Historical Return on Investment and Improved Quality Resulting from Development and Mining of a Hospital Laboratory Relational Database

Bradley B. Brimhall, MD¹, Timothy E. Hall¹, Steven Walczak, PhD²

¹School of Medicine and ²School of Business Administration
University of Colorado at Denver and Health Sciences Center

Abstract: A hospital laboratory relational database, developed over eight years, has demonstrated significant cost savings and a substantial financial return on investment (ROI). In addition, the database has been used to measurably improve laboratory operations and the quality of patient care.

Background: A relational database was created eight years ago to store patient laboratory test results. The database was developed with SQL Server and populated with new patient test results from the laboratory information system (Cerner). Hospital administrative data is also downloaded from the hospital information system to the database every night. The database includes more than 70 fields including patient demographic (e.g., age, gender), medical (ICD9-CM codes), billing (payer), and laboratory test information. Since its creation, the database has grown to include just over 2.3 million patient encounter records and more than 2.4 billion data elements.

Methods: An analysis of cost savings resulting from the laboratory database using 8-year actual financial figures. Both the net present value (NPV) and modified internal rate of return (MIRR) were calculated as project profitability measures. The MIRR was used rather than a simple internal rate of return to control for forward income due to unusually high internal project rates of return. For both measures the cost of capital was assumed 6%. In addition, uses of the database to improve laboratory operations and patient care were summarized.

Results: The database has been used extensively for data mining to identify and quantify medical, operational, and financial problems. These activities have been instrumental in planning and executing projects that 1) reduce costs and increase revenues, and 2) improve the quality of laboratory testing.

Initial costs to create the database included hardware, software, and professional time at a total cost of approximately $60,800. Annual upkeep costs ranged from $19,100 to $23,200. The database was used for three large cost-saving projects resulting in modification of the algorithm for urinalysis testing, as well as hospital policy changes for granulocyte transfusions and laboratory carve-out contracting. In 2005, cost savings from these projects was $746,200. This represents approximately 4.5% of laboratory direct costs. Financial ROI was substantial considering the small initial investment. The need to accumulate many months of data, prior to meaningful data mining, precluded savings from database projects during the first year. Nevertheless, the payback period for the database project was just over one year. The NPV and MIRR for the project are $2,968,639 and 59.4%, respectively.

The database has been employed to improve laboratory operations and patient care through projects to monitor and reduce test turn-around-time, and electronically notify physicians of important trends in patient test results. In addition, the database is routinely queried to generate instrument performance comparisons, workload reports, test review forms, and quality data summaries. These documents help staff monitor testing quality and satisfy requirements of the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and the College of American Pathologists (CAP). The laboratory web catalog includes several database queries through an HTML interface. This catalog is frequently used by laboratory employees as well as physicians.

The database has also been used for clinical research. The research has evaluated diagnostic accuracy and includes use of laboratory test results in multivariate models and artificial neural networks.

REFERENCES
1. Menachemi N, Burkhartd J, Shewchuck R, Burke D, Brookes RG. Hospital information technology and positive financial performance: a different approach to finding an ROI. J Healthc Manag 2006;51:40-58
2. Carpenter D. Three approaches to ROI. Hosp Health Netw 2005;79:suppl. 9-12