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# Methods for Systematic Reviews of Economic Evaluations for the *Guide to Community Preventive Services*

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**Objectives:** This paper describes the methods used in the *Guide to Community Preventive Services: Systematic Reviews and Evidence-Based Recommendations* (the *Guide*) for conducting systematic reviews of economic evaluations across community health-promotion and disease-prevention interventions. The lack of standardized methods to improve the comparability of results from economic evaluations has hampered the use of data on costs and financial benefits in evidence-based reviews of effectiveness. The methods and instruments developed for the *Guide* provide an explicit and systematic approach for abstracting economic evaluation data and increase the usefulness of economic information for policy making in health care and public health.

**Methods:** The following steps were taken for systematic reviews of economic evaluations: (1) systematic searches were conducted; (2) studies using economic analytic methods, such as cost analysis or cost-effectiveness, cost-benefit or cost-utility analysis, were selected according to explicit inclusion criteria; (3) economic data were abstracted and adjusted using a standardized abstraction form; and (4) adjusted summary measures were listed in summary tables.

**Results:** These methods were used in a review of 10 interventions designed to improve vaccination coverage in children, adolescents and adults. Ten average costs and 14 cost-effectiveness ratios were abstracted or calculated from data reported in 24 studies and expressed in 1997 USD. The types of costs included in the analysis and intervention definitions varied extensively. Gaps in data were found for many interventions.

**Medical Subject Headings (MeSH):** cost-effectiveness, costs, economic evaluation, systematic reviews (Am J Prev Med 2000;18(1S):75-91) © 2000 American Journal of Preventive Medicine

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## Introduction

This paper describes the procedures and instruments used to collect, abstract, adjust, and summarize results from economic studies reporting on cost, cost-effectiveness, cost-benefit or cost-utility of

selected interventions for the *Guide to Community Preventive Services: Systematic Reviews and Evidence-Based Recommendations* (the *Guide*). Methods were developed so that studies using disparate analytical methods can be consistently compared. Although these methods were developed specifically for the *Guide*, they are sufficiently complete and general enough to be readily adapted to a range of systematic reviews of economic evaluations in health care and public health.

Evidence-based reviews of effectiveness (e.g., the *Guide to Clinical Preventive Services*<sup>1</sup>) usually have not reported data regarding costs and financial benefits of preventive interventions. Users of evidence-based effectiveness reviews often do not have enough information to identify among effective interventions, those providing the greatest amount of health or financial benefit per dollar of resource used. This might be because of the absence of economic evaluation studies or prob-

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lems of comparability among available studies. Although little can be done on a short-term basis to increase the quantity of available studies, systematic reviews of economic studies can address problems of comparability. In addition, they can improve the usefulness of existing studies just as systematic reviews bring together and interpret a body of evidence of the effectiveness of interventions.

The lack of accepted, or even openly debated, methods and instruments for systematic reviews of economic studies is significant in light of both the need for such methods and the precedent set for such methods in the effectiveness literature. Inconsistencies in the methods employed in published, peer-reviewed economic evaluation studies make results not comparable and lead to skepticism<sup>2</sup> regarding the validity of the results of such studies. The lack of standardization in the design, analysis and reporting of economic evaluations is a matter of concern because changes in design and analysis produce substantially different results.

Independent published reviews regarding cost-effectiveness of clinical and public health interventions have been conducted by several authors. Tengs et al.<sup>3</sup> conducted a comprehensive review on the cost-effectiveness of 500 life-saving interventions in the United States, including motor vehicle safety devices, control of environmental hazards, cancer screening, heart disease screening and treatment, vaccination for infectious diseases and interventions to promote smoking cessation. Interventions ranged from those that are cost-saving to those that cost \$10 billion per life-year saved, with a median cost of \$42,000 per life-year saved (1993 USD). Ramsberg et al.<sup>4</sup> conducted a review regarding the cost-effectiveness of 165 life-saving interventions in Sweden, including screening and treatment for hypertension, road safety, smoking cessation and fire protection. Interventions ranged from those that are cost-saving to ones costing \$4.9 billion per life-year saved, with a median of \$19,500 per life-year saved (1993 USD). Graham et al.<sup>5</sup> reported on the cost-effectiveness of 40 interventions in the United States, including cancer, coronary heart disease and injury prevention interventions. Cost-effectiveness ratios ranged from those costing less than \$1,000 per quality-adjusted life-year (QALY) to ones costing \$1 million (1995 USD) per QALY. Most of the cost-effectiveness ratios reviewed were clustered in the range of \$10,000 to \$100,000 per QALY.

In the process of providing the public health community with lists of the cost-effectiveness of various interventions expressed in consistent units, the previously mentioned reviews (and other reviews concentrating on a more restricted set of health conditions<sup>6-8</sup>), have also provided the first steps toward the standardization of systematic reviews of published economic evaluations. In addition to published lists of cost-effectiveness ratios, these studies have reported general

inclusion and adjustment criteria. However, they usually do not provide an explicit or full description of the procedure used to adjust from the results of the primary studies to the results they report, nor do they provide the instruments used in the abstraction and adjustment of data. In addition, they leave the comparability of the results from various studies in question because they (1) make a limited number of adjustments to published ratios; and (2) report point estimates of cost-effectiveness ratios without sensitivity analysis of the adjustments.

Therefore, to our knowledge, standardized instruments for systematically translating economic data into comparable economic information have not been widely debated and are not available in the public domain.

The *Guide* is being developed by the Task Force on Community Preventive Services (the Task Force) in collaboration with many public and private partners under the auspices of the U.S. Department of Health and Human Services.<sup>9</sup> The *Guide* will include systematic reviews of a variety of issues, including effectiveness, applicability of effectiveness, harm, other positive and negative effects, barriers to intervention implementation, and economic evaluations of selected interventions for which evidence of effectiveness is strong or sufficient based on explicit criteria. Standardized methods and instruments for searching, including and abstracting studies of effectiveness were developed for the *Guide*<sup>10</sup> to reduce inconsistencies within and among chapters. A similar process was undertaken to develop methods and instruments for the systematic review of economic evaluations with the purpose of reducing error and bias in the abstraction and adjustment of results and making them comparable across interventions.

## Methods

The methods for reviewing economic evaluations involve (1) applying explicit criteria for deciding which evaluation studies were to be included in the reviews; (2) using a standard abstraction form to record individual study characteristics, abstract data, and adjust reported results; and (3) interpreting and summarizing economic information from related studies of each effective intervention assessed.

## Finding and Selecting Relevant Studies

For each chapter of the *Guide*, candidate economic studies are identified by systematic searches of the literature. A systematic search requires study inclusion criteria. Systematic reviews of economic evaluations in the *Guide* will, as much as possible, use consistent criteria across chapters (Table 1). Each chapter also requires specific inclusion criteria relevant to the inter-

**Table 1.** Standard inclusion criteria for economic evaluation studies for the *Guide to Community Preventive Services*

Criteria	Description
A	Evaluated interventions that the Task Force has already classified as “strongly recommended” or “recommended”
B	Used an analytical method (e.g., cost-analysis, cost-effectiveness, cost-benefit, or cost-utility)
C	Provided sufficient detail regarding methods and results to enable use and adjustment of the study’s data and results
D	Was a primary study rather than, for example, a guideline or review
E	Had a publication date appropriate to the particular subject matter
F	Was conducted in one or more Established Market Economies (EME) as defined by the World Bank <sup>11</sup>
G	Was written in English

ventions reviewed in that chapter. For example, for the Reviews of Evidence for Interventions to Improve Vaccination Coverage in Children, Adolescents and Adults,<sup>12</sup> a study was eligible if it met the standard criteria and addressed selected interventions to improve coverage levels for universally recommended vaccinations for children, adolescents, and adults.<sup>a</sup>

### Accounting for Methodological Differences in Primary Studies

A key decision in the design of the review process was whether or not to devise a method for scoring the quality of the study as was done for the review of effectiveness literature in the *Guide*.<sup>10</sup> A quality scoring was not done for several reasons. First, although some differences in methods in economic studies could reasonably be labeled as differences in quality, many differences in methods are attributable to different objectives or reasonable differences in opinion regarding the most appropriate methods. Second, even in cases where differences in methods could be reasonably labeled as quality related, the results of the study might still be informative in cases where the results indicate large cost-savings or very high cost per health benefit. Third, differences in methods affect the results of some studies more than others. For example, the difference between the use of 5% and 10% discount rates in a study with mostly short-term costs and benefits might be negligible, whereas the difference would be substantial in studies where most costs accrue many years in the future. Finally, the number of economic studies available from which to select is extremely limited for most

<sup>a</sup> For example, measles, mumps, and rubella vaccinations are recommended for young children; hepatitis B vaccinations are recommended for adolescents; and annual influenza vaccinations are recommended for adults aged  $\geq 65$ .

community preventive services. Therefore, the Task Force and chapter development teams decided to include the studies that met the inclusion criteria and to develop a method for adjusting the results of studies rather than excluding some studies because of quality limitations. Each study is abstracted by two reviewers to facilitate more thorough and balanced reviews. Differences of opinion about the adjustments are resolved by consensus.

### Abstracting Economic Evaluation Results from Primary Studies

The second step in performing reviews is abstracting results from included studies and adjusting them to improve comparability across studies. The abstraction form provides an explicit instrument for performing these tasks. The major sections of the form are summarized in Table 2; selected sections of the form are presented in Appendix A. The entire form including instructions can be obtained from the corresponding author or from the *Guide’s* Internet home page at the following address: <http://www.web.health.gov/communityguide>.

Essential information including intervention definition, methods and data sources of the primary study is recorded in Sections I–IV of the abstraction form. Section I records information about the topic and intervention under consideration in the *Guide* and the type of analytic method and summary measure reported in the study. Section II compares the intervention, as defined in the *Guide*, with the intervention described in the study. Section III assists the reviewer in locating the main elements of analysis in the article and Section IV allows descriptive study information such as perspective, comparator, analytic horizon, data sources and type of costs to be recorded. Sections V–VII deal with adjustments to results of economic evaluation and are discussed below.

### Adjusting Results of Primary Studies

Published results are adjusted to reflect what the results of the study would have been had the study followed a chosen set of standards. Adjustments are made sequentially. The reference case of the Panel on Cost Effectiveness in Health and Medicine (PCEHM)<sup>13</sup> is the standard with which cost-effectiveness and cost-utility studies are compared. The PCEHM reference case provides an explicit and well-justified set of rules for conducting and reporting cost-effectiveness studies in a manner that allows the results of different studies to be compared with one another. Although perhaps not the original intent of the PCEHM, the reference case also provides a reasonable set of rules with which to standardize the results of existing cost-effectiveness studies. For cost-analysis and cost-benefit studies, all standards pertaining to costs in the reference case also apply. The

**Table 2.** Elements of the abstraction form used for reviewing economic evaluation studies selected for the *Guide to Community Preventive Services*

Section	Purpose	Completed by
I. Classification information	Record tracking information, analytic method, and summary measure used in study	<i>Guide</i> staff and checked by reviewers
II. Comparison intervention	Record differences between intervention reviewed in the <i>Guide</i> and intervention analyzed in the study	<i>Guide</i> staff and checked by reviewers
III. Identifying information	Identify key result from study and key data elements reported in study	<i>Guide</i> staff and checked by reviewers
IV. Study information	Record detailed study information, including location, audience, setting, perspective, data sources, etc.	Reviewers
V. Costs and health outcome measure adjustments	Adjust key result to 1997 USD, adjust for discount rate, add or remove costs, remove productivity losses, adjust health outcome measure, and assess uncertainty	Reviewers
VI. Nonadjustable differences	Summarize differences between study methods and standard methods for which the study's key result cannot be adjusted	Reviewers
VII. Applicability	Summarize key parameters that might affect the interpretation of the results if intervention is applied in other settings	Reviewers
VIII. Summary table	Condense findings of review and allow for revision of abstracted information after detailed review of study	Reviewers

choice of the PCEHM reference case does not mean that the Task Force necessarily believes the corresponding methods are better than alternative methods. This choice was made because the reference case provides a convenient, thoroughly considered and generally accepted standard for conducting and reporting cost-effectiveness studies. Of note is the fact that the PCEHM does not recommend these methods as the sole means of conducting cost-effectiveness studies. Rather, the PCEHM recommends the reporting of the reference case, when possible, to facilitate comparisons among studies.

Section V of the abstraction form enables the reviewer to adjust the costs and health outcome measures reported in the study. The first set of adjustments are intended to convert data expressed in various currencies and base years to USD in a consistent base year. First, costs expressed in a foreign currency are converted to USD for the base year reported in the study using purchasing power parity rates. Purchasing power parity rates are estimates of the exchange rate at which an equivalent amount of goods or services could be purchased in two different countries, regardless of the currency being cited. Purchasing power parity rates are used for this purpose because they are less susceptible to financial flows and governmental exchange rate manipulation than are market exchange rates. Although purchasing power parity rates are less problematic than market exchange rates in converting the value of resources used from one currency to another, conversions can be inaccurate.<sup>14</sup> Therefore, studies that are not based on US prices and not reported in USD are considered only when similar USD-denominated studies are not available.

Second, costs are adjusted to the 1997 base year using either the consumer price index (CPI) or the medical consumer price index (MCPI).<sup>15</sup> Although the choice

of price index might not be particularly important for studies that report results in a base year one or two years before 1997, it can be very important for studies published earlier. For example, for studies reported in 1985 USD, the use of the CPI to convert to 1997 USD would inflate the numerator of a cost-effectiveness ratio by 49%, whereas the use of the MCPI would inflate the numerator by 106%. Therefore, we developed rules (Table 3) on when to apply the CPI or MCPI rather than relying on the use of one index in all cases.

Any rule for adjusting the value of the summary measure<sup>b</sup> is inherently inferior to re-estimation of a new value. For example, even if enough detail were presented in a study to allow the adjustment of individual prices by respective inflation rates, it is very unlikely that the weighted average prices of the intervention would increase at the estimated rate of inflation for the general economy (as would be required to accurately update prices using the CPI) or that the weighted average of medical prices would increase at the estimated rate of medical inflation. Though imperfect, we believe these rules are an improvement on standardization approaches using the same price index to adjust all cost-effectiveness ratios because they risk large errors in updating studies.

After base year, costs are adjusted for discount rate. The rate used to discount costs and health outcomes affects the value of the summary measure. The discount rate adjustment is based on the reference case of the PCEHM.<sup>13</sup> The recommended discount rate is 3% for both effectiveness and costs. The discount rate adjustment will be possible if the timing and amount of future intervention costs, costs of illness and health benefits are known or can be approximated from data

<sup>b</sup> Summary measure refers to cost, net cost, cost-utility or cost-effectiveness ratio.

**Table 3.** Criteria for base-year adjustments for the *Guide to Community Preventive Services*

Rules	Condition	Index	Justification
1	If both program costs and costs averted <sup>a</sup> are primarily non-medical, or if both program costs and costs averted are a mixture of medical and non-medical resources	CPI	Reflects the fact that the CPI is already partially weighted by estimates of medical care inflation
2A	If program costs are primarily non-medical, cost averted are primarily medical, and net costs are negative (cost-saving intervention)	MCPI	Although a mixture of costs exists, the negative net costs indicate that the medical prices in the costs averted are likely to play a larger role in changes to the net costs over time
2B	If program costs are primarily non-medical, cost averted are primarily medical, net costs are positive, and the reviewer can determine that the ratio of costs averted to program costs is $<0.25^a$	CPI	General price inflation is likely to be a more important factor in changes of the net costs over time
2C	If program costs are primarily medical, net costs are positive, and the reviewer can determine that the ratio of costs averted to program costs is $>0.75^a$	MCPI <sup>b</sup>	Medical costs are playing a substantial role, and net costs are likely to be decreasing over time rather than increasing because medical inflation is historically greater than general inflation
2D	If program costs are primarily non-medical, costs averted are primarily medical, net costs are positive, and (a) the ratio of costs averted to costs incurred falls between 0.25 and 0.75 <sup>a</sup> or (b) the ratio cannot be determined with a reasonable amount of certainty	No adjustment	Ratio is either relatively stable over time or the direction in which the adjustment should be made is too unpredictable

<sup>a</sup> “Program costs” (CP) include all positive costs due to the intervention and “costs averted” (CA) include all saved costs resulting from the intervention. When CA are considerably smaller than CP, the CA/CP ratio is relatively small ( $<0.25$ ), and the percent change in net costs (CP – CA) over time due to inflation approaches the economy-wide inflation rate. When CA approaches the magnitude of CP, the CA/CP ratio is relatively large ( $>0.75$ ) and the percent change in net costs over time due to inflation approaches negative infinity. The percent change in net costs will be approximately equal to the medical inflation rate when the CA/CP ratio equals 0.75. Reviewers are cautioned that the actual percent change in net cost may be significantly larger (in absolute value) than the medical inflation rate in cases where rule 2C applies and that inflation may cause net costs to decrease to zero and become negative. When the CA/CP ratio equals 0.5, the percent change in net costs over time due to inflation is approximately zero. Using either rule 2B or rule 2C (adjusting for inflation with either the CPI or MCPI) is not likely to improve the estimate of net costs when CA/CP is between 0.25 and 0.75.

<sup>b</sup> Ratio or net costs should be decreased using the MCPI rather than increased.

provided in the study. If so, the full abstraction form provides a table listing the effect of discounting one unit (whether 1 USD or one QALY) over various time periods for several common discount rates (0%, 3%, 5%, 7% and 10%).

The next set of adjustments ensures, to the extent possible, that the costs and effects included in the analysis are consistent from study to study. The additional costs sections provide entry for those administrative, clinical preventive services, follow-up or patient time and transportation costs missing from the analysis. The societal perspective requires that all costs and benefits be considered, regardless of who bears the costs or receives the benefits. In some instances, cost estimates used in the study might not represent the setting. For example, authors sometimes intentionally use high or low costs to obtain “conservative” estimates of the summary measure. The PCEHM reference case does not include a valuation of time lost as a result of chronic illness, long-term disability or death in the numerator (“productivity”) to avoid double counting of quality of life which is already accounted for in the denominator. Many studies report results with and

without this valuation of time, therefore allowing productivity to be subtracted.

The conversion of the health outcome measure to QALYs addresses the need to improve comparability of results by using a common metric for health outcome. It is difficult, for example, to compare the cost-effectiveness of different studies in which results are expressed as dollars per case of disease prevented, dollars per life-year saved or dollars per QALY saved. In following the PCEHM reference case whenever possible, we use QALYs for this metric. QALYs capture mortality in terms of life-years lost and capture morbidity as a product of years in a reduced health state times the value of that reduction from full health. The health effect measure adjustment will not be done for those cases where the study considered only intermediate outcomes or other health outcome measures (e.g., disability-adjusted life years [DALYs]). In the first case, an intermediate summary measure will be chosen depending on the chapter under consideration. In the second case, the summary measure will be expressed in USD per DALY as originally reported in the article and reported in a separate table.

**Table 4.** Example of a cost-effectiveness ratio conversion from dollars per year of life saved<sup>a</sup> to dollars per quality adjusted life year (QALY) for an immunization program to immunize infants against Hepatitis B

Item	Parameter	Source	Value <sup>a</sup>
A	Cost of program for infants, 1993 USD, millions	Table 4, chronic, medical costs <sup>18</sup>	47.0
B	Medical cost without program, 1993 USD, millions	Table 4, chronic, medical costs <sup>18</sup>	9.5
C	Medical cost without program, 1993 USD, millions	Table 4, chronic, medical costs <sup>18</sup>	3.1
D	Medical cost averted, 1993 USD, millions	(B - C)	6.4
E	Net cost, 1993 USD, millions	(A - D)	40.6
F	Net cost, discounted, USD, millions	(E) Discounted 50 years at 5%	3.7
G	Years of life saved, number	Table 5 <sup>18</sup>	18,879
H	Years of life saved, discounted, number	(G) Discounted 50 Years at 5%	1,699
I	Chronic infections prevented, number	Table 5 <sup>18</sup>	4,702
J	Quality adjusted life years from morbidity, number	(I) × 10 years of chronic infection × 0.3 QALYs	14,106
K	Quality adjusted life years from morbidity, discounted, number	(J) Discounted 50 years at 5%	1,270
L	Quality adjusted life years from morbidity and mortality, number	(H + K)	2,969
M	Cost-effectiveness ratio in 1993 dollars per QALYs	(F/L)	1,246

<sup>a</sup>Rounded to better reflect precision of adjustments.

The results of studies addressing a service which prevent significant morbidity and express results in terms of dollars per life-year saved must be adjusted to better reflect the total health benefits of the service. In most cases, these adjustments are made by scaling time spent in illness or disability to 70% of the value of time spent healthy. With this approximation, each year of illness or disability prevented by this service reduces 0.3 years of quality of life for most chronic and acute diseases or disabling conditions. The estimate of 0.3 is the difference between perfect health, valued at 1.0 on health utility scales, and a range of approximately 0.55 to 0.85, (midpoint, 0.7) for persons living with most chronic and acute diseases or disabling conditions as reported in published utility scales<sup>16,17</sup> ( $1 - 0.7 = 0.3$ ).<sup>c</sup>

Although making adjustments with QALY weights that vary according to the specific condition would be preferable, the simple rule of 0.3 QALYs lost annually for most conditions was adopted because no published scales include all conditions and health states that are likely to be needed in a cross-cutting review of preventive services. Regardless of the weights chosen, sensitivity analysis on the weights used to adjust health benefits is needed because no single means of defining weights is clearly more correct than others. For many conditions, mortality tends to dominate the estimate of QALY and the adjustment will not be sensitive to the QALY weight for morbidity.

Table 4 contains an illustration of how the health outcome measure adjustment might be made. The reviewer can use a higher weight if the 0.3 value is insufficient to represent the averted impact of major morbidities such as mental impairment, severe mental illness or blindness. If an alternative weight is used, the

reviewer states the reason on the form. Adjustments should be made whenever possible and in fact, approximations with wide ranges in sensitivity analysis are preferable to determining that differences are nonadjustable. However, reviewers are asked to record differences for which adjustments are not possible in Section VI of the abstraction form, "Nonadjustable Differences." This section addresses differences in effect size, characteristics of the target population and frequency and intensity of delivery of the intervention evaluated in the study under review and the "typical" intervention class evaluated in the *Guide* review.

### Improving Comparability and Consistency of Base Adjustments

The adjustments noted previously are only as precise as the underlying data and the reporting of the original study allow. However, three additional steps are taken to improve the quality of reviews. First, the adjustments are subjected to sensitivity analysis. Under the section "Predicted Degree of Error (Uncertainty of Adjustment)," reviewers are asked to assess the reliability of individual adjustments using alternate values for each of the adjustments. This assessment is virtually identical to a single-variable sensitivity analysis on the final adjusted value of the summary measure. Based upon this sensitivity analysis, reviewers are asked to determine to which of four predefined categories of uncertainty each adjustment belongs. The ranges of uncertainty associated with the categories ( $\pm 0\%$ – $10\%$ ,  $11\%$ – $30\%$ ,  $31\%$ – $50\%$  and  $>50\%$ ) are defined as a percentage of the final adjusted ratio, rather than as a percent of the ratio resulting from each individual adjustment, so that the sensitivity of each adjustment is evaluated on a common basis and the range of uncertainty has underlying meaning. No theoretical or empirical basis is

<sup>c</sup> Based on the fact that when mortality is measured, years of life are valued at 1, not at 0.9 (the rough average reported for those with no diseases or disabilities).

currently available for defining these ranges; therefore, the ranges were chosen to identify interpretable degrees of uncertainty.

Second, in Section VI, "Nonadjustable Differences," reviewers describe differences in methods and definitions of interventions where adjustments are not possible because of lack of information. This section allows the reviewer to indicate whether the final summary measure from Section V might under- or overstate the value that would have been observed had the economic methods in the study not differed from the reference case or had the specific intervention evaluated not differed from a more typical case for the interventions under review.

Third, on the basis of their experience in reading the article and making adjustments, reviewers identify variables to which the results are particularly sensitive and which are likely to change if the intervention is applied in predictable, but specialized situations. Section VII, "Applicability," is designed to record information that could be used to alert users of the *Guide* to predictable and substantial changes in the value of the summary measure. Variables in this section needing particular attention from reviewers include baseline prevalence (if applicable), population characteristics, effectiveness, size of the population and costs in the case of a more intensive application of an intervention.

Section VIII, "Summary Table," condenses the findings of the study review and adjustments. It is completed only after the full instrument has been completed and allows for revision of abstraction and adjustments. This summary table lists the main components of the study and the sequential adjustments made to the original ratio, costs, or cost-saving value. This table also facilitates the process of reconciling differences and reaching consensus in the abstraction and adjustments by the two reviewers.

### **Summarizing Results: Example for the Chapter on Vaccine-Preventable Diseases**

An excerpt of the economic summary table for one of the interventions included in the Reviews of Evidence for Interventions to Improve Vaccination Coverage in Children, Adolescents and Adults<sup>12</sup> is provided in Appendix B. Additional examples are shown in that report. Cost-effectiveness was expressed in this particular case as the cost of the program per additional vaccination above baseline coverage or the cost per fully vaccinated child. Baseline vaccine coverage is the coverage that would have occurred in the absence of the intervention. Average cost was defined as the cost of the program per person served by the program. Average cost is provided to give program planners a starting point for estimating the costs of new initiatives. The cost-effectiveness of interventions to increase vaccina-

tion rates is not summarized in terms of health outcomes (e.g., QALYs) because (1) effectiveness studies reviewed in the *Guide* considered only intermediate outcomes; and (2) the health benefits vary by vaccine.

The table in Appendix B summarizes information regarding the study and study results including type of analytic methods used in the study or used by the reviewer to obtain the summary measure from data reported in the study. It also lists the type of summary measure, original currency, costs included in the analysis, the results of the study before and after adjustments, characteristics of the study population and estimates of effectiveness used in the evaluation.

Results from the table are interpreted and summarized in the body of the *Guide* for each particular intervention under the "Economic Evidence" subheading. The economic information is available to users although they do not affect the recommendations. One of the summaries from the report on vaccine-preventable diseases follows:

The search identified 11 economic evaluations of client reminder/recall interventions. Nine studies provided 12 cost-effectiveness ratios for single-component reminder/recall interventions and 3 cost-effectiveness ratios for multicomponent interventions that include reminder/recall. Adjusted cost-effectiveness ratios for the single-component interventions based on those studies ranged from \$3 to \$46/additional vaccination with a median of \$9/additional vaccination. The adjusted cost-effectiveness ratios for multicomponent interventions were \$4/additional vaccination for a combination of client and provider reminders; \$51/additional vaccination for a combination of reminders and a lottery-type incentive; and \$43/additional vaccination for a combination of mailed reminders and free vaccinations. Adjusted average costs based on two available studies varied from \$0.65 to \$5.75/child. The lower boundary is an underestimate because the costs of the in-kind contribution of volunteer time were not included and the upper boundary might be an overestimate because it includes costs of clinical time to provide vaccinations.

### **Discussion**

At present, the body of economic evidence available to compare costs and returns of interventions to improve health is substantially limited in both quantity and comparability. Methods to review, abstract and summarize economic evaluations need to be developed and debated if economic information is going to be useful to managers, policy makers, program planners and researchers.

The development of the procedures and instruments for economic evaluation in the *Guide* required balanc-

ing several competing needs. The abstraction form needs to be flexible enough to allow for review of studies using various analytic methods (e.g., cost, cost-effectiveness, cost-benefit and cost-utility) and interventions. However, the abstraction process must be consistent to ensure comparability of data across interventions, control uncertainty and limit the number of subjective judgements which reviewers need to make.

The Task Force recognizes that no process of adjustment or other means of reviewing existing economic evaluations is flawless. However, data that is made more comparable is thought to be preferable to alternatives that would (1) ignore economic information entirely; (2) attempt to use noncomparable data; or (3) adjust in ways that are not systematic or explicit. These methods will continue to evolve with time, experience and input from interested readers. Further application and testing will determine whether the process performs well in a variety of studies and disease topic areas and whether the instrument could be streamlined.

The systematic review of the economics of interventions in health care and public health calls for standardized and explicit methodology. The efforts of the PCEHM were an important step toward achieving this goal. The PCEHM recommends that, in addition to other results, study authors report results on the basis of the reference case whenever possible. However, methods used to compare the large number of previously published studies, which employ disparate methodologies, are still needed. Although the comparability of published studies may have improved since the publication of the PCEHM recommendations, methods for comparing published studies will continue to be needed as some study authors face data constraints, funding constraints, editorial constraints and study objectives that are partially at odds with the reporting of reference case results.

The provisional methods presented here represents an initial effort to meet these current and future needs in the *Guide to Community Preventive Services*. This paper describes the methods used to review economic evaluations in the *Guide* with the hope that others (1) will provide recommendations for improving the methods for the *Guide*, (2) will adapt these methods to the needs of other reviews of economic evaluations; (3) will engage in a process of developing systematic methods for evaluating economic evaluations literature that equals efforts to develop methods for the systematic review of effectiveness literature; and (4) will encour-

age economic evaluation studies of interventions for which economic information is not available.

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**Appendix A**  
**Selected Sections of the Economic Evaluation Form**

**V. COSTS AND HEALTH OUTCOME MEASURE ADJUSTMENTS (*selected items*)**

23. Adjustment 1 — Currency

23.1 Currency Used in the Study  
 US\$     Other (*Specify*) \_\_\_\_\_ Base Year for Currency \_\_\_\_\_

23.2 Starting Ratio, Costs, or Cost-Savings Value \_\_\_\_\_

23.3 Ratio, Costs, or Cost-Savings Value Converted to US\$ \_\_\_\_\_

24. Adjustment 2 — Base Year (1997)

24.1 Base Year Used in Study \_\_\_\_\_

24.2 Starting Ratio, Costs, or Cost-Savings Value (from 23.3) \_\_\_\_\_

24.3 Ratio, Costs, or Cost-Savings Value Converted to Base Year 1997 \_\_\_\_\_

24.4 Inflation Adjustment Factor Used  
 Consumer Price Index—Urban (CPI-U)  
 MCPI  
 None

24.5 Predicted Degree of Error (Uncertainty of Adjustment)  
 Small (0%–10%)             Large (31%–50%)  
 Moderate (11%–30%)        ≥51% (*Specify*) \_\_\_\_\_

24.6 Explanation of Variation in Category or Calculated Range \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

25. Adjustment 3 — Discount Rate

25.1 Discount Rate Used in Study \_\_\_\_\_

25.2 Starting Ratio, Costs, or Cost-Savings Value (from item 24.3) \_\_\_\_\_

25.3 Basis for Adjustment (Numbers, Assumptions, or Calculation) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

25.4 Adjusted Ratio, Costs, or Cost-Savings Value \_\_\_\_\_

25.5 Probable Degree of Variation and Uncertainty of Adjustment  
 Small (0%–10%)             Large (31%–50%)  
 Moderate (11%–30%)        ≥51% (*Specify*) \_\_\_\_\_

25.6 Explanation of Variation Category or Calculated Range \_\_\_\_\_

26. Adjustment 4 — Additional Costs

- 26.1 Description of Costs Missing or Included \_\_\_\_\_  
\_\_\_\_\_
- 26.2 Starting Ratio, Costs, or Costs-Saving Value (from item 25.4) \_\_\_\_\_
- 26.3 Basis for Adjustment (Numbers, Assumptions, Calculation) \_\_\_\_\_  
\_\_\_\_\_
- 26.4 Adjusted Ratio, Costs, or Cost-Savings Value \_\_\_\_\_
- 26.5 Probable Degree of Variation and Uncertainty of Adjustment  
 Small (0%–10%)                       Large (31%–50%)  
 Moderate (11%–30%)                 ≥51% (*Specify*) \_\_\_\_\_
- 26.6 Explanation of Variation Category or Calculated Range \_\_\_\_\_  
\_\_\_\_\_

28. Adjustment 6 — Productivity Losses

- 28.1 Description of Productivity Loss Included \_\_\_\_\_  
\_\_\_\_\_
- 28.2 Starting Ratio, Costs, or Cost-Savings Value (from item 27.4) \_\_\_\_\_
- 28.3 Basis for Adjustment (Numbers, Assumptions, Calculation) \_\_\_\_\_  
\_\_\_\_\_
- 28.4 Adjusted Ratio, Costs, or Cost-Savings Value \_\_\_\_\_
- 28.5 Probable Degree of Variation and Uncertainty of Adjustment  
 Small (0%–10%)                       Large (31%–50%)  
 Moderate (11%–30%)                 ≥51% (*Specify*) \_\_\_\_\_
- 28.6 Explanation of Variation Category or Calculated Range \_\_\_\_\_  
\_\_\_\_\_

29. Adjustment 7 — Conversion of Health Outcome Measure (Denominator) to QALYs

- 29.1 Health Outcome Measure Used in Study (Specify) \_\_\_\_\_
- 29.2 QALY Weight Used in Original Outcome Measure (*if applicable*) \_\_\_\_\_  
\_\_\_\_\_
- 29.3 Starting Ratio, Costs, or Cost-Savings Value (from item 28.4) \_\_\_\_\_
- 29.4 Basis for Adjustment (Conversion Factor, Numbers, Assumptions, or Calculation) \_\_\_\_\_  
\_\_\_\_\_

- 29.5 Adjusted Ratio, Costs, or Cost-Savings Value \_\_\_\_\_
- 29.6 Predicted Degree of Error (Uncertainty of Adjustment)  
 Small (0%–10%)                       Large (31%–50%)  
 Moderate (11%–30%)                 ≥51% (Specify) \_\_\_\_\_
- 29.7 Explanation of Variation Category or Calculated Range \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**VI. NONADJUSTABLE DIFFERENCES (*selected item*)**

32. Nonadjustable Intervention Definition or Methods Differences:

32.1 Differences in :

- Intervention Definition                       Methods

From:

- |  |   |
|--|---|
| <input type="checkbox"/> Comparison Intervention (Incremental)     | <input type="checkbox"/> Baseline Incidence or Prevalence |
| <input type="checkbox"/> Technology (Choice or Change Over Time)   | <input type="checkbox"/> Perspective                      |
| <input type="checkbox"/> Intensity of Service (Frequency)          | <input type="checkbox"/> Effectiveness                    |
| <input type="checkbox"/> Setting (Clinic versus Home/School, Etc.) | <input type="checkbox"/> Location (Urban/Rural)           |
| <input type="checkbox"/> Audience                                  | <input type="checkbox"/> Other (Specify) _____            |

Affects:

- |   |  |
|---|--|
| <input type="checkbox"/> Time Frame                       | <input type="checkbox"/> Missing Cost-of-Illness Averted |
| <input type="checkbox"/> Analytic Horizon                 | <input type="checkbox"/> Productivity Losses             |
| <input type="checkbox"/> Included Intervention Costs      | <input type="checkbox"/> Cost of Harms                   |
| <input type="checkbox"/> Missing Intervention Costs       | <input type="checkbox"/> Morbidity Measure               |
| <input type="checkbox"/> Included Cost-of-Illness Averted | <input type="checkbox"/> Other (Specify) _____           |

32.2 Description \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

- 32.3 Expected Direction of "Bias"  
 Overstates Value                               Overstates Savings  
 Understates Value                             Understates Savings  
 Unable to Predict

- 32.4 Expected Magnitude of "Bias"  
 Small (0%–10%)                               Large (31%–50%)  
 Moderate (11%–30%)                         ≥51% (Specify) \_\_\_\_\_

32.5 Explanation of Direction or Magnitude (Specify) \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

## VII. APPLICABILITY

### 34. Variables That Differ Between Communities or Settings to Which the Ratio, Costs, or Cost-Savings Value Are Most Sensitive

Baseline Incidence or Prevalence Rates \_\_\_\_\_  
\_\_\_\_\_

Sensitivity of Value (To This Variable)     Moderate     Great

Population Characteristics \_\_\_\_\_  
\_\_\_\_\_

Sensitivity of Value     Moderate     Great

Effectiveness (Not Related to Population Characteristics) \_\_\_\_\_  
\_\_\_\_\_

Sensitivity of Cost-Effectiveness Value     Moderate     Great

Size of Population (Spreading Fixed Costs) \_\_\_\_\_  
\_\_\_\_\_

Sensitivity of Cost-Effectiveness Value     Moderate     Great

Preventive Service Costs, Community Intervention \_\_\_\_\_  
\_\_\_\_\_

Sensitivity of Cost-Effectiveness Value     Moderate     Great

Preventive Service Costs, Clinical Aspects \_\_\_\_\_  
\_\_\_\_\_

Sensitivity of Cost-Effectiveness Value     Moderate     Great

Costs of Averted Services \_\_\_\_\_  
\_\_\_\_\_

Sensitivity of Cost-Effectiveness Value     Moderate     Great

Other (1) \_\_\_\_\_  
\_\_\_\_\_

Sensitivity of Cost-Effectiveness Value     Moderate     Great

Other (2) \_\_\_\_\_  
\_\_\_\_\_

Sensitivity of Cost-Effectiveness Value     Moderate     Great

**VIII. SUMMARY TABLE**

Reviewer's Name \_\_\_\_\_

Category	Adjustment Summary
Tracking Number	
Intervention	
Target Population	
<i>Guide</i> Effect Size	
Study Effect Size	
Analytic Method	
Summary Measure	
Perspective	
Original Value	
New Value with Currency Adjustment	
New Value with Base-Year Adjustment	
New Value with Discount Rate Adjustment	
New Value with Cost 1 Adjustment	
New Value with Cost 2 Adjustment	
New Value with Productivity Losses Adjustment	
New Value with QALY Adjustment	
New Value with Other Adjustment	
New Value with Other Adjustment	
Final Adjusted Value of the Summary Measure	

**Appendix B  
Sample Economic Evaluation Summary Table**

**CLIENT REMINDER/RECALL**

**STRONGLY RECOMMENDED**

Author, Reference Number, Study Period	Analytic Method, Reported or Calculated Summary Measure	Study Location, Setting Type, Population Description, Vaccine	Interventions Studied, Comparisons	Base Year, Costs Included, Reported Summary Measure, Coverage Baseline and Increase	Adjusted Base Year, Summary Measure Adjusted Value, Notes
Buchner Ref. 1 1984	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Seattle, Washington; general practice; adults aged >65 years; influenza	1. Mailed client reminder 2. Control	1984 US\$; costs included direct costs of mailing reminders, including postage, printing, and envelopes; CE ratio of 1 versus 2 = \$30/AV; baseline coverage = 54%; net change in coverage = 1%	1997 US\$; CE ratio of 1 versus 2 = \$46.35/AV
Chiu Ref. 2 1994-96	Cost-analysis; average cost in dollars per child	Jacksonville, Florida; hospital nurseries and community wide; children aged <18 months; vaccines not specified	1. "Shots by Two" Project; volunteers "adopt" a baby, introduce themselves, and provide four postcard and phone reminders from the child's birth to age 18 months 2. No control	1994 (assumed) US\$; estimates do not specify whether per child or per reminder and do not include in-kind contributions of volunteer time; AC = \$0.60/child; county baseline coverage = 64.3%; net change in coverage = 16.5% (Entire increase in coverage cannot be attributed to the intervention)	1997 US\$; AC = \$0.65/child AC is an underestimate because costs do not include in-kind contribution of volunteer time
Frame Ref. 3 1991-92	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Dansville, New York; rural; family practice; adults aged ≥21 years; Td booster	1. Computer-generated provider and client reminders and tracking 2. Manual tracking	1992 US\$; costs included staff, materials, and postage; cost of installing computer-based system not included; CE ratio = \$3.71/AV; baseline coverage = 20%; net change in coverage = 21%	1997 US\$; CE ratio of 1 versus 2 = \$4.41/AV This intervention also increased provision of other preventive care; therefore, CE ratio probably underestimates overall CE
Frank Ref. 4 1981-82	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Hamilton, Ontario, Canada; urban community health center; adults aged >65 years; influenza	1. Mailed client reminders 2. Follow-up telephone calls to nonrespondents 3. Prior usual care	1982 (assumed) Canadian\$; costs included materials, labor, and postage; CE ratio of 1 versus 3 = \$2.16-\$2.50/AV; CE ratio of 2 versus 1 = \$5.00-\$8.00/AV; baseline coverage = 17%; net change in coverage attributable to 1 = 26%; additional net change in coverage attributable to 2 = 12%	1997 US\$; CE ratio of 1 versus 3 = \$2.80-\$3.20/AV; CE ratio of 2 versus 1 = \$6.40-\$10.37/AV Additional information regarding effectiveness of this intervention is reported in Hutchinson, Ref. 5

*Table 1 Continued*

Author, Reference Number, Study Period	Analytic Method, Reported or Calculated Summary Measure	Study Location, Setting Type, Population Description, Vaccine	Interventions Studied, Comparisons	Base Year, Costs Included, Reported Summary Measure, Coverage Baseline and Increase	Adjusted Base Year, Summary Measure Adjusted Value, Notes
Grabenstein Ref. 6 1990	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Durham County, North Carolina; pharmacy-based; adults aged >64 years; influenza	<ol style="list-style-type: none"> <li>Two mailed reminders regarding risk of influenza and availability of vaccinations</li> <li>No reminders</li> </ol>	1990 US\$; costs included materials, labor, and professional fees; CE ratio of 1 <i>versus</i> 2 = \$10.68/AV; baseline coverage = 54%; coverage increase = 10%	1997 US\$; CE ratio of 1 <i>versus</i> 2 = \$13.00/AV
Lieu Ref. 7 1994-95	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Northern California; managed care organization; children aged 20-24 months; MMR	<ol style="list-style-type: none"> <li>Computer-generated personalized client reminders</li> <li>Autodialer telephone system</li> <li>Control group with no reminder</li> </ol>	1996 US\$; costs included computer costs, printing, clerical labor, postage, and stationary; baseline coverage = 86%; net change in coverage = 4% for both 2 and 3 compared with 1; CE ratio of 1 <i>versus</i> 3 = \$4.04/AV; CE ratio of 2 <i>versus</i> 3 = \$2.14/AV	1997 US\$; CE ratio of 1 <i>versus</i> 3 = \$4.10/AV; CE ratio of 2 <i>versus</i> 3 = \$2.18/AV Assumes same effectiveness for autodialer system in increasing coverage that was observed for recall letters
Lieu Ref. 8 1996-97	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Northern California; hospital management organization; children aged 20 months; DTP, OPV, MMR, hepatitis B, Hib	<p>Randomized intervention groups 1-4 as follows:</p> <ol style="list-style-type: none"> <li>Letter reminder</li> <li>Automated phone reminder</li> <li>Letter followed by automated phone reminder</li> <li>Automated phone reminder and follow-up letter</li> <li>Nonrandomized comparison group</li> </ol>	1997 US\$; costs included computer time, staff time (e.g., programmers and clerical), maintenance of telephone software, postage, telephone fees, software programming (start-up); CE ratio of 1 <i>versus</i> 5 = \$10.50/AV; using postcard reminders rather than letters would result in CE ratio = \$6.50/AV if postcards and letters were equally effective; CE ratio of 2 <i>versus</i> 5 = \$9.80/AV; using lower cost assumptions thought to be consistent with costs at a public clinic would result in a CE ratio of \$2.20/AV; CE ratio of 3 <i>versus</i> 5 = \$7.00/AV; CE ratio of 4 <i>versus</i> 5 not reported; baseline up-to-date coverage in the study population not provided; of initially unvaccinated children, 36%-47% were fully vaccinated by age 24 months in the four study groups; net change in coverage not calculable from the data presented	1997 US\$; CE ratio of 1 <i>versus</i> 5 = \$10.70/AV; using postcards rather than letters, CE = \$6.70/AV; CE ratio of 2 <i>versus</i> 5 = \$10.00/AV; using lower public clinic cost assumptions would = \$2.30/AV; CE ratio of 3 <i>versus</i> 5 = \$7.20/AV

Table 1 Continued

Author, Reference Number, Study Period	Analytic Method, Reported or Calculated Summary Measure	Study Location, Setting Type, Population Description, Vaccine	Interventions Studied, Comparisons	Base Year, Costs Included, Reported Summary Measure, Coverage Baseline and Increase	Adjusted Base Year, Summary Measure Adjusted Value, Notes
McLeod Ref. 9 1996	Cost-analysis; average cost in dollars per child	Wellington, New Zealand; convenience sample of noncapitated and capitated practices; preschool-age children; vaccine not specified	<ol style="list-style-type: none"> <li>Costs of vaccinating preschool-age children among practices participating in a system of audit and feedback and using client recalls and reminders</li> <li>No comparison group</li> </ol>	1996 New Zealand\$; costs included practice nurse and general practitioner labor, materials, supplies, staff, and receptionist labor; cost of vaccine not included; costs of audit and feedback not included; AC = New Zealand\$8.51/child; no baseline coverage data; no net change in coverage data	1997 US\$; AC = \$5.75/child Includes costs of clinical time for providing vaccinations as well as recall; overestimates cost of recall alone
Moran Ref. 10 1991	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Boston, Massachusetts; urban community health center; poor to lower income; aged $\geq 65$ years or $< 65$ years but at high-risk; influenza	<ol style="list-style-type: none"> <li>Educational brochure</li> <li>Lottery-type incentive</li> <li>Both educational brochure and incentive</li> <li>Control group of usual care</li> </ol>	1991 (assumed) US\$; costs included graphic development, printing, prizes, postage, and clerical labor; costs of vaccine, software, tracking hardware, and student personnel not included; CE ratio of 1 versus 4 = \$3.45/AV; CE ratio of 2 versus 4 = \$8.74/AV; CE ratio of 3 versus 4 = \$43.06/AV; baseline coverage = 20%; coverage increase 1 = 16%, 2 = 9%, and 3 = 6%	1997 US\$; CE ratio of 1 versus 4 = \$4.06/AV; CE ratio of 2 versus 4 = \$10.00/AV; CE ratio of 3 versus 4 = \$50.73/AV
Nexoe Ref. 11 1995	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Denmark; general practices; adults aged $\geq 65$ years; influenza	<ol style="list-style-type: none"> <li>Mailed invitation for vaccination</li> <li>Mailed invitation plus free vaccination</li> <li>Comparison group of usual care</li> </ol>	1995 US\$; costs included postage and vaccination administration; CE ratio of 1 versus 3 = \$21.00/AV; CE ratio of 2 versus 3 = \$40.50/AV; includes price of vaccine; baseline coverage = 25%; coverage increase 1 versus 3 = 24%; 2 versus 3 = 47%	1997 US\$; CE ratio of 1 versus 3 = \$22.10/AV; CE ratio of 2 versus 3 = \$43.00/AV

Table 1 Continued



Author, Reference Number, Study Period	Analytic Method, Reported or Calculated Summary Measure	Study Location, Setting Type, Population Description, Vaccine	Interventions Studied, Comparisons	Base Year, Costs Included, Reported Summary Measure, Coverage Baseline and Increase	Adjusted Base Year, Summary Measure, Adjusted Value, Notes
Rosser Ref. 12 1983-86	Cost-effectiveness; cost-effectiveness in dollars per additional vaccination	Ottawa, Canada; University of Ottawa Family Medicine Center at Civic Hospital; adults aged >20 years; tetanus booster	1. Physician reminder 2. Telephone reminder by nurse 3. Letter reminder 4. Randomized control	1985 Canadian\$ (assumed); direct costs, including medical and non-medical staff labor, postage, and stationary; cost of producing provider reminders not included; CE ratio of 1 <i>versus</i> 4 = \$0.43/AV; CE ratio of 2 <i>versus</i> 4 = \$5.00/AV; CE ratio of 3 <i>versus</i> 4 = \$6.50/AV; baseline coverage = 3%, net change in coverage, 1 = 20%, 2 = 21%, and 3 = 27%	1997 US\$; CE ratio of 1 <i>versus</i> 4 = \$0.70/AV; CE ratio of 2 <i>versus</i> 4 = \$8.75/AV; CE ratio of 3 <i>versus</i> 4 = \$9.75/AV McDowell, Ref. 13, provides similar data regarding the same interventions to improve uptake of influenza vaccine

## References to Appendix B

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