

An essay on using costs in health technology assessments

A robust approach to modeling costs is necessary for a health technology assessment to accurately describe a medical intervention.

Health technology assessments (HTAs) can provide “well-founded information to support decisions” by health product makers, regulators, clinicians, patients, healthcare administrators, payers, government leaders, and others “about whether or how to develop an intervention, to allow it on the market, to acquire it, to use it, to pay for its use, to ensure its appropriate use, and more.”¹

HTAs provide an assessment of the value of a medical intervention at the population level, and, in addition to clinical effectiveness, ethics, and safety, HTAs consider the cost of a technology.^{1,2} Assumptions for the cost inputs used in HTAs can have a meaningful impact on the usefulness of study results.³ For example, if costs are limited to a specific hospital, the results may not be generalizable to the broader market. Or if the costs represent billed charges, actual amounts paid may vary from one insured population to another.

The use of costs and related assumptions therefore warrants careful consideration for individuals performing or interpreting findings of HTAs. We discuss some of these considerations from an actuarial perspective, including cost types and variability, payer reimbursement models, and time period.

Cost types and variability

Different types of costs comprise the various components of healthcare spending in the United States (U.S.; see Figure 1 for a brief overview).^{1,4} All costs, regardless of the type, are subject to variability that must be accounted for appropriately so as to permit accurate and reliable HTA findings.

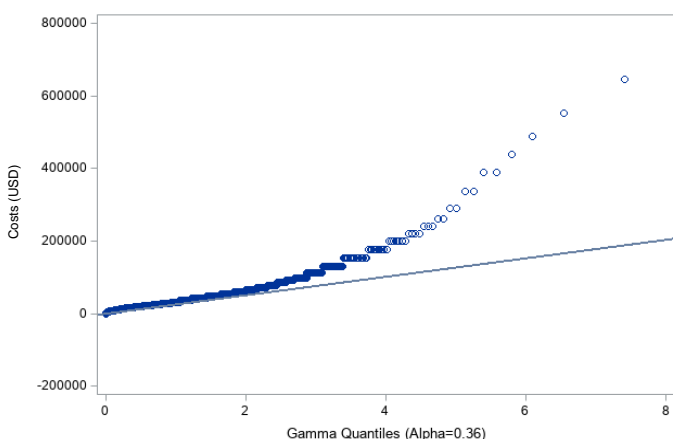
FIGURE 1: MEDICAL COSTS IN THE UNITED STATES^{1,4}

CATEGORY	DESCRIPTION OF MEDICAL COST
Direct Costs	<p>Costs for direct treatment of an individual, usually restricted to those related to the disease or condition being treated with the technology but they may overlap with a patients' other conditions.</p> <ul style="list-style-type: none"> ▪ Billed: The amount charged (or billed) by the provider. ▪ Allowed: The amount allowed for payment based on contracts between the payer and provider or as set by the Centers for Medicare and Medicaid Services (CMS). ▪ Paid: The amount paid by the insurer that does not include the patient pay amount. The patient pay amount includes copays, deductibles, and coinsurances. ▪ Hospital cost accounting charges: Billed charges multiplied by the cost to charge ratio (CCR; the ratio between a hospital's expenses and its charges); these amounts represent a theoretical hospital cost of providing a service and are sometimes considered a societal cost.
Indirect Costs	<p>Productivity losses to society caused by the health problem or disease.</p>

Patients are expected to have a wide range of costs for healthcare interventions received. A portion of the patients will have no medical costs for the year, while some will have one or more hospitalizations that may cost hundreds of thousands of dollars. To account for such variability in costs, HTAs typically apply a non-normal distribution of costs, usually a log-normal or gamma distribution, and a stochastic simulation to model the expected expenditures.^{5,6} Whereas an empirical distribution may show a higher frequency of lower-cost observations and fewer in the high-cost claims for this, the gamma distribution will give equal weight to claims in the tails.

Figure 2 illustrates a theoretical gamma distribution for costs in a commercially insured population (straight line). A Q-Q plot compares a sample of data (here, empirical distribution) on the vertical axis to a statistical population (here, gamma distribution) on the horizontal axis. The gamma distribution diverges from the empirical distribution (dotted curve) as the costs increase, suggesting that the empirical distribution is right-skewed, while the gamma distribution is not. Thus, while either distribution method does well for most purposes, the gamma distribution may be insufficient in the context of high-cost claims.

FIGURE 2: GAMMA QUANTILE-QUANTILE (Q-Q) PLOT FOR CLAIMS COSTS USING A GAMMA DISTRIBUTION AND EMPIRICAL DISTRIBUTION WITH SAME MEAN AND STANDARD DEVIATION



Payer reimbursement models

Healthcare claims billing is a specialized and complex subject. Differences in costs by payers could have significant impacts on the results of an HTA and potentially change the threshold of acceptance of the studied technology. In the U.S., there are several types of payers, each with different reimbursement levels and methods (see Figure 3 for a brief overview).

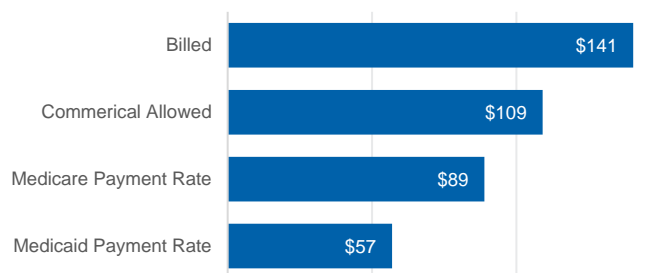
We analyzed Milliman’s Consolidated Health Cost Guidelines™ Source Database (CHSD) and publicly available information to

FIGURE 3: REIMBURSEMENT MODELS FOR U.S. HEALTHCARE PAYERS

PLAN/PAYER	DESCRIPTION OF POSSIBLE REIMBURSEMENT MODEL
Group-based Commercial	<ul style="list-style-type: none"> Traditional fee-for-service (FFS) payments Discounts off billed charges Prospective payment systems, where several aspects of service are bundled into one payment, similar to Medicare bundled payment arrangements Risk-based payments, where providers are rewarded with bonus payments if they operate within certain performance standards Population-based capitated services, where providers are paid a per member per month (PMPM) amount for each enrolled or allocated member regardless of the services used
Individual/ACA	<ul style="list-style-type: none"> Similar to group-based commercial plans, subject to Patient Protection and Affordable Care Act (ACA) regulations
Medicare	<ul style="list-style-type: none"> Fee-for-service (FFS) plans administered by CMS that operate according to CMS’s prospective payment systems Medicare Advantage (MA) plans are administered by private payers that contract with CMS to provide care for Medicare-eligible individuals and receive risk-adjusted PMPM payment
Medicaid	<ul style="list-style-type: none"> FFS plans administered by each state (reimbursement amounts will vary state-by-state); reimbursement likely lower than other payers, but payments can be higher for certain high-value services Managed Medicaid (MCO) plans are administered by private payers that contract with the state to provide care for Medicaid-eligible individuals and receive risk-adjusted PMPM payment
Other	<ul style="list-style-type: none"> Tricare and Veterans Health Administration are government-run programs that maintain their own fee schedules and cost allocation methodologies, which may differ from those above.

demonstrate the potentially wide variance in reimbursed cost by payer types. Figure 4 displays the average amount a physician might be paid for a standard office visit in North Carolina in 2022.

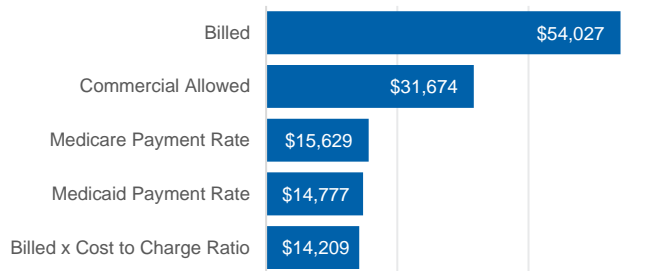
FIGURE 4: PHYSICIAN STANDARD OFFICE VISIT COST AMOUNTS (USD) BY PAYER TYPE, HCPCS 99213, NORTH CAROLINA⁷⁻⁹



HCPCS = Healthcare Common Procedure Coding System.

Figure 5 displays the average hospital amounts for a hip or knee replacement in North Carolina in 2022. Cost differences will vary from place to place, procedure to procedure, provider to provider, and year to year. In addition to adequate documentation of the types of costs used, analyses may benefit from the consideration of results for payer types for which a medical intervention is most likely to be applicable.

FIGURE 5: MAJOR HIP AND KNEE JOINT REPLACEMENT HOSPITAL COST AMOUNTS (USD) BY PAYER TYPE, MS-DRG 470, NORTH CAROLINA¹⁰⁻¹⁵



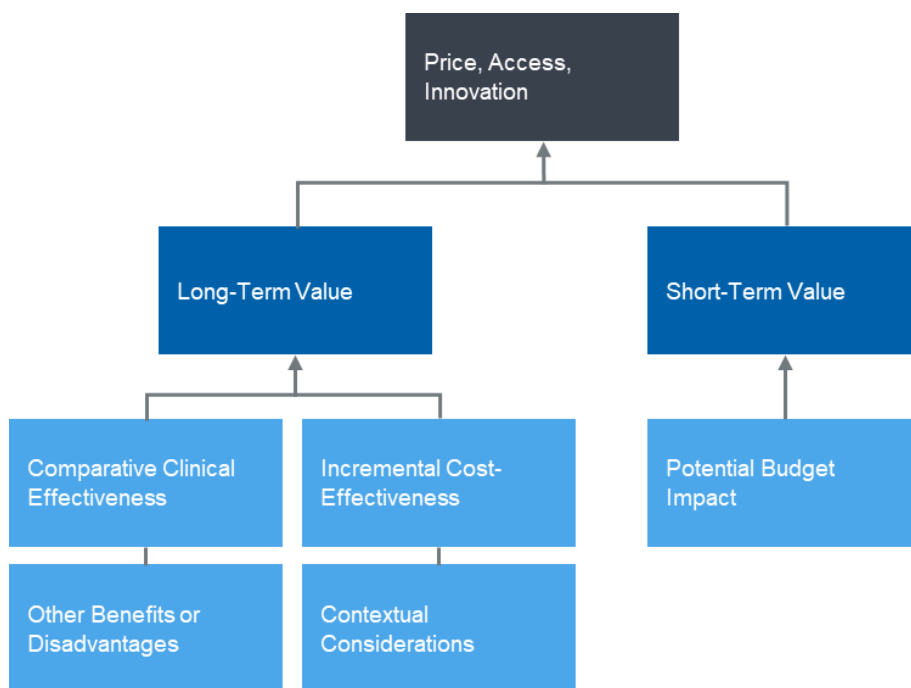
MS-DRG = Medicare Severity Diagnosis-Related Groups. Hospital costs represent facility services only and do not include surgeon, anesthesia, imaging, laboratory and pathology, physical therapy, or other costs that may be associated with a hip or knee joint replacement.

Time period

Current frameworks for HTAs assessing the value for a medical technology recognize long-term outcomes and costs as depicted in Figure 6. Costs are often projected with the life span of the expected impact of the technology and can be for as long as 30 years or more. A focus on long-term studies without an accurate short-term budget impact study may lead to inaccurate long-term cost assessments. Short-term impact studies are often not the basis, or starting point, for long-term studies.

However, it can be challenging to predict the likely lifetime of the technology being assessed, as well as the time needed for clinical benefits and potential cost offsets to be realized. New technologies emerge in a steady stream of innovations through advances in research and development and manufacturing, so it can be challenging to assess over what period a new technology may be relevant. Furthermore, the life cycle of new healthcare technologies is often assumed to be uniform for each technology throughout the HTA study period, with no assumption for obsolescence or innovative replacement.¹⁶ Nevertheless, the long-term look allows for more rational decision making as to the potential value before a new technology is widely adopted.

FIGURE 6: VALUE ASSESSMENT FRAMEWORK, ADAPTED FROM INSTITUTE FOR CLINICAL AND ECONOMIC REVIEW (ICER)²



In most long-term studies, costs are inflated through the long study horizon using a trend factor based on the medical consumer price index (CPI). This approach, though, may not be suitable for an analysis of more than three years. The Society of Actuaries (SOA) Long-Term Healthcare Cost Trends Model projects percentage growth rates and the health share of gross domestic product (GDP) for the next 80 years using income, inflation, and other factors.¹⁷ The SOA model is an alternative to CPI and is most applicable to the Medicare-aged population.

Summary

Failure to adequately describe or apply cost information in cost-effectiveness (CE) analysis for HTAs may lead to incomplete, misleading, or inappropriate conclusions. For example, a technology may be found to be cost-effective initially but, upon further evaluation, this benefit differs by payer (e.g., technologies may be cost-effective for Medicare payers but not for commercial payers). Such a finding would be important for the varied types of payer and regulatory decision-makers as they seek to optimize their healthcare budgets when confronted with a decision to cover or continue to cover a technology.

It is therefore imperative to clearly describe the types of costs being used in the analysis. An analysis that consistently uses billed charges may be understood more clearly than one that uses billed charges for the cost of the intervention and billed charges multiplied by the CCR for the costs of other healthcare received. Furthermore, the costs used for the analysis should align with the population for whom an intervention is intended to treat (e.g., for a Medicare-aged population, costs should be Medicare-based). Heeding these considerations may help to reduce the potential for misaligned and misleading findings.

Methods and Limitations

We analyzed CHSD data for 2019 and trended these amounts to 2022 using a 6% rate. The study population included nearly 28 million enrollees covered by commercial employer-sponsored insurance, including health maintenance and preferred provider organizations, Patient Protection and Affordable Care Act (ACA) plans, and other plans. Findings were not risk- or acuity-adjusted. The data set analyzed represents a convenience sample of healthcare administrative claims data for North Carolina and may not be generalizable to all individuals with similar health insurance coverage.



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ENDNOTES

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