient records. In addition, you should record any research-related events or information that is pertinent to the subjects’ medical status.

CHANGING HORSES MIDSTREAM OR PROBLEMS THAT ARISE AFTER YOU START

It is almost impossible to do everything right the first time, in any project. What generally happens is that you are well immersed in your project, have managed to recruit a few subjects, then encounter several pitfalls and difficulties. You now see clearly how these problems could have been prevented. Is it too late to change your protocol? Necessary changes generally lie in three categories, each of which must be dealt with differently.

Dropping a Test

You have discovered that one test you want to do just does not work. Either the equipment fails to work, subjects cannot understand the instructions, it just takes so long to carry out that it becomes impractical or you find that every subject answers in exactly the same way. You therefore decide to drop it entirely from your protocol. If you can be reasonably certain that administration of this test did not have any effect on the other tests you use, you can eliminate the problematic one from your protocol, delete that test data from your existing subject data and continue on your merry way. If you decide that you must replace this test with another new one, the situation becomes the same as that of adding a new test.

Adding a New Test

You discover a new test of which you were unaware when you designed your study and want to include it or you want to replace an existing one with a new one. If you are still engaged in your pilot study, this is no problem as you never intended to combine your pilot data with your real study. If, however, you add a new test without pre-testing it, you run the same risk of having to drop or change it later. You can also throw out the data on all your subjects collected to date and start over. Finally, you can act as if you have two separate studies—one with your original tests and one pilot study in which you are collecting information with this new test. Investigators commonly add extra questions to questionnaires or even entire tests, thereby using one study as a pilot for the next one. But what you cannot do is combine the data from subjects studied before the new questions with
those studied afterward and then try to analyze that particular test. This is because your subjects before and after will be different and you won't know whether these differences will affect your results. When you see reports of a study on 30 patients that describes 27 patients for one test, 25 for another, and 30 for a third, beware of their conclusions! Do they tell you why there are unequal numbers? Do they use fancy statistical techniques to deal with missing data? It is much simpler to make all testing changes during your pilot study rather than during your final study.

Changing a Test

You decide that you need to make a small change in one of your tests. For example, you have had a lot of trouble with a piece of equipment and want to install a new oxygen sensor or want to buy a newer model. If you are certain that the new data is the same as the old data (by running calibration checks, for instance), go ahead. If your checking shows that your new equipment always gives results 10% higher than the old, then you can multiply your old data by 1.1 to be comparable with the new and continue. Even if your old equipment was off by 1% one week, 2% the next, then 3% etc., you can adjust your data accordingly. The burden of proof is, however, on you to establish that your new data is indeed equivalent to the old data and that requires a study to prove it. What some investigators do is collect both the new and the old data for the remainder of the experiment, so as to firmly establish their equivalence. For example, after pilot testing on five subjects and final testing on two more, it was felt necessary to add a measure of usual walking speed in addition to maximal running speed. Subsequent testing showed a close mathematical relation between the two, so that usual speed could be predicted for the first two subjects even though it was not actually measured.

HOW TO KNOW WHEN TO CUT YOUR LOSSES AND QUIT

You have prepared carefully for your project after reading the previous five articles on this subject and have finally embarked on your study with every possibility of success or so you thought. Despite your efforts, 1) you have not been able to recruit more than one subject, 2) your data was consistently contradictory, 3) every subject you entered developed unexpected complications, 4) none of your original subjects followed through with your protocol after discharge from your facility or 5) some other disastrous events occurred. You have, by now, frequently flirted with the idea of terminating the study. Yet, your pride or stubbornness or conscientiousness or embarrassment would not allow you to do so. You have lost time, money and equanimity. What should you do? First, you must identify all the recognized and possible problems. For example:

1. Failure to recruit subjects inclusion or exclusion criteria too rigid protocol unacceptable to subjects poor timing of approach
2. Contradictory data equipment malfunction false readings or recordings inaccurate reports by subject or staff underlying medical process
3. Complications study entity not totally safe high risk patient population
4. Poor follow-through home situation not conducive to compliance home physician/visiting nurse discouraged continuation required more structured environment of rehabilitation facility

The next question you must ask yourself is given what you have seen so far, is it likely that the present situation will change. If the answer to this is yes, it is probably worthwhile hanging in a bit longer. Examples of improved situations include the arrival of new staff, getting more reporting, subsequent patient admissions, providing a lower risk subject pool, and/or the latest group of subjects returning to a better home situation.

If the answer to the question is no, which of the problems can you change by direct intervention or modification of your protocol? If you still come up with a blank, try contacting other researchers and/or clinicians who may be (or have been) doing similar studies and/or who work with similar patient populations and may have some gems of wisdom derived from their own experience that they are generous and benevolent enough to share. In addition, go back to the literature once again (remember that exhaustive review, as per article 2). Go over any similar studies with your fine-toothed comb of desperation. You may have missed a minute, but all-important item the first time around.

If all of the above proves fruitless, you can legitimately and guiltlessly terminate your study. You have already completed your premortem examination. If there is potential for further yield, conduct a post-mortem as well. But when that is completed do not grieve. For, in truth, you have not failed in your project if what you have learned from the experience will be utilized in the future and if you can honestly say you have done your best.

Although journals rarely report negative results, a letter to the editor can alert other researchers to potential problems. If you send a letter right after a related study is published, it is more likely to be printed. You might write "Dr. Smith is to be commended on her excellent study, particularly in view of the difficulties we had with . . ."
The commercial market abounds with computer software for project management. There are at least 100 different packages available, ranging in price from $99.00-$10,000. The advantage of using project management software is that it forces you to actually sit down and take the time to consider details that you otherwise might tend to put aside. Two of the programs that we have found to be excellent tools are: InstaPlan Version 2.0, a product of InstaPlan Corporation of Mill Valley, California (for long-term projects) and WHO-WHAT-WHEN by Chronos Software, San Francisco, California (for overseeing short-term projects).

InstaPlan ($99.00 base price, $269.00 complete) allows you to input individual project tasks with multilevel breakdowns of these tasks, the resources available to do these tasks (that is, personnel) along with their salaries/fees, work calendars and time allotments (planned and actual). The program then integrates all of this information to display the start and completion dates for all phases of the project, in proper sequence and overlap, as well as clear budgeting for the project. You can then juggle tasks, time frames and resources until you find the most efficient and economical way in which to conduct your project. In addition, this software allows you to see, at any given time, where you stand in the course of your project, regarding anticipated v actual time frame. This information can be displayed in outline form, spreadsheet, time bar charts (Gantt charts), interconnected task boxes (Program Evaluation and Review Technique-PERT charts), as well as specialized government reporting forms.

WHO-WHAT-WHEN ($169.00) is extremely adaptable to the needs of the medical professional as well as to the management of small to medium sized research projects. It consists largely of a daily calendar that is cross referenced into three practical management views: WHO: the people view that displays the people you work with, their projects and schedules; WHAT: the project view that displays your project tasks, the people involved, milestones and deadlines; WHEN: the time view that displays your daily or monthly calendar and that of every person working on the project. When you view a daily or monthly calendar, you gain access to all the activities scheduled with information on where and when each task is scheduled to be done, who will be working on it and to which larger project it belongs. An added feature at the top of the screen is a timeline highlighting those parts of the time period that are already filled with tasks.

The larger and more complex your project, the more potentially valuable is this time management software (it is described in the commercial literature as being used for building skyscrapers!). However, for a research project on a relatively modest scale, you can construct your own Gantt charts if you like, or any other individually designed charts, tables, forms or drawings that best meet your needs.

**BUDGETING**

Budgeting for any research project requires the skill of juggling as well as a little financial pessimism, i.e., "whatever you think it will cost-it will cost more." Especially as a novice in the preparation of budgets, you will need to overestimate or look at another researcher's budget for a comparable project to gain a realistic understanding of true costs. Always allow for totally unanticipated expenses (e.g., staff overtime when an experiment did not run smoothly and you were able to convince all eight members of your team to put in an extra weekend). Explore all possibilities of donated equipment and/ or supplies. If you can convince an equipment manufacturer or pharmaceutical company of what they stand to gain (via free advertising) by donating their product for your research project, you may be able to eliminate a sizable portion of your original budget. Be realistic about percent of staff time. You may have to record the exact number of hours spent by each staff member during your pilot study to make an accurate estimate of staff time.

**OTHER CONSIDERATIONS**

*Special Considerations for Multifacility Studies*

When more than one facility is involved in your study, specify and delineate publication plans, rights, responsibilities, liability and credits of each facility. This must also be done when you are performing a project sponsored by industry (e.g., a drug study for a pharmaceutical company). The principal investigator should be responsible for establishing authorship of the research article to be published.

Guidelines for authorship are included in the Uniform Requirements for Biomedical Publications."

*Subject Follow-up after the Study*

Don't forget to write thank you letters to your subjects and to their referring physicians after your study. While you may have gotten the data you need for your study, lack of follow-up can make these subjects reluctant to enter future studies (which just might be your own).

**EXERCISES**
1. Determine the desired sample size for your study (see article III').
2. Estimate ineligibility of subjects because of exclusion criteria, refusal to participate and drop out rates.
3. Calculate the total number of potential subjects you need to screen.
4. Obtain a list of potential subjects for your study. A good choice would be all patients admitted at the same time as that of your proposed project, but during the previous calendar year. Although they would not be eligible for a prospective study, the numbers provide a good estimate of the number you will find.
5. From basic diagnostic and demographic information, select persons who meet your inclusion criteria. Calculate the exclusion rate and compare with your estimate.
6. Select a small group of subjects to approach for informed consent. Revise your estimate of consent rate based on this. If necessary, contact subjects who are now ineligible for your study (because it has been too long since onset of disability) and ask hypothetically, "Would you have agreed to participate if I had asked you this earlier?"
7. Based on the length of time required to collect consent forms, how long will it take you to complete your subject recruitment?
8. Revise your estimate of the total number of potential subjects required. Compare this number with the number on the list obtained in Step 4.
9. Design some way of screening potential subjects so that you are notified of possible candidates. The effort you put into screening depends on how many subjects you can afford to lose.
10. For your study, demonstrate how you would ensure adherence to the five ethical principles described under "Background and General Principles."
11. Obtain a copy of a sample consent form from your IRB and modify it for your study.
12. Prepare a task list for your study including all the items that must be performed from the preparatory phases of the study through its completion, in correct order (see "Task List").
13. From this task list, choose optimal staffing, including backups. Assign each task to the appropriate staff member (see "Appropriate Staffing").
14. Establish a work plan with short- and longer term time frame, including actual dates (see "Time Frames").
15. Design an informatory letter for subjects' primary physician and other health professionals based on your consent form.
16. Choose three published reports of research studies and determine the interval between data collection and final acceptance of the article. Consider possible reasons for any delay and how you would prevent them. Do you think you can do your study in less time?
17. From your task list and staffing, estimate man-hours for your project. Multiply by an hourly rate ($25.00/hour for salary and fringe benefit for a person earning $40,000/year) for your personnel budget, which is usually the largest budget item.

REFERENCES

4. World Medical Association Declaration of Helsinki: Recommendations Guiding Medical Doctors in Biomedical Research Involving Human Subjects. Adopted by the 18th World Medical Assembly, Helsinki, Finland, 1964, and as revised by the 29th World Medical Assembly, Tokyo, Japan, 1975.

SOFTWARE SUPPLIERS

2. InstaPlan: InstaPlan Corporation, 655 Redwood Highway, Suite 311, Mill Valley, CA 94941; (800)852-7526.