Cost-Benefit Analysis of an Otolaryngology Emergency Room Using a Contingent Valuation Approach

Matthew R. Naunheim, MD, MBA1,2, Elliot D. Kozin, MD1,2, Rosh K. Sethi, MD, MPH1,2, H. Gregory Ota, MD1,2, Stacey T. Gray, MD1,2, and Mark G. Shrime, MD, MPH2,3

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Abstract
Objectives. Dedicated otolaryngology emergency rooms (ERs) provide a unique mechanism of health care delivery. Relative costs and willingness to pay (WTP) for these services have not been studied. This study aims to provide a cost-benefit analysis of otolaryngology-specific ER care.

Study Design. Cost-benefit analysis based on contingent valuation surveys.

Setting. An otolaryngology-specific ER in a tertiary care academic medical center.

Subjects and Methods. Adult English-speaking patients presenting to an otolaryngology ER were included. WTP questions were used to assess patient valuations of specialty emergency care. Sociodemographic data, income, and self-reported levels of distress were assessed. State-level and institution-specific historical cost data were merged with WTP data within a cost-benefit analysis framework.

Results. The response rate was 75.6%, and 199 patients were included in the final analysis. Average WTP for otolaryngology ER services was $319 greater than for a general ER (95% CI: $261 to $377), with a median value of $200. The historical mean cost per visit at a general ER was $575, and mean cost at the specialty ER was $551 (95% CI: $529 to $574). Subtracting incremental cost from incremental WTP yielded a net benefit of $343.

Conclusion. Dedicated otolaryngology ER services are valued by patients for acute otolaryngologic problems and have a net benefit of $343 per patient visit. They appear to be a cost-beneficial method for addressing acute otolaryngologic conditions. This study has implications for ER-based otolaryngologic care and direct-to-specialist services.

Keywords
cost-benefit analysis, contingent valuation, willingness to pay, emergency services, specialty emergency rooms

Primary care physicians and emergency room (ER) providers commonly manage acute otolaryngologic complaints. An estimated 10% to 50% of primary care physician visits relate to ear, nose, or throat diagnoses.1-4 In general ERs, otitis media and pharyngitis alone constitute approximately 4,175,000 visits per year in the United States and are among the top 20 diagnoses reported in the National Hospital Ambulatory Medical Care Survey.5 Previous work from our institution demonstrated the notable number of ER-based patient visits related to otolaryngologic complaints on a national level.6,7

An additional form of health care delivery for otolaryngologic complaints is a specialty-specific ER. This institution has been described in several countries across the globe, and it takes the form of a stand-alone ER, an integrated unit within a general ER, and an urgent care clinic.8 While otolaryngology-specific ERs are not common, they provide a unique model to study the benefits and costs of subspecialty health care delivery.8,9 Since the Patient Protection and Affordable Care Act was signed into law in 2010, understanding cost has become a focus of health care policy.10-12 New models of health care delivery hold promise for cost reduction,13-19 and economic analysis of new and existing health programs has become increasingly necessary.20,21 Cost-utility, cost-effectiveness, and

1Department of Otolaryngology—Head and Neck Surgery, Massachusetts Eye and Ear Infirmary, Boston, Massachusetts, USA
2Department of Otology and Laryngology, Harvard Medical School, Boston, Massachusetts, USA
3Department of Global Health and Population, Harvard School of Public Health, Boston, Massachusetts, USA

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Corresponding Author:
Matthew R. Naunheim, MD, MBA, Department of Otolaryngology, Massachusetts Eye and Ear Infirmary, 243 Charles Street, Boston, MA 02114, USA.
Email: Matthew_Naunheim@meei.harvard.edu
cost-minimization techniques have all been employed to this effect.

Cost-benefit analysis (CBA) is a form of economic evaluation wherein the benefits of a health care program are quantified in monetary units and compared with its costs. Benefits can be measured either through observed trade-offs made by patients within a specific scenario or through contingent valuation (CV) surveys wherein hypothetical dollar–health risk choices (ie, willingness to pay [WTP]) are stated directly by the patient. In this way, CV assesses the value of goods and services not available in a private market. To date, only a handful of CBAs have been published in the otolaryngology literature using a CV approach, and these studies were limited to evaluation of potential products (tinnitus devices, hearing aids, and pharmacologic treatment of rhinosinusitis) rather than health care services.

This study is a patient-focused CBA to analyze the net benefit of otolaryngology-specific emergency services. We hypothesized that the benefits of these services outweigh their costs when analyzed within a formal economic analysis.

**Methods**

**Setting**

The Massachusetts Eye and Ear Infirmary (MEEI) Institutional Review Board approved this study. The MEEI ER provides otolaryngologic care 24 hours per day, every day of the year. Patients that present to the MEEI ER come electively, are referred by other physicians, or are transferred from outside institutions (including general ERs, clinics, or rehabilitation facilities). The ER is staffed by at least 1 otolaryngology-trained physician at all times, as well as nurses and support staff. Otolaryngology residents are also trained in the ER by the attending staff. Standard ER services, including laboratory, radiology, microbiology, and pathology services, are available, as are specialty-specific services, such as audiology and in-room video endoscopy. Follow-up after ER care is offered in the main hospital clinics. The epidemiology and patient population of this ER have been described.

**Subjects**

Patients were included over a period of 5 months from October 15, 2014, through March 15, 2015. Inclusion criteria were as follows: adult patients ≥18 years, English speaking, and presenting to the ER for an ear, nose, throat, head, or neck complaint. Exclusion criteria included 3 groups that would have difficulty understanding the questionnaire: children, adults with decisional impairment, and subjects who are non-English speaking and reading. Prisoners, who may not be able to make voluntary or uncoerced decisions on participation, were also excluded. Patients with life-threatening problems (eg, significant epistaxis, posttonsillectomy bleeding, airway obstruction) were also excluded to prevent delays in diagnosis and treatment.

**Survey Instrument and Validation**

**Survey**. Benefits to the patient of otolaryngology-specific ER care were assessed by means of a CV survey designed to measure the marginal value of these services. Patients were given the option to participate upon arrival in the registration area; participants and nonparticipants were both recorded. The anonymous survey asked 21 questions that assessed sociodemographic data, income, referral patterns, and patients’ estimates of cost per visit. WTP for otolaryngology-specific (but not institution-specific) acute care was assessed using CV questionnaire (see appendix at www.otojournal.org/supplemental). This was done using the conceptual framework for CV studies in health care published by O’Brien and Gafni. Self-reported patient distress was recorded on a Likert scale (1 to 7). WTP values were explicitly formulated in terms of out-of-pocket expenses (paid for by the patient instead of a third-party payer). The cost of an average ER visit in the state of Massachusetts was provided to the patient ($575).

Critical aspects of this design included the following: framing the study in terms of resource allocation on a societal level; use of “compensating variation” (defined as the maximum amount that a consumer would be willing to pay to achieve his or her initial level of satisfaction after a change to the program in question); use of the ex post user-based perspective, where the respondent is assumed to be at the point of consumption and payment for ER services; adoption of a “holistic” model of assessment for the ER program as a whole rather than a “decomposed” model, which would assess the WTP of each component of specialty ER services separately; and use of “take it or leave it” (TIOLI) questions, which were eventually abandoned in favor of the more easily understood payment card format (see Validation section).

The survey was then reviewed in reference to the established best practices in CV methodology. Personal interviews were conducted in the early stages of the survey for validation and later substituted with paper-based surveys. The survey included detailed information on the ER resources available to patients in a clear format, with the benefits of each option outlined and with background information about hospital costs in general ERs. Questions assessing patient understanding were included.

**Validation**. The CV survey was validated through several techniques. First, the survey underwent review by the Delphi method, which consisted of several rounds of revisions based on expert opinion. The expert panel consisted of 5 peers holding advanced degrees in medicine, public health, business administration, and survey methodology; 4 were otolaryngologists. Second, the revised survey was administered to 15 patients in our ER in the presence of the lead author, and face-to-face structured interviews were conducted to ensure that the questions were well understood. Improvements were based on criticisms and comments. After this review, the question format was changed from the TIOLI format to a payment card format. A TIOLI question
may ask, “Would you be willing to pay $400 extra to be seen in a specialty ER, rather than a general ER?” with the dollar value varying for each respondent. A payment card question would ask “How much more would you be willing to pay to be seen in a specialty ER, rather than general ER?” and would then list a range of values from which to choose. Last, the final survey was piloted on an additional 15 patients in the MEEI ER in an unobserved fashion, with subsequent face-to-face interviews after survey completion. Of the 15 participants, 14 (93%) understood the survey, with 1 patient unable to answer the WTP question. No further refinements were made at this point.

Assessment of Costs

Historical institution-specific cost data were retrieved from hospital billing records from September 2009 through April 2014. This end date was 6 months prior to survey administration, to allow time for collection of payments. All patients presenting to our otolaryngology ER with ear, nose, throat, head, or neck complaints were included. Total cost was estimated by summing total payments from insurers and patients and was interpreted as the hospital’s willingness to accept valuation of services rendered. Charge data were not used. All costs were adjusted to 2014 levels using year-specific consumer price index ratios published by the Bureau of Labor Statistics values for urban consumers.37

Data Analysis

Demographic descriptive statistics were analyzed for mean, range, and variation. The CV questionnaire was then evaluated in several steps. Response rate was calculated as the number of respondents electing to fill out the survey, divided by the total number of surveys offered. Blank values for any specific question were omitted from analysis rather than imputed. Univariate and multivariate analyses were performed to determine the variables most likely to influence reported value metrics. Cost data were merged with survey responses within a CBA framework. Net benefits were determined by subtracting the costs from the WTP values (net benefits = WTP minus costs). Microsoft Excel and JMP statistical software (SAS, Cary, North Carolina) was used for all data analysis. Significance was defined at P = .05.

Results

Over the study period, 279 patients were offered a survey, and 211 patients agreed to fill it out, for a response rate of 75.6%. Figure 1 is a flowchart demonstrating the inclusion and exclusion of patients. Surveys with ≥1 missing values were included, with blank values excluded from calculations. No patients took the survey twice. Thus, 199 were included in the analysis; 45.7% of surveys were filled out by patients who had previously been to the MEEI ER.

Standard descriptive statistics of the population are shown in Table 1. The average age was 45 years (range, 18-87), with fewer men (n = 88, 44.2%) than women (n = 108, 54.3%). The majority of our patients identified as white/Caucasian (n = 149, 74.8%). The majority of patients (n = 103, 51.7%) reported having children, with an average number of 1.3 across the study group. Average yearly income was estimated at $91,434. Fifty-six patients elected not report income. Self-reported levels of distress were

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high, showing a modal response of 7 on a Likert scale of 1 to 7 (Figure 2).

Average patient-reported WTP for an otolaryngology ER was $319 greater than for a general ER (95% CI: $261 to $377), with a median value of $200 and a modal response of $100. A histogram plotting these responses is shown in Figure 3. Regression analysis of demographic variables, income levels, self-reported distress, and history of past visits at the MEEI ER did not show correlation with WTP.

Historical cost review at our institution returned 31,125 records for individual ER visits from September 2009 through April 2014. The mean cost at the MEEI ER was $551 (95% CI: $529 to $574). Based on historical governmental data, the cost of an average ER visit in the state of Massachusetts was $575.33

Net benefits were calculated by subtracting incremental cost from incremental WTP. The societal perspective was taken for analysis; all costs and benefits were included regardless of who received the benefit or bore the cost (eg, patient, insurance company, hospital). This gave the following equation:

\[
\text{Net benefit(\$)} = (\text{incremental benefit}) - (\text{incremental cost})
\]

\[
= (\text{WTP}_{\text{specialty ER}} - \text{WTP}_{\text{general ER}}) - (\text{cost}_{\text{specialty ER}} - \text{cost}_{\text{general ER}})
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\[
= (319) - (551 - 575)
\]

\[
= \$343
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Sensitivity analysis revealed the range of net benefit to be greater than zero, even with stringent assumptions for WTP and cost. With the modal response of $100 for WTP and the high end of the 95% CI for cost ($574), net benefit remained positive at $101.

Discussion

This study explores the relative costs of and WTP for specialty-specific care for acute otolaryngology complaints. Our analysis shows that there is a net benefit of $343 to an otolaryngology ER offering acute otolaryngologic care. In simple terms, this means that costs to the health care system of this program, as it currently exists, are outweighed by the benefits, and the patient-reported net value of each visit is...
$343. Patient WTP for urgent otolaryngology care is significant and, in this study, was not influenced by demographic variables, income levels, self-reported distress, and history of past visits to our institution.

Although our data indicate that otolaryngology-specific ERs are beneficial to a subset of patients, the implications are broader for specialty care in general. Even though the Patient Protection and Affordable Care Act has emphasized integration of care and reduced use of specialists, there is evidence that “focused factories”—hospitals or care units that focus on a specialized set of diagnostic and therapeutic tasks—provide better outcomes at a lower cost. A specialty-specific ER—or a different form of health care delivery that fulfills the same functions (eg, autonomous ear, nose, or throat units within general ERs or well-equipped urgent care centers)—can fill this niche while reducing the burden on general ERs. It has been estimated that up to 27% of general ER complaints could be seen at alternative care settings, such as urgent care centers or retail clinics; a center such as ours is one such setting that allows patients to be seen for acute otolaryngology complaints. This not only unburdens the general ER system but also provides a service that patients value.

This study does not answer the question of whether an otolaryngology ER provides better care for ear, nose, or throat complaints than that of a general ER. Health outcomes for this form of urgent care delivery must be researched to prove effectiveness relative to the current standard of care. However, one of the advantages of the current study is that CBA captures more than just the effectiveness and health benefits of a specific program; it also captures patient-reported benefits in terms of quality of life, option value (ie, having an otolaryngology ER in case of future emergency), alleviation of anxiety, patient education, and altruism effects. In the field of otolaryngology, where interventions are often aimed at improving quality of life, this patient-centric approach to care is essential. The results of this research indicate that an otolaryngology ER is a cost-beneficial health care service. Although this is an important first step in understanding the benefit of acute ear, nose, or throat care, it should be noted that a full financial analysis of creating and running a full-time otolaryngology ER is beyond the scope of this project.

While use of CV analysis is increasing, it is used less frequently than other sorts of economic analyses. WTP has several distinct advantages over other health care valuation methods:

- WTP is theoretically founded in welfare economics and values stated patient preferences regarding health care choices.
- WTP comprehensively values benefits of a health intervention, including not only health outcomes but nonhealth benefits (eg, anxiety reduction and patient education) and nonuse value (eg, option value for future care and the “caring externality,” or altruism, toward another individual’s potential health benefit from a program).
- WTP translates patient demand into dollar values, allowing comparisons of allocative efficiency across societal sectors outside of health care.

Respondents may have difficulty placing a dollar value on health conditions or outcomes in WTP questionnaires—indeed, the very nature of CV is that there is no market (and therefore no established price or value) for the health product in question. Of note, results from the present study indicate that respondents did not have significant difficulty answering WTP questions (1.5% indicated poor understanding of the questions, and 85.4% answered WTP question). Despite these concerns, CV analyses have gained acceptance in the health care literature, and their specific methodological techniques continue to be improved. For instance, we first used the TIOLI and then payment card questions to elicit WTP values, as we found that subjects had a more difficult time answering TIOLI questions, whereas payment cards offered a range of potential values. This payment card method may bias WTP by “anchoring” subjects to the range of listed values, in our WTP data, there were clear preferences for choosing “round numbers” (eg, 500 and 1000). However, there is evidence that reference values may actually improve respondents’ confidence in their WTP estimates. Ultimately, CV analyses are useful only when methodologically sound; further research should be done within otolaryngology to improve the reliability of their results.

This study has several limitations. Patients were surveyed before an episode of treatment, and they represent a convenience sample at a single institution, which may lead to sampling bias. An ideal sample would assess the entire population’s responses to a survey—including those with otolaryngologic complaints and those without. However, a methodological difficulty of many CV studies is that questions are too general and not pertinent to respondents; our questions were directly applicable to respondents. Additionally, our survey assumed a short timeline for care; costs were accounted for as a one-time, episodic value that did not assess future impact of cost (ie, savings or costs that resulted from otolaryngology-specific ER care). Presumably, quicker access to specialty care and the potential for more accurate diagnosis in an otolaryngology ER would save costs and increase the net benefit of the ER program. We excluded non-English-speaking patients for internal consistency within the questionnaire, which may induce bias. WTP survey analysis depends on the language used and the cultural context in which it is administered; inconsistencies among surveys in various languages may lead to confounded results. A more comprehensive study is warranted in further iterations of this research to understand cultural differences in WTP but is not the focus of this initial research. We conducted our study from October through March, a time with increased otolaryngology-related airway illness, which may bias our WTP values and levels of distress. Last, we excluded patients in extremis, for the purpose of patient safety. Further research is underway at our institution to address these issues.
Acute otolaryngology care is provided across the country in many settings, including general ERs, clinics, and primary care offices. While the described specialty-specific ER may not be a feasible model in many parts of the country, it nonetheless serves as an opportune way to study the patient-centric benefit of otolaryngology services provided in an urgent or emergent manner. This addresses the core questions of what patients value and what costs are incurred by their preferences—issues that challenge all otolaryngologists in the 21st century.

In summary, when comparing incremental WTP and costs, otolaryngology-specific ER care offers a net benefit over general ER services. This analysis shows that patients demand and will pay for acute otolaryngology services and that the benefits of such a program may outweigh the costs. A CV survey using WTP questions is useful for valuing patient preferences regarding acute otolaryngologic care. Patient-centric surveys like this one will become increasingly important in the valuation of health care services and will help to efficiently allocate resources in an era of cost reduction in medicine.

Conclusion

In this study, we demonstrate the feasibility of CBA using a CV survey for health care delivery in otolaryngology. Dedicated otolaryngology ER services are valued by patients for acute otolaryngologic problems and have a net benefit from a CBA perspective, with a calculated value of $343 per visit. Further research is underway to determine the generalizability of these findings.

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Author Contributions

Matthew R. Naunheim, contributed to design of project, preparation of survey, execution of cost analysis, interpretation of data, writing manuscript, coordinating editing process among authors; Elliot D. Kozin, contributed to project design, preparation of survey, execution of cost analysis, editing of manuscript; Rosh K. Sethi, contributed to execution of cost analysis, interpretation of data, editing of manuscript; H. Gregory Ota, contributed to project design, interpretation of data, editing of manuscript; Stacey T. Gray, contributed to project design, interpretation of data, editing of manuscript; Mark G. Shrime, contributed to design of project, preparation of survey, execution of cost analysis, interpretation of data, editing of manuscript.

Disclosures

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Supplemental Material

Additional supporting information may be found at http://otojournal.org/supplemental.

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