Eastern England SECURE DATA ENVIRONMENT

Part of the **NHS Research Secure Data Environment Network**

Health Innovation East

NHS

Developing a Return on Investment (ROI) for a Business Case or project proposal

Using Return on Investment (ROI) and preparing for future Health Economic Assessment

STAGE 1

Business Case / Project Proposal

STAGE 2

Understanding Scope for an HEA

STAGE 3

Health Economic Assessment

CAMBRIDGE UNIVERSITY Health Partners

Who this guide is for

This guide is an introductory resource to health economics[1] for those who are new to the topic. It highlights key concepts and shows how they might be applied to research proposals. It is not a step-by-step manual, but a starting point to help you consider economic inputs in your proposals. **This guide is the first of three.**

In the outset of any given project, there will likely be either a “business case” or “project proposal” required to obtain funding. As part of this deliverable, bidders may be asked to produce a rough return on investment of a piece of research or project relative to its direct and indirect costs in hopes of gauging value for money (VfM).

The funder is typically looking for the bidder to demonstrate what the future impact of the project or research could be to understand best use of available funds. Additionally, taking this a step further and thinking about a potential health economic assessment before the initiative starts **allows you to plan and set yourself up for success.**

1 Health economics is a branch of economics which evaluates issues that relate to effectiveness, efficiency, and value as a whole within health and social care sectors. It informs decision-making by prioritising resource allocation to help improve efficiency in the healthcare system and help patients to live longer and healthier lives.

What is a Return on Investment (ROI)?

ROI is a way of assessing the efficiency of a project by comparing the benefits it generates with its costs. It is expressed as a ratio of benefits to costs. Although ROI is not commonly used in health technology assessment, it is valuable for planning and business case development, in addition to large-scale investments such as new services or facilities, including hospitals[2].

Examples of ROI tools

Whilst several tools exist for assessing return on investment (ROI) for various disease prevention strategies, each ROI uses a variety of different evidence sources and assumptions. Therefore, there is no single standard method for the assessment of ROI across different risk conditions and interventions for any given disease prevention strategy. However, several ROI tools exist, which serve as a healthy foundation on which to develop future ROIs for any given healthcare intervention strategy[3]. For example, Public Health England (PHE) previously commissioned the University of Sheffield to put together a CVD prevention ROI tool focussing on the six high risk conditions related to CVD. The University of Sheffield chose to develop this ROI tool based off a modification of an existing type 2 diabetes prevention model (The School for Public Health Research (SPHR) Diabetes Prevention Model), which was previously used as the basis of a PHE tool to model the ROI of the NHS Diabetes Prevention Programme (NHS DPP[4]).

By conducting an ROI, it is possible to assess the return on investment from adopting each intervention within a specific geographical area, by measuring all the positive and negative consequences of an intervention in monetary terms (£). This can be a helpful step to complete when putting together the business need or project proposal for a given project.

2 Return on Investment [online]. (2016). York; York Health Economics Consortium; 2016. https://yhec.co.uk/glossary/return-on-investment/

3 Health economics: a guide for public health teams - GOV.UK

4 Sadler S, Thomas C, Brennan A, et al. NHS Diabetes Prevention Programme Return on Investment Tool V1.0: Public Health England & University of Sheffield; 2016 [Available from: https://dpp-roi-tool.shef.ac.uk/.

Required data inputs[5]:

When thinking about conducting either a return on investment or health economic analysis in the future for your intervention, it's important to keep in mind you will need certain data inputs to be available in order to conduct that analysis. Some examples of crucial data inputs are:

- ☑ **Effectiveness of the intervention**
- ☑ **Costs**
- ☑ **Duration of effect**
- ☑ **Eligible treatment group**

Examples of where to find data[6]:

NHS data assets		
Dataset	**Description**	**How to access**
Quality and Outcomes Framework (QOF)	Disease prevalence for common chronic long-standing conditions related to GP performance treating specific conditions.	QOF 2024-25 | NHS Digital accessed 16th January 2018
Hospital Episode Statistics (HES)	Inpatient, outpatient, A&E, and critical care data	In addition to the standard analyses published by NHS Digital, certain users can also access data via the: • Data Access Environment (DAE) - approved users can access NHS data to perform analysis • Monthly Managed Extract Service (MMES) - users receive an extract from HES on a monthly basis • Data Access Request Service (DARS) - users who require bespoke analyses can request extracts from HES, or tabulations tailored to their requirement If you request access to patient level data you may have to meet certain criteria before the application will be considered.
Health Survey for England (HSE)	The Health Survey for England monitors trends in the nation's health and care, providing information about adults aged 16 and over, and children aged 0 to 15, living in private households in England. Each survey includes core questions (e.g. about smoking, alcohol, general health); measurements such as height, weight, and blood pressure; and analysis of blood and saliva samples. In addition, there are question modules on specific topics that vary from year to year.	2022: https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/2022-part-2/health-survey-for-england-hse-2022-part-2-data-tables

5 NB: this list is not exhaustive, and would change based off the specific project.
6 NB: this list is not exhaustive, and would change based off the specific project.

NHSE Dashboards	A set of dashboards that can be used to compare East of England to the rest of England.	https://apps.model.nhs.uk/a-z#
NHS National Data Platform	Captures data in real time; is a single data, modelling and integration platform that provides users with reliable and timely data.	You will need to create a Foundry account (https://future.nhs.uk/system/loginnextURL=%2Fconnect%2Eti%2FInequalitiesImprovement%2Fview%3FobjectID%3D42527248) then some dashboards may require further access permissions

Cost data		
Dataset	**Description**	**How to access**
The Personal Social Services Research Unit (PSSRU) Unit Costs of Health and Social Care	Unit Costs of Health and Social Care for each calendar year In 2022, the Personal Social Services Research Unit (PSSRU) at the University of Kent and the Centre for Health Economics (CHE) at the University of York began a collaboration to estimate unit costs for health and social care and to deliver an annual volume.	Unit Costs of Health and Social Care programme (2022 – 2027) | The new home for the Unit Costs of Health and Social Care report Example year (2023): unit-cost-database-for-health-and-social-care-professionals.xlsx Example year (2024): The unit costs of health and social care 2024 (for publication)_Final.pdf
National Cost Collection for the NHS	The National Cost Collection publication comprises aggregated costs (the average unit cost of providing defined services to NHS patients in England) and patient-level costs/PLICS (a cost based on the specific interactions a patient has, and the events related to their healthcare activity).	NHS England » National Cost Collection for the NHS You can also access reference costs[7] for the financial years 2017/18 and 2016/17 on the page Archived Reference Costs, along with a link to earlier cost collections on the Department of Health website.

Condition-specific datasets		
Dataset	**Description**	**How to access**
National Cardiovascular Intelligence Network (NCVIN) prevalence estimates	Estimates of the number of people aged 16 and over with chronic kidney disease (CKD) in local and regional areas across England. Estimates of the number of people with atrial fibrillation in GP practices and clinical commissioning group (CCG) areas in England.	National Cardiovascular Intelligence Network: Public Health England; 2015 [Available from: https://www.gov.uk/government/publications/ckd-prevalence-estimates-for-local-and-regional-populations] National Cardiovascular Intelligence Network: Public Health England; 2017 [Available from: https://www.gov.uk/government/publications/atrial-fibrillation-prevalence-estimates-for-local-populations]

7 Reference costs are the average unit cost to the NHS of providing secondary healthcare to NHS patients.

National Diabetes Audit	Contains publications from the National Diabetes Core Audit and historic publications from the Diabetes Prevention Programme, Insulin Pump reports and Transition reports.	National Diabetes Audit - NHS England Digital Most recently published data: National Diabetes Audit 2024-25 Quarterly Report April 2024 to December 2024.xlsx
NHS Digital Stop Smoking Services Statistics	This quarterly report presents provisional results from the monitoring of the NHS Stop Smoking Services in England. It includes information on the number of people setting a quit date and the number who successfully quit at the 4-week follow-up. It also presents in depth analyses of the key measures of the service including pregnant women and breakdowns by age group, gender, ethnic group and type of pharmacotherapy received and regional analyses at Region and Local Authority (LA) levels.	Statistics on NHS Stop Smoking Services in England - data.gov.uk

Prescription data assets		
Dataset	**Description**	**How to access**
British National Formulary	Key information on the selection, prescribing, dispensing and administration of medicines.	BNF (British National Formulary) | NICE
English Prescribing Dataset (EPD)	This dataset contains information on prescriptions issued in England that have been dispensed in England, Wales, Scotland, Guernsey, Alderney, Jersey, and the Isle of Man. The dataset combines elements of the Detailed Prescribing Information (DPI) data previously released by NHS Business Services Authority (NHSBSA) via the Information Services Portal, and the Practice Level Prescribing in England (PLP) data released by NHS Digital via their website. It is intended to replace both of those sources.	English Prescribing Dataset (EPD) - Datasets - Open Data Portal

National statistics		
Dataset	**Description**	**How to access**
ONS	The UK's largest independent producer of official statistics. Responsible for collecting and publishing statistics related to the economy, population and society at national, regional, and local levels.	https://www.ons.gov.uk/aboutus

Fingertips	A large public health data collection which is then organised into themed profiles. It uses sources such as ONS, NHS, UKHSA, and MoJ.	https://fingertips.phe.org.uk/
Shape Atlas	Produced by DHSC. Takes data from the NHS, pharmacies, environment, education, etc. and geographically maps the values.	https://shapeatlas.net/
Consumer Data Research Centre (CDRC)	Source of consumer data, including population and mobility, retail futures, transport and movement, finance and economy, and digital.	https://data.cdrc.ac.uk/

Global data assets		
Dataset	**Description**	**How to access**
Global Health Data Exchange (GHDx)	Comprehensive catalogue of surveys, censuses and statistics. A key resource is the GBD Compare tool. However, this data is only updated every 10 years.	https://ghdx.healthdata.org/ https://vizhub.healthdata.org/gbd-compare/

Initial steps to take prior to conducting an ROI

The key steps described here can be used to help perform ROI calculations to assess the financial return on the intervention that you either are planning to or have already implemented. **Before you start to calculate ROI for any given intervention, you need to make several design decisions that will structure your approach to the analysis:**

→ **Design the scope of the intervention:**
define the setting, services, and costs included

Some actions will be limited to making improvements in one specific setting (e.g., A&E) and others will have a broader scope (e.g., across all maternity units). Carefully define the scope of services to be included in the ROI calculation and ensure that financial estimates are specifically related to that scope of services.

→ **Define the timeline for implementation:**
capture both short and long-term costs/benefits

The ROI needs to capture when these actions change the operating procedures over time, to estimate both the implementation costs and the financial effects of the intervention. If changes occur over years, you will need to adjust the estimates for inflation and discount future costs and revenues.

→ **Define the comparison group:**
with vs. without intervention

To estimate the numerator (net return portion) for the ROI ratio, you need to compare the health care setting's finances under two conditions – with the intervention in place and without it. Typically, this will be a comparison over time, with the "before" condition being the service processes before the intervention, and the "after" condition the service processes after the intervention.

→ **Capture complete information:**
include staff, equipment, overheads

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 (as is the case here), you will work with your best estimates of improvement action costs and of the components of net returns.

Key steps to conduct an ROI:

1 Conduct a feasibility study to consider the evidence required to develop an ROI tool

The evidence review should aim to identify the best quality evidence regarding the effectiveness and cost-effectiveness of interventions aimed at detecting and managing each health condition. There are a few key points to keep in mind for this initial step:

- Extract any existing evidence relating to the effectiveness of recommended interventions from NICE guideline documentation.
    - If such evidence was relevant to the review question, had been reviewed within the last year and contained outcomes of relevance to the ROI then no further review will be required.
    - If further evidence is required, searches should be designed to identify recent evidence relating to effectiveness of the intervention.
    - Searches should be aimed at identifying relevant systematic reviews, and if none are found, a second set of searches should be carried out to identify relevant randomised controlled trials (RCTs).
- Develop a review protocol to enable rapid reviewing for each search topic as well as inclusion/ exclusion criteria (i.e., based on an assessment of study quality, relevance to the topic question, and input from the relevant stakeholder group (e.g. the steering group)).
- To populate the tool input parameters, it's necessary to find data to inform current levels of detection and management of conditions, usage of interventions, information about the intervention's effectiveness, cost[8], duration of effect, and the eligible group as well as utility scores for each health state[9].
- Be upfront about assumptions made (in terms of cost, resources/outcomes). **If there is no direct evidence for the relationship between a given intervention and health outcome, these interventions should not be included in the ROI.**

8 Each health state would be associated with an average cost, which is accrued by all individuals for every time period for which the state is indicated.

9 Baseline utilities for individuals could be derived from responses within the HSE; for example with the EQ-5D as relevant to the given intervention or disease area.

2 Run your analysis

There are a few considerations to keep in mind when calculating the financial investment (denominator) and net financial returns of the intervention (numerator) of your ROI equation:

Considerations when calculating the financial investment:

Typically, you would use the same methods to estimate the financial investment that you would use for programme budgeting or financial accounting of actual costs. The costs involved in implementing an intervention may be incurred at different stages, for example: planning and development, training, startup, ongoing operation, monitoring, maintenance, shutdown) of the intervention.

Some example categories of costs at each stage are **staff, supplies, equipment, training, information systems, outreach and communications, and external consultant costs.**

Considerations for calculating net return:

Using the example of a hospital setting, you would need to capture two types of financial effects to calculate net return: (1) changes in the hospital's revenues and (2) changes in its operating costs. For example, by reducing its infection rates, a hospital could eliminate the costs it had been incurring to provide the extra care required to treat infections. It could also enhance or protect its revenues, if the NHS or healthcare payer offered incentives for infection control or imposed penalties for occurrences of infections.

When calculating the hospital's net return for the ROI, it is necessary to consider that the effects on revenues and effects on costs work in opposite directions. From the hospital's perspective, an increase in revenues is good, so a higher revenue due to improvement actions should be a positive number. On the other hand, a decrease in costs is good, so a lower cost due to improvement actions is good.

Once you have estimated the intervention costs and the net effects on revenues and costs, the actual calculation of the ROI ratio is quite simple. Simply divide the estimated total net returns by the total investment. For even more detailed step by step guidance on how to calculate your intervention costs and net return inputs for your ROI calculation, the **Agency for Healthcare Research and Quality (AHRQ)** in the United States has developed worksheets[10] you can complete to obtain these estimates, which you can find in the appendix of this document.

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

$$ROI = \frac{\textit{Net financial returns from the intervention}}{\textit{Financial investment in the intervention}}$$

10 https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/qitoolkit/combined/f1_combo_returnoninvestment.pdf

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

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

In other words, **the ROI is the key outcome measure represented by dividing total discounted benefits (financial returns) by total discounted costs (financial investment)**. When costs or benefits are 'discounted', this refers to costs and benefits which are predicted to occur in the future and are usually valued less than present costs. Where the time horizon is greater than one year, it is recommended that all costs and outcomes are discounted at a rate of 3.5% for costs and 1.5% for benefits. Examining anticipated financial outcome data can help hospital and health system leadership make more informed decisions when prioritising resources for new initiatives.

You can also calculate cost savings with the same inputs you just used in the ROI calculation. Cost savings may be of interest to certain individuals to answer the question "How much did we save?" The cost savings is the difference between returns and costs:

Cost savings = Net financial returns - Financial investment

3 Interpret the output

The output will show the potential return on investment if the user was to implement the chosen intervention in their population of choice. **The ROI values show the estimated value generated for every £1 spent on the intervention.**

- **ROI < 1 → intervention costs more than it returns**
- **ROI = 1 → intervention breaks even**
- **ROI > 1 → intervention generates net financial benefit**

If the ROI value is less than £1 for every £1 spent, this indicates that the cost of the intervention is greater than the value generated in one year, in the population selected. For example, an ROI of -1.5 indicates that for every £1 invested, £1.50 will be lost. As another example, an ROI of 0.8 indicates that for every £1 invested, 80 pence will be recouped.

Conversely, when an ROI is greater than or equal to £1, the returns generated by the intervention are greater than or equal to the costs for development and implementation. In this case, the ROI is positive. For example, an ROI of £1.80 indicates that for every £1 you invest in the intervention, £1.80 will be gained.

Understanding the point of view for ROI calculations is extremely important in interpretation. When performing your ROI calculations, you will develop estimates that represent the perspective of a specific party (i.e., a hospital, the NHS/PSS perspective, an investor), meaning both the investments and net returns are those of that party itself, as is the resulting ROI ratio.

Additional caveats to keep in mind

Time Horizon - results depend on short vs. long-term view

The choice of the time for the ROI calculation will affect results of the calculation in a couple of ways:

1. The costs of an intervention are usually high at the beginning of the programme while the investor must wait for some time to see the returns. Therefore, if the ROI is calculated at the initial stage of the programme, the result is likely to be negative. In comparison, if the ROI is calculated in the long run, the chance of having positive results will increase.
2. If the time horizon is only one year, the cost calculation may not need to consider the issues of inflation, discounting, and depreciation. Conversely, if the time horizon is two years or longer, the analysis must adjust for these issues.

Inflation and discounting – adjust future costs/benefits to today's value

Inflation: refers to rises in the prices of goods and services over a period. The ROI calculation can adjust for inflation by using constant pounds to measure the costs of a programme over a period.

Discounting: the difference between the original amount in the present and the same amount in the future. In other words, £50 next year is worth less than £50 this year. Therefore, future money must be discounted to be comparable to current money.

Depreciation: equipment loses value over time. The reduction in the value of an asset due to usage, passage of time, wear and tear, technological outdating, depletion, inadequacy, or other factors. You can calculate depreciation using the following formula:

Annual depreciation = [(Original cost) - (Salvage value)] / Years of life

Where the salvage value is an estimate of the value of the asset at the time it will be sold or disposed of; it may be zero or even negative.

Key broad questions to consider at project design stage to ensure a future Health Economic Assessment is possible:

In addition to calculating your ROI for your project proposal or business plan submission, you may want to think about the possibility of a future health economic assessment. To ensure a future health economic assessment is possible, there are some key questions to consider at the earliest opportunity in an intervention's implementation.

Design questions

1. **Who wants to know what?**
   Clarify what the aim is, including who it is for. This will help in deciding which economic question you wish to answer, such as identifying the least costly or most-effective option. In other words, what is the main research question and what are the key elements of the intervention (i.e., who is the target population, what is the technology, process, or product, etc.)?

2. **What is the time horizon of the study?**
   This needs to be long enough to capture all the costs and outcomes associated with the intervention.

3. **Consider whether to collect bespoke data before the intervention begins.**
   a. Identify appropriate measures and data collection as the initiative goes forward, especially where the data are not routinely collected. Plan the design, collection, and analysis of measures carefully to minimize the risk of bias and other data errors. What data would you have access to, or would you need to collect? What baseline data would be available?
   b. It may be an option to carry out analysis at a later date retrospectively through data. However, the required data may not be available risking the evaluation being either less robust or in some cases not possible at all.

4. **Is there a comparable group or service?**
   Possibilities may include a comparison between similar services, or between matched groups of patients, one of which is not affected by the intervention.

5. **Which perspective is being taken[11]?**
   In other words, whose costs and benefits are we considering? It's worth noting, the more groups you want to include, the more data you will need and the more complex the analysis will be; which may make it difficult to conclude with robust findings.

6. **What costs and benefits are relevant to this intervention?**
   It's important to understand and state limitations upfront: it is unlikely that all costs and benefits can be captured. So, whilst you should take all reasonable steps to identify important costs and benefits (including unintended consequences), if some simplification of the analysis is necessary considering missing data, make sure to state this.

7. **What existing literature is already available?**
   What can be learnt from existing published literature, as well as unpublished sources?

11 Examples of resources from the NHS perspective: staff costs, such as training or time, capital costs such as when an additional venue or facility needs to be used or built, equipment costs including maintenance and repair, rent costs, treatment costs such as medication or inpatient stay, consumables costs such as wound dressings, overheads costs such as cleaning services and lighting and electricity.

Methodological questions to consider:

1. **Is a well-defined question being posed?**
   1. What is the perspective?
   2. How many options are being compared?
   3. Are both costs and consequences considered?
   4. What is the time horizon?
2. **Can the effects of the intervention be identified, measured, and valued appropriately?**
   For example, effects can be measured in natural units (e.g. years of life) or more complex units (e.g. years adjusted for quality of life) or monetary equivalents of the benefit gained (e.g. £).
3. **Is the sample representative of the general population?**
4. **Are the costs translatable to the setting?**

Summary

Developing even a simple ROI at the business case stage helps strengthen funding proposals by demonstrating foresight, transparency, and a commitment to value for money. While ROI alone is not a substitute for a full health economic assessment, it provides an accessible first step in embedding economic thinking into project design. By considering the key design and methodological questions outlined above, researchers can ensure their projects are set up to generate meaningful evidence, attract investment, and enable more detailed economic evaluation in future stages. The appendix provides practical worksheets to help you apply these concepts to your own project planning.

For further information or support from a Health Economist, please contact us at healthinformatics@healthinnovationeast.co.uk to discuss your needs.

Appendix

Worksheet 1: Calculating Implementation Costs (ROI Denominator)[12]

These worksheets help you apply the ROI method step by step. Complete them using your best estimates if real world data are not available.

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 programme 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.
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 denominator for the ROI calculation).

Category of Implementation Costs	Implementation Costs by Stage of Improvement Actoin Implementation					
	Planning and Development	Training	Startup	Ongoing Operation and Maintenance	Shutdown	Total Costs
Personnel						
Supplies						
Equipment and depreciation						
Training						
Information systems						
Outreach and communication						
External consultant costs						
Total Costs						

12 https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/qitoolkit/combined/f1_combo_returnoninvestment.pdf

Worksheet 2: Calculating Net Returns (ROI Numerator)[13]

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 changes 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 (the numerator for the ROI calculation).

	(Real) Financial Effects of Improvement Actions			NOTES
Effects Identified	**(A) Comparison Period**	**(B) Implementation Period**	**Net Change**	**(Description of Effects Involved in Revenue or Cost Changes)**
Changes in Revenues:			(B minus A)	
Admissions, readmissions, length of stay				
Payments from insurers				
New services provided				
Avoidance of penalties from insurers for "never events"				
Other effects on revenues				
Changes in costs:			(A minus B)	
Service operating costs: staffing, supplies, equipment, other due to:				

13 https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/qitoolkit/combined/f1_combo_returnoninvestment.pdf

Admissions, readmissions, length of stay				
Intensity of care				
Productivity/ efficiency changes				
Avoidance of liability litigation				
Other effects on costs				
Net Financial Effect (Total)				

Case study example[14]

The Agency for Healthcare Research and Quality has helpfully provided a case study example of an ROI calculation for the implementation of a system within a hospital setting, which you can find below:

> "This case study is summarised 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)[15]. 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 CPOR 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 programme (numerator).

To estimate the savings generated from the CPOE system, the ROI team retrospectively identified each way the practice saved money (for a detailed description of each element of the programme and its method of cost savings, see Kaushal, et al., 2006). The benefits were determined using published literature, key informant interviews, and internal documents. For many components of the CPOE, the number of estimated adverse drug events (ADEs) averted was multiplied by an average cost per ADE.

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14 https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/qitoolkit/combined/f1_combo_returnoninvestment.pdf

15 Kaushal R, Jha AK, Franz C, et al. Return on investment for a computerized physician order entry system. J Am Med Inform Assoc 2006;13(3):261-6

Other types of cost savings identified included decreased drug costs (decreased use and shift from use of intravenous to oral medications, decreased laboratory tests, reduction in use of inappropriate radiology tests, savings in nursing and provider time by improved workflow). Drugs and tests were valued using charge amounts and applying a 0.2 cost-to-charge ratio).

Because different elements of the CPOE system were introduced in stages, benefits were only calculated for those elements starting on the first day of the month after the element was implemented. This process was repeated for every intervention and area of cost savings; they found that the system saved the hospital $28.5 million over the 10 years. Note that cost savings identified in their net return analysis does not take implementation costs, the denominator, into account.

Selecting the time horizon.
The staff assessed the ROI of the CPOE system over a period of 10 years to allow enough time to see a return. Because the time horizon was longer than 2 years, they needed to adjust for the following issues:

1. **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 standardise values to 2002 currency.
2. **Discounting:** All costs and benefits were discounted at a 7 percent annual percentage rate as recommended by the U.S. Office of Management and Budget for economic analyses performed for the Federal Government, representing a societal discount rate as opposed to a hospital-specific rate. Costs were discounted using a "beginning-of-period" convention and benefits were discounted using an "end-of-period" convention.
3. **Annualisation:** Annualised values were calculated by converting all the discounted costs and benefits into a series of equal annual payments.

Interpreting the results.
The ROI analysis yielded a positive return on investment – the CPOE system saved the hospital about $2.2 million per year over the 10-year period. It took more than 5 years for the system to have a net benefit.

Information BWH Used to Conduct an ROI Analysis for CPOE Implementation.

Element of Analysis	Measure(s) or Values	Description or Inclusions
Costs (denominator)	$11.8 million total: $3.7 million in capital costs; $600,000 to $1.1 million per year in operational costs	Workstations and printers, software, network, leadership, and training.
Returns (numerator)	$28.5 million	Averted adverse drug events; medication cost savings; decreased laboratory test usage for redundant or unnecessary tests; improved workflow (staff and resource savings); decreased length of stay; streamlined workflow; improved information access for patients at time of discharge; decreased radiological utilization
Discount rate	7% annualized rate	

Element of Analysis	Measure(s) or Values	Description or Inclusions
Consumer Price Index	$11.8 million total: $3.7 million in capital costs; $600,000 to $1.1 million per year in operational costs	Bureau of Labor Statistics' Producer Price Index time series for General Medical and Surgical Hospitals to standardize values to a 2002 base year
Prospective Reimbursement Rate (cost-to-charge ratio)	80%	
Live date (returns)	First day of the month following activation of the intervention or midpoint of the year (July 1) when only annual data were available	This is the date when they started counting the number of cost-saving events and calculating the associated cost savings.
Live date (start of calculating operational costs)	January 1, 1993	This is the date when the practice began to accrue operational costs.
End date	December 31, 2002	This date signifies the end of the study period.

Next Steps: How to get in touch for Health Economics Support

If you're exploring the impact of a healthcare intervention and would like to understand its economic value—whether through a basic return on investment (ROI) estimate or a more formal health economic analysis—we can help.

We specialise in supporting academic researchers by using high-quality NHS secondary care data, accessed within the secure data environment (SDE) for the East of England, to deliver meaningful and rigorous evaluations. You don't need to have a background in health economics—we're here to translate your research goals into economic questions and guide you through the process.

Avenues of Support

We offer a flexible range of support, depending on where you are in your research and what kind of economic input you need.

1 If you're applying for a funding call

and need **a quick, high-level return on investment (ROI) estimate** to include in your application or case for support, we can typically turn this around from **4-6 weeks**, depending on the complexity of the intervention and the data available.

- This kind of estimate is often based on published evidence, simple modelling assumptions, and local data where possible, providing enough rigour to strengthen a funding bid without requiring a full economic analysis.

2 For more in-depth support

such as **scoping or delivering a formal health economic assessment**, we can offer a range of tailored options.

- This might include identifying appropriate comparators, mapping out patient pathways using local data, and advising on appropriate modelling approaches (e.g. cost-effectiveness, budget impact).
- These projects are more bespoke and often evolve alongside your research, so timelines can vary. Typically from **6–8 weeks for a scoping piece**, to **4–6 months or more** for a full health economic evaluation depending on data access, methods, and study complexity.
- We're happy to collaborate on funding proposals, contribute to research design, or be involved as co-applicants or project partners where appropriate.

Please get in touch to discuss your needs. We're happy to provide advice on the most appropriate level of input and offer a clearer estimate once we understand your project in more detail.

We can be best reached at:
healthinformatics@healthinnovationeast.co.uk

Glossary

Incremental cost effectiveness ratio (ICER): ICERs help to determine whether the additional benefit of a treatment is worth the additional costs compared to an alternative option. The ICER represents the additional cost for each additional unit of effectiveness (e.g., an additional QALY) gained from one intervention over another.

- A lower ICER suggests that a treatment is more cost-effective, meaning it provides more benefit per unit of cost.
- A higher ICER suggests that the treatment is more expensive for the additional benefit it provides.

$$ICER = \frac{Cost\ of\ Intervention\ A - Cost\ of\ Intervention\ B}{Effectiveness\ of\ Intervention\ A - Effectiveness\ of\ Intervention\ B}$$

Example:

Imagine two treatments for a disease:
Treatment A costs $50,000 and provides 2.5 QALYs.
Treatment B costs $30,000 and provides 2 QALYs.

Using the ICER formula:

$$ICER = \frac{50{,}000-30{,}000}{2.5-2} = \frac{20{,}000}{0.5} = 40{,}000$$

Meaning: the ICER is GBP 40,000 per additional QALY gained by using Treatment A instead of Treatment B.

Quality adjusted life year (QALY): attempts to combine the effects of an intervention on both mortality (how long people live for) and morbidity (how well people are). One QALY represents one year of life in full health. It helps to compare options by considering both survival and quality of life, and to prioritize treatments or public health programmes based on the greatest health gain per dollar spent. To calculate QALYs, you will need to measure life years and HRQoL.

Example: If a new treatment gives a patient 5 extra years of life at a quality of 0.8 (80% of full health):

$$QALYs = 5 \times 0.8 = 4.0$$

Disability adjusted life year (DALY): a measure used in public health to assess the overall burden of disease. A DALY represents one lost year of "healthy" life due to either premature death or living with illness or disability. DALYs are used in public health prioritization, to compare the burden of different diseases and conditions, while helping governments and NGOs decide how to allocate health resources effectively.

Example: If someone dies at age 40 and the life expectancy is 80, that's 40 years of life lost (YLL). If they lived for 10 further years with a disability that has a weight of 0.5, that's 5 years lived with a disability (YLD). Therefore, **total DALYs would be 40 + 5 = 45 DALYs lost.**

Life years are estimates of how far an intervention extends life.

Health related quality of life (HRQoL) reflects an individual's perceptions of their own health, shown as specific health states or dimensions. There are many ways to measure HRQoL, the most widely used are generic measures such as the EQ-5D and the SF-36.

EQ-5D: a patient questionnaire developed by EuroQol for use in clinical and economic appraisal and population health surveys representing a measure for health-related quality of life[1]. It consists of two parts: a descriptive system and a visual analogue scale (VAS).

- The descriptive system comprises five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has 5 levels: no problems, slight problems, moderate problems, severe problems, and extreme problems.
- The EQ VAS (visual analogue scale) records the patient's self-rated health on a vertical visual analogue scale where the endpoints are labelled 'The best health you can imagine' and 'The worst health you can imagine'. The VAS can be used as a quantitative measure of health outcome that reflects the patient's own judgement.

SF-36: a short form health survey comprised of 36 items, developed by RAND[2].

- It assesses 8 health concepts: limitations in physical activities because of health problems, limitations in social activities because of physical or emotional problems, limitations in usual role activities because of physical health problems, bodily pain; general mental health (psychological distress and well-being); limitations in usual role activities because of emotional problems; vitality (energy and fatigue); and general health perceptions.
- It asks for participants to reply to questions according to how they have felt over the previous week using Likert-type scales.

1 EQ-5D-5L - EuroQol
2 36-Item Short Form Survey (SF-36) | RAND

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