# Running the Numbers on an EHR: Applying Cost-Benefit Analysis in EHR Adoption



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*Even with federal incentive payments, providers will be hesitant to adopt EHRs without understanding the return on investment. A cost-benefit analysis helps determine EHR profitability over time.*

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One of the major obstacles provider organizations face in EHR adoption is an unclear understanding of the return on investment (ROI).[1] Even though the "meaningful use" program within ARRA provides billions of dollars to help offset the significant costs, organizations are less likely to invest in EHRs without a clear ROI.

For organizational stakeholders to embrace EHR adoption, they need assurance that adopting an EHR system would positively impact business performance. Cost-benefit analysis is an effective approach to study this question.

## Steps of a Cost-Benefit Analysis

Cost-benefit analysis is a widely adopted tool in financial decision making. It estimates and totals the equivalent monetary value of the benefits and costs of projects to establish whether they should be undertaken. The process involves four steps:

1. Determine project goals
2. Estimate project costs and benefits in dollars
3. Discount the costs and benefits at an appropriate rate
4. Complete the analysis with a calculation based on one of several decision-making methods (in this article, by calculating net present value)

In an EHR adoption project, the goal of the cost-benefit analysis is to study if and when EHR adoption will bring net profit to the healthcare organization.

## Estimate Project Costs and Benefits

An EHR project generates a series of **cash flows** over its lifetime. An enormous investment is required at the beginning of the project, followed by annual expenditures. An EHR system also provides financial benefits by helping reduce costs and improve revenues.[2–4]

The costs associated with EHR implementation may be categorized in two groups: system costs and induced costs.[5] System costs include the costs of software and hardware, training, implementation, ongoing maintenance, and support. Induced costs are related to the temporary productivity loss during the EHR implementation.

It is comparatively easy to estimate system costs. A qualified vendor can provide detailed quotes about system costs that include hardware, software, implementation, training, and maintenance. The organization must also take into account internal costs incurred during implementation such as shift changes, overhead for training, and productivity loss.

Total cost per year is known as the annual **outflow** (or cash-out). For example, to implement an EHR in its initial year, Anytown Hospital will spend $1,500 in software, $6,000 in hardware, $2,000 in implementation, $1,000 in support, and suffer $2,000 in productivity loss. The outflow for the initial year is $12,500.

The outflow in the following years can be calculated similarly. However, it is important to keep in mind specific characteristics for certain costs-implementation cost is a one-time investment; hardware is typically updated every three years (or as needed); productivity loss can be mitigated; and software license(s) and support are annual expenditures. Thus the outflow in subsequent years might be less than the initial year.

Financial benefits include averted costs and increased revenues, which can be divided into three categories: payer-independent benefits, benefits under capitated reimbursement, and benefits under fee-for-service reimbursement.[6–10]

Payer-independent benefits come from reductions in paper chart pulls and transcription. Benefits under reimbursement come from averted costs by reducing adverse drug events, offering alternative medications, and reducing the utilization of laboratory and radiology tests. Benefits under fee-for-service reimbursement come from improving billing capture and reducing billing errors.[11–16]

Estimates of benefits should be based on historical data related to specific functions. For example, if the average cost of a chart pull in Anytown Hospital is $5 and the EHR can reduce 500 charts per year, the chart pull savings is $2,500 annually ($5 × 500). However, it is difficult to make precise point estimation. Sensitivity analysis (range estimation) can be applied to improve precision. This article uses point estimation for simple illustration.

Total benefits per year are known as the annual **inflow** (or cash-in). If Anytown Hospital can save $2,500 from chart pull and $2,000 from transportation in the year after implementation, inflow will be $4,500 in the first year. An EHR will bring more benefits to the healthcare organization as the staff becomes familiar with the system and eliminates the initial productivity loss in the following years.

The sum of the annual outflow and inflow is the net cash flow per year.

For example, Anytown Hospital will not realize a financial benefit in the initial year of implementation. The net cash flow in the initial year is -$12,500 ($0 inflow + -$12,500 outflow).

## Comparing Investment Decision Methods

A wide array of criteria are used in investment decision making, including payback period, discounted payback, internal rate of return, and net present value.

Payback period is the time period that is required for the net cash inflows to recover the initial investment in a project. The payback period is calculated as the following formula:

$$\frac{\text{Net initial investment}}{\text{Increase in annual net cash flow}} = \text{payback period}$$

The simplicity of the objective and the absence of complex formulas or multiple steps make the payback method easy to use and understand. But the payback period method ignores the time value of money (discussed in the following section), does not consider project cash flows occurring after the initial investment, does not consider reinvestment, and neglects the total project profitability. Thus, the application of payback period is limited.

In discounted payback, the cash flows are discounted with appropriate rates. Discounted payback incorporates the time value of money, but the other limitations of payback period still hold.

The internal return rate (IRR) is the project's expected rate of return. The IRR method determines the present value factor that yields a net present value equal to zero. IRR is complicated to calculate, whether using a printed IRR table or a computer program.

Moreover, IRR has other limitations. The method is based on an unreasonable reinvestment assumption-that cash flows from the investment can be reinvested at the same IRR. Secondly, IRR also assumes that the cash

flows are stable. When there are several alternating periods of net cash flows (net inflow versus net outflow) and the amount of the cash flows differs significantly, there can be multiple IRRs. Finally, IRR evaluates investment alternatives based upon the achieved IRR and does not consider the amount of the profit.

Net present value (NPV) is the difference between the initial amount paid for an investment and the future cash flows the investment brings in over time after they have been discounted by the cost of capital. Because NPV incorporates the time value of money, has flexible assumptions on annual cash flows, and can be used when there is no constant rate of return required for each year of the project, the method leads to a better investment decision.[19–21] The illustration of cost-benefit analysis offered in this article employs NPV.

## Discount Costs and Benefits at an Appropriate Rate

The process of assigning proper values to cash flows that occur at different points in time is called **time value analysis**.[17] A dollar today is not worth the same amount as a dollar at some future time. The difference in the value of money received or spent at different points of time is the time value of money. To understand the **time value of money** requires an introduction to **compounding and discounting**.

When money is invested, the interest it earns starts to earn interest itself-the interest compounds. Discounting is the reversal of this process as we go backward in time. When interest computations are conducted for compounding and discounting, one often speaks of the present value and the future value. The **present value** (PV) is the current value of future cash flows discounted at the appropriate discount rate. The **future value** (FV) is the amount an investment is worth after one or more periods.[18]

The relationship between the present value and the future value can be expressed in the following formulas.

$$FV_t = PV \times (1 + r)^t \quad \text{.....(1)}$$

$$PV = FV_t / (1 + r)^t = FV_t \times [1/(1 + r)^t] \quad \text{.....(2)}$$

PV denotes the present value
$FV_t$ denotes the future value at time
$r$ denotes the discount rate
$t$ denotes the number of periods

In cost-benefit analysis, the second formula computes PV of the future cash flows. The interest rate used for PV calculation is called the **discount rate**. The discount rate should be based on the organization's **cost of capital**, which is the **opportunity cost** of using resources in the organization. Generally, opportunity cost rates are obtained by looking at rates that could be earned on securities such as stocks or bonds of similar risks.

## Complete the Analysis by Calculating NPV

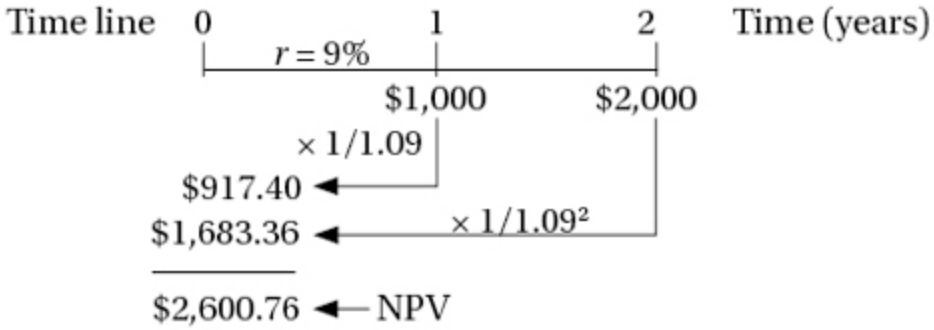
Finally, a timeline can be used to conduct the time value analysis. Timelines make it easier to visualize when the cash flows in a particular analysis occur. Suppose an HIM department needs $1,000 in one year, $2,000 more in two years, and can earn 9 percent on the money. The following formula describes how much money the department must put up today to cover these amounts in the future:

$FV_1 = \$1{,}000\ FV_2 = \$2{,}000\ r = 9\%$

According to formula (2), above:

$$PV_1 = FV_1 / (1 + r)^1 = \$1{,}000/(1 + 9\%)^1 = \$917.40$$

$$PV_2 = FV_2 / (1 + r)^2 = \$2{,}000/(1 + 9\%)^2 = \$1{,}683.36$$




A project should be accepted if the NPV is positive and rejected if it is negative. That is the **net present value rule**.

Let us suppose Anytown Hospital's EHR adoption project has the estimated cash flows shown in the illustration above during a five-year period. (Note: NPV should consider the cash flows from the project's entire lifetime. A five-year period is used here for simplicity.)

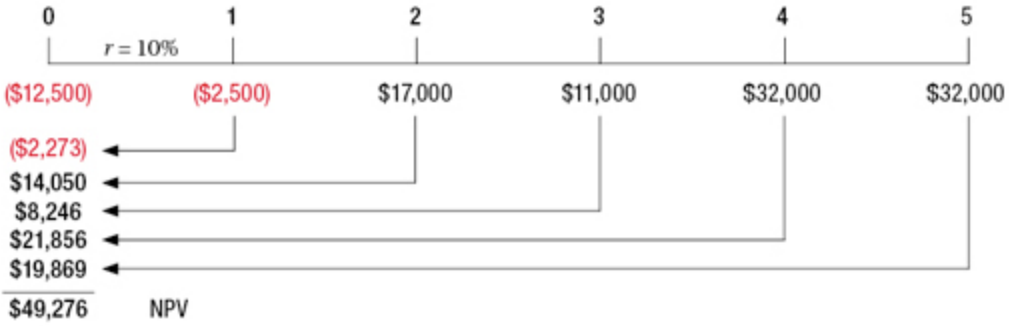
Based on the above time value analysis, the EHR project has a positive NPV of $49,276. The hospital should take the project.

The example used above is arbitrary and for illustration only. A real situation will most likely be much more complex. It is appropriate to note, also, that ROI may not be an organization's only factor in considering an EHR. Other goals such as quality of care may play a significant role in the decision.

## Cash Flows of Proposed EHR Project

In this final step of its cost-benefit analysis, Anytown Hospital calculates the net present value of its proposed EHR project. A timeline helps visualize cash flows by year (a five-year period is shown here for simplicity-actual calculations should consider a project's entire lifetime). After early outflow of cash, the project shows positive cash flow beginning in year 2. Given that positive net present value, Anytown Hospital should pursue the EHR project.

| EHR Project | | | | | | |
|---|---|---|---|---|---|---|
| | **Initial** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** |
| **Inflow** | | $4,500 | $20,000 | $20,000 | $35,000 | $35,000 |
| **outflow** | $12, 500 | $7,000 | $3,000 | $9,000 | $3,000 | $3,000 |

| EHR Project | | | | | | |
|---|---|---|---|---|---|---|
| | **Initial** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** |
| **Net Cash Flow** | ($12,500) | ($2,500) | $17,000 | $11,000 | $32,000 | $32,000 |
| | 0 | 1 | 2 | 3 | 4 | 5 |
| | ($12,500) | ($2,500) | $17,000 | $11,000 | $32,000 | $32,000 |
| |  | | | | | |



## Notes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### Health IT Evaluation Toolkit

For many organizations, cost-benefit analysis forms a central component of a broader project evaluation plan.

The Agency for Healthcare Research and Quality's "Health Information Technology Evaluation Toolkit" is a free resource that helps organizations determine the goals of their projects, identify what is important to their stakeholders, establish the measures that will satisfy stakeholders, and determine how to capture those metrics.

The toolkit is available for download at http://healthit.ahrq.gov.

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