

## Use of Time Studies for Determining Intervention Costs

Mary J. Findorff ▼ Jean F. Wyman  
Catherine F. Croghan ▼ John A. Nyman

- ▶ **Background:** Cost-effectiveness analyses are increasingly recommended to evaluate the effectiveness of health interventions. Determining the costs associated with delivery of a particular intervention is essential in conducting a cost-effectiveness analysis. Yet, there are few guidelines available to assist investigators in how to assess intervention costs associated with the personnel portion of an intervention.
- ▶ **Objectives:** To describe the use of time studies in calculating the program costs of personnel for use in future cost-effectiveness analysis of health interventions.
- ▶ **Methods:** The literature on calculating intervention costs for use in cost-effectiveness analyses is reviewed. The process for conducting a time study for determining personnel costs in delivering an intervention and a step-by-step example from a time study are used to illustrate how personnel costs associated with delivery of the intervention can be separated from those costs associated with implementation of research procedures in the determination of research costs.
- ▶ **Conclusions:** Time studies provide a good estimate of part of the cost of implementing an intervention that is often difficult to determine—personnel time. The design of the time study should consider intervention components, staff involvement, and the time period for data collection.
- ▶ **Key Words:** cost analysis · intervention · time studies

Assessing the cost associated with healthcare interventions is an increasingly important component of any analysis of intervention effectiveness (Smedley & Syme, 2000). Nursing research, in particular, must consider the costs associated with interventions if any effective cost-benefit or cost-effectiveness analyses are to be done (Polit & Beck, 2004). Ascertaining the cost of interventions can be difficult because cost information is often embedded deep within research procedures, and because it is often necessary to separate the cost of the intervention from the cost of conducting the research. This article discusses the use of time studies in determining the personnel cost portion of an intervention and provides an example from a fall prevention trial of how a time study can be used to estimate a portion of the intervention cost for use in a future cost-effectiveness analysis (CEA).

A panel of experts in CEA was convened by the Public Health Service in 1993 to standardize the conduct of CEAs (Gold, Siegel, Russell, & Weinstein, 1996). This panel, the Panel on Cost-Effectiveness in Health and Medicine, made a series of recommendations on how to appropriately include the various costs of an intervention in a CEA, including how to handle fixed costs, time costs, and costs that occur in the future. In a subsequent review of the nursing

literature, it was reported that adherence to many of the panel's recommendations is poor (Allred, Arford, Mauldin, & Goodwin, 1998).

The importance of conducting cost analyses for nursing interventions has been emphasized previously (Chang & Henry, 1999). Specific descriptions of how to perform the various types of cost analyses (e.g., cost-benefit analysis vs. CEA) also have been described elsewhere (Chang & Henry, 1999; Drummond & McGuire, 2001; Russell, Gold, Siegel, Daniels, & Weinstein, 1996; Weinstein, Siegel, Gold, Kamlet, & Russell, 1996). Potential costs that might be considered in determining intervention costs include the costs of (a) development of the intervention, (b) staff training, (c) personnel time associated with delivering the intervention, (d) teaching materials, (e) other supplies and equipment, (f) travel time if implemented in the clients' homes, (g) associated mileage, and (h) overhead. Specific examples of how to conduct cost analyses are missing from most nursing research textbooks, and few guidelines are

*Mary J. Findorff, PhD, RN, is Research Associate; Jean F. Wyman, PhD, APRN-BC, FAAN, is Professor and Cora Meidl Siehl Chair in Nursing Research, Director; and Catherine F. Croghan, MS, MPH, RN, is Research Nurse, Center for Gerontological Nursing, School of Nursing; John A. Nyman, PhD, is Professor, Division of Health Services Research and Policy, School of Public Health, University of Minnesota, Minneapolis.*

available from the health economics literature.

Determining program costs for personnel time can be complicated. Time spent on program implementation should be separated from time spent on tasks (e.g., the completion of a research instrument that would not be administered in a clinical setting or the obtaining of informed consent to participate in research) solely for research purposes. Examples of methods used to determine workers' time include work sampling and time-motion studies. Work sampling involves using a sample of workers' time and extrapolating the results to the total time spent in various activities. Time-motion studies (or time studies) involve direct determination of the time spent in those activities, through either direct observation or the workers' self-report. While these methods have been used previously to determine productivity or to address staffing patterns, this article addresses the use of these methods for determining the cost of an intervention.

An example of work sampling that separates out research costs for a nursing intervention was described by Oddone, Weinberger, Hurder, Henderson, and Simel (1995). This intervention involved inpatient and outpatient counseling of patients who had been diagnosed with diabetes mellitus, congestive heart failure, or chronic obstructive pulmonary disease. The primary aim of this intervention was to reduce hospital readmissions. Patients were randomized to either the treatment group, which received intensive follow-up by nurses, or the usual care control group. In this study, the time spent in care activities was estimated by providing nurses with randomized beepers. When the beeper sounded, nurses would record their activity. The percentage of counts they recorded in each activity was extrapolated to estimate the percentage of total time spent in that activity. One advantage of this type of study is that the research costs can be removed easily from the intervention cost estimates. Research costs were substantial in this study, accounting for 42.5% of the total time spent working. However, no validation was conducted to determine whether nurses accurately reported the activity they said they

were engaged in, or whether the proportion of times they recorded an activity was an accurate estimate of the proportion of total time spent in those activities.

The recommendations of the panel on cost-effectiveness are to include costs of a health worker's time in the numerator of a CEA, and to evaluate this time by the wage rate in the labor force (Weinstein et al., 1996). A time study is the most direct way to calculate the amount of time that is devoted to an intervention and also to be able to separate the cost of research.

### Time Study Exemplar

The following is an example of a time study done for a fall prevention intervention. The Fall Evaluation and Prevention Program (FEPP), funded by a grant from the National Institute of Nursing Research and the Office of Research on Women's Health, National Institutes of Health (R01 NR05107), was designed to test a nurse-led, home-based program for the prevention of falls in community dwelling, high-risk older women. Participants were randomized to two groups: (a) an intervention group receiving the fall prevention program, consisting of exercise, education, and tailored risk reduction counseling; and (b) a control group receiving general health education. Both groups received a 12-week intervention involving biweekly home visits alternating with biweekly telephone calls, followed by a 16-week tapered computerized telephone intervention.

Other studies addressing the cost-effectiveness of implementing fall prevention programs have been conducted (Robertson, Devlin, Gardner, & Campbell, 2001; Robertson, Devlin, Scuffham, et al., 2001; Robertson, Gardner, Devlin, McGee, & Campbell, 2001; Rizzo, Baker, McAvay, & Tinetti, 1996), and while these have separated research costs, they have not included details of how this was done. In addition, while these studies included costs such as personnel time, supplies, and overhead, some have also included airfare and overnight accommodations for personnel. While these costs may be appropriate to include in a CEA, they potentially

inflate program cost estimates for others who are considering implementing the intervention. The following example provides a more detailed description of how research-related expenses can be determined and separated from the program costs.

For the FEPP study, five categories of intervention costs were analyzed for their potential applicability to the time study. These included *Development and training costs* such as expenses associated with the development of the intervention protocols, including production of educational materials and the algorithm for the computerized telephone system, preparing the operational manual, and training research staff in the assessment and intervention procedures. *Enrollment costs* included staff time required to screen potential participants following initial contact to identify those who met eligibility criteria and were willing to participate. *Overhead costs* included estimates of office space rental, utilities, and supplies associated with the program. *Equipment costs* included health assessment equipment, participant educational materials, exercise equipment, and other items necessary to complete the assessment and intervention protocol. *Staff-related expenses* included the mean nurse contact time; mean time required to complete documentation of visits; mean time spent in round-trip travel to participants' homes; mean mileage costs associated with all assessment and intervention visits; mean time needed for consultation among the nurse, research physician, and participant's physician; and mean time required for telephone calls to participants. These costs were based on documentation collected over a 2-week period during the middle part of the study. The time study focused primarily on the enrollment costs and the staff-related expenses.

### Time Study Procedures

In a time study, the first step is identifying the general categories of costs. The three major steps in identifying costs are to (a) identify the relevant cost items, (b) measure the amount of resources used, and (c) place a value on those resources (Brouwer, Rutten, & Koopmanschap, 2001). It is important

at this step to get input from all the individuals involved in the intervention, particularly those directly delivering the intervention. Examples of time assessed from the FEPP study included travel time and mileage to and from participants' homes, enrollment time, length of assessment visits and intervention visits, and other miscellaneous administrative time, such as consultations with participants' physicians, photocopying materials, voice mail management, electronic

mail management, staff meetings to discuss issues that arise, and "downtime in the field" as nurses waited between scheduled home visits. The largest allocations of administrative time in the FEPP study were the consultations with participants' physicians to determine whether the person could participate in the exercise program, voice mail management, meetings, and downtime in the field.

The next step in a time study is to create a general outline for the

time chart or data-collection form (Figure 1). It is necessary to include all the times a person is likely to work, especially if employees may be working from home or work after hours. Generally, it is effective to allocate one sheet of paper to a single day and to break down the time periods into 15-min increments. All possible activity codes should be included and coded. If research procedures are embedded within the intervention, this activity should be separated from those activity

Name \_\_\_\_\_

Date \_\_\_\_\_

**Mileage**

Mileage for Assessment \_\_\_\_\_  
 Mileage for Fall Prevent. \_\_\_\_\_  
 Mileage for Health Ed. \_\_\_\_\_

**Enrollment costs**

01 Telephone Screening  
 02 Enrollment Administration  
 03 MD Letters

**Staff-related expenses**

10 Assessment Prep. Time  
 11 Assessment Visit 1  
 12 Assessment Visit 2  
 13 Assessment Travel  
 14 Assessment Documentation  
 15 Misc. Tel. Calls – Assess.  
  
 20 Fall Prevent. Prep. Time  
 21 Fall Prevent. Home Visit  
 22 Fall Prevent. Tel. Visit  
 23 Fall Prevent. Travel  
 24 Fall Prevent. Documentation  
 25 Misc. Tel. Calls – Fall Prevent.  
 26 Follow-up Tel. Calls Fall Prevent.  
  
 30 Health Ed. Prep. Time  
 31 Health Ed. Home Visit  
 32 Health Ed. Tel. Visit  
 33 Health Ed. Travel  
 34 Health Ed. Documentation  
 35 Misc. Tel. Calls – Health Ed.  
 36 Follow-up Tel. Calls Health Ed.

**Miscellaneous administration**

40 Consultation time  
*(between/among nurses, research MD, participant's MD)*  
 41 Computerized telephone system setup  
 42 Copying  
 43 Meeting maker  
 44 Voice Mail Management  
 45 Meetings  
 46 Downtime in the field

Time	R	Activity code	Comments
0700–0715			
0715–0730			
0730–0745			
0745–0800			
0800–0815			
0815–0830			
0830–0845			
0845–0900			
0900–0915			
0915–0930			
0930–0945			
0945–1000			
1000–1015			
1015–1030			
1030–1045			
1045–1100			
1100–1115			
1115–1130			
1130–1145			
1145–1200			
1200–1215			
1215–1230			
1230–1245			
1245–1300			
1300–1315			
1315–1330			
1330–1345			
1345–1400			
1400–1415			
1415–1430			
1430–1445			
1445–1500			
1500–1515			
1515–1530			
1530–1545			
1545–1600			
1600–1615			
1615–1630			
1630–1645			
1645–1700			
1700–1715			
1715–1730			
1730–1745			
1745–1800			
1800–1815			
1815–1830			
1830–1845			
1845–1900			

**FIGURE 1.** Example of the documentation form used for FEPP time study. *R* indicates time spent on research-related activities. Copyright 2002 by the Center for Gerontological Nursing, University of Minnesota, Minneapolis.

codes that are specific only to the intervention. For example, in the FEPP study, the research nurses administered several instruments measuring exercise constructs at the first and last home visit in the experimental group only. These were used only as a test of the theoretical model guiding the study and were not part of the intervention itself. Another major component was derived from the intention to compare the number of falls in the intervention group against the number of falls in the control group. This control group consisted of women who received information on general health education only. While this health education group was necessary for the research portion of the study, it would not be utilized if the intervention were to be applied more broadly. These data were collected for the time study and for future research planning purposes, but they were excluded from analyses that assess the cost of the fall prevention intervention because they were purely research-related. It is necessary also to include a space on the form for general comments about each time category so that miscellaneous information can be added by personnel as needed. For example, in the FEPP study, one nurse spent an unexpected amount of time commuting to a participant's home, but was able to explain that there had been a major traffic accident on the freeway at that time.

Once a data-collection instrument for a time study has been developed and approved by all of those working on the project, a pilot test of the instrument is necessary. This allows those who will actually be using the instrument to assess whether it applies to their experiences or if new codes and categories need to be added. It is also recommended that the pilot test be conducted using more than one individual as variability may exist in how the intervention is implemented and how codes are interpreted. Pilot testing on all types of visits or intervention components, so that all categories are utilized, will help determine if these categories need to be revised. Once the pilot study is complete, then the data-collection instrument should be revised accordingly. The more descriptive the categories are, the better will be the capture of data. Writing operational definitions of the cate-

gories or short descriptions of the type of activities covered in a particular category is essential. General categories like "other" or "miscellaneous" may be necessary, but if a large amount of time is put into these "other" categories, the data will not be as useful.

Once the instrument is revised, the time study can be implemented. It is important to select a time frame that is representative of the overall study from which to estimate costs. In the FEPP study, the intervention involved a series of home visits and telephone calls. These visits consisted of enrollment visits (to assess the person's eligibility and fall risk status) and intervention visits (where the intervention was administered). In addition, each intervention visit presented different material, so the length of the visits may have varied. If different types of visits are included in an intervention, it is important to choose a time period for the time study that will allow the assessment of the cost of each phase. In addition, some points in time may not adequately represent the cost of the intervention. The significance of learning curves on cost estimates is emphasized by Brouwer et al. (2001). Choosing a time period that is too early in the intervention may overestimate the time necessary if nurses are still learning the study protocol. Likewise, choosing a time period that is too late may result in missing key components of an intervention if one type of visit on all participants is complete. If individuals need to be assessed prior to the intervention, then choosing a time period, after all assessments have been completed, will limit the generalizability of the cost estimate to include this type of visit. In the FEPP study, a time period of 2 weeks that was midway through the intervention period was selected.

Once the data are collected, they can be entered into a spreadsheet for analysis. The totals for each code or type of activity can be summed and averaged, for an average amount of time per activity. As stated above, if research activities are present, these should be separated from the non-research activities. Once the time estimates are complete, then dollar amounts in wages can be applied for each time period to arrive at a cost estimate. This allows for differences in the job classification of the person com-

pleting each task and geographic variations in salary. Assumptions regarding the time study should be clearly stated; for example, the volume of visits would be constant across participants or the amount of downtime would be constant. For a study involving home visits, a consistent mileage cost should be used, such as that allowed by the federal government for tax purposes.

Time studies provide a good estimate of the *personnel* cost of implementing an intervention for use in cost-effectiveness analyses. The design of the time study should consider the intervention components, related activities, staff involvement, and the time period for data collection. Information obtained can be used also to redesign interventions for future testing. ▼

---

*Accepted for publication March 1, 2005.*

*Funded by the National Institute of Nursing Research and the Office of Research on Women's Health, National Institutes of Health (R01 NR05107).*

*The authors thank Lois Gildea, Melinda Monigold, Carrie Gomez, Kris Talley, and Jennifer Peters for their contributions to the time study and Sean Lamb-Vosen for data entry.*

*Corresponding author: Mary J. Findorff, PhD, RN, School of Nursing, University of Minnesota, 5-160 WDH, 308 Harvard St SE, Minneapolis, MN 55455 (e-mail: find0003@umn.edu).*

## References

- Allred, C. A., Arford, P. H., Mauldin, P. D., & Goodwin, L. K. (1998). Cost-effectiveness analysis in the nursing literature, 1992-1996. *Image: Journal of Nursing Scholarship*, 30(3), 235-242.
- Brouwer, W., Rutten, F., & Koopmanschap, M. (2001). Costing in economic evaluations. In M. Drummond & A. McGuire (Eds.), *Economic evaluation in health care: Merging theory with practice* (pp. 68-93). New York: Oxford University Press.
- Chang, W. Y., & Henry, B. M. (1999). Methodologic principles of cost analyses in the nursing, medical, and health services literature, 1990-1996. *Nursing Research*, 48(2), 94-104.
- Drummond, M., & McGuire, A. (Eds.). (2001). *Economic evaluation in health care: Merging theory with practice*. New York: Oxford University Press.
- Gold, M. R., Siegel, J. E., Russell, L. B., & Weinstein, M. C. (1996). *Cost-effectiveness in health and medicine*. New York: Oxford University Press.

- Oddone, E., Weinberger, M., Hurder, A., Henderson, W., & Simel, D. (1995). Measuring activities in clinical trials using random work sampling: Implications for cost-effectiveness analysis and measurement of the intervention. *Journal of Clinical Epidemiology*, 48(8), 1011-1018.
- Polit, D. F., & Beck, C. T. (2004). *Nursing research: Principles and methods* (7th ed.). Philadelphia: Lippincott Williams & Wilkins.
- Rizzo, J. A., Baker, D. I., McAvay, G., & Tinetti, M. E. (1996). The cost-effectiveness of a multifactorial targeted prevention program for falls among community elderly persons. *Medical Care*, 34(9), 954-969.
- Robertson, M. C., Devlin, N., Gardner, M. M., & Campbell, A. J. (2001). Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 1: Randomized controlled trial. *BMJ*, 322(7288), 697-701.
- Robertson, M. C., Devlin, N., Scuffham, P., Gardner, M. M., Buchner, D. M., & Campbell, A. J. (2001). Economic evaluation of a community based exercise programme to prevent falls. *Journal of Epidemiology and Community Health*, 55, 600-606.
- Robertson, M. C., Gardner, M. M., Devlin, N., McGee, R., & Campbell, A. J. (2001). Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 2: Controlled trial in multiple centres. *BMJ*, 322(7288), 701-704.
- Russell, L. B., Gold, M. R., Siegel, J. E., Daniels, N., & Weinstein, M. C. (1996). The role of cost-effectiveness analysis in health and medicine. Panel on Cost-Effectiveness in Health and Medicine. *JAMA*, 276(14), 1172-1177.
- Smedley, B. D., & Syme, S. L. (Eds.). (2000). *Promoting health: Intervention strategies from social and behavioral research*. Washington, DC: National Academy Press.
- Weinstein, M. C., Siegel, J. E., Gold, M. R., Kamlet, M. S., & Russell, L. B. (1996). Recommendations of the Panel on Cost-Effectiveness in Health and Medicine. *JAMA*, 276(15), 1253-1258.