Health Care Analysis 1: Hip Replacement

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A. Introduction

The U.S. GAO (2011) and the popular press (see the New York Times and Wall Street Journal references) find the following problems with health care cost, benefit, and performance data in the USA:

- Consumers don't receive information about the costs of their treatments until after the treatment occurs.
- The cost for the same health care treatment varies by several orders of magnitude. For example, the costs for a hip replacement varied by a factor of 10 (from $11,100 to $125,798).
- The definition of health care costs or benefits varies widely. For example, treatment costs differ depending on whether they are list price, market price, insurance-negotiated price, government imposed price, cost of production price, or some other price.
- Costs fail to account for the full cost of treatment. For example, the cost of a hip replacement in a typical hospital does not include the associated outpatient rehabilitation or new household furniture purchases needed because of the treatment.
- The variety of consumer health benefit structures (premiums, insurance reimbursement amounts, copays, employer penalties, deductibles, in-network versus out-of-network fees) makes it difficult to estimate a patient's out-of-pocket costs. Some insurance companies have specific agreements with some health care providers not to reveal data about costs.
- The quality of medical treatments is largely ignored. For example, in the case of a hip replacement, consumers can't access data about potential outcomes of treatments such as

rates of mortality, hip dislocations, inflammatory reactions, surgical wound infections, or blood clots.

- Data is not available summarizing patients' experiences with the health care they received. Treatments can't be assessed in terms of patient satisfaction with the treatment including their ratings of physical pain, mobility, emotional state, or other physical and socioeconomic factors.
- High costs help some health care providers "game" the system. The nature of the games vary from deducting higher costs on IRS reported expenses, providing medical services that aren't needed, billing the same procedure differently depending on the location of the procedure (i.e. office versus clinic), and using the billed cost to negotiate higher patient and insurance company payments.
- Governments and health care providers determine prices for medical services using opaque and mysterious methods. For example, the U.S. Medicare payment system releases one magical payment number for each reimbursable expense with no documentation about how that number is derived.
- Although health insurance companies are starting to cap payments for some types of medical treatments, they are doing so on a fragmented, company-by-company, experimental basis. In addition, they still haven't come up with uniform standards for pricing medical services and they are still unsure about how to uniformly measure the value of medical services. Public goods knowledge banks, social budgeting, uniform data standards, open source software platforms, and other types of modern information institutions, receive scant attention.
- Despite all of these data deficiencies, health care researchers and policy makers freely speak of "health care costs and benefits". In many instances, it's not clear they know the costs for a single medical treatment (**2***).

In fairness, some of these issues are starting to be addressed by governments (**6***), insurance companies, and health care providers, but this reference documents straightforward tools and techniques available in DevTreks that were built specifically to tackle these types of issues (**3***). The examples in the following sections use cost and benefit estimates completed for single

medical treatments to demonstrate better data management practices. In practice, doctors and hospitals usually need to report on populations of patients. Later sections of this reference address improved health care delivery at national and population scale.

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B. Value Based Purchasing (VBP)

One of the most important trends in health care in the U.S.A. right now is to base payments on outcomes, rather than strictly services. The U.S. Centers for Medicare and Medicaid Services (2013) explains their motivation for moving from "cost oriented" to a "performance oriented" payment systems as follows: "(Medicare) has begun to transform itself from a passive payer of services into an active purchaser of higher quality, affordable care. Further future efforts to link payment to the quality and efficiency of care provided, would shift Medicare away from paying providers based solely on their volume of services. The catalyst for such change would be grounded in the creation of appropriate incentives encouraging all healthcare providers to deliver higher quality care at lower total costs. This is the underlying principle of value-based purchasing (VBP). The cornerstones of VBP are the development of a broad array of consensus-based clinical measures, effective resource utilization measurement, and the payment system redesign mentioned above. The overarching goal would be to foster joint clinical and financial accountability in the healthcare system."

A recent newspaper article (NYT, June 2013, Employers Test Plans That Cap Health Care Costs) describes employers' motivation for using VBP to cap prices for medical treatments as follows: "(One employer capped medical service prices) that had a significant variation in price but did not vary in quality from provider to provider. … Employers that offer health plans have been pushing hard to get information on pricing and quality so their workers can make more informed decisions about providers".

In DevTreks, VBP, is similar to Earned Value Management (EVM) and Monitoring and Evaluation (M&E) (see the EVM and M&E references), but, in the case of government payment programs, VBP places greater emphasis on providing incentive payments for services that are delivered with higher quality, and better results, per unit of cost. In the case of insurance companies, VBP is used to cap medical treatment prices paid reimburse health care providers (NYT, June 24, 2013). The incentive, and price capping, systems use indicators to measure the efficiency of resource consumption (costs), the quality of a service (benefits), and the performance of the entity delivering the service (performance). These indicators are often measured using satisfaction surveys completed by patients, and performance reports completed

by health care providers. The specific content of the surveys and reports makes their uniform automation more of a task than simpler, more generic, EVM, M&E, and Resource Stock, measurement tools (i.e. Percent Complete or Weighted Milestone). The examples in this reference demonstrate that DevTreks' M&E and Resource Stock tools can be used to summarize the more comprehensive outcome results taken from the survey instruments and performance reports.

C. Work Breakdown Structures (WBS)

The health care industry takes classification codes, or Work Breakdown Structures, for medical services quite seriously. Providers of medical services are reimbursed based on industry-accepted, and government-mandated, codes. For costs, the USA uses four main coding systems for medical services (US CMS, 2013):

- **ICD10 PCS**: International Classification of Diseases, 10th Revision, Procedure Coding System. The U.S. CMS (2013) describes these codes as follows: "The ICD-10-PCS is a procedure classification published by the United States for classifying procedures performed in hospital inpatient health care settings."
- **ICD10 CM**: International Classification of Diseases, 10th Revision, Clinical Modification. The U.S. CMS (2013) describes these codes as follows: "The ICD-10-CM is a morbidity classification published by the United States for classifying diagnoses and reason for visits in all health care settings. The ICD-10-CM is based on the ICD-10, the statistical classification of disease published by the World Health Organization (WHO)."
- **HCPCS/CPT**: Healthcare Common Procedure Coding System/ Current Procedural Terminology. The U.S. CMS (2013) defines these codes as follows: "Level I of the HCPCS is comprised of CPT (Current Procedural Terminology), a numeric coding system maintained by the American Medical Association (AMA). The CPT is a uniform coding system consisting of descriptive terms and identifying codes that are used primarily to identify medical services and procedures furnished by physicians and other health care professionals. These health care professionals use the CPT to identify services

and procedures for which they bill public or private health insurance programs. Decisions regarding the addition, deletion, or revision of CPT codes are made by the AMA. The CPT codes are republished and updated annually by the AMA. Level I of the HCPCS, the CPT codes, does not include codes needed to separately report medical items or services that are regularly billed by suppliers other than physicians (… so a Level II defines additional codes)".

- **ICD-10-CM/PCS and MS-DRG**: Medicare Severity Diagnosis Related Groups. The U.S. CMS defines these in a Definitions Manual (in 2013, version 30.0 of the manual is available). Hospitals assign inpatient stays to one group using the principal diagnosis and procedures defined in the ICD10 codes. Hospitals are reimbursed based on a base cost multiplied by a weight (see the US CMS. PPS web site for a full explanation)

This reference primarily uses the MS-DRG coding system, but the DevTreks database includes examples of how to use the ICD10 CM and HCPCS/CPT coding systems. The ICD10 PCS system uses a "deep" hierarchical system that requires adaptation to fit into DevTreks (i.e. similar to the ICD10 CM hierarchy).

The health care industry has not made the same progress in coding the outcomes, or performance, of medical treatments. The U.S. CMS has begun to reimburse health care providers using several performance measurement systems, and their codes. Some of these systems are:

- **AHRQ Quality Indicators** (QIs): The US Agency for Healthcare Research and Quality (2013) defines these: "are measures of health care quality that use hospital inpatient administrative data and can be used to highlight potential quality concerns, identify areas that need further study and investigation, and track changes over time."
- **NQF Cost and Resource Measures:** The US National Quality Forum describes their project as "to advance the (US) National Quality Strategy affordability aim through the review and endorsement of cost and resource use measures for high impact clinical areas".

- **Hospital IPPS:** The US CMS (2013) describes the Hospital Inpatient Prospective Payment System (IPPS) as follows: "CMS established a set of quality measures, used to gauge how well an entity provides care to its patients. Measures are based on scientific evidence and can reflect guidelines, standards of care, or practice parameters. In this instance, a quality measure converts medical information from patient records into a rate or percentage that allows facilities to assess their performance. Hospitals submit quality data through the secure portion of the QualityNet Web site (www.QualityNet.org). Data from this initiative are used to populate the Hospital Compare website."
- **PQRS**: The US CMS (2013) describes the process as "The Physician Quality Reporting System (PQRS) is a reporting program that uses a combination of incentive payments and payment adjustments to promote reporting of quality information by eligible professionals." Furthermore, "In general, the quality measures consist of a unique denominator (eligible case) and numerator (clinical action) that permit calculating the percentage of a defined patient population receiving a particular process of care or achieving a particular outcome."
- **HCAHPS**: The US CMS (2013) describes the process as "The HCAHPS (Hospital Consumer Assessment of Healthcare Providers and Systems) survey is the first national, standardized, publicly reported survey of patients' perspectives of hospital care. HCAHPS (pronounced "H-caps"), also known as the CAHPS Hospital Survey, is a survey instrument and data collection methodology for measuring patients' perceptions of their hospital experience." A Wall Street Journal reference (October, 2012) explains how hospitals use this system.

Systems are also available for nursing homes, hospices, and other types of health care providers. Unlike a coding system such as ICD10, these classifications are much less mature and much more fragmented. The examples below demonstrate how these indicators can be used in DevTreks.

The international community also uses indicator systems to monitor the performance of health care sectors. The following example demonstrates that WHO provides global standards for indicators:

- **IHP/WHO**: The IHP and WHO (2011) describe the general use of indicators as "Indicator definitions should be aligned with global standards, which are available from WHO for virtually all disease areas and for health system monitoring. Indicators should include all necessary metadata descriptors: a clear description of its definition, the method of data collection and analysis, the frequency of measurement, and the level of disaggregation. Eventually, every country should maintain an indicator and metadata registry, linked to the country observatory of health statistics, within which core and supplemented indicators would be identified and defined along with data sources, analytic methods and the statistical values for the indicators (see: http://www.who.int/gho/indicator_registry/en/) ."

Because a full U.S. hip replacement dataset is unavailable for the examples that follow, the actual codes and prices used in the examples are not necessarily accurate and, in some cases, had to be invented.

D. Data –Hip Replacement Medical Treatment Example

This reference uses a hip replacement medical treatment (see New York Times, 2-12-2013, The Price for a Hip Replacement? Many Hospitals are Stumped) to demonstrate alternative ways to measure health care costs, benefits, and performance. The U.S. National Institute of Arthritis and Musculoskeletal and Skin Diseases (2013) and the American Academy of Orthopedic Surgeons (2013) have web sites that provide complete overviews of hip replacement treatment technologies, including: why a replacement may be needed, alternatives to consider, what takes place during a hip replacement treatment, life style adjustments that need to be made to deal with the treatment, and possible side effects associated with the surgery. These two overview sites are used in the examples to help define a "full" hip replacement treatment.

Costs are defined using the following sources:

1. A partial hip replacement cost estimate taken from a European dataset (see the English cost estimate in the Stargardt, 2008 or Geisler, 2011, references; converted using 1 Euro = 0.75 dollars for 2007/2008). Selected costs from a hip replacement Health Technology Assessment (de Verteuil, 2008, same conversion rate). Although these costs are not representative of U.S.A. health care costs, they demonstrate how to complete unit costs. They also highlight problems encountered comparing international health care costs (the Health Care Analysis 2 reference uses this dataset to conduct various types of analysis).
2. Typical U.S.A. costs for some cost elements (hospital room, doctor visit).
3. Suggestions taken from the two overview web sites (physical therapist, home improvements, transportation).

Three federal government medical cost databases are available in the USA -the Healthcare Cost and Utilization Project (HCUP), the Medical Expenditure Panel Survey (MEPS)), and Medicare price data. In addition, insurance companies and health care providers are starting to release additional health care datasets. DevTreks recommends using this type of data to develop "unit" input cost and output performance data that can be bulk uploaded into the database. The ICD10 and HCPCS WBSs have been bulk uploaded into Input, Output, Component, Outcome, and Budget datasets (examine the URIs above), but cost, benefit, and performance calculator data is not available to also bulk upload. The Malnutrition Analysis 1 tutorial provides a fuller example of using bulk uploads to manage data. The Resource Stock and Monitoring and Evaluation tutorials demonstrate storing the data as TEXT datasets linked to calculators.

Outcome data for a U.S.A. hip replacement could not be found. Benefits are defined using the following sources:

1. A fictitious final score taken from a U.S.A. patient reported satisfaction survey (see Section C, HCAPHS). The survey focuses on the quality of the communication and care received during inpatient stays. Many U.S.A. hospitals administer this survey to their patients because Medicare provides incentives to them when the scores are high.

2. A fictitious final score taken from a Health-Related Quality of Life patient survey. Several surveys are available that focus on hip replacement surgery alone (Faulkner, 1998, Fitzpatrick, 1998), but those surveys tend to be narrowly focused on the physical effects of the treatment. More comprehensive, but generic instruments (SF12, SF36, EQ-5D; see deVerteuil, 2008), measure additional dimensions of medical treatment quality, including social, emotional, and economic dimensions. The second output indicator takes the final score from these types of instruments. Medicare is also moving towards providing incentives for high scores on these types of instruments.
3. Two fictitious indicators reported using Medicare's Physician Quality Reporting System (see Section C, PQRS). Health care providers submit this report to Medicare because they get financial incentives for scores that signal high quality care.

Data for U.S.A. patient out-of-pocket-expenses related to hip surgery could not be found. Out-of-pocket-expenses are defined using the following source:

1. Premiums, rewards, and penalties come from a recent newspaper article (NYT, May 30, 2013) about a new U.S.A. insurance payment system that will provide incentives and penalties for patient behavior. Other expenses, such as copays, use fictitious U.S.A. rates.

The data can be examined by navigating through the following URIs. These datasets are owned by the HealthTreks West club in the HeathTreks network group (if needed, switch default clubs).

- **Input Service URI**: https://www.devtreks.org/healthtreks/select/urbandelivery/servicebase/Inputs, MS-DRG/2660/none/
- **Output Service URI (4*)**: https://www.devtreks.org/healthtreks/select/urbandelivery/servicebase/Outputs, MS-DRG/2664/none/
- **Component Service URI**: https://www.devtreks.org/healthtreks/select/urbandelivery/servicebase/Components, MS-DRG/2661/none/

- **Outcome Service URI (4*)**: https://www.devtreks.org/healthtreks/select/urbandelivery/servicebase/Outcomes, MS-DRG/2663/none/
- **Investment Service URI (4*)**: https://www.devtreks.org/healthtreks/select/urbandelivery/servicebase/Investments, MS-DRG/2662/none/
- **Multimedia Service URI**: https://www.devtreks.org/healthtreks/select/urbandelivery/servicebase/Health Care Resources/2632/none/
- **Story Service URI:** https://www.devtreks.org/healthtreks/select/urbandelivery/servicebase/Health Care Stories, Calculators, and Analyzers/2633/none/

The lack of real data, and real WBS codes, is problematical, but as explained in the Introduction, that's the problem being addressed by this reference. Readers should focus on the "big picture" - the social networks, knowledge banks, data structures, open source platform, tools, and techniques that can be used to collect and analyze the missing data.

E. Data -Stakeholder Perspectives

Two primary stakeholder perspectives will be used in the examples (Example 4a in the Social Performance tutorial explains more about these perspectives). The first perspective, Societal, is that of a government who needs to know the full resource costs and benefits of a treatment in order to set payment schedules. DevTreks recommends using this type of budget to explain health care costs and benefits. Typical costs include doctor visits, physician labor, attendant labor, x-rays, anesthesia and other drugs, household adjustments, earned income opportunity costs, administrative overhead costs, and profits. Typical benefits are measured using outcome indicators that include mortality rates, hospital stay days, complication rates, and patient-reported satisfaction rates.

The second perspective, Patient, is that of a patient interested in knowing their total personal cost for the treatment, including copays, deductibles, insurance company payments, premiums, and home improvement expenses. They also want to know the likelihood of a treatment's outcome, and are interested in the same outcome indicators as the Societal Perspective. Readers should recognize that the existing WBSs used by the health care industry (Section C) were designed to be used by health care professionals, not patients. All of those WBSs need to be revised to include patient-centric language and explanations. In the interim (until somebody in the industry comes to their senses), we recommend keeping the WBS code but changing the name to a patient-friendly name.

These are not the only perspectives possible and the examples that follow are not the only way to document costs and benefits for a perspective. For example, the examples that follow use Capital Budgets because, from the patient's perspective, a hip replacement is an investment with a 20 year life. However, from a hospital's perspective, or Industry Perspective, the costs are incurred annually and should be documented using annual Operating Budgets. Other providers may prefer to use Cost of Production studies that document machinery, equipment, and other non-expendable costs, as allocated overhead costs (i.e. refer to the Capital Input calculator in the Capital Input tutorial). Section 0. Knowledge Bank Standards, discusses the role of networks in setting data standards that meet the needs of the clubs in a network. In addition, as open source software, anyone can develop additional benefit and cost tools.

The examples that follow are more comprehensive than most other examples of health care costs and benefits (i.e. the state government web sites mentioned in the GAO, 2011 reference). In fact, health care practitioners are unlikely to have ever seen, let alone completed, these types of budgets. Although WHO (2003) recognizes the importance of using budgets to define health care costs and benefits, most of the health care literature ignores them. That's not because they're not the correct instrument, it's because the evidence (see the US CMS references) suggests that cost and benefit data is being "tagged onto" existing payment and financial accounting systems in a piece meal fashion. These are the same systems that cause most of the problems being addressed in this reference (**5***).

F. Example 1. Societal Perspective, Net Present Value (NPV) and Monitoring and Evaluation (M&E) Analysis

Example 1 documents costs and benefits using a Societal Perspective that is interested in knowing the economic, or full resource, costs and benefits of an investment for a single hip replacement treatment. DevTreks' NPV tools are used to document costs. DevTreks' M&E or Resource Stock tools are used to document benefits.

A. Basic WBS Cost Structure

The following basic WBS was used to classify all cost elements (Inputs and Components). Because drugs are a significant element of health care costs, we recommend specifying the price and cost for specific drugs.

Type: 13. Diseases and disorders of the musculoskeletal system and connective tissue

Group: DRG469. Major Joint Replacement or Reattachment of Lower Extremity

Component: 0SR9019a- 2007 Orthopedic Evaluation (Total Cost : $440)

Input 1: OSR9019L1. 2007 Orthopedic Doctor Visit (2 visits * $150 = $300)

Input 2: OSR9019T1. 2007 Tests, X-Rays (1 set * $120 = $120)

Input 3: OSR9019T1. 2007 Laboratory Fees (1 each * $10 = $10)

Input 4: OSR9019M1. 2007 Materials, General (1 each * $10 = $10)

Component: 0SR9019. 2007 Replace Hip Joint with Metal Syn Subs, Cem, Open (Total Cost : $12,096)

Input 1: OSR9019M1. 2007 Materials, Hip Joint Metal Synthetic Substitute (1 each * $880 = $880)

Input 2: OSR9019L1. 2007 Labor, Physician (2 hours * $152.5 = $305)

Input 3: OSR9019L1. 2007 Labor, Nurse (3 hours * $55 = $165)

Input 4: OSR9019L1. 2007 Labor, Anesthetist (2 hours * $152.5 = $305)

Input 5: OSR9019D1. 2007 Drugs, Anesthesia (1 each * $165 = $165)

Input 6: OSR9019M1. 2007 Materials, Surgery (1 each * $142 = $142)

Input 7: OSR9019D1. 2007 Drugs, Drug 01 (3.5 days * $171 = $598.5)

Input 8: OSR9019R1. 2007 Room, Hospital Stay (3.5 days * $1500 = $5250)

Input 9: OSR9019A1. 2007 Overhead, Administrative ($7810.28 percentage * .28 = $2186)

Input 10: OSR9019P1. 2007 Profit ($9997 percentage * .21 = $2099)

(**Note**: the last two numbers have to be added using the percentage as a price because the percentage is fixed while the amount varies for each treatment).

Component: 0SR9019b- 2007 Hip Replacement Home Recovery (Total Cost : $2,409)

Input 1: OSR9019L1. 2007 Orthopedic Doctor Visits (4 visits * $150 = $600)

Input 2: OSR9019L1. 2007 Physical Therapy Visits (4 visits * $81 = $324)

Input 2: OSR9019L1. 2007 Labor, Nurse (2 hours * $55 = $110)

Input 3: OSR9019D1. 2007 Drugs, Pain Relief Drug 01 (100 pills * $5.75 = $575)

Input 4: OSR9019H1. 2007 Household, Hip Replace Improvements (1 each * $300 = $300)

Input 5: OSR9019H1. 2007 Transportation, Taxi (400 miles * $1.25 = $500)

B. Basic WBS Benefit Structure

The following basic WBS was used to classify benefit elements (Outputs and Outcomes). Note that benefits are being measured using M&E indicators, not monetary amounts. The Resource Stock tutorials demonstrate alternative indicators that can also be used.

Type: 13. Diseases and disorders of the musculoskeletal system and connective tissue

Group: DRG469. Major Joint Replacement or Reattachment of Lower Extremity

Outcome: 0SR9019. 2007 Replace Hip Joint with Metal Syn Subs, Cem, Open

Indicator 1: 0SR9019A. Patient Health Status (100 = full targets met in descendant output indicators)

Refer to Example 5 in the SPA3 reference for an example of Stakeholder Impact Analyses that employ population algorithms for the following purposes.

[Demographic Indicators 1: Physiological demographics: age, weight, height, race, gender

Demographic Indicators 2: Health status demographics: number of preexisting conditions, number of risk factors, insurance coverage]

Output 1: OSR9019P1. 2007 Patient-reported quality measures

Indicator 1: OSR9019P1A. HCAHPS satisfaction survey (satisfaction with hospital quality)

Indicator 2: OSR9019P1B. Hip replacement quality rating (satisfaction with results of treatment)

Output 2: OSR9019P2. 2007 Physician-reported quality measures

Indicator 1: OSR9019P2A. PQRS Hospital Stay Days (3.5 average)

Indicator 2: OSR9019P2B. PQRS Severity of Complications (0 = no complications, 100 = death)

Output 3: OSR9019P3. 2007 Disability adjusted life year

Indicator 1: OSR9019P3A. Disability Adjusted Life Year = Q1 (years of life lost due to premature mortality in population for this condition) + Q2 (the equivalent health years lost due to this condition)

C. Basic WBS Budget Structure

Section A. Components and Section B. Outcomes were copied to the Time Period element of the following budget. The budget defines the benefits and costs of the complete medical technology. Benefits have not been monetized in these budgets, so benefits need to be analyzed using cost effectiveness techniques, such as Cost Per Hip Treatment Quality Indicator (see Section M. Health Care Analysis).

Type: 13. Diseases and disorders of the musculoskeletal system and connective tissue

Group: DRG469. Major Joint Replacement or Reattachment of Lower Extremity

Budget: 0SR9019. Replace Hip Joint with Metal Syn Subs, Cem, Open (Total Cost: $17,503)

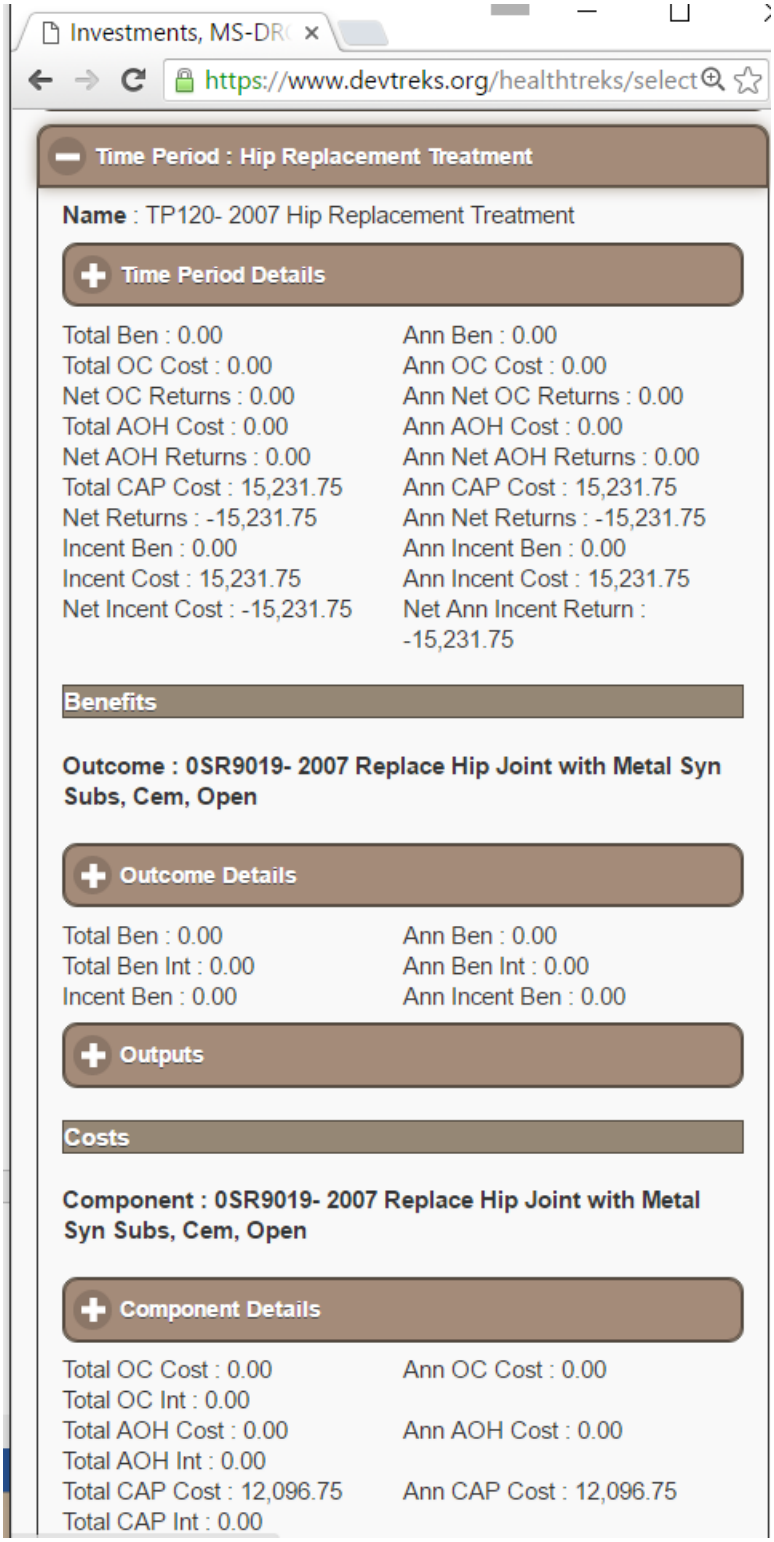
Time Period 1: 0SR9019TP1. 2007 Hip Replacement Treatment (Total Cost $17,503)

Indicator 1: 0SR9019TPA. Cost Per Hip Treatment Outcome Index (Indicator 1 = $143.4)

Outcomes (same as Part B)

Components (same as Part A)

The following image display what some of the cost results look like:



Investments, MS-DR

https://www.devtreks.org/healthtreks/select

Time Period : Hip Replacement Treatment

Name : TP120- 2007 Hip Replacement Treatment

Time Period Details

Total Ben : 0.00	Ann Ben : 0.00
Total OC Cost : 0.00	Ann OC Cost : 0.00
Net OC Returns : 0.00	Ann Net OC Returns : 0.00
Total AOH Cost : 0.00	Ann AOH Cost : 0.00
Net AOH Returns : 0.00	Ann Net AOH Returns : 0.00
Total CAP Cost : 15,231.75	Ann CAP Cost : 15,231.75
Net Returns : -15,231.75	Ann Net Returns : -15,231.75
Incent Ben : 0.00	Ann Incent Ben : 0.00
Incent Cost : 15,231.75	Ann Incent Cost : 15,231.75
Net Incent Cost : -15,231.75	Net Ann Incent Return : -15,231.75

Benefits

Outcome : 0SR9019- 2007 Replace Hip Joint with Metal Syn Subs, Cem, Open

Outcome Details

Total Ben : 0.00	Ann Ben : 0.00
Total Ben Int : 0.00	Ann Ben Int : 0.00
Incent Ben : 0.00	Ann Incent Ben : 0.00

Outputs

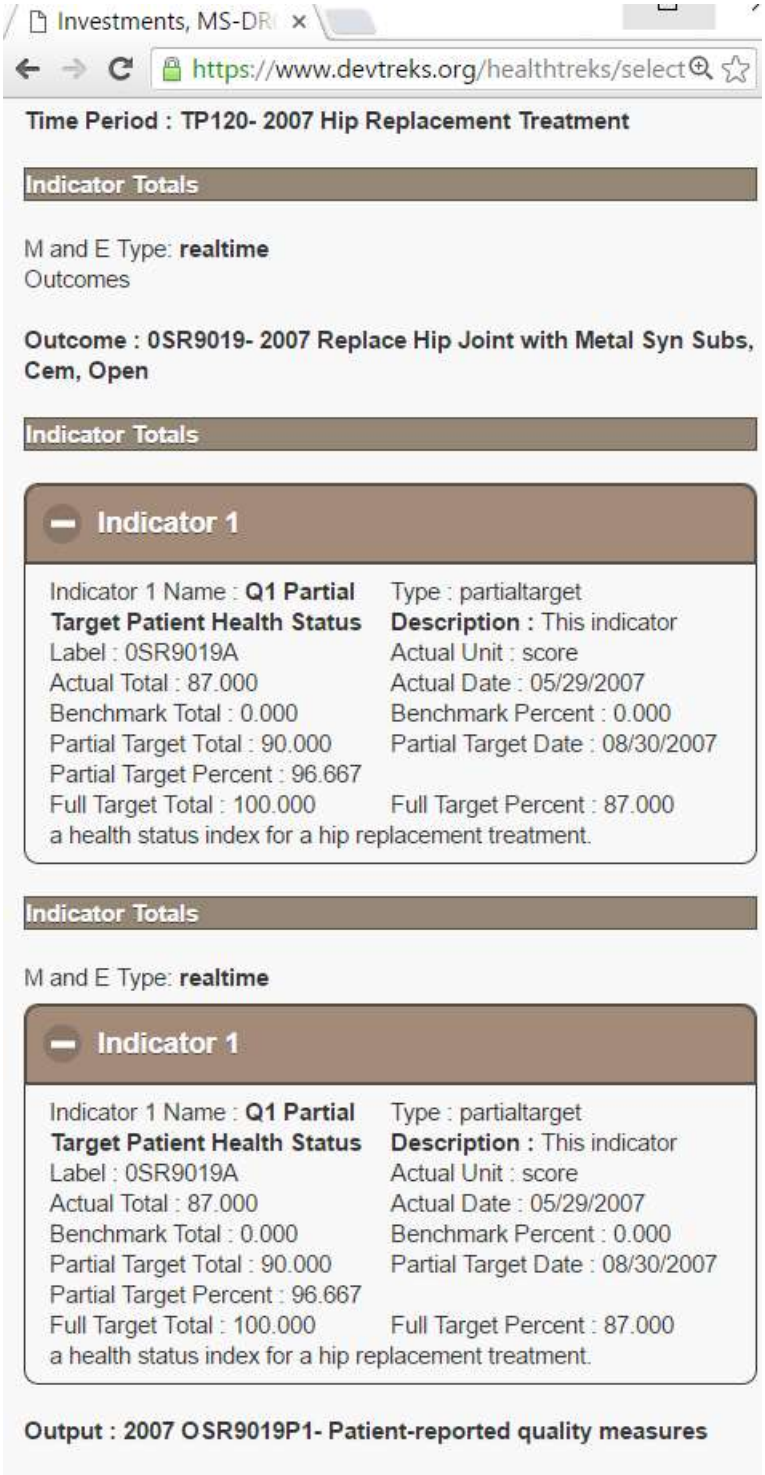
Costs

Component : 0SR9019- 2007 Replace Hip Joint with Metal Syn Subs, Cem, Open

Component Details

Total OC Cost : 0.00	Ann OC Cost : 0.00
Total OC Int : 0.00	
Total AOH Cost : 0.00	Ann AOH Cost : 0.00
Total AOH Int : 0.00	
Total CAP Cost : 12,096.75	Ann CAP Cost : 12,096.75
Total CAP Int : 0.00	

The following image display what some of the benefit indicator results look like (**4***):



G. Example 2. Societal Perspective, Partial Life Cycle Life Cycle Analysis (LCA) and M&E Analysis

This is the same as Example 1 but substitutes LCA, rather than NPV, tools to document costs. The LCA tools substitute most Inputs with SubCosts and retain the "single point-in-time" treatment estimate. The next example demonstrates the differences between single point-in-time, and full, life cycle budgets.

A. Basic WBS Cost Structure

Type: 13. Diseases and disorders of the musculoskeletal system and connective tissue

Component Group: DRG469- Major Joint Replacement or Reattachment of Lower Extremity

Component: 0SR9019. 2007 Replace Hip Joint with Metal Syn Subs, Cem, Open (Total Cost: $14,945)

Input: 0SR9019a- 2007 Orthopedic Evaluation (Total Cost: $440)

SubCost 1: OSR9019L1. Orthopedic Doctor Visit (2 visits * $150 = $300)

SubCost 2: OSR9019T1. Tests, X-Rays (1 set * $120 = $120)

SubCost 3: OSR9019T1. Laboratory Fees (1 each * $10 = $10)

SubCost 4: OSR9019M1. Materials, General (1 each * $10 = $10)

Input: 0SR9019. 2007 Replace Hip Joint with Metal Syn Subs, Cem, Open (Total Cost: $12,096)

SubCost 1: OSR9019M1. 2007 Materials, Hip Joint Metal Synthetic Substitute (1 each * $880 = $880)

SubCost 2: OSR9019L1. 2007 Labor, Physician (2 hours * $152.5 = $305)

SubCost 3: OSR9019L1. 2007 Labor, Nurse (3 hours * $55 = $165)

SubCost 4: OSR9019L1. 2007 Labor, Anesthetist (2 hours * $152.5 = $305)

SubCost 5: OSR9019D1. 2007 Drugs, Anesthesia (1 each * $165 = $165)

SubCost 6: OSR9019M1. 2007 Materials, Surgery (1 each * $142 = $142)

SubCost 7: OSR9019D1. 2007 Drugs, Drug 01 (3.5 days * $171 = $598.5)

SubCost 8: OSR9019R1. 2007 Room, Hospital Stay (3.5 days * $1500 = $5250)

SubCost 9: OSR9019A1. 2007 Overhead, Administrative ($7810.28 percentage * .28 = $2186)

SubCost 10: OSR9019P1. 2007 Profit ($9997 percentage * .21 = $2099)

(Note: the last two numbers have to be added using the percentage as a price because the percentage is fixed while the amount varies for each treatment).

Input: 0SR9019b- 2007 Hip Replacement Home Recovery (Total Cost: $2,409)

SubCost 1: OSR9019L1. 2007 Orthopedic Doctor Visits (4 visits * $150 = $600)

SubCost 2: OSR9019L1. 2007 Physical Therapy Visits (4 visits * $81 = $324)

SubCost 3: OSR9019L1. 2007 Labor, Nurse (2 hours * $55 = $110)

SubCost 4: OSR9019D1. 2007 Drugs, Pain Relief Drug 01 (100 pills * $5.75 = $575)

SubCost 5: OSR9019H1. 2007 Household, Hip Replace Improvements (1 each * $300 = $300)

SubCost 6: OSR9019H1. 2007 Transportation, Taxi (400 miles * $1.25 = $500)

B. Basic WBS Benefit Structure

The exact same benefits are used as Example 1.

C. Basic WBS Budget Structure

With allowance for these Components and Inputs, the same budget structure is used as Example 1.

The following image display what some of the results look like:


Investments, MS-DR
https://www.devtreks.org/healthtreks/s
Investment Group : DRG469- Major Joint Replacement or Reattachment of Lower Extremity
Benefit Details
Cost Details
Investment :
Benefit Details
Cost Details
Time Period : 0SR9019TP- 2007 Exam 2 Hip Replacement Treatment
Benefit Details
Total Revenue : 0.00
Total LCB : 0.00
Total EAA : 0.00
Total Unit : 0.00
Cost Details
Total OC : 0.00
Total AOH : 0.00
Total CAP : 14945.67
Total LCC : 14945.67
Total EAA : 828.22
Total Unit : 14945.67
SubCost 1 Name : Materials, General
SubCost 1 Amount : 3.000
SubCost 1 Unit : each
SubCost 1 Price : 1,032.00
SubCost 1 Total : 1,032.00
SubCost 1 Unit Cost : 1,032.00
SubCost 1 Description : These materials include paper dress, room preparation, and sundry materials.
SubCost 1 Label : OSR9019M1
SubCost 2 Name : Labor, Nurse
SubCost 2 Amount : 19.000
SubCost 2 Unit : hour
SubCost 2 Price : 796.00
SubCost 2 Total : 2,109.00
SubCost 2 Unit Cost :

H. Example 3. Societal Perspective, Full Life Cycle Life Cycle Assessment (LCA) and M&E Analysis

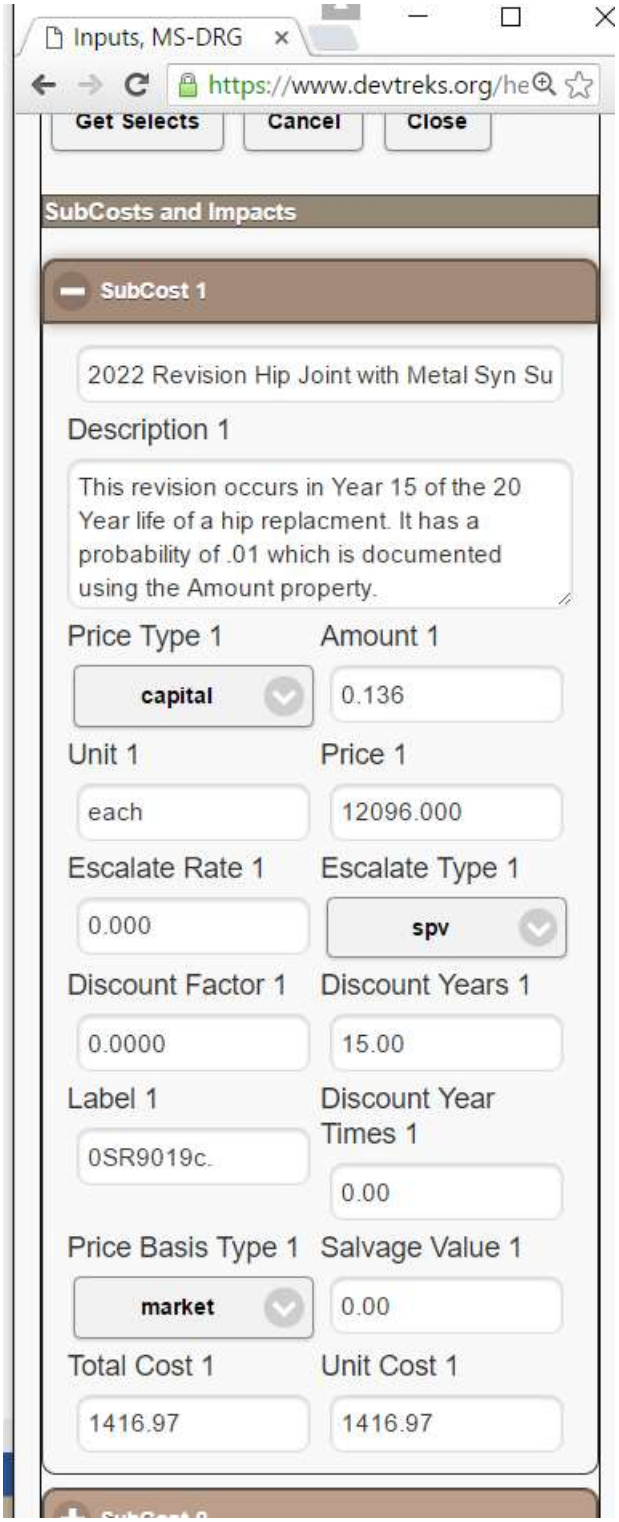
This example demonstrates how to add additional costs to Example 2 to calculate "full life cycle" costs rather than "single point in time" costs. The Faulkner (1998) and de Verteuil (2008) references discuss life cycle costs for hip replacements. Those references add additional probability-adjusted costs to the full costs of treatment to account for factors such as revision surgeries, dislocations, death, and infections. That technique can be replicated in Example 2 by adding the following types of Inputs and SubCosts to the example:

> **Input**: 0SR9019c. 2022 Revision Hip Joint with Metal Syn Subs, Cem, Open (Total Cost: $1,416.97)
>
> > **SubCost 1**: 0SR9019c. 2022 Revision Hip Joint with Metal Syn Subs, Cem, Open (.136 probability amount * $12,096 discounted 15 years into the future = $1,416.97)

Note that an ICD hip replacement revision code should actually be used. As to outputs, the M&E Indicators are designed to be recorded over time, so they don't necessarily require additional outputs, just additional indicators for additional time periods.

DevTreks' Life Cycle references explain additional techniques for calculating full life cycle costs and benefits. Note that many economists recommend using full life cycle estimates to explain full health care costs and benefits.

The following image shows that this Subcost would add $1,416.97 to Example 2's total costs:



I. Example 4. Patient Perspective, LCA Analysis

This example supplements the results from Example 2 with a Patient Perspective that is concerned about out-of-pocket expenses for copays, premiums, employer incentives, and deductibles. Besides these total out-of-pocket expenses, the patient also has a bill, or estimate, that documents the full treatment costs and benefits using the Example 1 or 2 formats. The patient also has instructions, such as this reference, explaining the relation between the two estimates.

A. Basic WBS Cost Structure

The following basic WBS was used to classify all cost elements (Inputs and Components).

Type: 13. Diseases and disorders of muscles, bones, and joints

Group: DRG469. Major Joint Replacement or Reattachment of Lower Extremity

Component: 0SR9019. Patient Replace Hip Joint with Metal Hip; Bone Cement; Open Cut (Total Cost: $6,908, with interest: $7,029)

Input: 0SR9019c- 2007 Patient Hip Replacement Premium Allocation (Total Cost: $5,100)

Subcost 1: OSR9019P1. Patient Premium Allocation (0.85 percent allocated * $4,500 = $3,825)

Subcost 2: OSR9019P1. Employer Premium Allocation (0.85 percent allocated * $1,500 = $1,275)

Input: 0SR9019a- 2007 Patient Orthopedic Evaluation (Total Cost: $100)

Subcost 1: OSR9019I1. Insurance Company Payment (0 contracted price * $340 = $0)

Subcost 2: OSR9019L1. Patient Copays, Doctor Visit (2 payments * $50 = $100)

Input: 0SR9019. 2007 Patient Replace Hip Joint with Metal Hip; Bone Cement; Open Cut (Total Cost: $500)

Subcost 1: OSR9019I1. Insurance Company Payment (0 contracted price * $11,600 = $0)

Subcost 3: OSR9019L1. Patient Copays, Surgery (1 payments * $500 = $500)

Input: 0SR9019b- 2007 Patient Hip Replacement Home Recovery (Total Cost: $1,207)

Subcost 1: OSR9019I1. Insurance Company Payment (0 contracted price * $1,300 = $0)

Subcost 2: OSR9019L1. Patient Copays, Doctor Visits (3 payments * $50 = $150)

Subcost 3: OSR9019L1. Patient Copays, Therapist Visits (4 payments * $25 = $200)

Subcost 4: OSR9019D1. Patient Copays, Drug 01 (.10 percent allocation * $575 = $58)

SubCost 5: OSR9019H1. 2007 Household, Hip Replace Improvements (1 each * $300 = $300)

SubCost 6: OSR9019H1. 2007 Transportation, Taxi (400 miles * $1.25 = $500)

B. Basic WBS Benefit Structure

Benefits are documented using Example 1 or 2.

C. Basic WBS Budget Structure

Budgets are documented using Example 1 or 2.

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https://www.devtreks.org/healthtreks/search/ruraldelivery/compon

Component Group

DRG469- Major Joint Replacement or Reattachment of Lower Extremity

SubCost Name	SubCost Amount	SubCost Unit	SubCost Price	SubCost Total	SubCost Unit Total	SubCost Label
Patient Copays, Drug 01	10.100	percent	14,465.00	1,007.50	1,007.50	OSR9019I1
The patient is required by the insurance company to pay 10% of the total drug cost.						
Transportation, Taxi	401.000	mile	301.25	800.00	800.00	OSR9019H1
The patient pays a taxi for transportation while recuperating from hip replacement surgery.						
Employer Premium Allocation	1.700	percent	6,000.00	5,100.00	5,100.00	OSR9019P1
The price is the total annual insurance premium paid by the employer. The amount is the percent premium allocated to hip replacement surgery.						

	Total OC	Total AOH	Total CAP	Total LCC	Total Unit	Total EAA
Totals	0.00	0.00	6907.50	6907.50	6907.50	382.78

Component

0SR9019 2007 Patient Replace Hip Joint with Metal Hip- Bone Cement- Open Cu(Amount: 1.000; Date: 12/31/2007

SubCost Name	SubCost Amount	SubCost Unit	SubCost Price	SubCost Total	SubCost Unit Total	SubCost Label
Patient Copays, Drug 01	10.100	percent	14,465.00	1,007.50	1,007.50	OSR9019I1
The patient is required by the insurance company to pay 10% of the total drug cost.						
Transportation, Taxi	401.000	mile	301.25	800.00	800.00	OSR9019H1
The patient pays a taxi for transportation while recuperating from hip replacement surgery.						

J. Example 5. Custom Health Care Treatment Analysis

This example demonstrates how custom health care cost and benefit tools can be built to document the specific cost, benefit, and performance properties that a particular health care network might need. This approach can be best when an entire network has reached accord on cost and benefit "standards" which can be enforced using custom tools. For example, some networks may want to assess benefits using Health-Related Quality of Life surveys that include uniform Quality Adjusted Life Years (QALY), Disability Adjusted Life Years (DALY), or Subjective Well Being (WV), calculations.

The following example was built using "first generation" custom health care cost and benefit calculators. Refer to the concluding paragraph of this section about the status of these tools.

A. Basic WBS Cost Structure

The following basic WBS was used to classify all cost elements (Inputs and Components). This WBS uses the HCPCS codes.

Type: 2. Procedures

Group: P8D. Endoscopy - colonoscopy

Component: 44389- 2012 Colonoscopy through stoma- with biopsy, single or multiple, Facility (Total Cost : $1,531.82 with discounted interest)

Input 1: 44389. 2012 Colonoscopy through stoma- with biopsy, single or multiple, Facility (1 composite OC costs * $500 = $500)

Custom Cost Properties: Diagnosis Quality Rating : 15.00, Treatment Quality Rating : 18.00, Treatment Benefit Rating : 10.00, Treatment Cost Rating : 10.00, Knowledge Transfer Rating : 10.000, Constrained Choice Rating : 18.000, Insurance Coverage Rating : 18.00, Cost Rating : 172.285, Receiver Cost : 2000.000, Incentives Cost : 0.000, Insurance Societal Perspective Cost : 700.000, Health Care Societal Perspective

Cost : 2000.000, Additional Cost : 1350.000, Base Price : 548.580, Base Price Adjustment : 700.000, Adjusted Price : 1397.160, Contracted Price : 1500.000, List Price : 3000.000, Market Price : 1950.000

Input 2: 99144. 2012 Sedation services, age 5 years or older (1 composite OC costs * $1,000 = $1,000)

B. Basic WBS Benefit Structure

The following basic WBS was used to classify benefit elements (Outputs and Outcomes). This WBS uses the HCPCS codes. The incremental Quality Adjusted Life Year (QALY) is a common metric used to carry out cost effectiveness studies (i.e. .043 QALYs per $1,531.82 treatment cost, or $35,604 per QALY)

Type: 2. Procedures

Group: P8D. Endoscopy - colonoscopy

Outcome: 44389- 2012 Colonoscopy through stoma- with biopsy, single or multiple, Facility

Output 1: 44389. 2012 Colonoscopy through stoma- with biopsy, single or multiple, Facility

Custom Benefit Properties: Health Rating : 5.00, Emotional Health Rating : 0.00, Social Health Rating : 0.00, Economic Health Rating : 0.00, Health Care Delivery Rating : 70.00, Average Benefit Rating : 37.500, Before Treatment QOL Rating : 50.00, After Treatment QOL Rating : 53.00, Before Treatment Years : 20.00, After Treatment Years : 20.00, Probability of After Treatment Years : 95.00, Equity Multiplier : 100.00, Quality Adjusted Life Years (QALY) : 7.848, Incremental QALY : 0.423, Time Tradeoff Years : 22.50, TTO QALY : 16.706, Output Cost : 500.000, Benefit Adjustment : 105.000, Adjusted Benefit : 525.000

C. Basic WBS Budget Structure

The following basic WBS was used to classify budget elements (Budget Group, Budget, Time Period). This WBS uses the HCPCS codes. As with Benefits, cost effectiveness criteria are used to make decisions about the worth of this treatment.

Type: 2. Procedures

Group: P8D. Endoscopy - colonoscopy

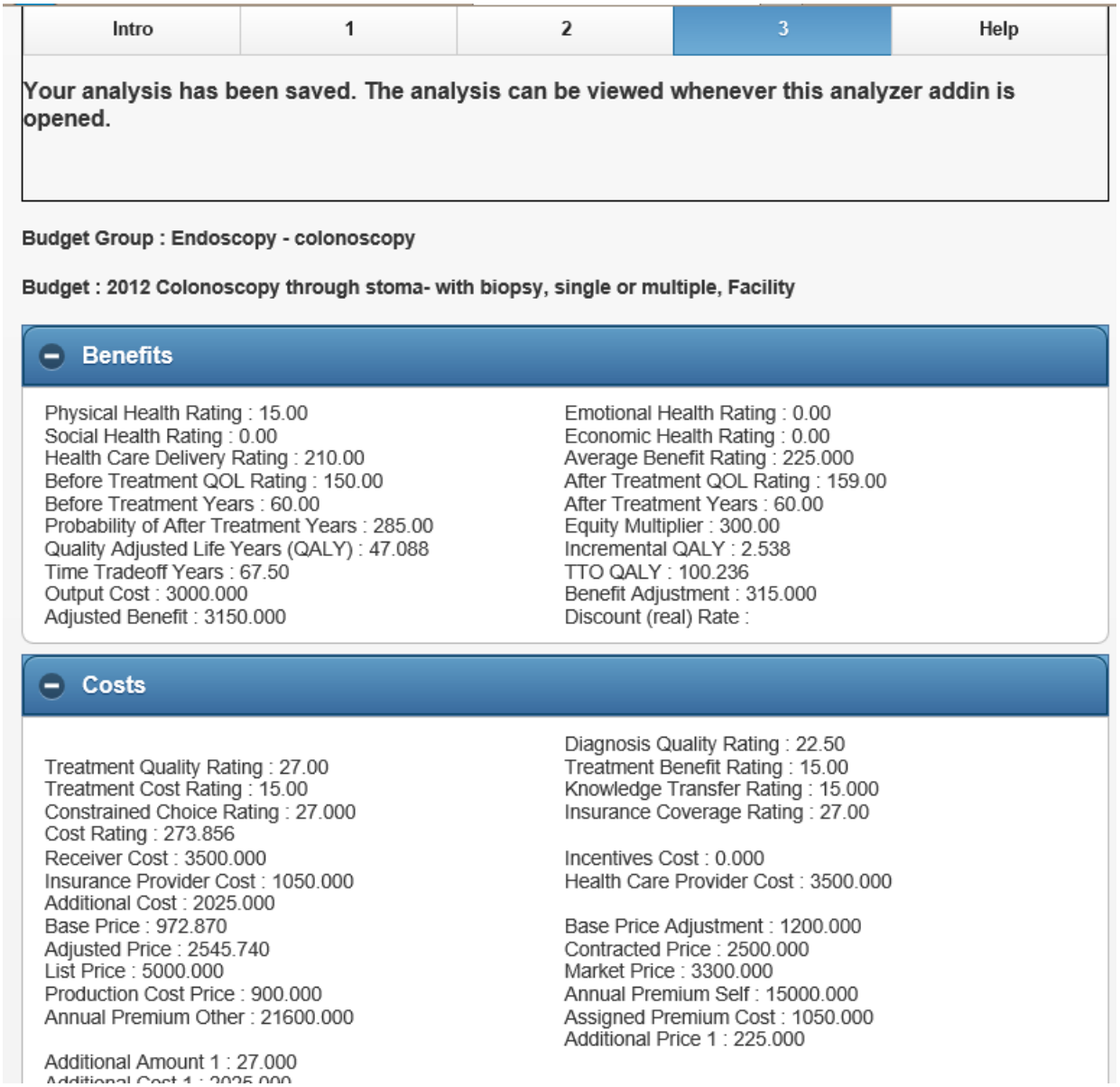
Budget: 44389- 2012 Colonoscopy through stoma- with biopsy, single or multiple, Facility

Time Period 1: 443892012. 2012 Colonoscopy through stoma-

Outcomes (same as Part B)

Components (same as Part A)

The following image displays what some of the budget results look like:



Intro | 1 | 2 | 3 | Help

Your analysis has been saved. The analysis can be viewed whenever this analyzer addin is opened.

Budget Group : Endoscopy - colonoscopy

Budget : 2012 Colonoscopy through stoma- with biopsy, single or multiple, Facility

Benefits

Physical Health Rating : 15.00
Social Health Rating : 0.00
Health Care Delivery Rating : 210.00
Before Treatment QOL Rating : 150.00
Before Treatment Years : 60.00
Probability of After Treatment Years : 285.00
Quality Adjusted Life Years (QALY) : 47.088
Time Tradeoff Years : 67.50
Output Cost : 3000.000
Adjusted Benefit : 3150.000

Emotional Health Rating : 0.00
Economic Health Rating : 0.00
Average Benefit Rating : 225.000
After Treatment QOL Rating : 159.00
After Treatment Years : 60.00
Equity Multiplier : 300.00
Incremental QALY : 2.538
TTO QALY : 100.236
Benefit Adjustment : 315.000
Discount (real) Rate :

Costs

Treatment Quality Rating : 27.00
Treatment Cost Rating : 15.00
Constrained Choice Rating : 27.000
Cost Rating : 273.856
Receiver Cost : 3500.000
Insurance Provider Cost : 1050.000
Additional Cost : 2025.000
Base Price : 972.870
Adjusted Price : 2545.740
List Price : 5000.000
Production Cost Price : 900.000
Annual Premium Other : 21600.000

Additional Amount 1 : 27.000

Diagnosis Quality Rating : 22.50
Treatment Benefit Rating : 15.00
Knowledge Transfer Rating : 15.000
Insurance Coverage Rating : 27.00

Incentives Cost : 0.000
Health Care Provider Cost : 3500.000

Base Price Adjustment : 1200.000
Contracted Price : 2500.000
Market Price : 3300.000
Annual Premium Self : 15000.000
Assigned Premium Cost : 1050.000
Additional Price 1 : 225.000

We decided not to upgrade these tools to “second generation” because these properties should be defined by a DevTreks network. In addition, the M&E, Resource Stock, LCA, and NPV tools introduced in Examples 1 to 4 can do a better job of documenting many of these particular costs and benefits. For example, all of the custom tool’s “subcosts”, such as additional costs, copays, list price, and market price, can be documented better using the LCA tools. The demographic properties, such as age, work status, severity of condition, and hospital provider code, can be documented using the Data URL property found in the Resource Stock analyzer tools. The

"indicators", such as social health rating, emotional health rating, health care delivery rating, and quality of diagnosis score, can be documented using the M&E or Resource Stock indicator tools. In this example, it may be more productive to customize these base tools (i.e. stylesheets that display rating systems), rather than to build a completely new set of custom tools.

Nevertheless, custom tools may be needed for specific medical conditions, special groups of patients, or for custom cost and benefit calculations (i.e. QALYs, DALYs, and WVs). This example, and the source code used to produce it, demonstrates that DevTreks can accommodate these custom tools.

K. Additional Examples

The following image comes from the Conservation Technology Assessment 1, Algorithm1 reference to demonstrate analyzing the costs and benefits of a construction investment by using Resource Stock Indicator properties along with Indicator.MathExpressions and custom algorithms.

Indicators

Math Expression: I6.QTM
Score Amount: 2,928,702.0412 | Score Unit: net benefits
Score D1 Amount: 2,935,000.0000 | Score D1 Unit: mean
Score D2 Amount: 300,000.0000 | Score D2 Unit: standard deviation
Distribution Type: normal | Math Type: algorithm1
Score Most Amount: 2,928,702.0412 | Score Most Unit: net benefits
Score Low Amount: 2,923,781.3996 | Score Low Unit: lower 90% ci
Score High Amount: 2,933,622.6828 | Score High Unit: upper 90% ci
Iterations: 10000 | Math Sub Type: subalgorithm1
Confid Int: 90 | Random Seed: 5
Base IO: none
Score Math Result: sampled descriptive statistics N,Total,Mean,Median,StdDev,Var,Min,Max
10000, 29287020411.8005, 2928702.0412, 2929586.9058, 298220.7041,
88935588383.0786, 1824176.0571, 4006434.3390, sampled cumulative density function
0.00,0.10,0.20,0.30,0.40,0.50,0.60,0.70,0.80,0.90,1.00
1824176.0571,2544896.2472,2676505.4723,2770676.2352,2854843.0512,2929603.8838,3004
Indic 1 Name: Units Rented | Label: UR
Date: 05/22/2015 | Rel Label:
Math Type: algorithm1 | Dist Type: gamma
Q1 Amount: 600.0000 | Q1 Unit: total units
Q2 Amount: 0.9400 | Q2 Unit: occupancy rate
Q3 Amount: 0.0000 | Q3 Unit: none
Q4 Amount: 0.0000 | Q4 Unit: none
Q5 Amount: 0.0000 | Q5 Unit: none
Math Express: I1.Q1 * I1.Q2 | Math Operator: equalto
QT Amount: 564.0000 | QT Unit: units rented
QT D1 Amount: 2,209.0000 | QT D1 Unit: shape
QT D2 Amount: 3.9170 | QT D2 Unit: scale
QT Most Amount: 563.9687 | QT Most Unit: units rented
QT Low Amount: 563.7721 | QT Low Unit: lower 90% ci
QT High Amount: 564.1653 | QT High Unit: upper 90% ci
Math Sub Type: subalgorithm1 | Base IO: none
Indic 1 Description: This indicator is used in a CTA tutorial.
Indic 2 Name: Unit Rental Price | Label: NIST2
Date: 05/22/2015 | Rel Label:
Math Type: none | Type: none
Q1 Amount: 1,200.0000 | Q1 Unit: rent per unit per year
Q2 Amount: 10.0000 | Q2 Unit: years
Q3 Amount: 0.0386 | Q3 Unit: real discount rate
Q4 Amount: 0.0000 | Q4 Unit: none
Q5 Amount: 0.0000 | Q5 Unit: none
Math Express: I2.Q1 * ((((1 + I2.Q3)^I2.Q2) - 1) / (I2.Q3 * ((1 + I2.Q3)^I2.Q2))) | Math Operator: equalto
QT Amount: 9,801.2643 | QT Unit: upv rent
QT D1 Amount: 0.0000 | QT D1 Unit: low
QT D2 Amount: 0.0000 | QT D2 Unit: high
QT Most Amount: 9,801.2643 | QT Most Unit: upv rent
QT Low Amount: 0.0000 | QT Low Unit: lower 90% ci
QT High Amount: 0.0000 | QT High Unit: upper 90% ci

The following table comes from Example 4 in the Social Performance Analysis 2 reference and demonstrates using custom algorithms and TEXT files to store and analyze cost, benefit, and

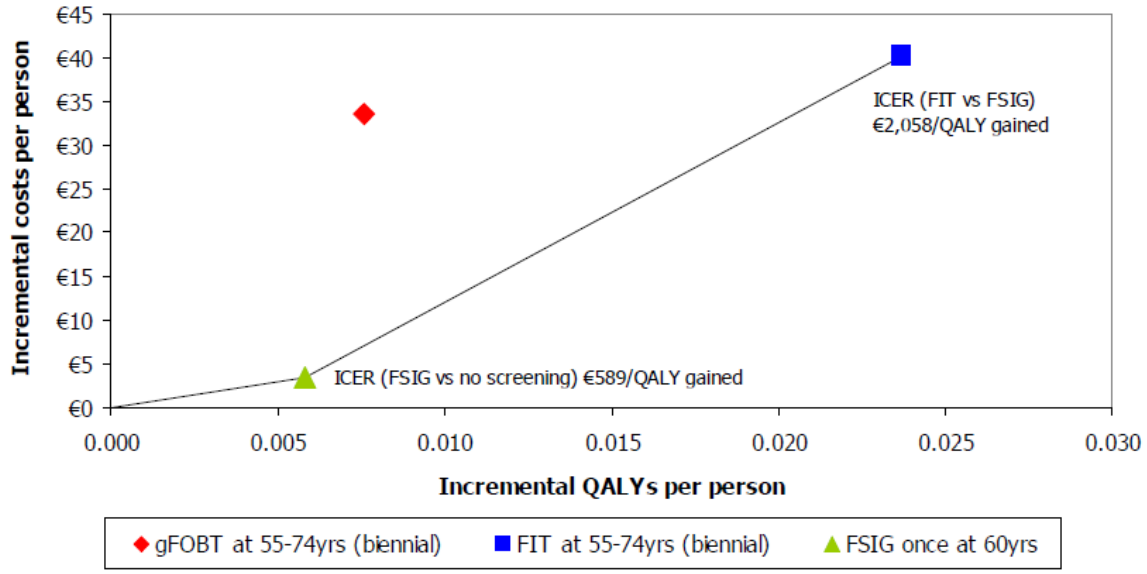
performance content.

label	locati	risks_and_indicators	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11
SCA	**1**	**Food**	0.00	0.00	0.00	0.00	montly cost	120.00	0.00	0.00	0.00	2.00	4.00
IF1A	1	Plain Rice	415.00	311.25	518.75	10.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1B	1	Sticky Rice	35.00	26.25	43.75	13.50	grams	none	0.00	1.00	1.00	3.00	3.00
IF1C	1	Noodles	9.00	6.75	11.25	50.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1D	1	Bread	6.00	4.50	7.50	20.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1E	1	Potato	20.00	15.00	25.00	10.60	grams	none	0.00	1.00	1.00	3.00	3.00
IF1F	1	Tofu	17.00	12.75	21.25	19.70	grams	none	0.00	1.00	1.00	3.00	3.00
IF1G	1	Peanuts	14.00	10.50	17.50	55.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1H	1	UHT milk	90.00	67.50	112.50	36.70	ml	none	0.00	1.00	1.00	3.00	3.00
IF1J	1	Eggs (duck)	58.00	43.50	72.50	32.30	grams	none	0.00	1.00	1.00	3.00	3.00
IF1K	1	Pork	21.00	15.75	26.25	65.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1L	1	Fish	88.00	66.00	110.00	25.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1M	1	Morning glory	140.00	105.00	175.00	12.90	grams	none	0.00	1.00	1.00	3.00	3.00
IF1N	1	Tomato	77.00	57.75	96.25	8.70	grams	none	0.00	1.00	1.00	3.00	3.00
IF1O	1	Mustard green	88.00	66.00	110.00	6.90	grams	none	0.00	1.00	1.00	3.00	3.00
IF1P	1	Banana	78.00	58.50	97.50	5.90	grams	none	0.00	1.00	1.00	3.00	3.00
IF1Q	1	Watermelon	96.00	72.00	120.00	7.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1R	1	Oil	20.00	15.00	25.00	22.50	grams	none	0.00	1.00	1.00	3.00	3.00
IF1S	1	Sugar	16.00	12.00	20.00	16.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1T	1	Tea	50.00	37.50	62.50	13.80	grams	none	0.00	1.00	1.00	3.00	3.00
IF1X	1	Fish sauce	16.00	12.00	20.00	20.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1Y	1	Additional Staple	0.14	0.12	0.20	21100.00	total cost	none	0.00	1.00	1.00	3.00	3.00
SCB	1	**Housing**	0.00	0.00	0.00	0.00	montly cost	1.00	0.00	0.00	0.00	2.00	4.00
IF2A	1	Electricity	122000.00	91500.00	152500.00	0.10	kwh/month	none	0.00	1.00	1.00	3.00	3.00
IF2B	1	Piped Water	70000.00	52500.00	87500.00	1.00	m3/month	none	0.00	1.00	1.00	3.00	3.00
IF2C	1	Garbage collection	1.00	0.75	1.25	10000.00	monthly cost	none	0.00	1.00	1.00	3.00	3.00
IF2D	1	Gas for cooking	80000.00	60000.00	100000.00	1.00	l/month	none	0.00	1.00	1.00	3.00	3.00
IF2E	1	Public lighting	1.00	0.75	1.25	5000.00	total cost	none	0.00	1.00	1.00	3.00	3.00
IF2F	1	Rent	1.00	0.75	1.25	800000.00	total cost	none	0.00	1.00	1.00	3.00	3.00
SCC	1	**NFNH**	0.00	0.00	0.00	0.00	montly cost	1.00	0.00	0.00	0.00	2.00	4.00
IF3A	1	Food Cost Ratio	0.794	0.596	0.993	2896332.000	nual food ra	none	0.000	1.000	1.000	3.000	3.000
SCD	1	**Miscellaneous**	0.00	0.00	0.00	0.00	montly cost	1.00	0.00	0.00	0.00	2.00	4.00
IF4A	1	Unexpected events	0.050	0.038	0.063	6173219.608	nual food ra	none	0.000	1.000	1.000	3.000	3.000
SC	1	**Household Expendables**	0.00	0.00	0.00	0.00	total cost	none	0.00	1.00	1.00	0.00	0.00
ECA	1	**Gross Monthly Wage Adjustments**	0.00	0.00	0.00	0.00	ntly living wa	1.00	0.00	0.00	0.00	2.00	4.00
IF1A	1	Net takehome pay	0.470	0.353	0.588	-6481880.588	1/fte/mont	none	0.000	1.000	1.000	3.000	3.000
IF1B	1	Mandatory deductions	0.105	0.079	0.131	3046483.877	nual food ra	none	0.000	1.000	1.000	3.000	3.000
ECB	1	**Benefits**	0.00	0.00	0.00	0.00	montly cost	1.00	0.00	0.00	0.00	2.00	4.00
IF2A	1	In kind benefits (lunch)	1.000	0.750	1.250	-358800.000	onthly bene	none	0.000	1.000	1.000	3.000	3.000
IF2B	1	Cash allowances and bonus	1.000	0.750	1.250	-448333.000	onthly bene	none	0.000	1.000	1.000	3.000	3.000
EC	1	**Wage Adjustments**	0.00	0.00	0.00	0.00	total cost	none	0.00	1.00	1.00	0.00	0.00
TR	**1**	**Adjusted Gross Living Wage**	0.000	0.000	0.000	0.000	0.000	none	0.000	1.000	1.000	0.000	0.000

L. Health Care Multimedia

The primary health care cost and benefit data explained in this reference should be summarized and explained using multimedia such as graphs, photos, and videos. Most people using or interpreting the data will not look at the primary data, they'll use the multimedia explanations. Multimedia support for the data, such as the following graph (Ireland HIQA, 2010), should be taken just as seriously as the data itself.

Figure 5.2 Incremental Cost-effectiveness Plane for core screening scenarios, based on QALYs

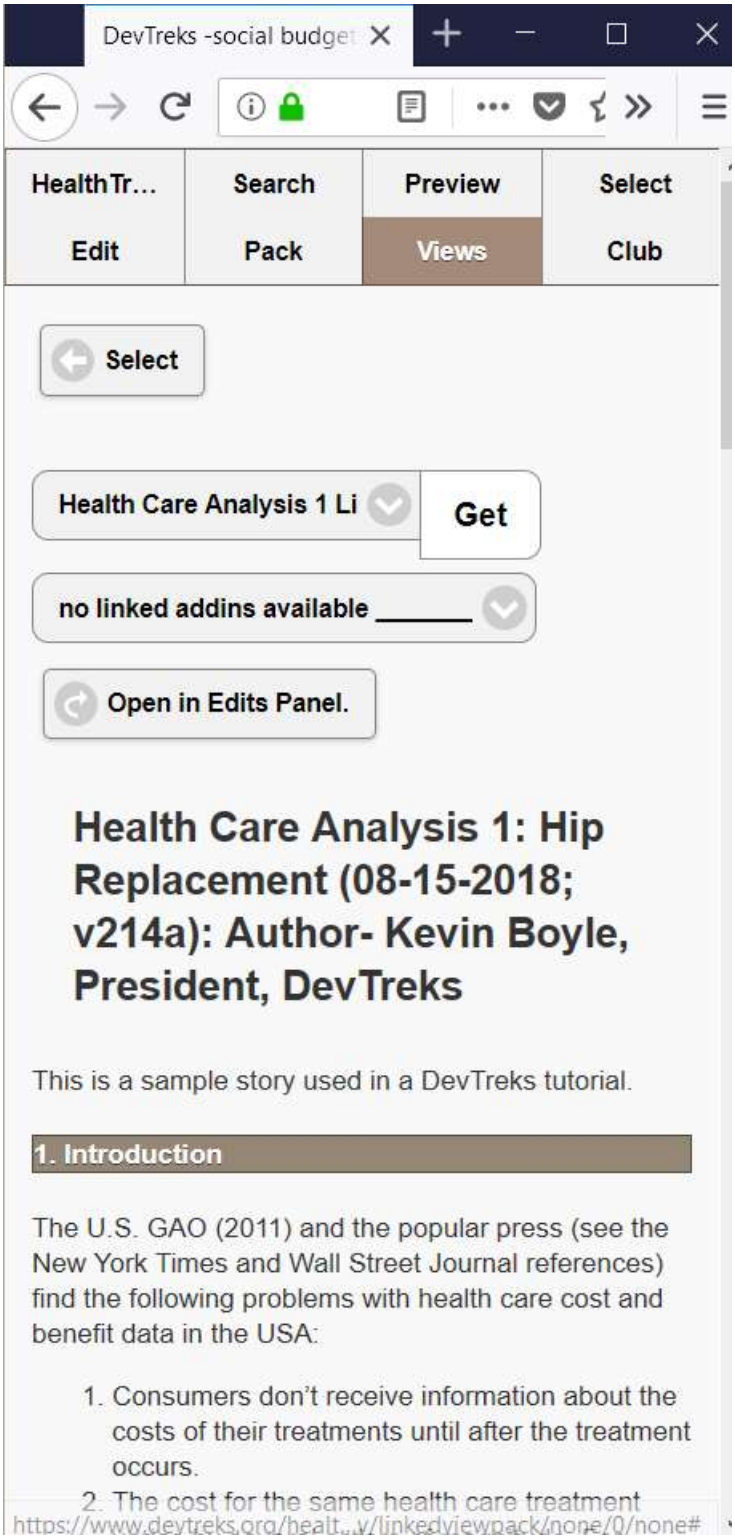


FIT=faecal immunochemical test; FSIG= flexible sigmoidoscopy; gFOBT=guaiac-based faecal occult blood test; QALY=quality-adjusted life year. Costs and outcomes discounted at 4%

Source: Health Information and Quality Authority (2009) *Health technology assessment (HTA) of a population-based colorectal screening programme in Ireland.*

M. Health Care Stories and Metadata

Each health care analysis must be supported with a story explaining the content of the analysis. The following image displays an example of a story that can contain the content of this pdf file. The Media URL property of any calculator or analyzer provides additional multimedia support to cost, benefit, and performance content.


DevTreks -social budget
HealthTr...
Search
Preview
Select
Edit
Pack
Views
Club
Select
Health Care Analysis 1 Li
Get
no linked addins available _____
Open in Edits Panel.
Health Care Analysis 1: Hip Replacement (08-15-2018; v214a): Author- Kevin Boyle, President, DevTreks
This is a sample story used in a DevTreks tutorial.
1. Introduction
The U.S. GAO (2011) and the popular press (see the New York Times and Wall Street Journal references) find the following problems with health care cost and benefit data in the USA:
1. Consumers don't receive information about the costs of their treatments until after the treatment occurs.
2. The cost for the same health care treatment

To accommodate WHO's recommendations that health ministries keep "metadata" documenting their use of indicators, one 'story' should be a metadata document. The following image demonstrates the use of the Dublin Core metadata standard as one page in a DevTreks story:

N. Health Care Analysis

This reference documents single point estimates for health care treatment budgets. DevTreks provides decision support by aggregating and analyzing these point estimates. Aggregate point estimates can supply several levels of decision support. A comparative analysis shows differences in costs and benefits between health care providers. A statistical analysis examines average and median costs and benefits for similar treatments. An analysis of hip replacement alternatives includes a budget laying out the "no treatment" alternative and budgets that evaluate viable alternatives. A more advanced level of support documents the probability of the costs, benefits, and outcomes. Finally, the next section addresses full decision support at entire industry or nation scale.

O. Health Technology Assessment (HTA)

Health technology assessment is the systematic evaluation of the properties, effects, and/or impacts of health care technology (Ireland HIQA, 2010). Most HTAs use probabilistic risk assessment techniques to assess whether or not a health technology works well enough, including consideration of costs and benefits, to justify using it. They prefer using data derived from randomized control trials to reach conclusions. The Faulkner (1998), Fitzpatrick (1998) and de Verteuil (2008) references provide examples of HTAs for alternative hip replacement treatments. The next section suggests how a lot of the manual labor needed in the past to complete a HTA can be automated, in part, by using online knowledge banks.

The General Analyzer Tutorials (Benefit Cost Analysis, Life Cycle Analysis, Monitoring and Evaluation Analysis, Resource Stock Analysis, DevPacks Analysis) demonstrate how to aggregate and analyze point estimates. The Social Performance Analysis 2 reference includes 3 examples of using the cost effectiveness analysis to carry out the recommendations of the U.S.A's Second Panel on Cost Effectiveness in Health and Medicine to complete Conservation Technology Assessments. Example 4B in the same reference explains how to improve the "technical and allocative efficiency" of country-wide health systems (i.e. the WHO, 2016 reference discusses using cost estimates, budgets, and M&E systems at national scale for this purpose).

P. Health Care, Sustainable Development Goals, and Climate Change

The following image comes from the Social Performance references and introduce sustainable accounting system goals, targets, and indicators that the international community wants tackled by 2030.

A1.4 Hotspots Analysis and the Sustainable Development Goals

At the United Nations Sustainable Development Summit on 25th September 2015, world leaders adopted the 2030 Agenda for Sustainable

Goal 11 on sustainable cities and communities is implicitly linked to identifying poverty hotspots and addressing these in an inclusive and participatory manner. Goal 12, in particular target 12.8 aimed at ensuring that people everywhere

15 http://socialhotspot.org/
16 http://bookshop.europa.eu/en/social-sustainability-in-trade-and-development-policy-pbLBNA26483/

Figure 19: UN Sustainable Development Goals

Many of these goals relate directly to the improved delivery of health care-related services, including No Poverty, Zero Hunger, Good Health and Well Being, Clean Water and Sanitation, and Climate Change. USHHS (2012) introduces the term “health states” to demonstrate how the

health care sector carries out Performance Monitoring and Impact Evaluation (M&E), or, their preferred term, "Epidemiology". These "health states" measure how populations move between states such as healthy, sick, seriously ill, and death (i.e. quality of life states measured as QALYs, DALYs, or WVs). In the context of the SDG, the health states measure how stakeholders move between quality of life states such as High Poverty, Medium Poverty, and Low Poverty. The health care sector has developed several algorithms to analyze and simulate these population transitions (i.e. Markov transition algorithms; the WHO, 2003, reference introduces advanced population models). The Social Performance Analysis references introduced new algorithms, along with additional formal M&E techniques, to ensure that the SDGs are being measured and accomplished at population scale.

The health care sector recognizes that climate change, or SDG Goal 13, is having major impacts on the health of their customers through reduced air quality, extreme weather events, rising seas, increased disease outbreaks, and displaced populations (Newkirk, 2018). Chen and Murthy (2019) confirm that many hospitals in the United States recognize these impacts and are taking proactive actions now –switching to LED lightbulbs, changing their transportation requirements, and building new energy-efficient hospitals. The authors document the partnerships and business practices that the health care sector can take right now to achieve zero GHG emission business goals by 2030 (**8***).

Q. Health Care Supply Chain Institutional Reform (6*)

The following image (WHO, 2017), first introduced in the Social Performance Analysis 2 reference, demonstrates how the international health care sector sets priorities for improving health systems performance.

Health system performance dimensions

Equity. Equitable access to needed services and protection against financial hardship are the key dimensions of UHC and health system performance. The focus on equity in access and financing implies that progress towards UHC cannot be assessed based only on national averages; rather, disaggregated data are important to understand the extent to which there are systematic disparities in access, effective coverage and the financial burden associated with health services (for example, by sex, age, geographical area, education, income, ethnicity, disability, migrant status). A robust but sensitive monitoring system is essential for assessing whether equity is being achieved. The UHC monitoring framework, developed by WHO and the World Bank, covers promotion, prevention, treatment, rehabilitation and palliative services. The monitoring framework also assesses protection against financial hardship caused by high household expenditures on health, using the incidence of catastrophic payments and of impoverishing expenditures[16].

Quality. Quality of health care is "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge"[17 18]. Shortfalls in quality - in terms of safety, effectiveness, patient-centeredness and timeliness - result in avoidable risks for patients and under-performance of health systems relative to what can be achieved with available resources.

Responsiveness. The concept of responsiveness refers to the extent to which a health system meets people's expectations and preferences concerning non-health matters, including the importance of respecting people's dignity, socio-cultural beliefs and preferences, autonomy and the confidentiality of information, besides responding to the needs and demand of patients. Although measurement and systematic benchmarking within and across countries present unresolved challenges, responsiveness is widely acknowledged as a key dimension of health system performance.

Efficiency. At the broadest level, health system efficiency is concerned with the extent to which available inputs (for example, expenditures and other health system resources) generate the highest possible level of health outcomes. Inefficiencies in a health system may be related to waste or poor operational performance in the production of health services or outcomes (technical inefficiency) or a sub-optimal choice of inputs, such as a mix of labor skills (allocative inefficiency). Either way, the result is that the health system is under-performing relative to what could potentially be achieved.

Resilience. Recent public health emergencies have highlighted the importance of health system resilience. Although resilience lacks a formally accepted definition, it is referred to here as "the capacity of health actors, institutions, and populations to prepare for and effectively respond to crises; maintain core functions when a crisis hits; and, informed by lessons learned during the crisis, reorganize if conditions require it."[19]

The SPA2 first used this image with the following statement:

> Given that the conventional institutions in some countries appear incapable of understanding, let alone applying, these common sense dimensions, social networks and clubs may need to take independent action.

Even if the algorithms and techniques introduced in these tutorials were perfect, the health care industry in many countries is unlikely to deliver health care services better. Perfect software, technology, or algorithms, won't make any difference when the real issues involve institutional failure (**3***). This reference recommends consequential digital activism that allows consumers and "good actor" health care delivery professionals to independently assess the performance and accountability of all parts of the health care supply chain, from research to consumer consumption. The direct consequences must lead to better decisions about purchases, penalties, punishments, incentives, and institutional reforms.

As an example, the Social Performance Analysis 4, or SPA4, reference introduced new algorithms that help 3rd party sustainability workers to directly rate organizations, including hospitals, and products, including medical treatments. Rather than leaving it up to the existing medical establishment to inform stakeholders about industry performance (**7***), informed stakeholders use these 3rd party ratings to make production and consumption choices. SPA4 confirms that the current climate change emergency requires producers and consumers to make these choices today (**8***).

R. Machine Learning (ML) for Health Care Decision Support (7*)

The Social Performance Analysis tutorials discuss, in depth, the general problem associated with any effort to use cost, benefit, or performance content to help stakeholders make improved choices –the complexity of causal attribution among stakeholders, risk drivers, corrective actions, and final impacts. Machine learning algorithms that can be trained with high quality performance data might be able to understand the complexity better than humans. Example 7 and 8 began introducing Machine Learning and statistical algorithms to conduct formal Impact Evaluations of health care interventions at population scale.

S. Knowledge Banks

All health care analyses should be entered into online knowledge banks (i.e. production servers as contrasted to development servers) that can be used to analyze the costs, benefits, and

performance of medical treatments. That structured knowledge must be passed down to future generations. These knowledge banks aggregate and analyze all of the data in a network. Future references will discuss how these knowledge banks will evolve (i.e. semantic data, forecasts) to support future decision making needs. The flexibility offered by DevTreks in documenting costs and benefits means that networks need to develop "rules" explaining the "standards" that should be followed by clubs in their network. The "standards" make it possible to build knowledge banks.

Summary and Conclusions

In summary, clubs using DevTreks can start to collect, measure, and analyze uniform health care benefit, cost, and performance data for any city, county, state, nation, or industry. Rather than use murky definitions of benefits and costs that are mired together with payment and financial accounting systems, they can use budgets whose sole purpose is to measure costs, benefits, and performance. Networks can start to build knowledge banks of benefit, cost, and performance data that can help save lives and purses. The networks and their clubs will have to work on modern institution building and software code, but their efforts may help people to improve the sustainability of their lives and livelihoods.

Footnotes

1. The author is not a health care expert –he's an expert at building the tools documented in this reference. The role of networks is to provide guidance to their clubs about best practices and data quality standards to follow. As usual, we encourage source code users to develop their own tutorials and algorithms that target the needs of their own audiences.
2. A discussion of the "empty box" syndrome, whereby scientific peers ignore these types of data deficiencies and forge ahead with policy recommendations, can be found in the Social Budgeting 1 reference.
3. Although DevTreks can be hired to build new features and work on improvements, we recommend that users of the technology do their fair share of work. DevTreks provides the open source technology to anyone who is willing to work to improve the technology.

We think the possibilities are endless, but we doubt that the existing industry, or supporting institutions, will support anything other than "status quo", or conventional, technologies. The fact that no one, ostensibly, who is part of the status quo, realizes the importance of using the correct instruments (budgets) to document costs and benefits, bodes poorly for "fixing" the data problems. In addition, we have been unable to find substantive references that mention the importance of "public goods" information, the advantages of "open source" software, or even what a "knowledge bank" is (i.e. why did the US government transfer millions of dollars to the private sector to develop proprietary, monopolistic, automated heath care systems?). Alternative institutions, with less dependence on the status quo and greater understanding of the public good, need to be developed. Alternative media and scientific outlets that understand these nonconventional institutions need to be supported. The Internet may be particularly good at fostering these alternatives. Section M, Institutional Reform was added to the Version 2.1.4 release to further address institutional failure.

4. The M&E 1 calculator and analyzers used with these data service were deprecated in favor of the M&E 2 tools. The Resource Stock tutorial explains that, absent the labor constraints of a small ngo, networks should build as many calculators and analyzers as they need (i.e. after addressing institutional reform).

5. The newspaper references (NYT, The Price for a Hip Replacement? Many Hospitals are Stumped) provide evidence that private sector financial and cost accounting is one factor explaining why no one in the USA seems to know much about the costs or benefits of health care. It's not surprising –those systems are designed mostly for internal financial control, or, in the case of Medicare, external payment. Unlike DevTreks, they are not designed primarily as public goods information systems. DevTreks realizes that the U.S. government has issued mandates requiring that most government data be made available to machines –machine-accessible cost and benefit data is another potential source for the "missing data" in this reference (but we suspect that our machine-accessible data is going to be more useful for making decisions based on the benefits and costs of health care).

6. The popular press (NYT, Nov. 15, 2019) reported that new federal laws in the United States will force hospitals to "disclose the discounted prices they negotiate with insurance

companies" and to require insurers "to allow patients to get advanced estimates of their out-of-pocket costs before they see a doctor or go to the hospital". Although this sounds exactly like what DevTreks was designed to accommodate, this reference still believes that institutional failure will prevail. For example, the consolidation of health care providers throughout the US in recent years has already led to local monopolies that accommodate price increases. The consolidation of drug manufacturers has already contributed to oligopolies that result in higher prices. More recent news reports indicate that the health care industry is gearing up to fight these measures, even though health care scientists have been advocating these policies for decades. This reference still recommends consequential digital activism that can directly support institutional reform.

7. The author broke his hand last year and went through the bizarre paperwork that hospitals bestow on patients to keep them informed (i.e. or more likely to cover their xxx). For example, a typical visit might entail a doctor examination, an x-ray, and a visit with a physical therapist. The resultant mountain of paperwork from this single visit (i.e. 3 copays) was truly inexplicable to this software developer. Training machine learning algorithms with that type of administrative paperwork may be worse than doing nothing at all. Time will tell whether non-conventional software development practices, including TEXT-based row and column performance data, will come up with better solutions (i.e. the author would present a patient with 1 cumulative table showing each visit's costs and results on 1 line).

8. On January 22, 2020, the author changed these sentences (i.e. from "net carbon neutral business goals" to "zero emissions business goals by 2030") because of the current evidence presented in SPA4 about the climate emergency, ongoing producer and consumer complacency, [and in support of Thunberg's speech on Jan 21, 2020 –some youngsters know more about economics than the Treasury Secretarys of some countries].

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References Note

We try to use references that are open access or that do not charge fees.

Improvements, Errors, and New Features

Please notify DevTreks (devtrekkers@gmail.com) if you find errors or can recommend improvements.

Video tutorials explaining this reference can be found at:

https://www.devtreks.org/commontreks/preview/commons/resourcepack/Health Care Analysis 1/449/none/