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In May 1998 the TCTI Listening Center Cochlear Implant administrative team presented a business plan to the institutional business review group. All rehabilitation and audiology service volumes for this program are primarily directly related to surgical implantation volumes. FY 97 records showed 63 surgeries budgeted and 43 actually performed. FY 98 data budgeted for 79 and actually performed 60. Consequently, the funds requested were approved minus $88,000 needed to fund additional clinical and administrative support staff.

Retrospective review of first quarter fiscal year 1999 data indicated 27 surgical implantations performed against 15 budgeted. A review of a sample of first quarter patient surgery charges revealed several charge system errors that were subsequently corrected. Combining increased patient volume with charge system corrections that result in an increase in per implantation allowable charges resulted in a substantial increase in institutional revenue. Updated surgical volume and revenue information was presented to institutional finance and management personnel. Subsequently, funding was allocated to support additional staff requirements. Recommendations were made to provide further accurate and detailed data that will assist in performing another cost benefit analysis when current staff is not able to support patient volumes.

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U.S. Army-Baylor University Graduate Program in Healthcare Administration

Graduate Management Project:

A Cost Benefit Analysis for Justification of Additional Funding to Support the Listening Center Cochlear Implant Services at a Large Tertiary Care Teaching Institution

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31 March 1999

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Abstract

Cochlear implant devices are surgically implanted to assist nerve deaf individuals to hear environmental sounds and potentially develop verbal communication skills. Research has shown that providing individuals with the ability to hear has the potential to allow them to attend main stream educational programs, improve potential job prospects, increase annual salaries, facilitate increased social interaction, and generally provide for an improved quality of life.

A large nonprofit tertiary care teaching institution in the northeast is known for its dedication to providing high quality patient care, first rate professional medical education, and leading the way in medical research. This institution is located in a rate regulated state and is consistently challenged to control expenses in an environment of increasing medical care costs with decreasing reimbursements. Internal requests to expand service programs must be accompanied by a solid rational supported by accurate, up to date financial information that concisely explains the cost/benefits associated with any proposed program expansion. In May 1998 the Listening Center Cochlear Implant administrative team presented a business plan to the institution business review group. All rehabilitation and audiology service volumes for this program are primarily directly related to surgical implantation volumes. FY 97 records showed 63 surgeries budgeted and 43 actually performed. FY 98 data budgeted for 79 and actually performed 60. Consequently, the funds requested were approved minus $88,000 needed to fund one additional audiologist and one administrative support staff member.

Retrospective review of first quarter fiscal year 1999 data indicated 27 surgical implantations performed against 15 budgeted. A comprehensive review of a sample of first quarter patient surgery charges revealed several charge system errors that were subsequently corrected. Combining increased patient volume with charge system corrections that result in an increase in per implantation allowable charges resulted in a substantial increase in institutional revenue. This information was presented to institutional finance and management staff and resulted in funding to support additional staff. Recommendations were made to provide further accurate and detailed data that will assist in performing another cost benefit analysis when current staff is not able to support patient volumes. Multiple system issueswere identified for potential process improvement initiatives that have the potential to improve accuracy of data and process efficiencies.

Cochlear implants are electronic devices that allow profoundly nerve deaf individuals to hear environmental sounds and potentially develop verbal communication skills. Considering that 600,000 to 1,000,000 individuals are profoundly deaf and unable to derive any benefit from hearing aids, there is a large deaf population that can benefit from cochlear implants.

A large tertiary care teaching hospital in the northeast has been providing cochlear implant services since 1991. These services have largely been underwritten through grants and philanthropic donations. The cochlear implant surgery caseload at this institution has grown from one patient in 1991 to 60 patients in 1998. As cochlear implant technology has become more sophisticated over the last seven years and grants and financial gifts have become more difficult to obtain, clinical and administrative staff at this institution have requested full funding for the program. A business plan was formulated and presented to the Institutional Business Review Group in May of 1998. All funds requested were approved, excluding $88,891 for two additional staff positions.

This research project was done in response to a request to research actual cochlear implant surgery volumes for 1st quarter FY 99 in order to support a second request for two additional staff positions. In the process of learning more about the program and the financial issues involved, it became clear that it would also be necessary to identify cochlear implant surgery facility costs and patient charges to help support a benefit analysis. Results of the research indicated a positive margin for each cochlear implant surgery performed. Revenues from subsequent rehabilitative and audiology services were more difficult to identify, but indications are that the program is more than capable of supporting itself.

During the process of conducting the research, multiple systems issues were identified. Some were addressed immediately by the Tertiary Care Teaching Institution (TCTI) administrative staff, others will most likely result in process improvement initiatives to research and identify the best approach to handling the problems identified.

Literature Review

Health care dollars are under increased scrutiny at the Federal, State, and local levels (Koch, Wyatt, Francis, & Niparko, 1997). As funds have become more scarce, everyone involved in health care is looking very closely at program costs as they relate to health issues and education. Outcome measures that incorporate cost data are used to appraise impact and facilitate efficient and economical use of available health care dollars (Koch, 1997). As facilities are constantly challenged to control costs, increase revenues, and improve profit margins, the decision to expand, maintain, contract, or eliminate a specific medical service requires evaluation of multiple issues (Ginter, Swayne, & Duncan, 1995). The TCTI mission and vision statement specifically states its commitment to innovation in all areas of research, teaching and clinical practice, and to providing facilities and amenities that enhance the surrounding community. (Tertiary Care Teaching Institution, July 1998). With this kind of commitment to medicine, management is continually challenged to fund multiple quality patient care initiatives.

All healthcare institutions must bring in revenue that minimally covers their expenses. Through the 1980's to the early 90's healthcare costs have risen at twice the rate of the gross national product (National Center for Policy Analysis, June 1998). TCTI has always enjoyed a world-renowned reputation for excellence. It is one of the premier institutions where patients with unusual and difficult medical problems turn when the local mainstream medical care has not succeeded. As healthcare costs have risen, individual ability to pay has declined, and financial resources have become more scarce. All programs requesting funds to expand services meet stiff intrafacility competition for limited resources. One quantitative method available to determine the profitability of the Listening Center Cochlear Implant program is to develop a spreadsheet with data that uses multiple estimates of key variables, including prices charged in generating revenue and fixed and variable costs attributable to the program (Austin,and Boxerman, 1995)

The National Institute of Health Consensus Development Conference statement (May 1995) states that primary benefits of cochlear implants includes improvements in speech perception, speech production, and that implantation combined with habilitation, rehabilitation, and education results in an increase in self-esteem, independence, social interaction and vocational prospects (National Institute of Health, 1995). Cost utility analyses, looking at results in terms of cost per quality-adjusted life-year (QALY) indicates that cochlear implantation provides significant improvements in quality of life and is cost-effective (Koch et al,

1997; National Institute of Health, May 1995; Wyatt, Niparko, Rothman, & deLissovoy, 1996). Post implant rehabilitation can average as much as 27 hours for adults (National Institute of Health, May 1995) and 52 hours for children (John Niparko, M.D., Chairman TCTI Listening Center, personal communication November 2, 1998). Review of the sensitivity analysis done as part of a 1996 cost utility analysis (Wyatt et al, 1996) indicates that cost and revenue numbers will need to be identified for preimplantation evaluation, the cochlear implant device, surgical implantation, and post implantation rehabilitation.

There are approximately 600,00-1,000,000 individuals with profound hearing loss who are unable to derive any benefit from hearing aids (Wyatt et al, 1996). Statistics indicate that unemployment is high for adults; for those who are employed their income level is only 70.3% of the national median (Wyatt). Deaf children are most often in special educational placements programs in either state or privately run schools for the deaf, which require a much higher staff/student ratio than public school classrooms. The cost of special education for deaf children is four to six times greater than the cost of mainstream public education (Francis, Koch, Wyatt, Niparko, 1997; Wyatt). The Listening Center Cochlear Implant program not only addresses individual needs and quality of life issues, but also has the potential to have a tremendous impact on state and federal funds supporting education and low-income individuals and families.

A Cochlear implant is an electronic device, for the profoundly hearing impaired, that allows individuals to access environmental and voiced sounds so the deaf may interact with the hearing world and broaden their educational, occupational, and social opportunities (Niparko, 1998; Harris, Anderson, Novak, 1995; Weizmann, 1996;). The cochlear implant program at TCTI has grown from one implant in 1991 to over 60 implants in 1998. Demand has outgrown the facilities ability to support the program. To determine the fiscal viability of the program, a cost benefit analysis was performed (Listening Center, 1998).

In May 1998, TCTI Department of Otolaryngology administrative staff presented a business proposal to the TCTI business review group. All expenses were identified and potential revenues were analyzed. The results were annualized and incremental net revenue, variable expenses, programmatic expenses, indirect expenses, and net income were predicted through FY 03 (Listening Center, 1998). As of

November 1998 it was unclear exactly what the final outcome was of that request (Conan Dixon, personal communication, November 18, 1998). The Administrator for the Listening Center Cochlear Implant program was under the assumption that all funds requested were approved, except for two FTE's needed to support the post implantation rehabilitation program (Tony Etzel, personal communication, November 15, 1998). Communications between administrators and financial staff are ongoing and the exact budget status is unclear. The process of developing this graduate management project proposal appears to have mobilized a renewed interest in tracking the status of program funds.

Methods and Procedures

This project focused on a quantitative analysis of revenues and costs associated with the Listening Center Cochlear Implant program. The first step was to do a review of the business plan as it was submitted in May 1998. As a large percentage of the staff involved with the initial compilation of data for the original business plan were no longer working on the CI project, it was necessary to backtrack to identify information sources that could provide the new data necessary. As a result of initial discussion with staff involved in the original request for funding, it become clear that some of the data used was estimated and management had been hesitant to commit funds based on a concern regarding the program's ability to meet surgical implantation volume projections. Actual surgeries had been less then projections for the last two fiscal years.

Review of the Initial Business Plan

An electronic copy of the initial business plan draft was impossible to locate. The original staff involved in developing the project no longer worked in the Otolaryngology Department. A hardcopy of the final draft was located and reviewed. Market and financial analyses provided support for a request for $108,888 in one time capital funding and $454,291 in programmatic operating expenses. Projected volume and revenue figures were reviewed without the benefit of access to the formulas used to project future volumes and revenues.

Identification of Source Data

All rehabilitation and audiology services are primarily[1] related to cochlear implant device surgical implantation. Consequently, the Otolaryngology Department Administrator requested that research be conducted that identified 1st quarter FY 99 surgical volume, charge, and cost data. A list of all cochlear

implant surgery patients was obtained from the Department of Otolaryngology professional fee system, responsible for patient billing for physician time, and cross checked with the TCTI Outpatient Center quarterly report and a manual review of Outpatient Surgery Scheduling Records.

A list of 27 1st quarter FY 99 patients was compiled and a sample of seven patients was identified for an in-depth record review, to include all age groups. The ages ranged from 1 year to 65 years of age. Breaking the age groups out into pediatric and adults left one 20-year-old patient as an outlier as the range went from 1-16, age 20, then 29-65 years old. Discussion with outpatient surgery staff identified a concern regarding the potential difference in time and supply charges for the pediatric patients (1-16), the young adult (age 20), and the older adults (29-65). It was decided to include three patients from the pediatric group, the 20 year old, and three patients from the older adult group. Once the groups were identified and listed in ascending chronological order, sample patients were selected by picking every third name from the pediatric and older adult group.

Outpatient surgery charge data was obtained for each patient in the sample and compared to the final patient billing record data obtained from the KEANE[2] billing system. All items and costs were entered into an electronic spreadsheet by patient age and surgery date[3], item description and revenue procedure code. Outpatient surgery charge data and KEANE billing system data were cross checked for consistency and accuracy against each other and against the TCTI central revenue procedure code data base. When inconsistencies were noted, or revenue procedure codes were not listed, finance department, outpatient surgery materiel management staff, and/or computer information analysis staff were consulted. While identifying costs for each supply item, it became necessary to work with both the Outpatient Surgery material management staff and the chief cochlear implant surgery nurse to correctly identify supplies and equipment used for every cochlear implant surgery and research costs by locating the most recent purchase order for each item (see Appendix A).

The revenue and volume projection data from the original May 1998 business plan was entered into an electronic spreadsheet and the projection formulas were determined. Rehabilitation and Audiology ratios to surgeries were determined by review of the original business plan formulas. It is important to note that the relationship between the cochlear implant surgeries and the demand for rehabilitation/audiology support services is indirect as the number of support service visits per surgery is spread out over an average

of four years with the demand for services decreasing each year. The relationship is very complex. The new demand for rehabilitation/audiology services was determined based on using the same ratios established in the original business plan.

The return on investment (ROI) regarding the $108,888 capital funding request was obtained using the net present value of the five-year cumulative net income and average net income at a 5% discount rate. The methodology used to determine the ROI, based on the new 1st quarter FY 99 surgery volumes, was an exact duplicate of that used in the original business plan. It was important not to introduce anything that would corrupt the ability to compare the new volume data with the data in the old business plan.

Presentation of Data

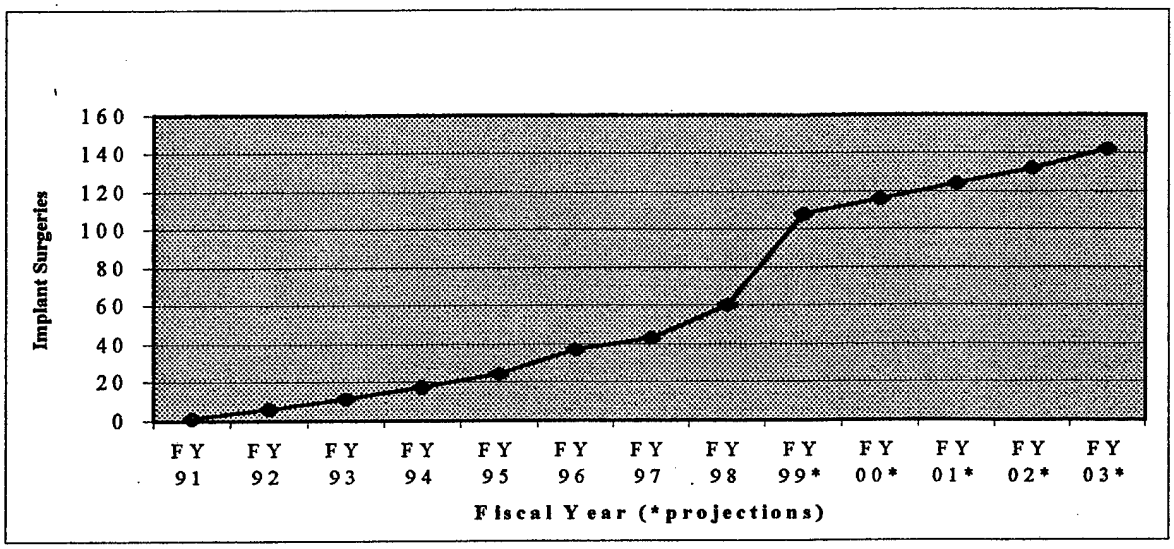
Three separate spreadsheets were developed and presented to the Otolaryngology Department administrator. The first spreadsheet contained all outpatient surgery charges and revenues and determined average cost and revenue for cochlear implant surgery (See Appendix A). The second spreadsheet contained all Cochlear Implant surgery, rehabilitation and audiology volume and revenue data from the May 1998 business plan for FY 96 to FY 98 with projections through FY 2003 and new volume and revenue data projections developed from the 1st quarter FY 99 patient record review (see Appendix B). The third spreadsheet contained a summary of the second spreadsheet for potential presentation to the business review board to support the Otolaryngology Department request for the $88,888 to support the two additional FTE's originally requested in the May 1998 business plan (see Appendix C).

Results

Review of the Business Plan

Cochlear Implants surgical volumes have consistently risen over the last eight years (see Figure 1).

Figure 1. Cochlear Implant Surgical Implantation Volumes for Fiscal Years 1991 through 2003



Note. 1991-1998 are actual surgeries performed; 1999 – 2003 are projections based on first quarter FY 99 actual surgeries performed.

TCTI has experienced an 80% increase in cochlear device implantation over FY 98 volumes (60 actual surgeries in FY 98 to annualized 108 surgeries in FY 99). Over 90% of the cochlear implant market have not yet been treated and the demand for cochlear device implantation is predicted to increase 25% per year over the next two years. There are four major facilities in the Maryland and Virginia areas that are performing cochlear implantations, but TCTI performed 2/3 of all the cochlear implant surgeries performed in the Mid-Atlantic market in FY 98. TCTI has also performed 97% of all the cochlear implant surgeries done in Maryland since 1994.

The TCTI Business Plan surgical volume data (see Table 1) shows an average of 113% annual increase in volumes from FY 91 through FY 98. Discussions with staff peripherally involved with developing the business plan (John Dunn, personal communication, 28 January 1999) indicate that TCTI business planning analysts felt that predicting volumes based on an average annual percentage increase of

113% would result in potentially unrealistically high volumes versus using actual numbers, which show an average annual incremental increase of 13 surgical implantations per year for the same time period. Once

Table 1

TCTI Business Plan Surgical Volume Data FY 1991-FY 1999 Annual Changes by Percent and Incremental Volumes

Year	Annual Volume	Annual Change by Percent	Annual Change by Number of Surgeries (incremental volumes)
FY 91	1		
FY 92	6	500%	5
FY 93	11	83%	5
FY 94	17	55%	6
FY 95	24	41%	7
FY 96	37	54%	13
FY 97	43	16%	6
FY 98	60	40%	17
Average		113%	13

Note: Annual volume data taken from "Business Plan: the Listening Center at Tertiary Care Teaching Institution", internal document by Department of Otolaryngology – Head and Neck Surgery, May 1998, Baltimore, MD.

the decision was made to use the actual numbers, the average incremental increase of 13 was still felt to be potentially unrealistic. The final decision to increase predicted volumes by 10, for FY 99, and then by five for each year thereafter was made based on discussion, clinical experience, and instinct (John Dunn, personal communication, 27 February, 1999). Review of the TCTI business plan numbers indicated that the annual incremental increase of five surgeries each year from the five-year business plan approximated a 7% annual increase (see Appendix D).

Review of volume data by quarters (see Table 2) revealed that there is a slight decrease in volumes during the 2nd quarter of each fiscal year, which appears to be attributable to the Thanksgiving and Christmas holiday seasons. FY 97 and 98 data indicate that basing fiscal year FY 99 predictions on annualized first quarter volumes was a conservative approach.

Table 2

FY 96 –FY 99 Quarterly Volume Data for Cochlear Implant Surgery Cases

	FY 96	FY 97	FY 98	FY 99
1st Quarter	13	9	12	27
2nd Quarter	6	8	11	25
3rd Quarter	8	11	19	Not available
4th Quarter	10	15	18	Not available
Total	37	43	60	52

Note: Cochlear implant surgical case volume data prior to FY 96 not available. FY 99 3rd and 4th quarter data not available as project was completed during middle of 3rd quarter FY 99.

The patient mix for this program draws from six states and 23 Maryland counties. In FY 1997, 39% of cochlear implant patients were from states adjacent to Maryland, 21% were local or from central Maryland counties, 16% were from the Maryland suburbs of Washington, D.C., and 10% were of foreign origin.

The payer mix for this product is 60% indemnity insurance, 12% HMO coverage, 10% Medicare, 12% Medicaid patients, and 13% are in an other or self-pay/no charge category. The post implantation rehabilitation program is extensive, but to date, internal institutional statistics indicate that insurers[4] are reimbursing for the program. The 17% used to compute bad debt against revenues was considered high by some TCTI staff. Discussions with a TCTI financial analyst revealed that the 17% is a system wide number and is actually on the low side for outpatient services, particularly if emergency department charges and revenues were included.

The May 1998 Business Plan was comprehensive in that it addressed opportunities, competition in the market, a comprehensive analysis of program needs projected forward over a five year period, and an in-depth analysis of rehabilitation and audiology support full time equivalents in relationship to program demands. The financial analysis supported the need for additional staff and a one-time capital equipment investment of $108,888 with an average ROI of 139% with a payback period of 8.63 months. The business plan predicted a 62% increase in cochlear surgery implantation volumes from FY 97 to FY 99 (see Appendix B) with a commensurate increase in rehabilitation and audiology support service volumes and

estimated "other" variable expenses as 50% of outpatient surgery charges. In the 1st quarter of FY 99 the surgical volume was 27 patients. Assuming that the volume will remain the same throughout the remainder of FY 99, this translates into a volume of 108 surgeries, or an increase of 151% from FY 97. This large volume increase is reflected in the new ROI numbers. The return on investment changed from a prediction of 139% with a nine-month payback period, to over 1000% with a payback period of less than one month. This raised some obvious questions, which are addressed in the discussion section of this paper.

The market opportunities and competition remain the same as in the original business plan. A comprehensive retrospective chart review and research of current charges and costs indicate that expenses are actually responsible for 60% of outpatient surgery charges (see Appendix A, page 5). Communication between information systems is inconsistent, incomplete, and will require a resource investment to update revenue procedure codes that are incorrect or are no longer listed in the current database. Market sensitive charges have not been updated in over two years. Discussion with the TCTI Outpatient Center Assistant Administrator resulted in his acknowledgement of this as a priority issue and staff have begun to work on the project.

Review of the TCTI Outpatient Surgery charge capture data revealed that many of the cost figures in the central revenue procedure code data base were outdated and some items that were used on every case, had not been charged to all patients (see Appendix A). This information was gratefully received by the Director for Outpatient Surgery and provided further impetus to support the need to update costs and charges for the entire outpatient surgery department. This information further resulted in discussion of the need to develop a "charge by exception" work sheet for the Outpatient Surgery nursing staff. This issue will most likely become a process improvement initiative in the near future.

The business plan continued in detail, explaining the intricacies of joint agreements between different organizations with the TCTI structure. Key to the issue was that the TCTI University and TCTI Hospital jointly provide support staff for the cochlear implant program. At the conclusion of this research project two staff audiologists were funded by the TCT University and, by joint agreement, TCTI Hospital reimburses the University for those staff members. This joint agreement reimbursement process results in an extra expense to the TCTI Hospital as hospital staff benefits are 17% of salary while TCTI University staff benefits are 28% of salary. Having to reimburse the TCTI University for program staff costs results in

an extra 11% for staff salaries. The agreement for the future is that all program staff will be employed by the hospital, thus eliminating the extra cost due to the reimbursement agreement.

A second key point is that TCTI has a joint agreement with Suburban Hospital, which is located in the Washington D.C. area. Surgeries are performed at TCTI Outpatient Surgery Center but patients elect to obtain post-implantation care at Suburban. Suburban charges $150 per rehabilitation visit, versus TCTI charges of $105. Suburban retains 8% of revenues and returns the balance to TCTI. Part of the budget request is to purchase more space and provide funds to reimburse staff for transportation to the Suburban facility. The partnership with Suburban is a major factor in drawing cochlear implant patients from the Washington D.C. area.

A third key point is that the business plan notes that each adult audiologist can see 1,100 adult patients each fiscal year and each pediatric audiologist can see 1250 pediatric patients per fiscal year. These numbers were not used as a part of this project, but were important to acknowledge, as they were instrumental in supporting one of the recommendations made for a future project.

Source Data

All outpatient surgery charges and revenues were identified for the seven sample patients. (see Appendix A). It was not possible to identify TCTI expenses for every charge. Charges were listed for every patient and an average for each supply item or service was determined. Where costs were available, they were subtracted from the average charges to compute profits. Where costs were not available no profit was identified. Six items were identified as losses to the Outpatient Surgery Department as the revenue procedure codes were either non-existent or outdated such that the cost of the item, as determined by review of the latest purchase order, exceeded the patient charge. These items were microscopic drape ($9.03 per drape); Nim needle electrode ($45.67 per electrode), gelfilm ($4.13 per case); bone wax ($3.07 per case); grounding pad ($4.35 per case); and electrosurgical pencil $(3.10 per case). Each of these items is used on every case, so the total loss per case for use of unreimbursed/incorrectly charged supplies was ($69.35).

Surgery patients were charged for Outpatient Surgery anesthesia minutes, which covers amortization of the anesthesia machines, intravenous medication pumps, carbon dioxide monitors, etc.; Outpatient Center anesthesia, which covers disposable anesthesia tubing, etc.; Outpatient Surgery facility

fee, which covers recovery room services; and adult or pediatric minute charges which cover anesthesia medication pharmacy charges during surgery (see Appendix A). Most of these charges were considered market sensitive, in that they should have been adjusted on a regular basis, in relationship to competition in the market. Researching these charges revealed that many of them had not been reviewed for two years or longer.

Reconciling Outpatient Surgery charge capture data and KEANE billing system data revealed a discrepancy in charges for two of the sample cases. The discrepancies were less than 0.001% and as such, were not considered to have a major impact on the averaging of charge data. The average charges for cochlear implant surgery during 1st quarter FY 1999 were: adults: $27,270.61 and pediatrics: $ 27,757.66. The average charge for a cochlear implant surgical implantation was $27,514.13. During the process of researching revenue procedure code charges and expenses, the researcher discovered an error in the charges for the cochlear implant device. The revenue procedure code data sheet stated that the charge for the device should have been cost plus 65%. Yet, when checking the actual charges, they had been entered at cost plus 40% and the cost of the device had risen $1,148 in the last month. Combining the mark up error with the increased purchase order price resulted in considerable lost revenue for TCTI. When figuring charge and cost data to be used for presentation to the business review board, both errors were corrected so that the correct cost data and mark up charge was used to determine patient charges and TCTI revenues for cochlear implant surgery.

In the process of working with materials management, outpatient surgery charge capture, and finance staff, it became clear that there are multiple different systems for warehousing expense data and they do not have a direct communication link to each other. All supply information was entered into a working spreadsheet and given to the Director for Outpatient Surgery to assist with a future project to develop a more user friendly, interconnected supply cost information system and work toward updating Outpatient Surgery costs. This worksheet contained charge and costs data from the Outpatient surgery material manager, the TCTI central finance office computer data bank, TCTI Outpatient Center pharmacy catalog (1997), the revenue procedure code central files, and central stores and manufactures identification numbers (when identified) (See Appendix A).

Presentation of Data

A spread sheet was developed that compared May 1998 business plan data with new data based on 1st quarter FY 99 cochlear implant volumes and revenue numbers (see Appendix D). Unless otherwise identified, costs and charges were directly transferred from the business plan to the new spreadsheet. The 1st quarter FY 99 volume data was annualized to predict full FY 99 volume and then volumes were increased by 7% a year over five years. Net operating revenue was determined and presented to the Otolaryngology administrator (see Appendix C).

The original electronic spreadsheet containing the formulas used to develop the financial data sheets in the May 1998 business plan were unavailable. The electronic spreadsheets used to develop the financial data were corrupted so that the formulas and related worksheet links would not function. Due to this loss of basic information and lack of access to the primary financial analyst, an attempt was made to determine the relationships between annual cochlear implant surgeries, rehabilitation and audiology visits. (See Appendix D) The attempt was unsuccessful as the only direct relationship identified was between surgical volume and surgical revenues. Review of the business plan and discussions with Listening Center staff revealed that the rehabilitation and audiology visits are not directly related to surgeries. It appears that the incremental data in the business plan spreadsheet was developed with a complicated formula that allowed for rehabilitation visits that require multiple year program support for each implantation. Consultation with TCTI Otolaryngology administrator and rehabilitation senior clinical staff, Outpatient Center assistant administrator, Outpatient Center project manager, and a TCTI senior financial analyst did not solve the problem. After much discussion it was decided to use the same relationship between surgical volume and rehabilitation and audiology services found in the May 1998 Business Plan.

The original project request was to identify outpatient surgery volumes for 1st quarter FY 99. The cost and revenue data was provided as a bonus as a result of the research necessary to complete the volume data research. If the request had been for clinical data, it would have been necessary to start from scratch and develop the intricate formulas necessary to accurately incorporate multiple year patient demand for services on program staff.

Discussion

The primary impetus for this project was to research TCTI Outpatient Surgery 1st quarter FY 99 volume data and identify current charges and expenses associated with cochlear implant surgery. The volume information was needed to allow the Otolaryngology Administrator to return to the TCTI Business Review Board and request funds to support two full time equivalency positions (one clinical and one administrative) that had been denied by the board in the original Listening Center Cochlear Implant Program request for capital and programmatic funding in May 1998. The Board was concerned that projected volumes would not be met and resultant revenues would not be realized to support the additional staff positions. The need to research charges and expenses became obvious as discussions with TCTI Outpatient Surgery, Department of Otolaryngology, and TCTI Outpatient Center staff revealed that some of the outpatient surgery charge and expense data for the original plan had been estimated and it would be helpful to all concerned to actually identify the exact charge and expense information. This information was successfully obtained and provided to all concerned.

The next phase of this project was to extrapolate the cochlear implant surgical volume, cost and charges information to revise the original cost benefit analysis. Incremental expense data was determined from a combination of the new outpatient surgery incremental volume data and baseline Department of Otolaryngology expense data from the original May 1998 Business Plan (see Appendix E). The results indicate that this additional step was far beyond the scope of this project, as the ROI numbers indicate. The 1505% ROI (Appendix F) indicates that the volume for FY 99 is already much higher than projected and additional clinical support staff and capital equipment necessary to support this volume, have not been obtained. The second possible answer for this percent ROI is that the ratios between the surgeries and the rehabilitation and audiology visits are in error, thus making the revenue figures incorrect.

The researcher's initial assumption was that there would be a direct relationship between surgical volumes and rehabilitation and audiology service volumes. This was in error. Extensive review of the business plan and discussion with Listening Center staff reveal that rehabilitation and audiology service demands vary considerably depending on patient history and age group (pediatric versus adult), and can spread out over a period of eight months prior to surgery and continue for up to four years after surgery.

Also, because rehabilitation and audiology staff have not been able to meet demand, review of historical data may not accurately predict future demand for these post surgical implantation needs as retrospective review of Listening Center Cochlear Implant program patient volume records will not account for all patients who would have received services had they been available.

The second assumption was that the researcher would have access to the original authors of the financial information and the final electronic spreadsheet containing the formulas used to determine the relationship between the cochlear implant surgeries and rehabilitation and audiology volume data included in the May 1998 business plan document. This assumption was also in error. Some electronic spreadsheets were obtained, but the links between worksheets had been corrupted and many of the formulas were not available. The final electronic spreadsheets were never located. Some of the numbers needed were only available from a printed copy of the final business plan and there was no one person available who could explain the methods used to determine the relationships. An attempt was made to identify the association between number of surgery cases and audiology and rehab visits in order to provide an updated ROI based on the new surgical volumes. The resulting >1000% return on investment (see Appendix E) indicates a potential flaw in the methodology used to determine these relationships. There is very little confidence in the accuracy of the new ROI. It became apparent that to complete an accurate, updated cost benefit analysis based on a retrospective review of cochlear implant surgery volumes was well beyond the scope of this project.

Although the ROI results appear to indicate a need to return to the beginning and research the relationships between the cochlear implant surgeries and the rehabilitation and audiology service demands, there have been numerous positive results from these research efforts.

1. A revenue procedure code error was uncovered that indicated that charges for the cochlear implant device were 25% below allowable mark-up. This error was brought to the attention of the TCTI Outpatient Center Assistant Administrator who took immediate action to rectify the mistake.
2. There had been a delay in transferring approved programmatic and capital equipment funds into the Department of Otolaryngology budget. This oversight was not discovered until this researcher began asking questions and requesting current financial data. Within three weeks of the discovery, after multiple discussions with finance personnel, and the TCTI Outpatient Center

Assistant Administrator, Vice President for Administration, and the Department of Otolaryngology Administrator, the funds were finally transferred to the appropriate budget.

3. The Cochlear Implant Surgery workload for 1st quarter FY 99 was well above predicted volumes. At this time, it appears that the volume data, along with the cost and expense data that indicate a solid profit margin, has successfully addressed the lingering concerns regarding volume predictions and the requested two FTE's will be approved.

4. The charge and cost data obtained from the retrospective chart review, based on a sample of the 1st quarter FY 99 cochlear implant surgery patients, has uncovered a number of issues that appear to be leading to process improvement initiatives.

a) Many of the revenue procedure codes that were put in place seven years ago are no longer in the revenue procedure code central database. Some items are not being charged to the patient at all, and other items must be entered under a general "catch all" revenue procedure code. The charges for several of the general "catch all" revenue procedure codes have not been reviewed for more than six months in some cases, and two years in others. Several revenue procedure codes for market sensitive services have not been updated in more than two years. There are staff working to remedy this problem as this report is being written.

b) A meeting with the senior cochlear implant surgery team registered operating room nurse revealed that there are standard items used in every implant surgery case (see Appendix A). Some of these charges have been missed and result in an unreimbursed cost to the outpatient surgery cost center. Although the total cost of missed charges in less than 1% of the total charges for an individual case, there is a concern that this discovery could be indicative of missed charges in other areas. This information was presented to the Director for Outpatient Surgery and a process improvement initiative is currently in discussion stage regarding the potential development of a "charge by exception" worksheet for operating room staff.

c) Operating rooms supplies are obtained from a TCTI central supply system and direct purchase order. The supplies are then stored in the outpatient surgery central supply

area. The central supply system number, direct purchase order numbers, and the shelf storage numbering system do not coincide. This will become a process improvement initiative in the future, and may be addressed as part of the revenue procedure code team project currently in place.

Conclusions and Recommendations

TCTI is a very large facility that has become very decentralized. There is a current initiative in place to review this management approach. In the meantime, there are multiple systems in place to monitor productivity, track departmental expenses, and provide the information necessary to charge fair and appropriate dollar amounts for supplies and services, within the guidelines of the Maryland state rate setting system. Part of the current problem is internal communication between different information systems. Also, like all medical care facilities today, this institution is attempting to do more with less, and to provide quality service to all patients in a cost effective and efficient manner while maintaining a quality working environment for the Listening Center staff..

The TCTI Listening Center Cochlear Implant program is a quality program that is meeting patient needs, as well as developing a rehabilitation program that is seen as setting a standard for the industry. The staff are knowledgeable and dedicated to the hearing challenged patients that require their services. Surgical implantation, rehabilitation, and audiology service volumes far exceed projections. It appears that the additional two full time equivalent positions are desperately needed to meet service demands. Further research is needed to identify optimal staffing ratios and space requirements for this very large increase in patient volumes.

The original surgical patient volume projections have been exceeded by 89%. Recommendations are:

1. Develop patient load capabilities for each Listening Center Cochlear Implant staff position.
    a) Number of possible surgeries per quarter for each of the two cochlear implant surgeons
    b) Projected caseload capability for each rehabilitation specialist, audiology specialist, and speech language pathologist for adult and pediatric patients[5].

c) Identify number of administrative staff support required per full time equivalent for surgical and post surgical services staff

2) Identify number of additional operating room hours available and amount of operating room time needed to support potential increase in expected surgical volumes

3) Identify number of rooms (space) required for rehabilitation, audiology staff, speech pathology, and administrative staff.

4) Identify additional capital equipment requirement to support the projected increased caseload.

5) Develop a new electronic spreadsheet that predicts surgical and post surgical support service volumes and predicts expenses and revenues based on the new volume projections derived from the 1st quarter FY 99 surgical volumes.

6) Research the potential to eliminate travel time and expenses for rehabilitation and audiology staff between TCTI and Suburban Hospital by permanently assigning staff to the Suburban location. This will require a separate cost analysis based on research to identify the current caseload seeking services at the Suburban location.

Beyond the Listening Center Cochlear Implant Program issues, there remain a number of systems issues. Recommendations are:

1) Support an information systems process improvement initiative to facilitate internal communication between TCTI supply sources.

2) Support an information systems process improvement initiative to facilitate internal communication and sharing of current costs and charges between the central revenue procedure code database and individual patient procedure departments.

3) Initiate a regular review of costs and charges for each TCTI Outpatient cost center.

TCTI is becoming increasingly challenged to distribute limited resources among many competing quality requests for funding. The challenge to expand, contract, or initiate new programs requires the most productive and efficient use of available funds. The TCTI Listening Center Cochlear Implant Program is growing beyond expectations. The Outpatient Surgery costs and charges indicate that, within that sector of the program, it is more than providing a positive ROI. The TCTI Business Review Board has approved all funds requested. The current challenge will be to remain proactive and anticipate increased capital

equipment needs, programmatic funding requirements, including additional post surgical rehabilitation and audiology staff, that are going to result from the increased demand for services due to actual volumes that are greatly exceeding expectations. Recent review of cochlear implant surgical volumes for 2nd quarter FY 99 reveals that projections remain consistent with actual volumes. The TCTI challenge will be to meet the financial support demands of a successful program while maintaining a quality and profitable product.

TCTI Outpatient Surgery Cost Charge Data
Appendix A

[illegible]

RPC codes		448 0621	555 3020	555 3098	52800020	41091000	44531040	445 3102	44531040	44599990	44599990	44599990
Age	Date (1998)	Skull ser limit	Heme-8	Red Cell M	Anes Mins	OPT Ctr Anes	O/P Surg Fac	Adult >=60 min	Peds >=60 min	Bacitracin	Bibiotic Conc	Cortisporin Otl
1	11-Sep				141.36	27.00	166.00		86.02			
3	1-Jul				152.52	27.00	166.00		86.02	1.86	4.44	6.81
6	24-Jul				150.04	27.00	166.00		86.02			
20	5-Aug				109.12	27.00	166.00	121.59			2.00	
49	24-Jun				94.24	27.00	166.00	121.59				
61	23-Jul		16.74	6.46	105.40	27.00	166.00	121.59		1.86	4.44	
65	10-Sep	109.92			97.34	27.00	166.00	121.59				
Avg Charges		109.92	10.28	6.46	121.43	27.00	166.00	121.59	86.02	1.86	3.63	6.81
True Costs		109.92	10.28	6.46	110.39	27.00	86.02	110.54	78.20	0.63	1.08	2.27
Avg Charges-True Costs*		0.00	0.00	0.00	11.04	0.00	79.98	11.05	7.82	1.23	2.55	4.54

DC #
Vfx #
Source: OPS Materiel Mgr& Material Mgmt PO's as of Oct "98"
Source: [illegible]
Source: Finance Office (Ed Barranick) general markup for 445 3102 & 3104 is 1.1% this is a HSCRC minute charge
Source: [illegible]
Source: OPS Financial Mgr - increased cost (11/98)
Source: OPS Financial Mgr - increased charge (11/98)

Source: Pharmacy Catelog 3/21/97										0.63	1.08	2.27
Source: RPC Control file Charge $												
Cost		by RVU					78.20	110.54	78.20			
Charge		117.61	14.52	9.13	10.54	27.00	86.02	121.59	86.02			

Source: JHOC OPS Charge list (Finance Office: Ed Barranick)

* areas where it was impossible to determine cost related to a particular item, the cell was set to indicate a 0 positive margin

TCTI Outpatient Surgery Cost Charge Data
Appendix A

[redacted]

RPC codes		4459990	44599990	4459999	44599990	44599990		47865840
Age	Date (1998)	Cefazolin	Lidocaine w epi	Clindamycin	Epi	Ondansetron	1L Ringers Lactate	D5W 500cc .
1	11-Sep	2.73	1.92					2.30
3	1-Jul	3.03	2.13		0.57			4.60
6	24-Jul		2.13		1.14	91.62		2.30
20	5-Aug	2.73	1.92		1.02		3.19	
49	24-Jun				1.14		13.48	
61	23-Jul		2.13	5.07		45.81	16.67	
65	10-Sep		1.92		1.02	41.23	3.19	
Avg Charges		2.83	2.03	5.07	0.96	59.55	9.13	3.07
True Costs		1.00	0.72	1.69	0.19	15.28	0.94	0.69
Avg Charges-True Costs*		1.83	1.31	3.38	0.79	44.27	8.19	2.38

DC #	W46572	W46561
Mfx #	79530939	79220334
Source: OPS Materiel Mg & Material Mgmt PO's as of Oct "98"	0.94	0.69

[redacted]

Source: OPS Financial Mgr - increased cost (11/98)
Source: OPS Financial Mgr - increased charge (11/98)

Source: Pharmacy Catelog 3/21/97	1.00	0.72	1.69	0.19	15.28	.

[redacted]

Cost	2.90	2.09
Charge	3.19	2.30

Source: JHOC OPS Charge list (Finance Office: Ed Barranick)

* areas where it was impossible to determine cost related to a particular item, the cell was set to indicate a 0 positive margin

TCTI Outpatient Surgery Cost Charge Data
Appendix A

RPCs used on every case

RPC codes		47865780			52800020			Rec Rm St	53040600	530 4050	53040650
Age	Date (1998)	.9 NACL 100cc	1l Irrigating	.9 NA	Surg Mins	Stapler	Suction Filter	Supplies	Bur CuttingR	Bur Carbide	Bur Diamond
1	11-Sep			10.29	2,129.08	25.00		24.00			
3	1-Jul			10.29	2,329.34	44.00		21.00			
6	24-Jul			10.29	2,403.12	25.00	14.00	24.00			
20	5-Aug			10.29	1,781.26	25.00	14.00	24.00	230.00		170.00
49	24-Jun			10.29	1,538.84	22.00	13.00	21.00	207.00		
61	23-Jul			10.29	1,602.00	25.00	14.00	24.00		166.00	
65	10-Sep	3.64		10.29	1,486.14	25.00	14.00	24.00			
Avg Charges		3.64		10.29	1,895.68	27.29	13.80	23.14	216.50	166.00	170.00
True Costs		1.16		0.86	1,895.68	4.43	2.51	9.51	92.00	66.50	68.00
Avg Charges-True Costs*		2.48		9.43	0.00	22.86	11.29	13.63			
										Acorn	XOMed
DC #		W00125		W46554		W02039	W89229			31-12540	31-13540
Mfx #		154212626		71380919		2000-10AZ	N0139			B0527	B05286
Source: OPS Materiel Mg & Material Mgmt PO's as of Oct "98"		1.16		0.86		4.43	2.51			92.00	67.50

Source: [illegible]
Source: Finance Office (Ed Barranick) general markup for 445 3102 & 3104 is 1.1% this is a HSCRC minute charge
Source: Financial Office (Ed Barranick) price is market sensitive - set as of 7/1/98
Source: OPS Financial Mgr - increased cost (11/98)
Source: OPS Financial Mgr - increased charge (11/98)

Source: Pharmacy Catelog 3/21/97

Source: RPC Control file Charge $	3.64		3.43		25.00	14.00		230.00	166.00	170.00
Cost	set	set at	.78		9.85	5.70	9.51	92.00	66.50	68.00
Charge	3.64		3.43	10.54	25.00	14.00	24.00	230.00	166.00	170.00

Source: JHOC OPS Charge list (Finance Office: Ed Barranick)

* areas where it was impossible to determine cost related to a particular item, the cell was set to indicate a 0 positive margin

TCTI Outpatient Surgery Cost Charge Data
Appendix A

RPC's used on every case

RPC codes		Avg Burs	(530-090)	530-4107	530-4114	530-4180	53041850	530-7010(X4)
Age	Date (1998)		Drape Microsco	Glassock Ear D	Coch Implant	Nim Needle Electrode	Nim Stimulator Probe	Sutures - Gen
1	11-Sep		19.00		24,626.00	20.00		51.00
3	1-Jul		17.00		24,626.00	18.00		45.00
6	24-Jul		19.00	33.00	24,626.00	20.00	135.00	51.00
20	5-Aug			33.00	24,626.00	20.00	135.00	51.00
49	24-Jun		17.00	29.00	24,626.00	18.00		45.00
61	23-Jul		19.00	33.00	24,626.00			51.00
65	10-Sep		19.00	33.00	24,626.00	20.00		34.00
Avg Charges		184.83	18.33	32.20	30,917.70	19.33	135.00	46.86
True Costs		75.50	27.37	11.33	18,738.00	65.00	60.80	20.22
Avg Charges-True Costs*		109.33	(9.03)	20.87	12,179.70	(45.67)	74.20	26.64
				Central Stores		central stores		
DC #						2297600	85-25102	
Mfx #			2161429H	2067700		B0521	B0533	
			27.37	11.33		65.00	60.80	

Source: OPS Materiel Mg & Material Mgmt PO's as of Oct "98"

Source: OPS CIPN

Source: Finance Office (Ed Barranick) general markup for 445-3102 & 3104 is 141% this is a HSCRC minute charge

Source: Financial Office (Ed Barranick) price to market sensitive [illegible] 7/1/98

Source: OPS Financial Mgr - increased cost (11/98)

Source: OPS Financial Mgr - increased charge (11/98)

Source: Pharmacy Catelog 3/21/97

Source: RPC Control file Charge $	19.00	33.00		20.00	135.00	17.00
Cost	7.75	13.00	17,590.00	7.83	54.00	6.74
Charge	19.00	33.00	24,626.00	20.00	135.00	17.00
Source: JHOC OPS Charge list (Finance Office: Ed Barranick)			18,738.00			
			30,917.70			

* areas where it was impossible to determine cost related to a particular item, the cell was set to indicate a 0 positive margin

TCTI Outpatient Surgery Cost Charge Data
Appendix A

RPCs used on every case		530 7015	530 7070	530 7030		530 2105	530 7520	530 7545	530 7005	530 0185	530 0190
RPC codes					Avg Sutures					Grounding Pad	Grounding Pad
Age	Date (1998)	Ethilon 3.0	Prolene	All Ot Silk D Tach		Gelfilm	Tray, Head	Tray, Prep	Bone Wax	(adult)	(Peds)
1	11-Sep						130.00	15.00			
3	1-Jul			14.00			117.00	28.00			
6	24-Jul						130.00	15.00			
20	5-Aug						130.00	15.00			
49	24-Jun						117.00	14.00			
61	23-Jul			15.00			130.00	15.00			
65	10-Sep		13.00			one	130.00	15.00			
Avg Charges			13.00	14.50	13.75	0	126.29	16.71	0	0	0
True Costs		3.05	5.00	6.17	5.59	4.13	48.72	5.57	3.07	4.35	5.60
Avg Charges-True Costs*					8.17	(4.13)	77.57	11.14	(3.07)	(4.35)	
DC #		W01951					W09797	W09777	W02064	W07705	W07854
Mfx #		1663H					.		W31G	E7507	E7510-25
Source: OPS Materiel Mgr & Material Mgmt PO's as of Oct "98'		3.05				4.13	48.72	5.57	3.07	3.10	5.60

Source: OPS GERN

Source: Finance Office (Ed Barranick) general markup for 445 3102 & 3104 is 11%, this is a HSCRC minute charge

Source: Financial Office (Ed Barranick) price is market sensitive as of 7/1/98

Source: OPS Financial Mgr - increased cost (11/98)

Source: OPS Financial Mgr - increased charge (11/98)

Source: Pharmacy Catelog 3/21/97

	Ethilon 3.0	Prolene	All Ot Silk D Tach	Avg Sutures	Gelfilm	Tray, Head	Tray, Prep	Bone Wax	Grounding Pad (adult)	Grounding Pad (Peds)
Source: RPC Control file Charge $					10.00	150.00	15.00			14.00
Cost		5.00	6.17			52.17	6.00			5.40
Charge		13.00	15.00			130.00	15.00			14.00

Source: JHOC OPS Charge list (Finance Office: Ed Barranick)

* areas where it was impossible to determine cost related to a particular item, the cell was set to indicate a 0 positive margin

TCTI Outpatient Surgery Cost Charge Data
Appendix A

[redacted]

RPC codes			5309990		
Age	Date (1998)	Electrosurg Pencil	Gown	TOTAL	discrepancies in charges
1	11-Sep			27,476.70	
3	1-Jul		40.00	27,764.61	
6	24-Jul			28,031.66	
20	5-Aug			27,699.12	
49	24-Jun			27,101.58	(27,093.42) KEANE
61	23-Jul		10.00	27,259.46	(27,242.79) KEANE
65	10-Sep			27,022.28	
Avg Charges		0	25.00	34,835.50	
True Costs		3.10	2.86	21,799.38	
Avg Charges-True Costs*		(3.10)	22.14	12,700.44	average positive margin on each case
DC #		W07788	W16020		
Mfx #		E2516H	90042		
Source: OPS Materiel Mg & Material Mgmt PO's as of Oct "98"		3.10	2.86		

[redacted]

Source: OPS Financial Mgr - increased cost (11/98)
Source: OPS Financial Mgr - increased charge (11/98)

Source: Pharmacy Catelog 3/21/97

[redacted]

Cost
Charge
Source: JHOC OPS Charge list (Finance Office: Ed Barranick)

Adult Avg $	27,270.61
Peds Avg $	27,757.66
Avg $ per case	27,514.13

Sample of 7 cases taken from 1st Qtr FY 99 CI Data:
13 Peds/14 Adults

* areas where it was impossible to determine cost related to a particular item, the cell was set to indicate a 0 positive margin

Volume and Revenue Data
Appendix B

	FY 96	FY 97	FY 98	FY 99 Projected (a)[1]	FY 99 Projected (b)[2]	FY 99 Projected (c)[3]	FY 00 Projected (a)[1]	FY 00 Projected (c)[3]
Surgical Volume	37	43	60	70	108	108	75	113
Increase in volume (annual)		16%	40%	17%	80%	80%	7%	5%
Surgical Revenue		1,363,068	1,939,226	2,309,540	3,490,607	3,762,180	2,522,993	4,012,009
cost per pt		31,699	32,320	32,320	32,320	34,835	32,320	35,505
% annual cost increase			2%	0%	0%	8%	0%	2%
Rehab Volume		1,312	1,878	3,191	7,150	7,150	3,917	8,521
Rehab Revenue		135,705	197,197	340,102	750,777	750,750	423,738	911,747
Increase in volume (annual)			30%	41%	74%	74%	19%	19%
Revenue per rehab visit		103	105	107	105	105	108	107
Avg Number of Rehab visitis per Surgical Implantation		31	31	46	66	66		
% annual cost increase			2%	2%	2%	2%	1%	2%
Audiology Volume				2,122	13,793	13,793	2,640	12,320
Audiology Revenue				247,667	1,475,851	1,475,851	312,729	1,342,880
Avg Number of Audiology visits per Surgical Implantation				30	128	30	35	30
Revenue per Audiology Visit				117	107	107	118	109
Gross Revenue		1,498,773	2,136,423	2,897,310	5,717,234	5,988,781	3,259,460	6,266,636
Deductions and Bad Debt		(254,791)	(363,192)	(492,543)	(971,930)	(1,018,093)	(554,108)	(1,065,328)
% of bad debt to gross revenue		17%	17%	17%	17%	17%	17%	17%
Net Operating Revenue		1,243,982	1,773,231	2,404,767	4,745,305	4,970,688	2,705,352	5,201,308

Data Sources:

[1] Data taken from May 1998 Business Plan

[2] Surgical volume prediction increased due to retrospective review of 1st quarter FY 99 data

[3] Surgical volume prediction increased and new surgical revenue data revised due to retrospective review of Outpatient Surgery charges for 1st quarter FY 99

Volume and Revenue Data
Appendix B

	FY 01 Projected (a)[1]	FY 01 Projected (c)[3]	FY 02 Projected (a)[1]	FY 02 Projected (c)[3]	FY 03 Projected (a)[1]	FY 03 Projected (c)[3]	Five Yr Avg. (FY99-FY03) Projections (a)[1]	Five Yr Avg. (FY99-FY03) Projections (c)[3]
Surgical Volume	80	118	85	123	90	129	80	118
Increase in volume (annual)	7%	5%	6%	5%	6%	5%		
Surgical Revenue	2,743,929	4,270,052	2,972,560	4,536,531	3,187,239	4,849,268	2,747,253	4,286,008
cost per pt	34,299	36,187	34,971	36,882	35,414	37,591		
% annual cost increase	6%	2%	2%	2%	1%	2%		
Rehab Volume	4,671	9,675	5,253	10,118	5,759	10,515	4,558	9,196
Rehab Revenue	512,880	1,054,575	585,433	1,123,098	651,451	1,188,195	502,721	1,005,673
Increase in volume (annual)	19%	14%	12%	5%	10%	4%		
Revenue per rehab visit	110	109	111	111	113	113		
% annual cost increase	1%	2%	1%	2%	1%	2%		
Audiology Volume	3,099	11,621	3,541	11,331	3,997	11,458	3,080	12,105
Audiology Revenue	372,664	1,289,931	432,203	1,280,403	495,179	1,317,670	372,088	1,341,347
Revenue per Audiology Visit	120	111	122	113	124	115		
Gross Revenue	3,629,473	6,614,558	3,990,197	6,940,032	4,333,869	7,355,133	3,622,062	6,633,028
Deductions and Bad Debt	(617,010)	(1,124,474)	(678,333)	(1,179,805)	(736,758)	(1,250,373)	(615,750)	(1,127,615)
% of bad debt to gross revenue	17%	17%	17%	17%	17%	17%		
Net Operating Revenue	3,012,463	5,490,084	3,311,863	5,760,228	3,597,111	6,104,760	3,006,311	5,505,413

Data Sources:

a[1] Data taken from May 1998 Business Plan

b[2] Surgical volume prediction increased due to retrospective review of 1st quarter FY 99 data

c[3] Surgical volume prediction increased and new surgical revenue data revised due to retrospective review of Outpatient Surgery charges for 1st quarter FY 99

Volume and Revenue Data to Support Two Additional Listening Center Staff
Appendix C

	FY 97	FY 98	FY 99 Projected (a)[1]	FY 99 Projected (b)[2]	FY 00 Projected (b)[2]	FY 01 Projected (b)[2]	FY 02 Projected (b)[2]	FY 03 Projected (b)[2]	Five Yr Avg. Projected (b)[2] (FY99-FY03)
Surgical Volume	43	60	70	108	113	118	123	129	118
Surgical Revenue	1,363,068	1,939,226	2,309,540	3,762,180	4,012,009	4,270,052	4,536,531	4,849,268	4,286,008
cost per pt	31,699	32,320	32,320	34,835	35,505	36,187	36,882	37,591	
Rehab Volume	1,312	1,878	3,191	7,150	8,521	9,675	10,118	10,515	9,196
Rehab Revenue	135,705	197,197	340,102	750,750	911,747	1,054,575	1,123,098	1,188,195	1,005,673
Revenue per rehab visit	103	105	107	105	107	109	111	113	
Audiology Volume			2,122	13,793	12,320	11,621	11,331	11,458	12,105
Audiology Revenue			247,667	1,475,851	1,342,880	1,289,931	1,280,403	1,317,670	1,341,347
Revenue per Audiology Visit			117	107	109	111	113	115	
Gross Revenue	1,498,773	2,136,423	2,897,310	5,988,781	6,266,636	6,614,558	6,940,032	7,355,133	6,633,028
Deductions and Bad Debt	(254,791)	(363,192)	(492,543)	(1,018,093)	(1,065,328)	(1,124,474)	(1,179,805)	(1,250,373)	(1,127,615)
Net Operating Revenue	1,243,982	1,773,231	2,404,767	4,970,688	5,201,308	5,490,084	5,760,228	6,104,760	5,505,413

Data Sources:

[1] Data taken from May 1998 Business Plan

[2] Surgical volume prediction increased and new surgical revenue data revised due to retrospective review of Outpatient Surgery charges for 1st quarter FY 99

Incremental Old and New Revenue Data
Appendix D

Business Plan Data	FY 99 Projected	FY 00 Projected	FY 01 Projected	FY 02 Projected	FY 03 Projected	Five Yr Average (FY 99- FY03)
Surgical Volume	10	15	20	25	30	20
Surgical Revenue	$ 329,934	$ 504,599	$ 685,982	$ 874,282	$ 1,062,413	$ 691,442
percentage annual increase	17%	7%	7%	6%	6%	8.52%
revenue per pt	32,993					
Rehab Volume	1100	1826	2580	3162	3668	2,467
Rehab Revenue	$ 117,249	$ 197,542	$ 283,292	$ 352,401	$ 414,923	$ 273,082
Rehab volume/incremental surg volume	110	122	129	126	122	
Audiology Volume	2,122	2,640	3,099	3,541	3,997	3,080
Audiology Revenue	$ 247,667	$ 312,729	$ 372,664	$ 432,203	$ 495,179	$ 372,088
Audiology volume/incremental surg volume	212	176	155	142	133	164
Gross Revenue	$ 694,851	$ 1,014,870	$ 1,341,938	$ 1,658,887	$ 1,972,515	$ 1,366,612
Deductions and Bed Debts	($118,125)	($172,528)	($228,129)	($282,011)	($335,328)	($227,224)
Net Operating Revenue	$ 576,726	$ 842,342	$ 1,113,809	$ 1,376,876	$ 1,637,187	$ 1,109,388
New Data*						
Incremental Surgical Volume** (FY 97 baseline)	65	70	75	80	86	75
Surgical Revenue	$ 2,264,275	$ 2,438,450	$ 2,612,625	$ 2,786,800	$ 2,995,810	$ 2,619,592
Rehab Volume***	7150	8521	9675	10118	10515	9196
Rehab Revenue	$ 750,750	$ 912,635	$ 1,055,930	$ 1,124,964	$ 1,190,501	$ 1,006,956
per visit charges	105	$ 107	$ 109	$ 111	$ 113	$ 109
Audiology Volume	13,793	12,320	11,621	11,331	11,458	$ 12,105
Audiology Revenue	$ 1,475,851	$ 1,344,605	$ 1,292,051	$ 1,282,918	$ 1,320,657	$ 1,343,216
per visit charges	107	$ 109	$ 111	$ 113	$ 115	$ 111
Gross Revenue	$ 4,511,924	$ 4,716,638	$ 4,982,010	$ 5,216,243	$ 5,529,054	$ 4,991,174
Deductions and Bad Debts	($767,027)	($801,828)	($846,942)	($886,761)	($939,939)	($848,500)
Net Operating Revenue	$ 3,744,897	$ 3,914,810	$ 4,135,069	$ 4,329,482	$ 4,589,115	$ 4,142,674

* New data derived from retrospective review of FY 99 cochlear implant surgery volumes, Keane billing data, Outpatient Surgery Charge Capture Data, and patient sample record review

** Volume data annualized from actual FY 99 1st quarter surgical volumes: Surgeries figured at 7% annual increase; Rehab visits = recognizes multi year visits for each implantation. Ratio of new surgeries to rehab and audiology visits maintained as established in the original business plan

***all charges figured at 2% annual increase

Incremental Expense Data
Appendix E

May 1998 Business Plan Data	FY 99	FY 00	FY 01	FY 02	FY 03	Five Year Average
Incremental Surgical Volumes (FY 97 baseline)	27	32	37	42	47	37
Implants* (FY 97 baseline)	$ 490,887	$ 593,428	$ 699,874	$ 810,341	$ 924,946	$ 703,895
Supplies for Implants**	$ 8,537	$ 10,321	$ 12,172	$ 14,093	$ 16,086	$ 12,242
Other Variable Expenses***	$ 40,430	$ 48,661	$ 57,138	$ 65,866	$ 69,143	$ 56,247
Incremental Variable Expenses	$ 539,854	$ 652,409	$ 769,184	$ 890,300	$ 1,010,176	$ 772,385
Incremental Programmatic Expenses (total)	$ 475,708	$ 618,728	$ 704,199	$ 814,952	$ 951,910	$ 713,099
Total Variable and Incremental Expenses	$ 1,015,562	$ 1,271,137	$ 1,473,383	$ 1,705,252	$ 1,962,086	$ 1,485,484
New Values with New Outpatient Surgery Volume Data						
Incremental Surgical Volumes (FY 97 baseline)	65	70	75	80	86	75
Implants*	$ 1,217,970	$ 1,329,292	$ 1,460,195	$ 1,595,763	$ 1,736,199	$ 1,467,884
Supplies for Implants**	$ 20,540	$ 22,417	$ 24,600	$ 26,848	$ 29,250	$ 24,731
Other Variable Expenses***	$ 152,802	$ 165,951	$ 181,392	$ 197,281	$ 213,561	$ 182,197
Incremental Variable Expenses	$ 1,391,377	$ 1,517,730	$ 1,666,262	$ 1,819,973	$ 1,979,095	$ 1,674,887
Incremental Programmatic Expenses (total)	$ 475,708	$ 618,728	$ 704,199	$ 814,952	$ 951,910	$ 713,099
Total Variable and Incremental Expenses	$ 1,867,085	$ 2,136,458	$ 2,370,461	$ 2,634,925	$ 2,931,005	$ 2,387,987

*non-compensation expense = 2% annual inflation rate
**$316 per implanted device with 2% annual inflation rate
*** annual inflation rate for Outpatient surgery charges ($21,799 average/case) with 1.5% inflation rate
annual inflation rate for compensation expense = 2.5%

Return on Investment
Appendix F

Data from May 1998 Business Plan (BP)	FY 99	FY 00	FY 01	FY 02	FY 03	Five Year Average	Five Year Total
Incremental Net revenue	$ 1,092,353	$ 1,367,841	$ 1,649,372	$ 1,922,698	$ 2,190,038	$ 1,644,460	
Incremental variable expense	$ 539,854	$ 652,409	$ 769,184	$ 890,300	$ 1,010,176	$ 772,385	
Incremental programmatic expense	$ 475,708	$ 618,728	$ 704,199	$ 814,952	$ 951,910	$ 713,099	
Net Income (loss)	$ 76,790	$ 96,704	$ 175,989	$ 217,446	$ 227,952	$ 158,976	$ 794,881
PV of Net Income (loss) at 5% discount rate	$73,133	$92,099	$167,609	$207,091	$217,097	$151,406	$ 757,030

New Data based on 1st quarter FY 99 surgical volumes*

Incremental Net revenue	$ 3,744,897	$ 3,899,957	$ 4,101,823	$ 4,277,580	$ 4,517,375	$ 4,108,327	
Incremental variable expense	$1,391,377	$1,517,730	$1,666,262	$1,819,973	$1,979,095	$1,674,887	
Incremental programmatic expense	$475,708	$618,728	$704,199	$814,952	$951,910	$713,099	
Net Income (loss)	$1,877,812	$1,763,499	$1,731,362	$1,642,655	$1,586,370	$1,720,341	$ 8,601,698
PV of Net Income (loss) at 5% discount rate	$1,788,392	$1,679,523	$1,648,916	$1,564,433	$1,510,829	$1,638,420	$ 8,192,093

	BP Data	New Data
Five Year Cumulative Net Income	$ 794,881	$ 8,601,698
PV of Five Year Cumulative Net Income	$ 757,031	$ 8,192,093
Average Net Income	$ 158,976	$1,720,341
Average PV of Net Income	$ 151,406	$1,638,420
Capital Investment	$ 108,888	$ 108,888
Average Return on Capital Investment (Present Value)**	139%	1505%
Months to Payback***	8.63	0.1

Note: FY 97 is baseline for calculating incremental values
*see Appendix D New Data
** average PV of net income/capital investment
*** capital investment/average net income

References

Austin, C.J. , & Boxerman, S.B. (1995). Quantitative analysis for health services administration. Ann Arbor: AUPHA Press.

Harris, J.P., Anderson J.P., & Novak, R. (1995). An outcome study of cochlear implants in deaf patients. Audiologic, economic, and quality-of-life changes. Archives of Otolaryngology Head Neck Surgery, 121(4), 398-404.

Koch, M.E., Wyatt, J.R., Francis, H.W., & Niparko, J.K. (1997). A model of educational resource used by children with cochlear implants. Otolaryngology Head Neck Surgery, 117, 174-9.

Francis, H.W., Koch, M.E., Wyatt, J.R., & Niparko, J.K. (1997). Trends in Educational Placement and Cost-Benefit Consideration in Children with Cochlear Implants. Paper presented at the Vth International Cochlear Implant Conference, New York City, NY.

Ginter, P.M., Swayne, L.M., & Duncan, W. J. (1995). Strategic management of health care organizations (3rd ed.). Malden, MA: Blackwell.

National Center for Policy Analysis (1998, June). Rising healthcare costs (WWW document). www.ncpa.org/~ncap/w/w38.html

National Institute of Health (1995, May 15-17). Cochlear implants in adults and children: National Institute of Health Consensus Development Conference Statement [WWW document]. http://www.text.nlm.nih.gov/nih/cdc/www/100txt.html

Niparko, J.K. (1998). An update on cochlear implants: Part I: the technology and biology related to cochlear implantation. Hearing Loss, July/August, 8-13.

Listening Center (1998, May). Proposal for tertiary care teaching institution support of the listening center. (internal document). Baltimore, MD: Department of Otolaryngology- Head & Neck Surgery.

Tertiary Care Teaching Institution (1998, May). Business plan: the listening center at tertiary care teaching institution (internal document). Baltimore, MD: Department of Otolaryngology – Head and Neck Surgery.

Tertiary Care Teaching Institution. (1998, July). Mission and vision statement (internal document). Baltimore, MD: Department of Administrative Services.

Weizmann, A. C. (July 1996). Cochlear implants - facts [WWW document]. http://weizmann.ac.il.deaf-info/ci-facts.html

Wyatt, J.R., Niparko, J.K., Rothman, M., & deLissovoy, G. (1996). Cost utility of the multichannel cochlear implant in 258 profoundly deaf individuals. Laryngoscope, 106, 816-21.

Endnotes

[1] A small percentage of audiology visits are necessary for pre-surgical evaluation and the number of post surgical program visits depends on patient history, age, and availability of appointments due to FTE limitations.

[2] KEANE patient billing system software is available commercially, but has been adapted to interface with the TCTI data information systems, thus the TCTI KEANE system is proprietary.

[3] Names were not listed in the spreadsheet to maintain patient confidentiality

[4] These numbers are not yet available for adult rehabilitation and pediatric speech language therapy