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Abstract

Background—Patient-centered health care interventions, such as heart failure disease management programs, are under increasing pressure to demonstrate good value. Variability in costing methods and assumptions in economic evaluations of such interventions limit the comparability of cost estimates across studies. Valid cost estimation is critical to conducting economic evaluations and for program budgeting and reimbursement negotiations.

Methods and Results—Using sound economic principles, we developed the Tools for Economic Analysis of Patient Management Interventions in Heart Failure (TEAM-HF) Costing Tool, a spreadsheet program that can be used by researchers and health care managers to systematically generate cost estimates for economic evaluations and to inform budgetary decisions. The tool guides users on data collection and cost assignment for associated personnel, facilities, equipment, supplies, patient incentives, miscellaneous items, and start-up activities. The tool generates estimates of total program costs, cost per patient, and cost per week and presents results using both standardized and customized unit costs for side-by-side comparisons. Results from pilot testing indicated that the tool was well-formatted, easy to use, and followed a logical order. Cost estimates of a 12-week exercise training program in patients with heart failure were generated with the costing tool and were found to be consistent with estimates published in a recent study.

Conclusions—The TEAM-HF Costing Tool could prove to be a valuable resource for researchers and health care managers to generate comprehensive cost estimates of patient-centered interventions in heart failure or other conditions for conducting high-quality economic evaluations and making well-informed health care management decisions.

Disciplines

Cardiology | Cardiovascular Diseases | Health Information Technology

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Introduction of the TEAM-HF Costing Tool: A User-Friendly Spreadsheet Program to Estimate Costs of Providing Patient-Centered Interventions

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Abstract

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Conclusions—The TEAM-HF Costing Tool could prove to be a valuable resource for researchers and health care managers to generate comprehensive cost estimates of patient-centered interventions in heart failure or other conditions for conducting high-quality economic evaluations and making well-informed health care management decisions.

Keywords

Computing Methodologies; Disease Management; Health Care Costs

Introduction

Patient-centered health care interventions, such as heart failure disease management programs, are under increasing pressure to demonstrate good value as health care budgets are further scrutinized for inefficiency. High-quality cost estimates are important to health care managers for budgetary decision making, setting payment rates, negotiating reimbursement contracts, forecasting costs with program expansion or contraction, and identifying ways to improve program efficiency. In research settings, there is also a growing demand for economic evaluations that provide accurate and standardized cost estimates so that national and international bodies, professional societies, and managed care organizations can make informed guidelines and recommendations.[1-7]

The general lack of detail regarding cost-estimation methods in published studies of patient-focused interventions like cardiac rehabilitation, disease management interventions, and other programs targeting patients with chronic conditions suggests that there has been little standardization of costing methods.[8-19] The available information suggests that program costs are systematically underestimated. Some studies report on savings induced by the programs but do not include the cost of the intervention,[20-22] and others limit cost estimation to personnel time devoted to providing the intervention without consideration of overhead or other fixed or variable costs.[9,13-15] Some analysts have applied reimbursement rates for similar services as a proxy,[23] and some have applied fees paid to or charges from the companies that provide the intervention.[24-26] Although the latter strategy may represent the appropriate cost from the payer's perspective, this strategy may lead to poor decision making by the provider or broader national decision-making bodies, because fees or charges can misrepresent the resources actually devoted to the intervention.[27,28]

Much of the literature has focused on heart failure, for which expenditures are massive.[29] More than 4 million Medicare beneficiaries have heart failure, and more than one-quarter of patients with heart failure die within 1 year.[30] With more than 60% of expenditures attributable to inpatient care,[29] providers have long recognized the potential economic savings of programs designed to reduce hospital admissions among patients with heart failure.

Tools for Economic Analysis of Patient Management Interventions in Heart Failure (TEAM-HF) consists of 2 projects. The first project is the development of a costing tool designed to assist with estimating costs of patient-focused interventions in heart failure or other conditions. The second project aims to develop a customizable computer model to estimate the long-term cost-effectiveness of patient-focused interventions in heart failure. In this paper, we report on the development of the first project, the TEAM-HF Costing Tool. Then, we compare estimates of the cost of an exercise training program for patients with heart failure patients derived from the costing tool with cost estimates reported in a recently published economic evaluation of exercise training.[9] Lastly, we describe the potential uses of the tool and discuss its strengths and limitations.

Methods

Determining the cost of a medical intervention requires consideration of the study perspective and time horizon. The study perspective is critical for determining which resources should be included and how they should be valued.[27,28] A study can take one or multiple perspectives depending on the objectives of the study. The societal perspective is generally recommended, but other perspectives, such as payer, patient, and provider may also be of interest. If an economic evaluation (eg, cost comparison, cost-effectiveness analysis) is performed from the societal perspective, all resources incurred in the delivery of the intervention should be included. In a clinic-based disease management program, these resources include time for all personnel involved directly or indirectly (eg, administrative staff) in the delivery and maintenance of the program, supplies and equipment used, facilities (for personnel or patients), and any incentives, materials, and transportation services provided to patients (or caregivers) enrolled in the program. With a societal perspective, patients' and caregivers' time associated with the program should also be incorporated, including time spent participating in the program and time spent adhering to interventions associated with program.[27,31]

To determine how fixed costs are handled requires determination of the time horizon of interest. Time horizon can be classified into short and long depending on how costs for various resources may change over time and with potential changes in volume. In the short run, costs of administration (eg, support personnel) and capital (eg, facilities, equipment) may be considered fixed costs in that costs for these resources may not be expected to change in the near term or increase to a significant degree with the initiation of a small disease management program. That does not mean, however, that these costs are zero. Over the long run or with growth in the numbers of patients participating in the program, administrative and facility costs would be expected to change and should be allocated to the cost of the program.[32]

Upon identification of resources involved, each must be measured or estimated. With a societal perspective, each of these resources should then be valued at their opportunity cost, which is defined as the value of the resource in its next best use. The economic concept of opportunity cost promotes standardization across interventions and allows for a fair comparison of resources necessary to carry out different types of programs and treatments. Market prices typically provide a good approximation of the opportunity cost for a resource. In health care, however, prices (ie, charges) are sometimes inflated well beyond the opportunity cost necessary to deliver a given service, and adjustments or other sources of unit costs are necessary. However, from the perspective of a payer, charges are relevant. And, from the perspective of a provider, accounting costs (ie, the amount paid for the resources) are appropriate.

Development Process

In developing the TEAM-HF Costing Tool, we wished to design a user-friendly spreadsheet program that would facilitate the systematic identification, enumeration, and valuation of resources involved in the provision of patient-centered health care interventions (eg, disease management programs, skills coping training, exercise training, home-based care). Ultimately, we aimed to increase the validity and reliability of estimated program costs used in published economic evaluations to increase comparability across studies for higher-quality decision making. We recognized, however, that to maximize the utility of the instrument for a wide range of users, the instrument had to be designed to derive cost estimates that could represent the different study perspectives discussed above. We also sought to develop a tool that could account for costs incurred by different types of programs, in various settings, and for various health conditions.

Throughout a series of drafts, we obtained feedback from an expert advisory panel consisting of 2 academic nurse researchers, a community-based nurse practitioner with expertise in disease management programs, a health economist, an academic cardiologist, and a health policy expert.

Structure of the TEAM-HF Costing Tool

The TEAM-HF Costing Tool consists of a series of worksheets. The "Overview" worksheet provides written documentation regarding the features and methods applied in the costing tool. The second worksheet, "Description and Costing Options," classifies the type of patient-focused program being assessed and the options available for cost estimation. There are 2 worksheets representing different strategies for deriving personnel costs, and 1 worksheet for each of the following types of resources: facilities, equipment, supplies/ incentives, and miscellaneous items. There is also a worksheet to estimate start-up costs and another to document revenues or funding for the program. There are two results worksheets. One summarizes total program costs and the other incorporates revenues to generate profit/ loss estimates. Finally, there are 2 worksheets that represent standardized and customized unit costs that are assigned to itemized resources included in the preceding worksheets.

Incorporating the economic principles discussed above, the TEAM-HF Costing Tool was developed as a Microsoft Excel application to facilitate adoption by a diverse array of users for numerous potential purposes (Table 1). The tool includes a user manual and a separate Excel-based questionnaire in which the user's responses generate customized, printable forms to guide data collection. The TEAM-HF Costing Tool and associated documents will be available for download from the Internet at no cost to the user [http://team-hf.org].

Description and Costing Options—The TEAM-HF Costing Tool was developed to estimate costs for 3 types of scenarios based on (1) whether patients participate in a given program for a fixed period of time or indefinitely; and (2) whether the user wishes to estimate costs for a fixed number of patients (eg, a cohort of 100 patients) or per unit of time for a program that continues to enroll new participants (eg, annual cost per patient). Based on the type of program selected, the required inputs vary (Table 2).

Personnel—Personnel typically account for the majority of costs in the provision of behavioral or educational interventions. Personnel costs are estimated using 1 of the 2 methods: the top-down approach and the bottom-up approach. With the top-down approach, users provide estimates of weekly time associated with the program. With the bottom-up approach, users provide estimates of time spent by each type of personnel for each encounter (eg, face-to-face session, telephone call).

Facility Costs—The "Facility Costs" worksheet is designed to estimate costs associated with the physical locations required to provide the intervention (eg, office space, clinic examination rooms). Users may choose to estimate facility costs using 1 of the 3 methods: (1) fixed percentage based on personnel cost; (2) cost per square foot; and (3) an "off-the-shelf" cost (Table 3). The off-the-shelf method is similar to the cost-per-square-foot approach but uses standard estimates of square footage for different types of facilities (eg, offices, examination rooms) to reduce user burden.

Equipment Costs—The "Equipment Costs" worksheet captures information on resources used across multiple patients but not depleted during the delivery of the program (eg, computers, software, office furniture). Costs for equipment are amortized over time to represent the usable life of each resource.

Supplies and Incentives—The "Supplies and Incentives" worksheet captures information on resources that are depleted during the delivery of the program. Supplies represent items given to individual patients, such as exercise equipment, medications, or remote monitoring devices (eg, digital scales, handheld personal digital assistants), or used in the provision of services to individual patients (eg, education materials, intravenous diuretics, disposable medical equipment). Information on patient time and costs incurred by patients (eg, parking, transportation) can be accounted for in this worksheet.

Miscellaneous Costs—The "Miscellaneous Costs" worksheet is designed to capture costs not directly associated with the number of individuals enrolled in the program or the number of encounters. Miscellaneous costs can include professional licensing fees, professional training and travel, and other resources, such as subscriptions to medical journals for staff involved in the program.

Start-up Costs—Start-up costs represent personnel costs and other resources or expenses incurred before the program is initiated. Start-up costs could include costs associated with training personnel, developing intervention materials, and advertising or other outreach activities necessary to initiate the program. There is sometimes confusion between equipment costs and start-up costs. For example, a software program designed to monitor electronic devices for heart failure patients may be considered to be a start-up cost. However, a purchased program should be captured as an equipment cost to be allocated across individuals participating in the program over its expected duration of use.

Total Costs—The "Total Costs" worksheet provides tables summarizing resource-specific and total costs on an annual and weekly basis for the program as a whole and for each patient. Consistent with the other worksheets, cost estimates are provided using standardized as well as customized units in separate worksheets containing unit prices and other assumptions (eg, fringe benefit rates) necessary for cost estimation. The primary source for salary and benefit information in the "Standardized Units" worksheet is the US Bureau of Labor Statistics.[33] Estimates regarding years of use for equipment were obtained from the Internal Revenue Service.[34]

Pilot Testing

Upon development of the final draft of the costing tool, 4 individuals participated in pilot testing: 3 from academic medical centers and 1 from a community setting. The participants were asked to complete the costing tool for the disease management program they were involved with or for a hypothetical disease management program. We allowed for representation of a hypothetical program, because our primary interest was in assessing ease of use and identifying areas where further clarification or modifications were needed rather than developing accurate cost estimates from 4 disparate programs. To elicit structured feedback, we developed a short survey for completion by each of the 4 individuals involved in pilot testing.

Results

All 4 individuals who participated in pilot testing completed the written survey. Three out of 4 reported using the data collection forms. Two chose the "top-down" costing method and 2 chose the "bottom-up" method to estimate personnel costs. For estimating facility costs, all participants chose the approach in which facility costs are based on a percentage of personnel costs. Respondents agreed that the costing tool was clear, well formatted, and followed a logical order.

Comparison With Published Cost Estimates

To evaluate the extent to which the costing tool generates valid and reliable cost estimates, we applied cost inputs and assumptions recently reported in an economic evaluation of HF-ACTION, an exercise training program for patients with heart failure.[9] We compared the estimates generated by the TEAM-HF Costing Tool with estimates reported in the HF-ACTION economic evaluation.

The exercise training protocol prescribed 3 sessions per patient per week across 12 weeks. Patients completed, on average, 17.1 hours of exercise in 32.7 sessions, a mean of 31.4 minutes per session. In the HF-ACTION analysis, trainers supervised an average of 1.7 patients per session and spent an average of 35 minutes before and after each session on associated activities, such as documentation in the medical record, billing, and scheduling. Time was not explicitly recorded for sessions when patients failed to arrive. Details regarding salaries for exercise physiologists, facility space, exercise equipment, and other assumptions necessary to generate cost estimates were also reported in the appendix accompanying the manuscript.[9]

To generate costs using the TEAM-HF Costing Tool, we selected the option representing the program type as a "fixed duration per cohort - single cohort," which is appropriate for estimating costs in the setting of a clinical study (Figure). We then populated corresponding cells to indicate that the program duration of 12 weeks and the cohort size of 14, consistent with the 1159 patients enrolled in the exercise training arm distributed across 82 sites. To derive personnel costs, we applied the "bottom-up" method, entering 66.4 minutes as the time spent by exercise physiologists for each encounter. Although the costing tool was not designed to account for group sessions, we accounted for the number of patients per session by dividing 42 sessions per week by 1.7. Then, to account for the actual number of sessions completed rather than prescribed, we multiplied by the ratio of completed to prescribed sessions (ie, 32.7/36). To value each of the resources, we applied the standardized units included in the costing tool and populated the "Customized Units" spreadsheet to correspond to reported salaries, fringe benefit rates, rental rates, and equipment costs.

In the HF-ACTION economic evaluation,[9] the direct total cost of supervised exercise training was estimated at $632 per patient. Total costs for supervised exercise training generated with the Costing Tool were $675 using standardized costs and assumptions built into the tool. However, when we used the customizing features of the tool to apply unit costs for salaries, fringe benefit rates, and other assumptions consistent with the HF-ACTION analysis, the resulting cost estimate was $634 per patient (Figure).

Discussion

As the health care system evolves to address the needs of patients with chronic conditions, new care management strategies are proliferating. Although most are patient-centered, they are heterogeneous, differing with regard to the focus of the intervention (eg, medication adherence, care coordination, exercise training), the mode of delivery (eg, home visits, telephone, remote monitoring), targeted patient populations (eg, higher vs lower disease severity, low income), frequency of contact, duration, and the types of health care providers involved. Even among similar types of programs, comparisons of program costs currently available in the literature are nearly impossible given the lack of methodological detail, the wide range of costing strategies that could be applied, and variations in wage rates and other costs across practice settings and geographic locations. To promote the generation of high-quality cost estimates for informed decision making, we developed the TEAM-HF Costing Tool for use by researchers, managers, and other professionals throughout the health care

system and demonstrated its utility for computing costs associated with an exercise training program.

The TEAM-HF Costing Tool can facilitate standardization of unit costs and assumptions for estimating intervention costs for application in cost-effectiveness analyses. However, choices used in the generation of the cost estimates must be consistent with economic principles underpinning the design and execution of a cost-effectiveness analysis. The study perspective and time horizon must be selected in accordance with the intended audience for the analysis. With a societal perspective, a long-term time horizon is typically appropriate, and analysts should include all program-related resources valued to approximate opportunity costs. To facilitate comparisons across separate studies, we recommend the standardized units incorporated in the costing tool. When a provider or payer perspective is chosen, the user would be advised to apply customized units to generate meaningful and accurate cost estimates. Also with regard to the use of cost estimates from the costing tool, cost-effectiveness analyses can be carried out as a program-level analysis or a patient-level analysis. In a program-level analysis, aggregated estimates of program costs would be paired with aggregate estimates of clinical benefits relative to standard care. In a patient-level analysis (eg, data from a randomized trial), disaggregated estimates of program costs, such as the estimated cost per patient per week, could be applied to each patient based on the number of weeks of participation in the program. Another benefit of the costing tool from a research perspective is that use of standardized unit costs for salaries, facilities, and other resources allows individual programs to publish study results while avoiding public disclosure of confidential cost information. Finally, the availability of the tool promotes full reporting of methodological approaches and assumptions applied in specific analyses, thereby allowing readers to determine whether "apples-to-apples" comparisons are possible.

In addition to developing the TEAM-HF Costing Tool to facilitate standardization of costing methods for use in economic evaluations, we recognized the need for a flexible tool that could serve multiple potential uses for health care managers. To inform budgetary decisions, health care managers can use the "Customized Units" spreadsheet to enter salaries and benefits paid to employees, rental rates, supply costs, and other units to generate cost estimates for the specific program at their site. Similarly, because the costing principles integrated into the tool are generally accepted across countries, individuals outside the United States could modify the inputs in the "Customized Units" worksheet to generate local cost estimates for a given program.

Wide adoption of the TEAM-HF Costing Tool would lead to collection of cost estimates across patient-focused programs. Since the development of the Drug Abuse Treatment Cost Analysis Program (DATCAP) in early 1990s,[35] the tool has been used by more than 110 programs to estimate costs for a range of treatment programs including prison-based, residential, and outpatient programs.[36] This compilation of cost estimates allowed for publication of a set of cost bands for 8 treatment modalities to facilitate funding and reimbursement decisions for substance abuse treatment.[36] With adoption of the TEAM-HF Costing Tool across a variety of users and dissemination of the resulting cost estimates, similar cost bands could be developed for specific types of patient-focused interventions in heart failure or other conditions.

Limitations

Although we aimed to develop a user-friendly costing system that is both flexible and comprehensive, we cannot anticipate all user needs. As mentioned previously, it is important to recognize that the system is not designed to evaluate the impact of programs on medical costs stemming from reduced rehospitalization rates or other clinical outcomes. However, we are in the process of developing another TEAM-HF tool to evaluate the cost-

effectiveness of patient-focused programs specifically targeting patients with heart failure. This tool will incorporate changes resulting from an intervention on patients' clinical and treatment characteristics to project downstream consequences on costs and quality-adjusted survival. In addition, although we believe that incorporating standardized unit costs into the TEAM-HF Costing Tool offers an advantage over costing systems developed for other uses, no one set of standardized units will be appropriate for all programs. For example, standardized unit costs for supplies such as blood pressure cuffs may reflect costs incurred across a wide range of practices, while salaries for personnel may vary across locations and settings. As the costing tool is adopted, we expect that users will point out which standardized units are inappropriate and have a meaningful impact on estimated program costs. As this information becomes available, future versions of the costing tool could be updated to incorporate more suitable inputs. Also, unit costs will require updating over time. We anticipate incorporating unit costs for future years and allowing the user to simply select from a list representing years for which standardized unit costs are available.

We believe that researchers or program managers can successfully complete the costing tool with the information available in the user manual. The amount of time required will depend on the user's choice to use the standardized or customized unit costs, the costing methods selected, and the availability of information about the size of the program and provider time spent on associated activities. Feedback from our pilot study suggests that a guided introduction to the TEAM-HF Costing Tool would positively influence the extent to which it is adopted by users. To promote its use, we are planning to provide training seminars at regional and national professional meetings and to develop online training videos that will be available when individuals are ready to begin using the tool. Lastly, we encourage individuals to visit the TEAM-HF Web site for the costing tool and associated documentation [link to be provided for publication].

Conclusion

The TEAM-HF Costing Tool can assist researchers and health care managers in the generation of high-quality, comprehensive cost estimates of patient-centered interventions that can be applied in economic evaluations and facilitate well-informed decision making for internal budgeting, program planning, reimbursement negotiations, and improving the efficiency of existing programs.

Acknowledgments

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Description and Costing Options	
Descriptive Information about Program	
Description/Name of the program	HF-ACTION
Target patient population	NYHA Class II-IV, stable outpatients
Program Type/Scenario *(select type)*	Fixed duration per patient- single cohort
Duration of the program *(in weeks)*	12
Number of patients per cohort	14
Options for Cost Estimation Methods	
Approach to estimating personnel costs *(select approach)*	Time per encounter for personnel [bottom-up method]
Include start-up costs? *(select yes or no)*	No
Include facility costs? *(select yes or no)*	Yes
Approach to estimating facility costs *(select approach)*	'Cost-per-square-foot' method
Include equipment costs?	Yes
Include personnel time devoted to research activities? *(select yes or no)*	No
Include costs for supplies and/or incentives provided at each encounter or for each new patient enrolled?	Yes
Total number of patient encounters per week *(used to calculate supply costs)*	42

Results						
Fixed Duration Per Patient, Single Cohort	Standardized Costs			Customized Costs		
Resource Category	Per intervention cohort	Per patient per week in the program	Per patient	Per intervention cohort	Per patient per week in the program	Per patient
Start-up	$0	$0	$0	$0	$0	$0
Personnel	$8,766	$52	$626	$8,293	$49	$592
Facilities	$447	$3	$32	$337	$2	$24
Equipment	$243	$1	$17	$251	$1	$18
Supplies	$0	$0	$0	$0	$0	$0
Miscellaneous	$0	$0	$0	$0	$0	$0
Total Cost	$9,457	$56	$675	$8,881	$53	$634

Per patient cost from HF-ACTION: $0; $588 ($44); $0; $0; $632

Excerpt from 'Description and Costing Options' Worksheet

Excerpt from 'Total Costs' Worksheet

Figure.
Excerpt From the TEAM-HF Costing Tool and Comparison of Findings With Published Estimates From HF-ACTION
* assumed that costs for utilities and other overhead are included in the cost per square foot.
± costs for facilities and equipment were reported as 'facility costs' in the manuscript reporting on results from the economic evaluation of HF-ACTION. [9]

Table 1

Potential Uses of the TEAM-HF Costing Tool

Potential Uses	Explanation
Budgeting	The tool can assist in annual budgeting in terms of estimating costs for specified numbers and types of personnel, facilities, equipment, and other costs necessary to provide a patient-centered intervention.
Reimbursement negotiations	The tool will allow the user to compare estimated costs to deliver the program with reimbursement rates set by a given insurance company. The user may use the cost estimates generated with the tool to negotiate for higher reimbursement rates.
Improve efficiency of an existing program	The tool can be used to examine the cost impact of various program changes, such shortening time spent per encounter, increasing volume of patients enrolled to allocate fixed costs (eg, facilities and equipment) over a larger number of patients.
Cost-effectiveness evaluation	The tool can be used to compute the average cost (per patient, per encounter) for the program that can be used in a cost-effectiveness analysis designed to evaluate whether the intervention provides good value for money if other scientifically sound principles of economic evaluation are followed.

Table 2

Three Types of Scenarios Modeled in the TEAM-HF Costing Tool

Scenario Type	Description	Example	Inputs Required
Fixed duration per patient, single cohort	This scenario represents a program in which a given number of patients are enrolled for a fixed period of time or a fixed number of 'encounters'.	8-week disease management program for a cohort of 30 patients	• Duration of program per patient • Number of patients per cohort
Fixed duration per patient, ongoing accrual	This scenario represents a program in which individual patients are enrolled for a fixed period of time or a fixed number of 'encounters', and the program is continually accruing new patients.	Disease management program that enrolls patients for an 8-week intervention after the patient's first hospitalization for heart failure	• Duration of program per patient • Total number of patients accrued in the program over one year
Ongoing duration per patient, ongoing accrual	This scenario represents a program in which patients continue participation for a non-specified duration and the program is continually accruing new patients.	Disease management program in which patients participate until they drop out or die	• Total number of patients participating in the program over one year

Table 3

Options for Estimating Costs for Facilities

Costing Strategy	Description	Inputs Required
Fixed percentage based on personnel cost	Costs for facilities are estimated as a fixed percentage of the total personnel costs which are estimated using either the "top-down" or "bottom-up" approaches for estimating personnel costs.	• None; estimates are based on personnel costs.
"Cost-per-square-foot method"	Costs for facilities are based on estimates of square feet used by the program and the proportion of time the space is used by the program. This method also provides an option for the user to apply an "add-on percentage" to assign costs for utilities and other overhead costs.	• Estimates of square footage of for each type of space used by the program. • Percentage of time the space is used to deliver the program.
"Off-the-shelf" method	With this method, standardized estimates of square footage for each type of space are applied. When using this method, costs for utilities and other overhead are already included in the estimated facility costs.	• Number of each type of space required (eg, 2 offices, 1 examination room). • Percentage of time the space is used to deliver the program.