Value-Based Pathology
A Cost-Benefit Analysis of the Examination of Routine and Nonroutine Tonsil and Adenoid Specimens

JULIE C. NETSER, MD,[1] ROBERT A. ROBINSON, MD, PhD,[1] RICHARD J. SMITH, MD,[2] AND STEPHEN S. RAAB, MD[1]

To study the cost-effectiveness of the histologic examination of tonsil and adenoid specimens, the histologic diagnoses for all routine (2,700) and nonroutine (71) tonsil and adenoid specimens during a 10-year period were reviewed. There were 27 routine cases (1%) and 56 nonroutine cases (79%) with a diagnosis other than normal, tonsillitis, or hyperplasia. Twelve of the 27 routine cases did not have a significant clinical history, and a potentially significant pathologic diagnosis was made in only 6 cases; in none of these cases did the pathologic diagnosis affect patient care. In all nonroutine cases, the pathologic diagnosis affected patient care. The average charge per case to detect potentially significant disease in routine and nonroutine cases was $64,718 and $525, respectively. We conclude that histologic examination of nonroutine cases is cost-effective, whereas in most routine cases with adequate clinical history, histologic examination is not cost-effective. (Key words: Cost; Pathology; Head and neck; Tonsils; Adenoids) Am J Clin Pathol 1997;108:158–165.

As efforts persist to obtain quality care at an affordable cost, cost-effectiveness has become a dominant issue for deciding optimal medical care, including diagnostic testing.[1] The traditional goals of the pathologic examination have been the following: (1) to provide information to guide patient care; (2) to serve as a quality control measure; and (3) to teach residents and fellows. These goals now must be weighed against the cost of examination.

Applying cost-benefit analysis to anatomic pathology is complicated because the utility depends on the type of tissue examined. All tissues do not provide equal information to guide patient care, and specimens simplistically may be classified as routine or nonroutine. Routine specimens, such as hernia sacs, gallbladders, elective joint replacement tissue, and disk material, rarely provide diagnostic information that affects patient care.[2–7] Nonroutine specimens, such as those from biopsies and most resections, are removed primarily to determine the pathologic basis of disease, and the pathologic diagnosis usually affects patient care.

Some specimens, such as tonsils and adenoids (T&A), are routine or nonroutine, depending on the clinical scenario.[8] In North America, there are not uniform laboratory practice parameters for examining routine T&A specimens.[9] In a national survey of pediatric otolaryngologists, Dohar and Bonilla[10] found that only approximately half (56%) of those responding stated their T&A specimens had undergone microscopic analysis. Some pathology laboratories histologically examine all routine T&A specimens; others use an age cutoff below which routine specimens undergo gross examination, and still others do not perform a histologic examination on any specimen. These practices are guided by the following contrasting beliefs: (1) Unless all routine T&A specimens are examined histologically, a rare case of a clinically significant disease may be missed; and (2) Clinically significant disease is so rare that no histologic examination is warranted.[11,12] The incidence of clinically significant disease and the utility of the histologic examination never have been studied in routine T&A specimens. In comparison with these specimens, nonroutine T&A specimens always are examined histologically, although the value of this examination also has not been studied.

From the Departments of [1]Pathology and [2]Otolaryngology, University of Iowa Hospitals and Clinics, Iowa City, Iowa.

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Address reprint requests to Dr Raab: University of Iowa Hospitals and Clinics, Department of Pathology, 200 Hawkins Dr 6235 RCP, Iowa City, IA 52242-1009.

We used cost-benefit analysis to study the incidence of clinically significant disease and the utility of the histologic examination of routine and nonroutine T&A specimens.

MATERIALS AND METHODS

The final diagnosis text for all specimens coded according to SNOMED (standardized nomenclature of medicine) as "tonsil or adenoid" during a 10-year 8-month period from January 1, 1985, to September 1, 1995, at the University of Iowa Hospitals and Clinics were reviewed retrospectively. During this period, the records for 2,700 patients who had undergone bilateral tonsillectomy, bilateral tonsillectomy and adenoidectomy, or adenoidectomy alone were identified. These patients were considered to have *routine* specimens. Patients fulfilling these criteria, but having the procedure performed as part of a multiple biopsy panendoscopy procedure were excluded. Of the 2,700 patients, 1,033 (38.3%) had tonsillectomy, 898 (33.3%) had tonsillectomy and adenoidectomy, and 769 (28.5%) had adenoidectomy alone. Of the cases, 2,500 (92.6%) were not performed in conjunction with any other procedure; 125 cases (4.6%) were performed as part of a uvulopalatopharyngoplasty procedure; and 75 cases (2.8%) were performed in conjunction with other procedures, such as operations on the sinuses, nevi removal, or submandibular gland excision. To generate an age distribution, pathology reports for the first 20 to 25 cases accessioned during each calendar year (270 cases) were reviewed, and the age and type of procedure were recorded.

Of the patients with a routine specimen, 27 (1%) had a diagnosis other than normal, acute or chronic tonsillitis, or lymphoid or follicular hyperplasia. The medical chart, pathology requisition form, pathology final report, and histologic slides were reviewed for each of these patients. From the medical charts, the age, clinical impression, and follow-up data were recorded. From the pathology requisition form, the clinical history was recorded as *significant* or *nonsignificant*. A significant clinical history consisted of a reported clinical diagnosis other than normal, tonsillitis, or hyperplasia. A recorded clinical diagnosis of normal, tonsillitis, or hyperplasia or no recorded clinical diagnosis was considered nonsignificant. The diagnosis from the pathology report was compared with the diagnosis on retrospective histologic review, and the number of discrepant diagnoses was recorded. The slides were reviewed by one of us (R.A.R.) who was unaware of the original diagnosis and history. The pathologic diagnoses were reclassified as *consequential* and *nonconsequential*. Nonconsequential diagnoses (eg, papilloma) did not affect patient care, whereas consequential diagnoses (eg, granulomatous disease) could affect patient care.

To determine the percentage of potentially misdiagnosed routine cases, the histologic slides of 2% (54 cases) of the cases with a diagnosis of normal, tonsillitis, or hyperplasia were randomly reviewed, and the number of discordant diagnoses was recorded.

During the same 10-year 8-month period, 71 patients had a unilateral tonsillectomy (18 patients) or a tonsillar biopsy (53 patients) that was not performed as part of a panendoscopy procedure. These patients were considered to have *nonroutine* specimens. The medical chart, pathology requisition form, pathology final report, and histologic slides were reviewed for each patient.

The clinical utility of performing the gross and histologic examination for routine and nonroutine specimens was performed using charge-benefit analysis. A pathologic examination was assumed to be beneficial if the diagnosis determined by this examination had a potential or an actual effect on patient care. The benefits of quality assurance and teaching were not assessed.

For routine specimens, if no cases had undergone pathologic examination, there would have been no changes in patient care because disease detected by pathologic examination would have gone undetected. A potential effect on patient care existed under the following conditions: (1) the pathologic diagnosis was not normal, tonsillitis, or hyperplasia; (2) the clinical history was insignificant; and (3) the pathologic diagnosis was consequential. By the first criterion, 2,673 patients were excluded, leaving the set of 27 patients previously discussed. The second and third criteria further excluded patients. Thus, the group of patients in whom the pathologic diagnosis had a potential effect on patient care had to have no reported clinical diagnosis or a benign clinical diagnosis and a pathologic diagnosis that was unsuspected and of enough import to warrant possible intervention. In only a subgroup of these patients was there an actual effect on patient care as determined by chart review.

For all nonroutine specimens, we assumed that patient care depended on the pathologic diagnosis; these specimens had been removed primarily to obtain diagnostic information. In a subset of these patients, there was an actual effect on patient care, which was determined by chart review.

The charge benefit for the pathologic examination of routine specimens was the total pathology charge associated with all routine specimens divided by the number of specimens in which the pathologic diagnosis had a potential or an actual effect on patient care. The resulting value was the charge per case of potential effect on patient care or the charge per case of actual effect on patient care. In other words, this was the charge per case to detect a potentially or actually significant unexpected disease, assuming all routine cases were processed.

The charge benefit for the pathologic examination of nonroutine specimens was the total pathology charge associated with all nonroutine specimens divided by the total number of specimens. This was the charge per nonroutine case to determine a pathologic diagnosis that affected patient care.

All case charges consisted of a technical and a professional charge. The technical charge consisted of a charge per block submitted, whereas the professional charge consisted of a charge per part examined. Charge data were obtained from the University of Iowa Hospitals and Clinics pathology billing office and are reported in 1996 US dollars. To determine the total charge for routine specimens, the average number of blocks submitted per case (2 blocks per bilateral tonsillectomy, 1 block per adenoidectomy, and 2.4 blocks per bilateral tonsillectomy and adenoidectomy) was used. The total pathology charge for a routine specimen was $78.25 per slide.

For nonroutine specimens, the average number of blocks per case was 1.7 (range, 1–8 blocks). The total pathology charge was $135.25 per slide. In some cases, ancillary studies, such as immunoperoxidase, direct immunofluorescence, gene rearrangement, and other special stain charges were assessed. Immunoperoxidase was performed in 5 cases (average charge, $515). Direct immunofluorescence was performed in 11 cases (average charge, $1,309). Gene rearrangement studies were performed in 5 cases (average charge, $445).

RESULTS

Patients With Routine Specimens

The average age was 24.2 years (range, 2–66 years; median, 19.5 years), and the male-to-female ratio was 1.7:1. Of the 270 patients included, 161 were younger than 9 years old. Of the 27 patients with a routine specimen and a pathologic diagnosis other than benign, tonsillitis, or hyperplasia, 12 had a nonsignificant clinical history, and 15 had a significant clinical history. In patients younger than 16 years of age, a diagnosis other than benign, tonsillitis, or hyperplasia was made in one of every 1,015 routine specimens examined. A similar diagnosis was given for one of every 168 patients older than 16 years. Retrospective histologic review of the 27 cases showed 100% concordance with the original histologic diagnoses.

Patients with nonsignificant clinical history—The indications for operation in these 12 patients were sleep apnea (4 patients), recurrent tonsillitis (6 patients), or middle ear disease (2 patients). The average age was 26.6 years (range, 2–66 years; median, 22 years), and the male-to-female ratio was 1.4:1. Six patients had a consequential pathologic diagnosis (Table 1) and six patients

TABLE 1. PATIENTS WITH ROUTINE SPECIMENS, INSIGNIFICANT CLINICAL HISTORY, AND CONSEQUENTIAL PATHOLOGIC DIAGNOSES

Case No.	*Age/Sex*	*History*	*Histologic Diagnosis*	*Change*	*Follow-up*
1	2/M	Chronic serous otitis media, adenoid hyperplasia*	Atypical lymphoid proliferation suggestive of posttransplant lymphoproliferative disorder	None	4 y, no evidence of disease
2	31/F	Chronic tonsillitis	Noncaseating granulomas, infectious cause *vs* sarcoidosis considered	None	None
3	20/F	Recurrent tonsillitis	Ulcerative tonsillitis with follicular and immunoblastic hyperplasia consistent with viral mononucleosis	None	None (Epstein-Barr virus titers equivocal)
4	4/M	Persistent middle ear effusion	Lymphoid hyperplasia and reactive immunoblastic hyperplasia suggestive of a viral infection	None	2 y
5	19/F	Chronic tonsillitis	Follicular hyperplasia with granulomas and yeast consistent with *Histoplasma capsulatum*	None	None
6	29/M	Chronic tonsillitis	Reactive hyperplasia with some atypical features	None	8 d

*History not provided; 2 years after organ transplantation.

TABLE 2. PATIENTS WITH ROUTINE SPECIMENS, INSIGNIFICANT CLINICAL HISTORY, AND INCONSEQUENTIAL PATHOLOGIC DIAGNOSES

Case No.	*Age/Sex*	*History*	*Histologic Diagnosis*	*Change*	*Follow-up*
7	22/F	Recurrent pharyngitis	Follicular hyperplasia and papilloma	None	None
8	22/M	Recurrent tonsillitis	Lymphoid hyperplasia and fungal aggregates	None	6 y, no evidence of disease
9	52/F	Excessively loud snoring, redundant mucosa, and normal tonsils	Follicular hyperplasia and papilloma	None	None
10	66/M	Sleep apnea	Follicular hyperplasia and papilloma	None	1 y, no evidence of disease
11	5/M	Sleep apnea and adenotonsillar hypertrophy	Lymphoid hyperplasia and papilloma	None	None
12	47/M	None	Lymphoid hyperplasia and papilloma	None	2 wk, no evidence of disease

had an inconsequential pathologic diagnosis (Table 2). The six patients with a consequential pathologic diagnosis had a clinical history of recurrent tonsillitis (4 patients) or middle ear disease (2 patients). The average age of these patients was 17.5 years (range, 2–29 years), and the male-to-female ratio was 1:1. Two patients were younger than 16 years, and 4 were older. These patients were considered to have a pathologic diagnosis that potentially affected patient care. However, based on chart review, the pathologic diagnosis did not affect clinical management in any case. Indeed, nowhere in the clinical notes were the histologic diagnoses mentioned. The most concerning diagnosis, "atypical lymphoid proliferation worrisome for PTLD [posttransplantation lymphoproliferative disorder]," was made in case 1. This case should have been considered nonroutine, or at least routine with a significant history, because the patient had undergone organ transplantation 2 years earlier and was at risk for such a process. Thus, the subset of patients in whom the pathologic diagnosis had an actual effect on management was empty.

The six patients who had an inconsequential pathologic diagnosis had a clinical history of sleep apnea (4 patients) or recurrent tonsillitis (2 patients). The average age was 36 years (range, 5–66 years), and the male-to-female ratio was 2:1. Five patients had papillomas, and one had fungal aggregates identified in the tonsillar crypts. There was no tissue invasion by the hyphae, and it was believed that the fungi were only colonizers. In no case was there an effect on patient care.

Patients with significant clinical history—Data for the 15 patients who had significant clinical history are given in Table 3. In all cases, the clinical and pathologic diagnoses were congruent. In 13 cases, the pathologic diagnosis was consequential, and in 2 cases, the pathologic diagnosis was inconsequential (squamous papilloma).

Patients with normal diagnoses—Retrospective histologic review of the 54 cases with a pathologic diagnosis of normal, tonsillitis, or hyperplasia showed 100% concordance with the original diagnosis. In this group, the average patient age was 9.3 years (range, 9 months to 60 years).

Nonroutine Specimens

The clinical and pathologic diagnoses of the 71 patients who had a nonroutine specimen are shown in Table 4. The average patient age was 48.6 years (range, 6–87 years; median, 46.5 years), and the male-to-female ratio was 3:2. Three patients were 16 years of age or younger. A diagnosis other than normal, tonsillitis, or hyperplasia was made in 56 (79%) of the 71 patients. The overall concordance between the clinical and pathologic diagnoses was 89%. There was a high clinical suspicion of malignancy in 31 cases, which was confirmed by pathologic examination in 29 cases; in the other 2 cases, the pathologic diagnosis was atypical lymphoid proliferation. In six cases the clinical diagnosis was squamous cell carcinoma, and the pathologic diagnosis was another malignancy. The clinical impression was "favor benign" in 40 cases, and a compatible histologic diagnosis was made in 39 cases. In the discordant case, the patient had a history of acquired immunodeficiency syndrome and an ulcer that was believed, based on clinical data, to be benign;

TABLE 3. PATIENTS WITH ROUTINE SPECIMENS AND SIGNIFICANT CLINICAL HISTORY

Case No.	*Age/Sex*	*History*	*Histologic Diagnosis*	*Follow-up*
13	5/M	Obstructive sleep apnea and Hurler's syndrome	Follicular hyperplasia and histiocytes consistent with storage disorder	2 y
14	4/M	Obstructive sleep apnea and type 6 mucopolysaccharidosis	Histiocytes consistent with storage disorder	6 mo
15	60/F	Tonsillitis with left peritonsillar abscess	Follicular hyperplasia and peritonsillar abscess	None
16	34/M	Acute tonsillitis and anterior tonsillar bulge consistent with abscess	Lymphoid hyperplasia and wall of abscess	1 mo
17	18/F	Peritonsillar abscess	Tonsillitis and peritonsillar abscess	2 y
18	27/M	Acute tonsillitis and peritonsillar abscess	Lymphoid hyperplasia and peritonsillar abscess	None
19	19/F	Papillomatous lesion	Squamous papilloma	None
20	34/M	None	Squamous papilloma	1 wk
21	29/F	Huge tonsils in patient with mononucleosis and airway obstruction	Features consistent with mononucleosis	1 mo
22	19/M	Mononucleosis and streptococcal tonsillitis	Marked lymphoid proliferation consistent with mononucleosis	None
23	15/M	Necrotic oozing tonsils, hemorrhagic tonsillitis, agranulocytosis, and hemocytophagia secondary to Epstein-Barr virus	Left tonsil, exudate containing yeast consistent with *Candida* organisms; right tonsil, lymphoid depletion	5 y
24	3/M	Obstructive tonsillitis and necrotic tonsils; rule out mononucleosis	Necrotizing tonsillitis with florid immunoblastic hyperplasia	None
25	5/F	Hepatic transplantation; differential diagnosis, lymphoid hyperplasia vs posttransplantation lymphoproliferative disorder	Follicular and immunoblastic hyperplasia	2 y
26	17/F	Tonsillectomy 4 to 5 weeks earlier with no adenoids seen; then obstructive adenoids; workup for lymphoproliferative disease	Follicular and interfollicular hyperplasia; consider mononucleosis	1 mo
27	44/M	Acute myelomonocytic leukemia (M5), with airway obstruction	Leukemic infiltrate	1 1/2 years, died of disease

histologic examination showed an atypical lymphoid proliferation that, on follow-up, behaved aggressively. Based on the medical chart review, in all cases, the pathologic diagnosis affected patient care. The retrospective histologic diagnosis in all cases was concordant with the original histologic diagnosis.

Charge-Benefit Analysis

Data from the charge-benefit analysis are shown in Table 5. The total pathology charge for the examination of all routine T&A specimens was $390,482, or $36,608 per year. The average charge for the examination of a routine case was $145. The average charge per routine case to detect a diagnosis other than benign, tonsillitis, or hyperplasia was $14,462. The average charge per routine case to detect potentially clinically significant disease was $64,718; this figure excludes patients with significant clinical history (15 patients). There was no charge determined per case for actual effect on patient care, because in no cases was there actually a change in patient care based on the pathologic examination.

The total pathology charge for the examination of all nonroutine T&A specimens was $37,269. The average charge per nonroutine case was $525; this figure also was the charge to detect potentially clinically significant disease.

DISCUSSION

For routine T&A specimens, the incidence of clinically significant disease was remarkably low. In only 27 (1%) of 2,700 cases from a period somewhat longer than 10 years was the pathologic diagnosis something other than benign, tonsillitis, or hyperplasia. After excluding the cases in which the clinical history was significant or in which the pathologic diagnosis was not significant, there were only six cases in which the pathologic diagnosis had the potential to affect patient care. The charge per case to examine all routine T&A specimens to detect these six cases was $64,718. In

TABLE 4. PATIENTS WITH NONROUTINE SPECIMENS

Clinical Diagnosis	*Histologic Diagnosis*	*No. of Cases*	*Concordance Between Clinical and Histologic Diagnoses (%)*
Squamous cell carcinoma (n = 17)	Squamous cell carcinoma	11	65
	Lymphoma	3	
	Undifferentiated carcinoma	1	
	Spindle cell neoplasm	1	
	Metastatic small cell carcinoma	1	
Papilloma, wart, or polyp (n = 13)	Papilloma	13	100
Benign (n = 12)	No diagnostic abnormality	4	100
	Follicular hyperplasia	6	
	Cyst	2	
Lymphoma (n = 11)	Lymphoma	10	91
	Atypical lymphoid proliferation	1	
Ulcer (n = 6)	Benign ulcer	3	83
	Cytomegalovirus	1	
	Granulomatous inflammation	1	
	Atypical lymphoid proliferation	1	
Atypical, favor benign (n = 6)	Chronic tonsillitis	1	100
	Follicular hyperplasia	2	
	Mucosal gland heterotopia	1	
	No diagnostic abnormality	2	
Malignancy, not otherwise specified (n = 3)	Lymphoma	2	100
	Primary melanoma	1	
Peritonsillar abscess (n = 2)	Peritonsillar abscess	2	100
Granulomatous disease (n = 1)	Granulomatous disease	1	100
Total		71	89

actuality, the pathologic diagnosis did not affect patient care even in these six cases, and the total charge to process all routine specimens was $390,482.

For nonroutine specimens, the incidence of malignancy was 39%. However, even in cases in which the pathologic diagnosis was not cancer, the pathologic diagnosis still affected patient care. The charge per case to examine all nonroutine T&A specimens was $525.

These findings indicate that it is relatively expensive to affect patient care by examining routine T&A specimens and relatively inexpensive to affect patient care by examining nonroutine T&A specimens. In no way should these results by themselves dictate policy. Instead, they should be incorporated into a value-based system that may be used to compare the utility of pathologic tests with each other and to compare the utility of pathology services with other medical services.[13,14]

A value-based pathology system may be used to determine practice parameters for all specimen types.[15,16] The value of routine pathologic examination of hernia sacs, gallbladders, appendices, joint replacement tissues, and intervertebral disks has been questioned.[2–7] For routine T&A specimens, if cost were not a factor, pathologic examination could be performed in all specimens. However, in a managed care environment, cost is a dominant factor, and, consequently, the utility of specimen examination must be proved to justify the cost.[1] Implicit in this concept is the idea of a cost cutoff, below which specimen examination is justified and above which examination should not be performed. This concept is relatively foreign to anatomic pathology but is used in other fields of medicine. Studies determining how a pathologic diagnosis affects life expectancy, depending on specimen type, have not been performed. However, even without performing these studies, to spend $390,482 during a 10-year period and still not affect patient care seems costly.

Despite more than 10 years and 2,700 cases, it could be argued that our sample size was not sufficiently large and that a rare case of a clinically significant disease could be missed. Theoretically this may be true, although case reports demonstrating these surprises are exceedingly rare.[8] The incidence of clinically significant disease in this population has not been reported but is assumed to be extremely low. In addition, the cost society is willing to spend to detect these cases has not been determined, and the extent to which a missed diagnosis would harm a patient is uncertain. Several reports point to the clinical value of examining T&A

specimens histologically. Sarcoidosis and lymphoproliferative disease are disorders in which the diagnosis can be established by examining T&A specimens.[17–19]

In our study, cost-benefit calculations were performed in terms of charges rather than actual costs. Choosing the appropriate unit of cost is complicated because of regional differences in costs, charges, and reimbursement; the unit of cost value is of different import depending on location. We used charges only to provide a reference by which to compare test utility.

We did not study the utility of quality assurance and teaching. Studies of the cost-effectiveness of these issues in anatomic pathology have not been undertaken. Although quality assurance and teaching are highly valuable, they can be achieved without examination of all routine T&A tissues. The goals of quality assurance and teaching could be achieved by examining random specimens. In addition, trainees could learn by examining T&A study sets.

For nonroutine specimens, as was expected, the histologic examination was cost beneficial by most generally accepted standards. Even with low cost-cutoff values, the histologic examination of nonroutine specimens probably would be cost-effective, because patient care depends on the pathologic diagnosis. In a value-based pathology system, it is not enough, however, to simply accept that a procedure is cost beneficial. The cost benefits of nonroutine T&A specimens should be compared with the cost benefits of other nonroutine specimens to determine the best use of pathology laboratory time and personnel. Nonroutine specimens may be triaged in terms of the magnitude of the clinical importance of the pathologic diagnosis. Although many laboratories use triaging, it is based on anecdotal evidence, rather than rigorous cost-effectiveness analysis. The value of the histologic examination of nonroutine specimens also should be compared with the value of other medical services. For example, what is the cost value of a computerized axial tomography examination in comparison to the histologic examination of a nonroutine specimen?

We believe that our data support specific recommendations about the role of the pathologist in the examination of T&A specimens.

When routine T&A specimens are removed because of repeated infection or enlargement, gross-only examination or no examination should be performed. If gross-only examination is to be performed, we recommend a diagnosis of "consistent with tonsils." However, we recognize that gross-only examination generally adds little information for patient care. Before eschewing histologic examination, however, an adequate history and physical examination should be recorded on the pathology requisition sheet. Any atypical clinical history, such as the possibility of a lymphoproliferative disease, should result in a histologic examination even of routine specimens. A careful clinical examination of the patient is equally important, because its absence could result in missing potentially significant lesions. This point cannot be overemphasized, and there must be communication of this information to the pathologist. Thus, not examining T&A specimens should be considered only when the surgeon has good clinical experience in recognizing abnormally appearing tonsils and adenoids. The data also indicate that there is no specific age cutoff beyond which histologic examination should always be performed. Before discontinuing histologic examination, pathologists, otolaryngologists, pediatricians, oncologists, and hospital tissue committee members should meet to review these data and establish institutional policies.

We determined that there is a striking difference between the cost utility of the pathologic examination of routine and nonroutine T&A specimens. Although the T&A specimen is but an example, cost-benefit studies such as this one would raise other issues about the role of diagnostic anatomic pathology in an era of cost containment and managed care.

TABLE 5. CHARGE BENEFIT OF THE PATHOLOGIC EXAMINATION OF ROUTINE AND NONROUTINE TONSIL AND ADENOID SPECIMENS

Type of Specimen	*Total Charges ($)*
Routine	
Hospital (technical)	215,825
Physician	174,657
Hospital and physician	390,482
Per year	36,608
Per unexpected diagnosis	14,462*
Per consequential pathologic diagnosis	64,718†
Per consequential pathologic diagnosis per year	6,067
Nonroutine	
Hospital (technical)	16,943
Physician	20,326
Hospital and physician	37,269
Per year	3,494
Per unexpected diagnosis	—
Per consequential pathologic diagnosis	525
Per consequential pathologic diagnosis per year	49

*n = 27 unexpected diagnoses.
†n = 6 consequential pathologic diagnoses.

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