An ROI is calculated as the ratio of two financial estimates:

Where the numerator and denominator of this ratio are defined as follows:

- *Net financial returns from improvement actions.* The financial gains from the implementation of the improvement actions, which are generated by net changes in quality, efficiency, and utilization of services, or in payments for those services.
- *Financial investment in improvement actions.* The costs of developing and operating the improvement actions.

How does ROI differ from cost-effectiveness analysis (CEA)? CEA and ROI share some common features, but they differ in the effects that are addressed. Both ROI and CEA are expressed as ratios, and they use the same dollar amounts for improvement investment costs. ROI shows how much financial gain a hospital or health system can obtain from each dollar it invests in a quality improvement program, while the results of a CEA indicate the costs to a hospital for each unit of effectiveness it achieves through quality improvement actions, such as the costs for each adverse event avoided. These differences are reflected in the formulas used to calculate the ratios.

The step-by-step procedure described here can be used to perform ROI calculations to assess your financial return on improvement actions that you either are planning or have implemented. Additional information that may be useful to consider is provided in the section titled "Additional Guidance for Effective ROI Calculation."

Throughout this document, the term "improvement actions" refers to any hospital program or initiative that aims to improve the quality or safety of hospital inpatient care, which may include a focus on improving performance on the AHRQ QIs.

Before you start to calculate ROI for any given improvement actions, you need to make four design decisions that will structure your approach to the

as short as a few months or as long as years. The ROI analysis needs to capture when those actions change the hospital's operating procedures over time, to estimate both the implementation costs and the financial effects of improvement actions. If changes occur over years, you will need to adjust the estimates for inflation and discount future costs and revenues.

3. **Define the comparison group.** To estimate the numerator (net return portion) for the ROI ratio, you need to compare the hospital's finances under two conditions—with the improvement actions implemented and without them. Typically, this will be a comparison over time, with the "before" condition being the service processes before improvement actions, and the "after" condition the service processes after implementation. Other possible comparisons are comparisons across units within the same hospital, or across hospitals. If you use other units or hospitals as comparisons, be sure to choose comparison groups that have similar characteristics to your service entity except that they did not implement the improvement actions.
4. **Capture complete information on financial contributors.** To obtain the most accurate ROI estimate, you will need to identify and quantify as many of the financial contributors as possible for both the numerator and denominator of the ROI formula. For a planning phase ROI, you will work with your best estimates of improvement action costs and of the components of net returns. For a postimplementation ROI, you will have actual data from your financial system on those contributors.

To calculate the ROI for the improvement actions, you will develop estimates for both the numerator and denominator of the ROI ratio:

$$\frac{\textit{Net returns from the improvement actions}}{\textit{Implementation costs}}$$

Worksheets are provided here for your use in developing these estimates. Worksheet 1 can be used to estimate the costs for your investment in the improvement actions, and Worksheet 2 can be used to estimate the net returns from those actions.

Considerations When Calculating Implementation Costs. Instructions for completing Worksheet 1 are provided at the top of the worksheet. You will use the same methods to estimate these costs that you would use for program budgeting or financial accounting of actual costs. The grand total of estimated implementation costs calculated in Worksheet 1 is the ROI denominator.

The costs involved in implementing improvement actions may be incurred at different stages of the implementation process. *Your hospital's financial staff will need to estimate these costs at all stages of the program from start to end if using the ROI tool for planning. If you use the ROI tool for evaluation purposes, you will need to track costs throughout implementation.*

Table 1 shows example categories of costs at each stage of program planning, implementation, and maintenance (see descriptions of these components in Appendix I). These broad categories are meant as suggestions. Not all costs included will apply to all types of programs or quality improvement initiatives. In addition, you may identify other relevant costs that should be included but are not shown here.

for an ROI analysis is 2 years or longer, the analysis has to adjust for these issues, as described in the next section.

- *Inflation* refers to rises in the prices of goods and services over a period of time. The ROI calculation can adjust for inflation by using constant dollars to measure the costs of a program over time.
- *Discounting*

Instructions for completing Worksheet 1 (**Note:** These are costs for implementation, NOT the subsequent changes in service finances.)

1. Prepare these costs using the same methods used for program budgeting. When the ROI is calculated during planning for a set of improvement actions, it is in fact a budget for that set of actions. Use the same line items for calculating actual costs after implementation. Some costs might be drawn from your hospital financial statements; others you will need to calculate yourself.
2. Enter the estimated costs for each line item (personnel, supplies, etc.) that is relevant to the improvement actions for each implementation stage (planning, training, etc.).
3. Sum the costs across rows to obtain a total cost estimate for each line item.
4. Sum the costs down the columns to obtain a total cost estimate for each improvement stage.
5. Obtain the grand total costs by summing the line item total costs (the highlighted box). *This is the denominator for the ROI calculation.*

Instructions for completing this worksheet: (**Note:** These are changes in service revenues and operating costs resulting from implementing the improvement actions.)

1. Identify items for which the improvement actions will have financial effects and list them in first column. The top set lists effects on revenues; the bottom set lists effects on costs. The ones listed here are examples; you may use different sets of items.
2. Estimate the costs for each item for the comparison group (e.g., before) and following implementation. If the comparison periods involve more than 1 year, you may need to adjust some of the costs for inflation or discount future costs to reflect time preference for money.
3. Calculate net change in revenues = B minus A (increase in revenue). Calculate net change in costs = A minus B (decrease in cost).
4. Sum the line item net changes to obtain the total net change (highlighted box). *This is the numerator for the ROI calculation.*

This case study is summarized from a published journal article that evaluated the financial impact of implementing a computerized physician order entry (CPOE) system at Brigham and Women's Hospital (BWH).[i] Few ROI analyses have been published in the health services literature because they are not typically performed as research studies.

Calculating implementation costs (denominator). Costs were determined for each stage of practice implementation from 1992 to 2002. First, the capital costs of developing and implementing the CPOE system were estimated to be $3.7 million, based on internal documents and interviews with the developers. Sixty percent of this cost was attributed to the first year of the study period (development costs) and 20 percent was attributed to each of the next 2 years (startup).

Next, operational costs starting in year 2 of the study period were calculated. These costs included hardware (workstations and printers), software, network, leadership, and training. They did not include costs for the pharmacy system, medication administration system, or clinical data repository. Operational costs ranged from $600,000 to $1.1 million per year. Development, implementation, and operation of the CPOE system cost $11.8 million over 10 years.

Calculating net returns from the program (numerator). To estimate the savings generated from the CPOE system, the ROI team retrospectively identified each way the practice saved

- *Inflation:* Dollar values for costs and benefits were converted to a constant dollar basis to adjust for inflation. They used the Bureau of Labor Statistics' Producer Price Index time series for General Medical and Surgical Hospitals to standardize values to 2002 currency.
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Drummond M, O'Brien B, Stoddart G, et al. Methods for the economic evaluation of health care programmes. 2nd ed. New York, NY: Oxford University Press; 1997.

The U.S. Bureau of Labor Statistics provides information about wage rates of more than 800 occupations in 50 States and the District of Columbia (http://www.bls.gov/oes/current/oessrcst.htm). The information is useful for calculating personnel costs, such as doctors and nurses, which is part of the ROI analysis.

The U.S. Bureau of Labor Statistics also provides information about inflation rates across the Nation and over time (http://www.bls.gov/CPI/), including price index of medical care (http://www.bls.gov/cpi/cpifact4.htm).

The Red Book by Thomson Reuters provides comprehensive drug product and pricing data (http://www.micromedex.com/products/redbook/database/).9

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Rothschild JM, Bates DW, Franz C, et al. The costs and savings associated with prevention of adverse events by critical care nurses. J Crit Care 2009 Sep;24(3):471.e1-7.

Swensen, SJ, Dilling, JA, McCarty, PM et al. The business case for health care quality improvement. J Pat Saf 2013 Mar;9(1):44-52.

Zhan C, Miller MR. Excess length of stay, charges, and mortality attributable to medical injuries during hospitalization. JAMA 2003;290:1868-74.

Implementation of improvement actions may be divided into the following stages:

- **Planning and program development.** This is the first stage of any program. Right from the start, the hospital needs to spend money on planning and program development activities, such as conducting situational analysis, searching the literature, identifying target areas and populations for the quality improvement program, assembling a team to work on the program, purchasing equipment, and setting up an information system.
- **Training.** Some training sessions may be part of planning and program development while other training sessions may happen in later stages of program implementation. It is also common to have training sessions during the implementation process to refresh the knowledge or skills of hospital staff members. Therefore, training is listed here as a separate item.
- **Startup.** The hospital needs to pay for running the quality program, including costs of personnel, supplies, equipment, and information system.
- **Ongoing operation, monitoring, and maintenance.** During the implementation process, the hospital needs to make sure its quality program is functioning as planned. Data about quality, utilization, costs, and revenue indicators should be collected to monitor changes in these indicators. The hospital also needs to spend on maintenance services for both the information system and the equipment for the quality improvement program.
- **Shutdown costs for time-limited intervention or failures.** While some quality programs may last a long period and become routine operation for the hospital, other programs might just be temporary, or may fail and have to be shut down after a short time. In these cases, there may be costs associated with shutting down the program.

Shutdown c