Fall 2008

Development of a Physician Profiling Data Mart

Connie Chambers
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Regis University
College for Professional Studies Graduate Programs
Final Project/Thesis

Disclaimer

Development of a Physician Profiling Data Mart

by

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A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer Information Technology

School of Computer and Information Sciences
Regis University
Denver, Colorado

August 10, 2008

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Abstract

Hospitals and medical centers participate in a physician profiling process. This process is important to ensure that physicians are providing safe care and to comply with regulations. One medical center was struggling with the ongoing generation of physician performance reports that were an important part of the profiling process. A design research project was undertaken to demonstrate that an Access-based data mart could successfully streamline this report generating process. The research also demonstrated the need to eliminate excessive detail and deliver highly summarized reports. In addition, the research provided thorough documentation of the entire data mart development approach. This documentation can serve as a resource for future research and/or for other medical centers that might be struggling to manage the profiling report requirements.

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Executive Summary

A design research project was undertaken to demonstrate the successful selection and development of a Microsoft-Access data mart to solve a medical center's business problem: the need to streamline the generation of physician profiling reports

The research began with recognition of the importance of the physician profiling process. Profiling is an essential component of the physician credentialing/re-credentialing process that is carried out in hospitals and medical centers across the country to monitor the safety and competence of physician performance. This monitoring of physician performance is important for a number of reasons. A hospital or medical center must ensure that its physicians are providing safe care to its patients in order to maintain public trust and to reduce the risk of legal liability. The physician profiling process is also required for regulatory compliance. Through profiling, and through the credentialing/re-credentialing process, a medical center can demonstrate its ongoing surveillance of physician performance and help ensure the safety of the care it provides to its patients.

A difficulty existed at one medical center with the monthly generation of profiling reports that a committee reviewed to support physician reappointment decision-making. The reports were being generated from different systems via a time- and labor-intensive process. A review of practices at other medical centers revealed that this difficulty in generating profiling information was not unique, nor was there a universal method to streamline the process. Compounding this problem was the reality that few resources were available at the medical center to simplify the report generating process.

A suggestion was made that a Microsoft Access data mart would solve the profiling report generating problem. A review of literature supported this suggestion.

The research entered the artifact development stage, where an Access data mart was designed and constructed according to the Systems Development Life Cycle waterfall methodology.

An evaluation of the resulting artifact revealed that the data mart met its stated goals and was technologically successful. The system was able receive and link data from a variety of sources and accurately and easily generate comprehensive profiling reports. As a result, the system facilitated the combination concept of knowledge management, where multiple sources of explicit information were combined to create new explicit information. The research thus demonstrated that an Access-based data mart could successfully solve the profiling report generation problem.

However, an evaluation of the new profiling reports that were generated from the data mart revealed that the additional information was too overwhelming for the committee. In other words, the reports did not meet the knowledge management concept of internalization, as the explicit information in the reports did not result in the production of new tacit knowledge among the committee members to enhance their decision-making.

Nevertheless, this design research was fruitful and worthwhile. The technologic success of the data mart resulted in the generation of new knowledge about a new approach for solving the physician profiling report generating problems. Likewise, the lack of committee acceptance of the new reports also resulted in new knowledge about the need to further summarize the content of the reports for committee use. Neither of these findings could have been realized without the actual creation of the data mart and use of the new data mart reports. These findings can serve as a starting point for further research.

Chapter 1 – Problem Definition

1.1 – Credentialing/Re-credentialing and Profiling

Hospitals and medical centers exist to serve and treat patients. In doing so, they have an obligation to their patients, communities, and regulatory agencies to ensure that their physicians provide safe and competent care. Most hospitals manage this obligation with a credentialing/re-credentialing process. This process generally consists of the following series of steps:

1. A hospital receives a physician's application to join the hospital medical staff.
2. The hospital evaluates the physician's professional and personal background.
3. The hospital appoints the physician to the medical staff and assigns clinical privileges for a specified period of time.
4. The hospital monitors the physician's performance during this timeframe.
5. The hospital reviews the physician's performance at the end of the timeframe and reappoints him/her to the medical staff for another specified period of time on an ongoing basis (O'Connor, 2002, p. 1).

Hospitals usually manage the monitoring of physician performance by maintaining a set of reports and measures that summarize this performance. The process of maintaining and monitoring these reports and measures is known as profiling. The actual evaluation of performance by fellow physicians is known as peer review. The overall credentialing/re-credentialing/profiling process is important for a number of reasons, as the University HealthSystem Consortium (UHC) summarized in a 2003 paper entitled *Peer Review and Use of Quality Data in Physician Reappointment White Paper*:

> In the era of health care accountability and transparency, hospitals must have effective peer review/reappointment processes…. Without effective processes, patient safety will continue to be in jeopardy, boards of directors may be subject to criminal and civil charges, and ultimately the public's trust in the health care system will be lost. (Flynn, Ramersad, and Santelli, 2003, p. 1)

The UHC paper cited numerous legal cases where hospitals were found liable when patients experienced bad outcomes as a result of their failure to monitor the quality of their physicians' treatment.

The physician profiling process is also important for regulatory compliance. Hospitals have to remain in good standing with a myriad of federal, state, and private regulatory agencies. One of the predominate private regulatory agencies is The Joint Commission, an organization that "has been accrediting hospitals for more than 50 years. [Joint Commission] accreditation is a nationwide seal of approval that indicates a hospital meets high performance standards" (The Joint Commission, 2008, p. 1). One of the Joint Commission standards that pertains to physician practice requires the "continuing surveillance of the professional performance of all individuals … who have delineated clinical privileges." (CAHM, 2008, MS.1.20) Furthermore, most hospitals mandate profiling activities in their internal Medical Staff Bylaws or Rules & Regulations. As a result of these external and internal requirements, hospitals have to be able to demonstrate their ongoing surveillance of physician performance.

One hospital, Regional Medical Center[1], has been following a formal credentialing/re-credentialing process and related profiling activities for decades. Figure 1

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[1] An anonymous name is being used to preserve the medical center's privacy.

summarizes the steps in this process and the related profiling activities. A discussion of the steps follows the figure.

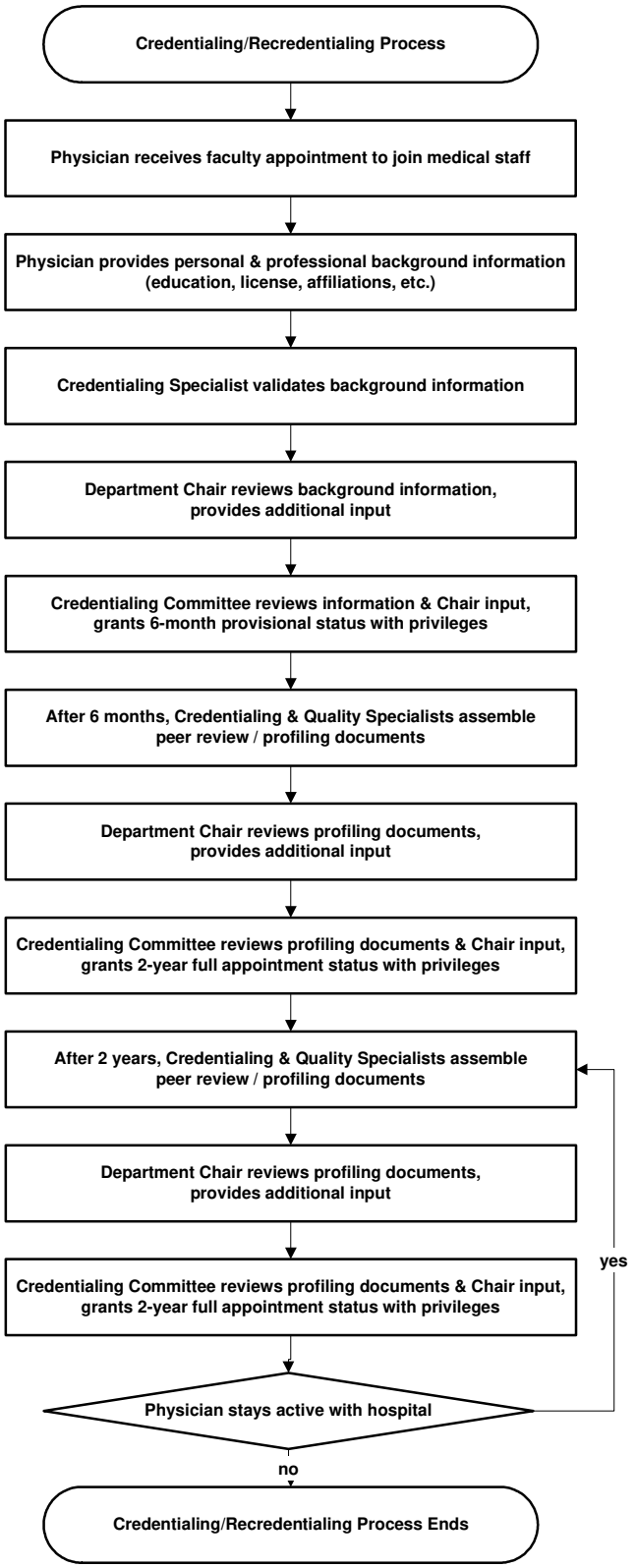

Figure 1. The credentialing/re-credentialing process and related profiling activities.

As Figure 1 illustrates, the credentialing/re-credentialing process at Regional Medical Center proceeds as follows:

1. A physician receives a faculty appointment to join the medial staff.
2. The physician provides personal and professional background information.
3. A credentialing specialist validates the accuracy of the information.
4. The information is formally reviewed by the physician's Department Chair and a Credentialing Committee. The Credentialing Committee is comprised of the President and President-Elect of the Medical Board, physicians, hospital executives, a risk manager, an attorney, and credentialing and quality staff.
5. The Committee grants provisional privileges for a six-month period of time, during which time the Medical Center closely observes and monitors the physician's practice.
6. After six months, credentialing and quality specialists assemble profiling documents from multiple sources that summarize the physician's practice. These profiling documents are reviewed by the physician's Department Chair and the Credentialing Committee.
7. If all is well, the Committee grants full appointment status for a two-year period of time.

The overall process, from offering an initial appointment until granting full appointment status, is known as credentialing.

After two years, credentialing and quality specialists again assemble profiling documents from multiple sources that summarize the physician's practice. These profiling documents are reviewed by the Department Chair and Credentialing Committee. If all is still well, the

Committee grants another two-year full appointment status. This profiling/reviewing/granting of privileges cycle repeats every two years, as long as the physician actively practices at the Medical Center. This renewal process is known as re-credentialing.

1.1.1 – The current profiling report generating process

At Regional Medical Center, approximately seventy physicians are credentialed or re-credentialed every month during a Credentialing Committee meeting, although the actual number of physicians can range from 60-100. To manage the volume and frequency of physician reviews, a credentialing specialist generates a Reappointment List that contains the name and pertinent information of every physician due for review each month. This list helps ensure that the Committee reviews all of the appropriate physicians who are due for re-credentialing, which is also known as reappointment.

Credentialing and quality specialists use the Reappointment List to manually prepare profiling reports from two separate data sources and create a packet of performance information for each of the seventy physicians each month. The profiling reports consist of peer review reports from VisionPro, a medical staff database, and volume reports from twenty-two Excel files that are generated by Universal Practice Indicators (UPI), a physician billing system. Peer review reports identify and summarize any issues or untoward outcomes that may have resulted from each physician's practice. Volume reports provide statistics on the number of procedures and treatments performed by each physician and department. For both the peer review and volume reports, the credentialing and quality specialists must first identify and select the seventy individual physicians, run their respective reports, apply page breaks and reformat the reports, then print and collate them into individual packets. In addition, the specialists occasionally receive additional reports from ancillary departments, such as anesthesia or the clinical

laboratory. The specialists assemble the separated VisionPro reports, Excel spreadsheet reports, and any ancillary department reports into a packet for each physician. The specialists then forward the packets to the appropriate Department Chairs and to the Credentialing Committee for review.

The reappointment list and profiling packet-creating process is repetitive, tedious and time consuming. The following flowchart summarizes the steps and data flow involved in gathering the information from the originating sources.

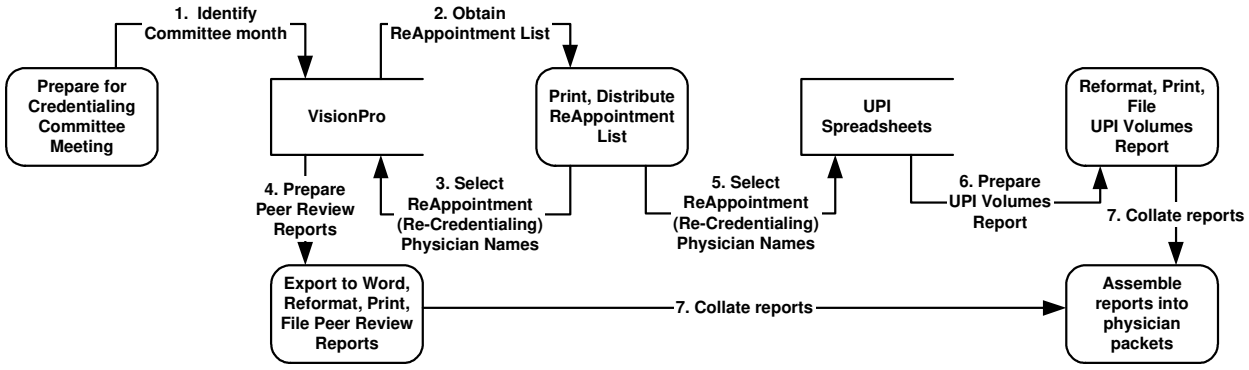

Figure 2. Current profiling report generating process

1.1.2 – Untapped sources of profiling information

In addition to the VisionPro peer review and UPI volume information, Regional has another internal source of profiling information in its Health Data Management (HDM) system. Queries can be run in HDM to provide information about how well each physician is managing patients in terms of average length of stay, mortality rate, and similar indicators. The queries can be run for any designated timeframe, but the results have to be exported to a flat file on a periodic basis and formatted for use in the profiling package. The credentialing and quality specialists have not had the knowledge or time to run the queries and add the reports to the

profiling packets. However, because this content would provide additional information about physician performance, it would be beneficial to add it.

Additional performance information recently became available from University HealthSystem Consortium (UHC), an organization of academic medical centers that exists to promote the sharing of best practices in healthcare among its members. UHC would send the performance information upon request on a periodic basis in the form of two separate Access databases.

One UHC Access database focuses on physician Core Measures compliance. Core Measures are sets of evidence based treatment guidelines to help ensure good outcomes for patients experiencing heart attacks, heart failure, pneumonia, pregnancy, and certain surgeries. Evidence has shown that these guidelines lead to good patient outcomes; this evidence is available on the Department of Health & Human Services (HHS) and The Joint Commission websites[2]. Therefore, it is advantageous to monitor how well physicians are following these Core Measures. The UHC database contains reports that compare each physician's compliance with that of other physicians at the hospital and across the country. The timeframe for the data in each database covers one calendar quarter. This means that, for one Credentialing Committee meeting, seventy individual physician reports would have to be run from each of the four quarterly databases to track physician performance for an entire year, a process could take up to 20 hours.

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[2] The HHS website address is www.hospitalcompare.hhs.gov. The Joint Commission's Core Measures overview is available at http://www.jointcommission.org/NR/rdonlyres/48DFC95A-9C05-4A44-AB05-1769D5253014/0/AComprehensiveReviewofDevelopmentforCoreMeasures.pdf.

The other UHC Access database focuses on Peer Review performance indicators. Peer Review is the evaluation or comparison of physician practice by and among peers. This database contains reports that show how well each physician is managing patients in terms of average length of stay, mortality rate, complication rate, and readmission rate, which is similar to the information that is available in the HDM system. However, this database's reports compare each physician's performance with that of other physicians at the hospital and at a national level, making this database's reports more comprehensive than those that can be generated from the HDM system. The UHC Peer Review database contains information for a two-year timeframe, but separate reports would have to be run for each individual physician, a process that could take nearly six hours per month.

The credentialing and quality specialists had not yet begun to include the additional information from the UHC databases in the physician profiling packets. This was primarily because of the overwhelming number of reports and the amount of time that would be required to run the reports from these two sources each month.

1. 2 – Identifying a Need to Tame the Profiling Report Generating Process

Due to the internal and external focus on physician profiling, and due to the fact that the existing profiling report generation process was so burdensome, it was apparent that Regional needed to find a way to streamline its profiling report generating process.

1.2.1 – Problem: The hospital needed an all-inclusive profiling report generating system

After dealing with the complicated series of steps required to prepare the monthly profiling reports for years, a quality specialist finally asked if it would be possible to add the UPI physician volume data to the existing physician peer review report that was being generated from the VisionPro medical staff database system. The specialist currently had to run the individual

physician peer review reports in VisionPro, then had to obtain, print and separate physician and division volume reports from the twenty-two UPI Excel spreadsheets. To eliminate some of the steps, the specialist specifically wondered if the Excel data could somehow be fed into VisionPro to include this volume information in the peer review content. In addition, the specialist was concerned that new regulatory standards were looming that would require the inclusion of even more comparative information in the profiling packets and wondered how much more effort these new requirements would demand.

Further discussion ensued, including a formal meeting with the specialist and a Regional executive who was also a physician member of the Credentialing Committee. The decision was made during this meeting to proceed with a mechanism to combine data from the two sources, plus allow for the introduction of additional profiling information to satisfy the impending regulations. The following figure illustrates the initial concept that was conceived during the meeting to combine the data sources and streamline the profiling report generation process.

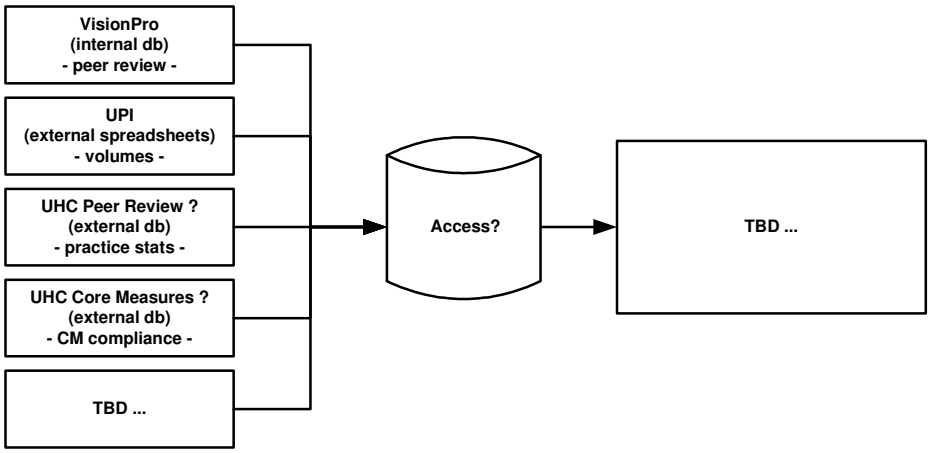

Figure 3. Initial concept for streamlining the profiling report generating process

1.2.2 – Thesis: An Access-based data mart could solve the report generating problem

As the preceding figure illustrates, there was a need to combine data from various sources to make it easier to create the monthly profiling reports. A suggestion was made that a data mart would be an effective solution to this problem. Furthermore, the data mart could be successfully built and maintained in Microsoft Access. A decision was made to proceed with this suggestion and create an Access-based profiling data mart with the following considerations.

1.2.3 – Data mart scope

The data mart would begin with the following limited scope:

- Combine the existing sources of profiling data into one system
- Use this one system to generate the same reports that are currently used, but make it possible to run the reports based on Credentialing Committee meeting/physician re-credentialing dates instead of individual physician names
- Let the quality specialist serve as subject matter expert and project champion who would be responsible for approving the development of the system

1.2.4 – Data mart goals

The primary goals of the profiling data mart system would be:

- To make the gathering of information and creation of reports a less time-intensive process
- To augment the profiling information and make it more comprehensive for the Credentialing Committee's review

1.2.5 – Data mart users

The principle users of the data mart would be:

- The credentialing and quality specialists who were responsible for assembling the profiling reports
- The members of the Credentialing Committee who reviewed the reports

1.2.6 – Data mart barriers and issues

The medical center was not going to provide resources for this project beyond allocating portions of salaried employees' time. Regional was already planning, analyzing, designing, implementing, and supporting dozens of mission critical, enterprise-wide clinical and business systems; in addition, a lengthy prioritized list of future system requests already existed. The medical center was also in the midst of building new medical facilities and was utilizing every possible resource for this endeavor. The profiling report generating process was known to be an essential, mandated activity, but the process was actually being accomplished, even if by a burdensome, time-consuming, manual approach. Therefore, while the profiling data mart project was approved and deemed worthwhile, it was not considered a high-priority project, especially when compared to other patient-care technology projects that would literally help save lives. As a result, the project would have to utilize whatever personnel, hardware, and software resources that were readily available.

Chapter 2 – Literature Review

2.1 – Supporting Knowledge

2.1.1 – Profiling requirements, practices, and existing products

Numerous legal precedents demonstrate the need for hospitals to monitor the competency and performance of its medical staff. One of the first precedents occurred with Darling v. Charleston Community Memorial Hospital in 1965. This case involved a teenage boy who had fractured his leg and was treated at Charleston's emergency department by an independent physician. The boy suffered serious complications from the treatment and ultimately had to have his leg amputated. The court found the hospital liable because "it failed to properly review the work of an independent doctor," along with other related findings. This landmark case and its verdict resulted in the establishment of the principle of "hospital corporate liability for the quality of the medical staff" (Harvard Medical International, 2005, p. 1).

Regulatory agencies, such as The Joint Commission, have thus established standards that dictate the need for hospitals to maintain a formal mechanism to ensure physician competency. Likewise, the federal Centers for Medicare & Medicaid Services mandates: "the medical staff must periodically conduct appraisals of its members." (CMS, 2008, Sec. 482.22(a)(1)). The question then is not whether a need exists for a profiling mechanism, but how other medical centers are accomplishing this responsibility.

Peer review and profiling is a relatively common topic posed on UHC's quality listserv, which is an email discussion group that facilitates the sharing of best practices among academic medical center members. In addition, UHC hosted a Peer Review and Credentialing Workshop in 2005 to address peer review and profiling needs and published a booklet of the speaker presentations. Based on a review of the listserv's postings, along with a review of the workshop

presentations, it was apparent that most hospitals had created their own system or series of steps to manage their profiling data and reporting process. Some hospitals had taken advantage of UHC's Peer Review database, the Microsoft Access tool that UHC sends to members on request and contains two-year snapshots of comparative physician data. Regional had begun receiving this Peer Review database, but it had not yet incorporated its reports into its profiling report package.

Commercial, off-the-shelf systems are currently available to support the profiling process. In fact, Regional's existing credentialing application, VisionPro, supports some of the profiling requirements, but not all. Specifically, the application tracks peer reviewed activity, which consists of the entry and reporting of untoward patient events and follow-up evaluations, but the profiling standards require more than this.

To be specific, the existing VisionPro application does not allow the entry of total patient volumes per physician, which is important to serve as a denominator for calculating the rate or significance of an untoward event. This lack of a denominator is a challenging limitation. To explain why: imagine that a physician had one surgical complication during a given year, but had performed 1000 surgeries during the year. This one complication would be less significant than if he had performed only 10 surgeries during the year.

In addition, the existing application does not allow the entry or monitoring of additional physician performance indicators, such as lengths of stay, patient satisfaction scores, or Core Measures compliance.

Finally, the existing application has integrated Crystal Reports into its system as its method to generate standardized reports; these reports are run on demand and can be printed or sent to an electronic file. However, the application's standardized reports do not include enough

of the system's data nor the formatting that the principle users and the Credentialing Committee desire. Regional's specialists have thus created custom reports for the VisionPro application to better meet the formatting needs of the profiling process, but the vendor does not support these custom reports during upgrades or system issues. As a result, because the custom reports could not contain enough information to fully meet the needs of the profiling process, and the ongoing stability of the reports could not be assured, these reports alone could not satisfy the profiling requirements.

Other vendors offered off-the-shelf profiling systems, but at a price. For example, The Greeley Company, a healthcare consulting and education firm, offers a Physician Profile Reporter application. According to the marketing materials, this application "compiles all sources of data to produce a single, reliable performance report." (Greeley, 2008) Another vendor, Midas+, explains that its Seeker system is a "feature-rich provider information solution … [that] has everything you need to effectively streamline your data collection and management…. a powerful tool for managing provider records, as well as for generating provider activity and performance reports." (Midas+, 2008) While these products look appealing, their price is prohibitive, considering no funds are available to purchase a profiling solution due to other competing demands at the medical center.

2.1.2 – Knowledge Management considerations

Information about physician practice falls along a data continuum. The continuum is illustrated in Figure 4, and a discussion follows.

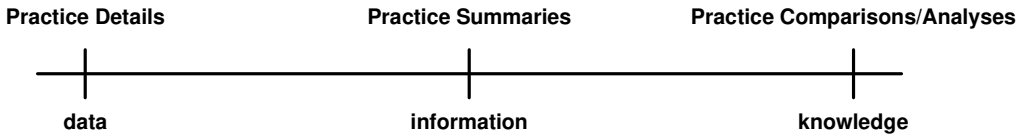

Figure 4. Physician practice data continuum

Details about physician practice, such as the names, diagnoses, and treatment dates of individual patients, exist in the form of data. Summaries about physician practice, such as the total number of patients treated over time, can be calculated from data to create information. Comparative or analytic information about physician practice, such as the percent of good vs. bad outcomes by type of patient as compared to the outcomes of other physicians, can be processed from information to create knowledge.

The need to provide profiling reports to the Credentialing Committee can thus be considered a knowledge management challenge, as the Credentialing Committee needs comparative knowledge about physician practice to help the members make appropriate re-credentialing decisions.

It is important to review additional definitions of information and knowledge to better understand these concepts. Bellinger (2004) defines information as "an understanding of the relationships between pieces of data, or between pieces of data and other information" (p. 2), and that information "only becomes knowledge … when one is able to realize and understand the patterns and their implications." (p. 3) Tiwana (2002) defines knowledge as actionable information that enables decision-making. Furthermore, Tiwana explains:

> Knowledge is supported by formal and informal processes and structures for its acquisition, sharing, and utilization. … Data and information are essential, but it's the

> knowledge that can be applied … that makes the difference between a good decision and a bad decision. (p. 37-38)

Knowledge is commonly categorized as being tacit or explicit. Tacit knowledge includes personal ideas and intuitions, which are hard to categorize and share. (Becerra-Fernandez, Gonzalea, and Sabherwal, 2004, p. 20) As Marwick (2001) simply explains, "tacit knowledge is what the knower knows." (p. 1) With regard to profiling, tacit knowledge could be represented by a Department Chair's observations and opinions about a physician's practice. In contrast, explicit knowledge consists of discrete facts and phrases that are easier to classify and share. (Becerra-Fernandez et al., p.19) This type of knowledge "is represented by some artifact … which has typically been created with the goal of communicating with another person." (Marwick, p. 1) In physician profiling, explicit knowledge is represented by the processed data contained in the profiling reports.

Nonaka developed a model to depict how new knowledge is created and used by individuals and organizations through the sharing of existing tacit and explicit knowledge. This model consists of four components. The first component, socialization, occurs with the sharing of tacit knowledge and experiences among individuals. The second component, externalization, involves the translation of tacit or experiential knowledge to a discrete or explicit form. The third component, combination, consists of the merging or reorganizing of explicit knowledge into something more complex or meaningful. The fourth component, internalization, occurs with the taking in and incorporating explicit knowledge and making it tacit. The Socialization-Externalization-Combination-Internalization (SECI) model is illustrated in Table 1. For each of the four possible combinations of tacit and explicit knowledge sharing interactions, one or more best methods exist to support effective sharing. An example of an appropriate method for each

type of knowledge sharing interaction is included in the table. (Tiwana, 2002, p. 168; Samara, 2007, p. 3; Marwick, 2001, p. 1)

Table 1. Nonaka's Socialization-Externalization-Combination-Internalization (SECI) Model

Socialization	**Externalization**
Tacit to Tacit sharing	Tacit to Explicit sharing
ex. personal communication	ex. data capture tool
Internalization	**Combination**
Explicit to Tacit sharing	Explicit to Explicit sharing
ex. notetaking	ex. database

Because a profiling data mart would contain facts about physician performance, the sharing of this information could be considered explicit-to-explicit sharing, or the combination knowledge sharing process. As Becerra-Fernandez et al. (2004) explain, “new explicit knowledge is discovered through combination,” (p. 33) where explicit knowledge is captured and reorganized from multiple sources to create the new explicit knowledge. Marwick (2001) agrees that reconfiguring collected knowedge, such as through a shared database, makes it more usable. (p. 2)

A profiling data mart would thus facilitate combination knowledge sharing, as it would enable the reorganization, aggregation, and sharing of explicit information through a series of comprehensive reports. In addition, this knowledge combination would facilitate the sharing of explicit physician performance knowledge with the Credentialing Committee for decision-making, which could be considered explicit-to-tacit sharing, or the internalization knowledge sharing process. Marwick (2001) summarizes this process as follows:

> In order to act on information, individuals have to understand and internalize it, which involves creating their own tacit knowledge. By reading documents, they can to some extent re-experience what others previously learned. By reading documents from many sources, they have the opportunity to create new knowledge by combining their existing tacit knowledge with the knowledge of others. However, this process is becoming more challenging because individuals have to deal with ever-larger amounts of information. A typical activity would be to read and study documents from a number of different databases. (p. 2)

A profiling data mart would facilitate the preparation and delivery of documents from a number of different sources, which would support the Committee's internalization of knowledge and, in turn, support re-credentialing decision-making.

To take the concept of knowledge a step further, knowledge management (KM) is an institutional activity that "focuses on organizing and making available important knowledge wherever and whenever it is needed." (Becerra-Fernandez et al., 2004, p.3) Levinson (2007) provides a more succinct description of the activity: "The point of a KM program is to identify and disseminate knowledge gems from a sea of information." (p. 4) Bellinger (2004) concludes that, to create value, data must be captured and organized in a way that will be meaningful to others. (p. 7)

Knowledge management can have a direct or indirect impact on an organization. For example, if knowledge is used to increase revenue, KM has a direct impact. If knowledge is used to improve effectiveness or efficiency, KM has an indirect impact. (Becerra-Fernandez et al., 2004, p. 60, 91) A profiling data mart would promote report generation efficiency, which would have an indirect impact on the medical center as an organization.

Tiwana (2002) identifies three components of knowledge management that occurs within an organization. The first component, knowledge acquisition, is the development of human insights and skills, or tacit knowledge. This component can be harnessed with data capture technologies, although considerable work remains in developing these technologies, due to the unstructured nature of these insights and skills. The second component, knowledge sharing, consists of communicating what is known with other individuals. This component can be facilitated with knowledge sharing systems. The third component, knowledge utilization, involves integrating what is known and applying it to new situations. This last component can be achieved by retrieving the captured knowledge and using it for decision-making. (p. 50)

As the name implies, knowledge sharing systems allow individuals and organizations to share information. A profiling data mart would be a knowledge sharing system. To help ensure that the data mart would be a fully functioning system, it would be prudent to consider the five elements that Becerra-Fernandez et al. (2004) deem to be crucial for success (p. 304):

1. Collect information from the appropriate systems and sources.
2. Use explicit information, as this would make system development easier and faster than if trying to capture tacit information.
3. Address the users' needs and incorporate their feedback.
4. Integrate the system into existing information workflow processes.
5. Make sure the system provides the right information to users when they need it.

Levinson (2007) suggests two additional considerations for success: "pilot the project among employees who have the most to gain," (p. 4) and make the system effortless for the users. (p. 6) Furthermore, Jennex (2008) defines KM success as "capturing the right knowledge, getting the right knowledge to the right user, and using this knowledge to improve organizational and/or

individual performance." (p. 1) Therefore, to be successful, the profiling data mart should appropriately integrate these elements of success.

However, Marwick (2001) warns, "knowledge management problems can typically not be solved by the deployment of a technology solution alone. The greatest difficulty in knowledge management … [is] 'changing people's behavior,' and the current biggest impediment to knowledge transfer [is] 'culture.'" (p. 3) This warning signifies the importance of carefully considering user workflow processes and user needs when developing the data mart.

2.2 – Support for the Solution: A data mart built with Microsoft Access

2.2.1 – Data mart concepts and appropriateness

The ultimate objective of this research is to demonstrate that a data mart would serve as an appropriate mechanism to make the gathering of profiling information and creation of reports a more inclusive, less time-intensive process. Gallagher, Nelson, and Proctor (2005) defines a data mart as:

> A repository of data gathered from operational data and other sources that is designed to serve a particular community of knowledge workers…. The emphasis of a data mart is on meeting the specific demands of a particular group of knowledge users in terms of analysis, content, presentation, and ease-of-use. Users of a data mart can expect to have data presented in terms that are familiar. (p. 1)

The Centers for Medicare & Medicaid Services (CMS; 2005) define a data mart as:

> A persistent physical store of operational and statistically processed aggregated data that supports businesspeople in making decisions based primarily on analyses of past activities and results. A data mart contains a predefined subset of enterprise data organized for rapid analysis and reporting. (p. 1)

The terms data mart and data warehouse are sometimes used synonymously, as both represent repositories of organizational data, and both are "storage mechanisms for read-only, historical, aggregated data." (Utley, 2008, p. 2) In fact, the data for both "represent a series of 'snapshots' depicting the state of [the] business at specific points in time." (Pratte, 2001, p. 3) However, differences exist between the two types of repositories. Table 2 summarizes these differences.

Table 2. Differences between a data mart and a data warehouse

Data Mart	**Data Warehouse**
A data mart is a tactical, subject-oriented system that is used for a specific need or set of users. (Open Source Analytics, 2008, p. 1; Gallagher, Nelson, and Proctor, 2005, p. 1)	A data warehouse is a strategic, enterprise-wide system that is used as a central data repository for multiple needs and users. (Open Source Analytics, 2008, p. 1; Gallagher et al., 2005, p. 1)
A data mart's hardware, software, and data are owned by an individual department. (Inmon, 1999, p. 1)	A data warehouse's components are owned by a centralized department, such as an IT department. (Inmon, 1999, p. 1)
A data mart's design begins with an analysis of user needs. Its structure is based on specific user requirements. (Gallagher et al., 2005, p. 1; Inmon, 2005, p. 132)	A data warehouse's design begins with an analysis of existing data and potential uses. Its structure is based on corporate-wide needs. (Gallagher et al., 2005, p. 1; Inmon, 2005, p. 127)

According to Meyer (2000), data marts have become appealing because, "if a department has its own data mart, it can customize the data as the data flows [in]…. The department can summarize, sort, select, and structure its own data without considering other departments." (p. 1) In addition, Meyer summarizes that the appropriate scenario for a data mart would be one where an organization has a specific business problem involving only a few regular users who have predictable data querying needs. (p. 1-2)

In addition, Pratte (2001) offers additional advantages of data marts over data warehouses: they can be built quickly at relatively low cost; they require less coordination and cooperation among departments; they require lower levels of management sponsorship; and they provide quicker benefits. (p. 4)

Isken, Littig, and West (2001) agree that "A more pragmatic approach of creating smaller, departmental data marts to address specific business processes or problems has gained popularity in practice…. Very useful and valuable data marts can be incrementally developed with widely available, low-cost tools. A departmental data mart can provide a 'quick win.'" (p. 144)

At Regional Medical Center, the profiling report generation process is a specific, subject-oriented activity that fulfills a specialized need for a particular set of users. The data involved in the profiling report generation process is owned or accessed by only a small, well-defined set of individuals for use by one committee; there is essentially no need for other departments within the organization to have access to this information. Some of the profiling data is generated and resides within the organization, but some is retrieved from sources outside of the organization. Therefore, the appropriate type of data repository to solve the problem associated with profiling report generation would be a data mart, not a data warehouse.

Data marts are proving to serve as a viable solution for unique business needs at a number of healthcare organizations. For example, The University of Texas Medical Branch maintains three internal data marts that contain human resource and financial data to facilitate the generation of management reports. (UTMB, 2007, p. 1) The Ohio Department of Mental Health maintains a web-based public data mart that imports provider treatment data that makes it possible for consumers to generate outcomes reports. (ODMH, 2008, p. 1) The William Beaumont Hospital in Michigan maintains a data mart that includes data on hospital bed utilization, surgical patterns, and staffing resources to support physical capacity and labor analyses. (Isken et al, 2001, p. 144)

Isken et al. (2001) describe their experience in building a data mart at William Beaumont Hospital, which provides insight for other developers. As they explain:

> The data mart grew naturally out of a true business analysis application need, not a search for the holy grail of a massive enterprisewide data warehouse for which we simply could not afford to wait…. The data mart consists of several independent databases…. As quantitatively trained analysts, maybe we were uniquely qualified to recognize the potential for a data mart and had the technological savvy to pull it off (p. 145-146, 152)

A similar situation exists at Regional Medical Center: the medical center has a true business analysis application need, uses data from several independent sources, and has the technological ability to "pull it off." Therefore, Regional's situation supports the assertion that a data mart would be an appropriate mechanism to manage the profiling report generating process.

2.2.2 – Development Considerations: Star Schema Approach

The development of a data mart centers on understanding a specific business need or problem, then identifying how to link together the appropriate data to address that need or

problem. This data linkage is usually accomplished and organized using a star schema approach. At the center of the linked data, or star schema, lies a fact table. A fact table identifies "what we want to see," or the essential details about the subject of interest. (Utley, 2008, p. 8) The linked data that surrounds the fact table in a star schema are contained in various dimension tables. Dimension tables tell us what we want to know about the facts. (Utley, p. 8) To put it another way, a dimension adds meaning or usefulness to a fact. (Adamson, 2006, p. 5-6) A star schema is usually represented with a star schema diagram, as illustrated in Figure 4. (Chenoweth, Schuff, and St. Louis, 2003, p. 94; IBM, 2005, p. 1)

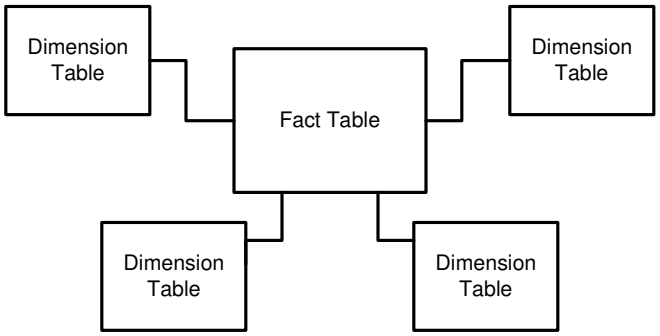

Figure 5. A generic star schema diagram

To further explain the star schema concept, consider the example of a sales order data mart. For this type of data mart, a fact table might contain specific data about the orders, such as unique or identifying details about each order. The fact table would also contain fields or foreign keys, such as order numbers, that relate the fact table to its various dimensions. Dimension tables might contain data about the orders' vendors, customers, or related data. (Inmon, 2005, p. 128)

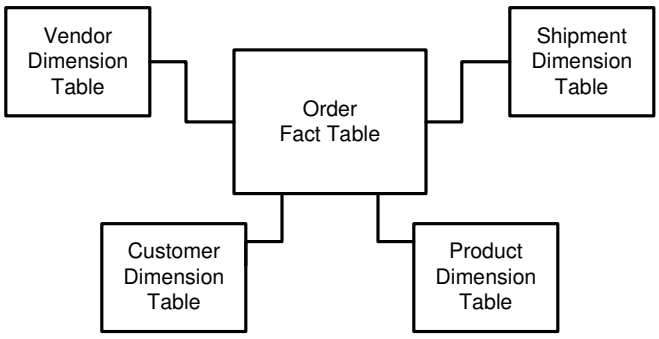

Figure 6. An example of a star schema diagram for a sales order data mart

Likewise, in a profiling data mart, a fact table might contain specific data about physicians and include such fields as identification numbers that link the physician data to the various dimensions. Dimension tables might contain data about the various aspects of physician performance, such as peer review events or practice volumes.

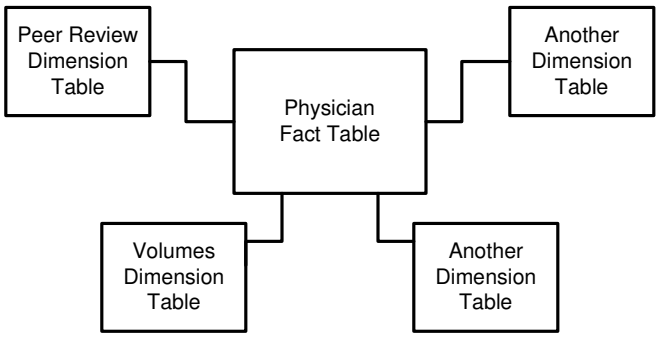

Figure 7. An example of a star schema diagram for a physician profiling data mart

2.2.3 – Development Considerations: Extract, Transform, Load Process

The method of actually getting data from the originating source systems into a data mart is often achieved through a process known as Extract, Transform, Load, or ETL.

Extraction consists of selecting data from an originating data source, then loading it into to another data system or repository. (Inmon, 2005, p. 5) As Simon (1998) explains, this process may be achieved by creating direct link from the data in a source system to a data mart, by

performing a manual or automated withdrawal of data from a source system and depositing the data into a data mart, or combining these two techniques. (p. 8-9) According to Adamson (2006), the extraction and load may actually be thought of as two steps: performing an initial extraction and load, then performing periodic or incremental extractions and loads. (p. 156) Simon agrees: "extraction needs to be addressed in two domains: for purposes of initial loading of the data mart, [and] on an ongoing basis each time the data mart needs to be restocked." (p. 172)

Because data in the originating source systems may be represented differently, issues may develop when extracting and loading data from different sources. Therefore, it may be necessary to transform the data from their original formats to a common code or format for use in the data mart. For example, variations may exist among the source systems with how each stores a field of data related to gender. One source system may store gender data using the words 'male' and 'female', while another system may store them using 'M' and 'F.' Likewise, inconsistencies may exist in the way different source systems store identification numbers. One system may store these numbers as a four digit codes, while another may store them as a seven digit codes and add leading zeros for codes that contain fewer than seven digits. This latter situation is the case with physician profiling data, where standard physician ID numbers exist but are formatted differently in different systems and would need to be transformed in the data mart.

A staging system or interim step may be necessary to perform the transformation on the extracted data and before loading the data into a data mart. As an alternative, transformation may occur after the extracted data have been loaded into the data mart, making a more suitable name for the overall data movement process Extract/Load/Transform, or ELT. (Inmon, 2005, p. 112) This latter ELT process would work for the profiling data mart, as the physician ID number could be technically transformed after loading the data into the system.

2.2.4 – Development Considerations: Microsoft Access Features and Fit

An associated objective of this research is to demonstrate that the appropriate application to house the data mart is Microsoft Access. Access' strengths include:

> Ease of use, rapid application development environment, and simplistic distribution…. It may not have all the features … of more sophisticated solutions … but for many situations, those features are irrelevant…. Access offers an excellent solution for database challenges for individuals, small teams, and workgroups across a network. (Chung, 2004, p. 1)

Access is successfully used in numerous healthcare settings to manage a variety of data management processes. For example, nursing researchers advocate the use of Access for research data management. Research data entry "can be tedious and is fraught with potential for errors that affect study findings." Nursing researchers describe Access as "an accurate and user-friendly data entry system that is widely available," which allows them to minimize entry errors and streamline data entry. In one case, researchers acquired a National Institute of Nursing Research grant to provide instruction on Access database development to other nursing researchers. (Kraenzle Schneider, J., Schneider, J. & Lorenz, R, 2005, p. 1)

A Family Practice resident program in North Carolina developed a small electronic medical record (EMR) in Access to help its residents provide and document the care they provide to their patients. The EMR developers and the users cite Access' benefits as being "inexpensive, adaptable, easy to maintain, very well accepted, and … [causing] little interruption of our clinical activities." (Chambliss, Rasco, Clark, and Gardner, 2001, p. 1)

Analysts in a Michigan hospital's Management Engineering department selected Access as the application to house its utilization and labor data mart. One analyst explains that a number

of factors led to the decision to use Access: the hospital's staff was familiar with Microsoft Office products, the amount and size of the data was within Access' capacity, and Access is inexpensive, which was an important consideration for the nonprofit hospital. (Isken et al, 2001, p. 145)

As these examples demonstrate, Microsoft Access is successfully being used to manage data in a variety of healthcare settings, and it could likewise serve well at Regional Medical Center.

Specifically at Regional, the reasons for using Access include the consideration that workstations run on a Microsoft Windows 2000 platform, and the standard image for each workstation includes Microsoft Office 2002 with Microsoft Access 2002. The specialists who are involved with the physician profiling process are all quite familiar with the Office interface. Furthermore, Regional's Information Services (IS) network team has already established server directory space for the specialists to store their work files, meaning the specialists are familiar with opening and saving documents from a directory structure. The IS team would create additional secure share directories upon request when appropriate.

Although several significant reasons exist for using Access, it is important to recognize Microsoft Access' limitations. Because Access is relatively easy to use, it is easy for a developer to create an Access-based data system using a poor design and implementation approach. This concern could be eliminated by using established project management and a Systems Development Life Cycle approach. Table 3 summarizes Access' other limitations (Bertrand, 2008) and explains how these limitations are not relevant to the profiling data mart system.

Table 3. Microsoft Access' limitations are not relevant to the profiling data mart

Access has a limited ability to …	**Access' limitation is not an issue for the profiling data mart because …**
Handle heavy traffic	Only a dozen or fewer individuals would actually be using the physician profiling data mart system and only on an episodic basis.
Maintain a transaction log or roll back mechanism	The data mart users would be running pre-formatted reports only; they would not be entering additional data nor creating ad hoc queries.
Manage different levels of security	All data mart users would require the same level of security. Security could also be established on the network level for additional protection.
Modify or backup the database in a live environment	The data mart users would be using the system during standard business hours. Modifications or backup procedures could occur during after-hours timeframes.

Access has a limited ability to …	**Access' limitation is not an issue for the profiling data mart because …**
Hold a huge amount of data, due to a 2GB size restriction	Much of data in the system could come into the system via linked tables from other sources. A mechanism could be developed to purge the data that would be stored in the system, if size should become an issue.

Based on this discussion of the pros and cons of Microsoft Access, it evident that this application could successfully serve to house and support a physician profiling data mart system.

Chapter 3 – Project Approach – Design Research Methodology

3.1 – Design Research Concepts and Framework

The purpose of this research is to demonstrate that an Access-based data mart would successfully serve as an effective solution for the profiling report generation problem. In order to demonstrate this premise, it is important to first review the concepts and framework for information systems design research.

3.1.1 – Design Research Concepts

According to McKay and Marshall (2005), research is essentially a process that involves the collection, analysis, and interpretation of information. It is a systematic and confirmable activity that is based on specific objectives and results in knowledge. (p. 6) With regard to Information Systems (IS), Orlikowski, Barley, and Robey (2001) explain that IS research examines how organizations use technology and, in contrast, how technology shapes organizations. As a result, IS research often focuses on "the design, deployment, and use of artifacts" that solve organizational problems. (p. 2) An artifact, as defined by Dictionary.com, is "any object made by human beings," or something that is "not naturally present … but formed by artificial means." (2008) Therefore, with information systems, research occurs in the form of design research, in which artifacts – such as software or systems – are created and evaluated "to solve identified organizational problems." (Hevner, March, Park, and Ram, 2004, p. 3)

Design research is "somewhat similar to any other research. The only difference is that researchers come up with an artifact then test it as opposed to coming up with a hypothesis." (Titin, 2008, p. 1)

The actual outputs or artifacts of IS design research fall into one of four categories:

- Constructs: the creation of new concepts, vocabularies, or symbols

- Models: the creation of new representations or relationships among constructs
- Methods: the creation of new algorithms or practices
- Instantiations: the creation of new systems

(Järvinen, 2005, p. 9; Vaishnavi and Kuechler, 2007, p. 5; Hevner, 2004, p. 2)

The creation of an Access-based profiling data mart would be an instantiation of Design Research.

3.1.2 – Design Research vs. Design

One of the ways that design research differs from design is by its output. The ultimate output of a design project is a new product, but the ultimate output of design research project is a new product and new knowledge. (Vaishnavi and Kuechler, 2007, p. 12) As Järvinen (2005) explains, the knowledge that results from design research can be used in solving other problems. For example, an engineer can use the knowledge gained from prior bridge design research, such as the properties of different bridge types and materials, when designing a new bridge. Likewise, an IS professional can use the knowledge gained from prior IS design research when designing a new IS system. (p. 10)

Hevner, March, Park, and Ram (2004) agree with this difference between design and design research. With design, an IS professional can apply existing knowledge to support a common organizational activity, such as following an established process to develop an accounting system. However, with design research, an IS professional addresses uncommon problems in "unique or innovative ways," and thus contributes to the knowledge base for future reference. (p. 5)

Carlsson (2005) stresses that IS design research should yield practical, abstract knowledge. The resulting knowledge should not be so concrete that it can serve only as a model

for a specific need. Instead, it should be general enough to be useful for a class or variety of IS situations. The user of the knowledge can then fit the general knowledge to a specific need (p. 98)

3.1.3 – Design Research: The Knowledge Building Cycle

Over time, design research can be considered a cyclical process, where the creation and evaluation of new artifacts builds knowledge, and the knowledge is used to create new artifacts. Vaishnavi and Kuechler (2007) illustrate this process with a "model for generating and accumulating knowledge." Figure 8 summarizes this model. (p. 3)

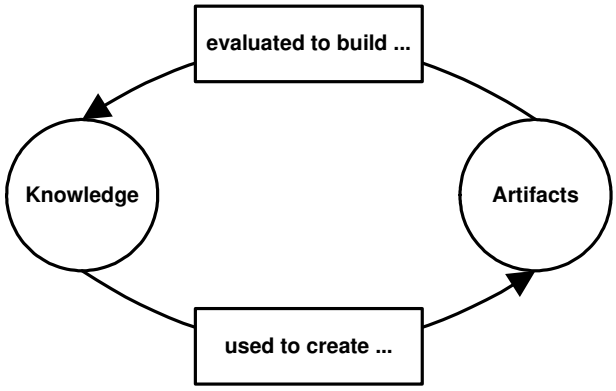

Figure 8. Design research knowledge building cycle (from Vaishnavi and Kuechler, 2007)

It is evident then, that in addition to the creation of a new artifact, a key component of a design research project is the evaluation of the artifact, as the outcome of the evaluation is required for the formation of new knowledge. Järvinen (2005) believes the evaluation should consider not only whether an artifact was successful in its technical aspects, but also in social terms. (p. 9) In other words, because design research is often motivated by an awareness of a problem, "that a better interface can be developed that will allow users to more quickly and effectively obtain answers to questions about the performance of their business operations,"

(Vaishnavi and Kuechler, 2007, p. 6) it makes sense that the evaluation of an artifact consider how well it helps its users solve their business problem, in addition to how well it works.

3.1.4 – Design Research: Relevance vs. Rigor

Hevner et al. (2004) propose a model or framework for "understanding, executing, and evaluating design research." (p. 4) The model is illustrated in Figure 9.

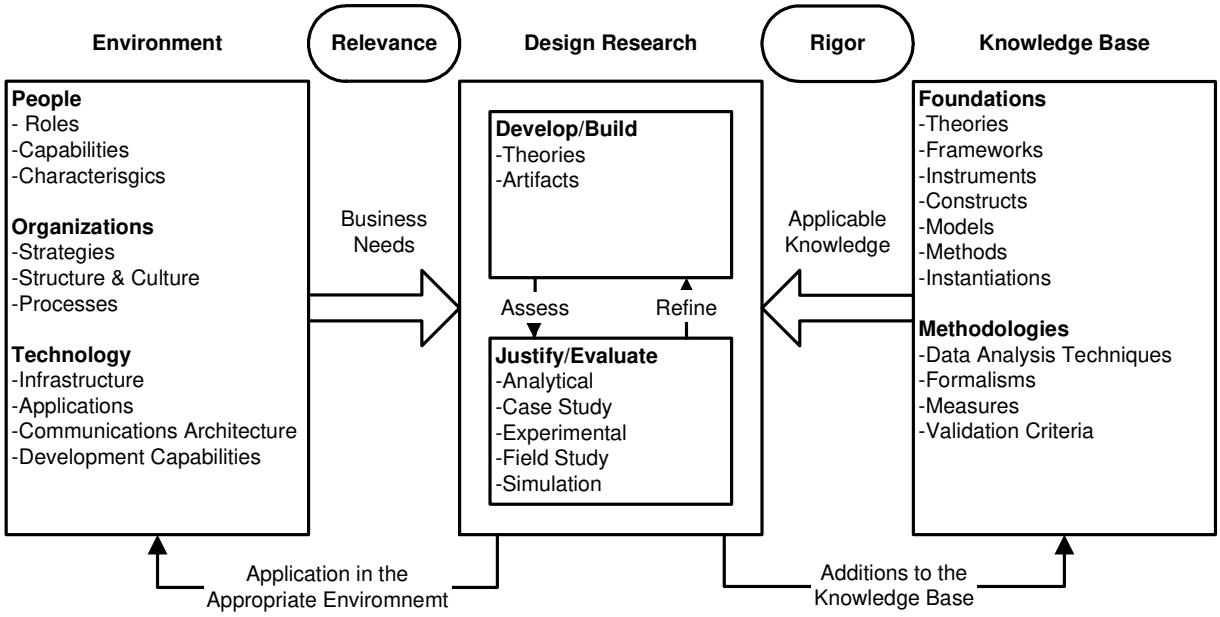

Figure 9. Design research framework (Hevner, 2004, p. 6)

This model indicates that, in order to ensure design research relevance, a design research effort should address a true business need. To ensure rigor, the research should adhere to "existing foundations and methodologies." (p. 4, 5)

Carlsson (2005) explains that the primary recipients or users of the knowledge that arises from design research are IS professionals – those "professionals who plan, manage and govern, design, build, implement, operate, maintain and evaluate different types of IS" (p. 98) to solve real-world problems. However, Carlsson (2006) also suggests that recent design research has not been "addressing relevant issues and research" nor "producing useable results." (p. 192)

Therefore, it is imperative that "design science research should meet the criteria of [both] scholarly quality and practical (professional) relevance." (p. 194)

Benbasat and Zmud (1999) concur that relevant research "is potentially useful and accessible to its intended audience. However, much of the IS literature lack sufficient relevance due to more emphasis on rigor than relevance." (p. 1) Benbasat and Zmud advise that, to increase relevance, researchers should consider purpose and readability when documenting their research for IS professional audiences. (p. 1) Topics should "address enduring (or current) organizational problems, challenges, and dilemmas as well as articles that address timely business issues." (p. 1-3) Furthermore, "articles that tend to be read by IS professionals are those that "are shorter, use more exhibits, use everyday language …, have less discussion of related literature, have less discussion of a study's methods, have more contextual description, [and] have more prescriptions" (p. 3-4) This implies that a design research effort, such as one related to the use of an Access-based data mart, must not only be methodically rigorous, but it must also be real-world relevant.

3.2 – Design Research Methodology

Vaishnavi and Kuechler (2007) developed a methodology to ensure relevance and rigor when conducting design research. Their methodology consists of a series of five process steps: Awareness of Problem, Suggestion, Development, Evaluation, and Conclusion. (p. 12) Each step produces a specific output, and the activity involved with moving between the steps builds knowledge. The methodology is illustrated in Figure 9.

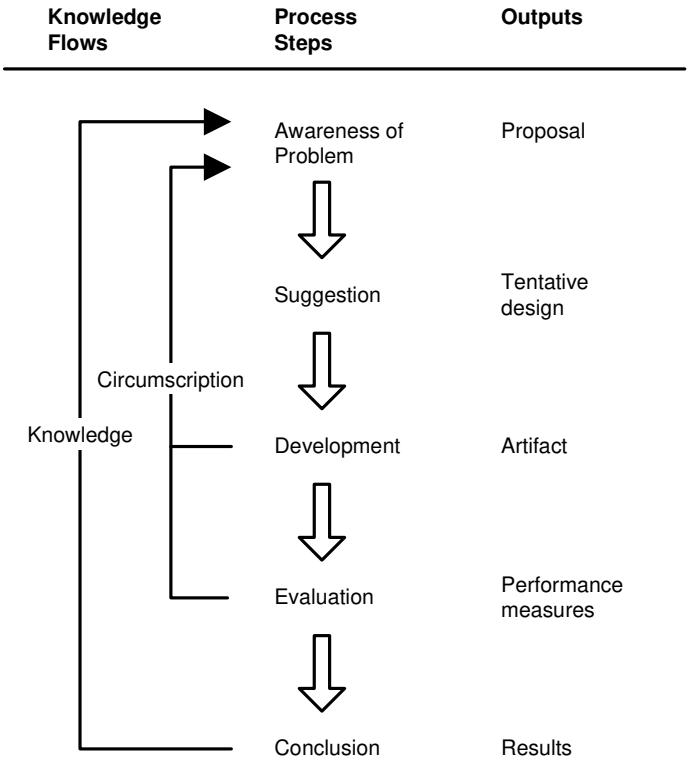

Figure 10. Design research methodology (Vaishnavi and Kuechler, 2007, p. 9)

The actual research for this profiling data mart design research project was conducted by using Vaishnavi and Kuechler's five process steps.

3.2.1 – Design Research Methodology: Awareness of the Problem

As previously explained, this design research endeavor began with a request from a medical center specialist to determine if it would be possible to add volume data to the existing physician profile report that was being generated from the VisionPro credentialing system. After discussion, the request evolved to an awareness of the need to create a more comprehensive profiling report generating system, partly because of the legal, regulatory, and safety focus on physician profiling, and partly because of the fact that the current profiling report generation process was so burdensome. Under the current process, the medical center specialists had to

generate performance reports from a variety of sources for approximately seventy physicians each month, after first identifying each of the seventy individual physicians who were due for re-credentialing on any given month. To add to the complexity, a preview of new regulations revealed that the profiling reports would have to include additional performance measures to provide a broader portrayal of physician performance. Therefore, it became increasingly obvious that the current profiling report generating process was problematic and had to be fixed by some sort of comprehensive profiling report generating system. The specialist and a medical center executive gave the approval to proceed with finding a way to fix the problem.

3.2.2 – Design Research Methodology: Suggestion

Based on the problem – the need to combine data from various sources to make it easier to create the monthly profiling reports – and the limited availability of resources – due to the existence of multiple other mission critical, enterprise-wide clinical and business priorities – a suggestion was offered that a Microsoft Access-based data mart would provide the solution to the profiling report generating problem. The initial version of the profiling data mart would be confined to the following scope:

- To combine the existing sources of profiling data into one system
- To use this one system to generate the same reports that are currently used, but to make it possible to run the reports based on Credentialing Committee meeting/physician re-credentialing dates instead of individual physician names
- To designate the quality specialist as subject matter expert and project champion who would be responsible for approving the progress and completion of the system

The primary goals of the profiling data mart consisted of the following:

- To make the gathering of information and creation of reports a less time-intensive process
- To augment the profiling information and make it more comprehensive for the Credentialing Committee's review

The users of the profiling data mart would be:

- The specialists who were responsible for generating and assembling the profiling reports
- The members of the Credentialing Committee who reviewed the reports

3.2.3 – Design Research Methodology: Development

The Systems Development Life Cycle (SDLC) is a systematic approach that allows developers to successfully plan and manage information system projects. The phases of the SDLC waterfall methodology were followed for the development of this data mart project. These phases are: Planning, Analysis, Design, Implementation, and Maintenance. (Whitten, Bentley, and Dittman, 2001, p. 80; Shelley, Cashman, and Rosenblatt, 2001, p. 1.19)

With the waterfall methodology, "the result of each phase, often called an end product or deliverable, flows down into the next phase." (Shelley et al., p. 1.19) The methodology is illustrated in Figure 10.

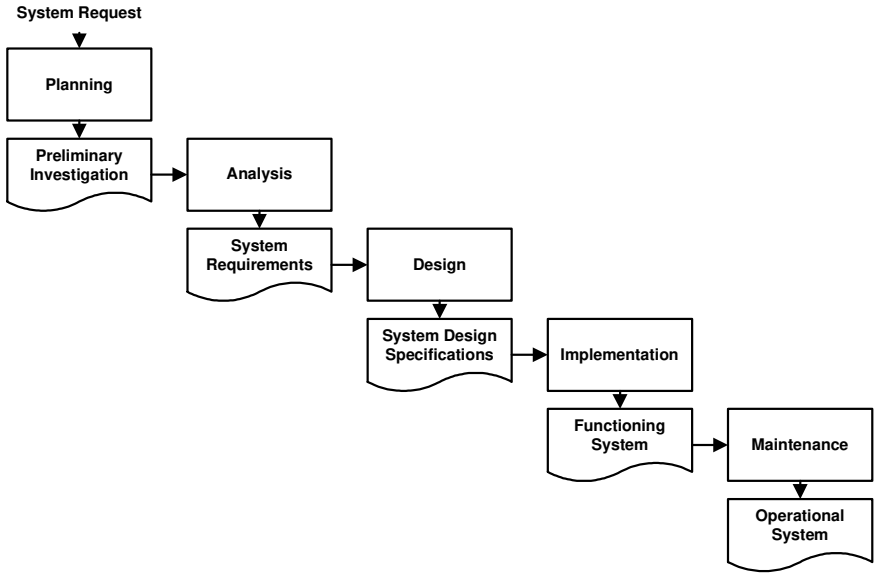

Figure 11. The classic waterfall development model (from Shelley et al, 2001, p. 1.19)

However, the actual approach used for the development of the profiling data mart was, at times, more interactive than the classic model, as the development involved ongoing dialog with the specialists. In other words, some of the SDLC phases were performed simultaneously, such as determining the goals and deliverables for the planning phase while defining the business process in the analysis phase, as both tasks were achieved while conducting user interviews. As a result, a new phase of the waterfall methodology was sometimes initiated before the preceding phase was fully finished. At the end of each phase, an executive summary report was prepared, and a formal sign-off was obtained from the specialist champion to indicate that the phase was satisfactorily completed.

The interactive waterfall approach used for this design research project is somewhat similar to the Rational Unified Process (RUP) development methodology. Like the waterfall methodology, the RUP methodology consists of a lifecycle with phases, with specific activities occurring within each phase. This lifecycle is illustrated in Figure 12.

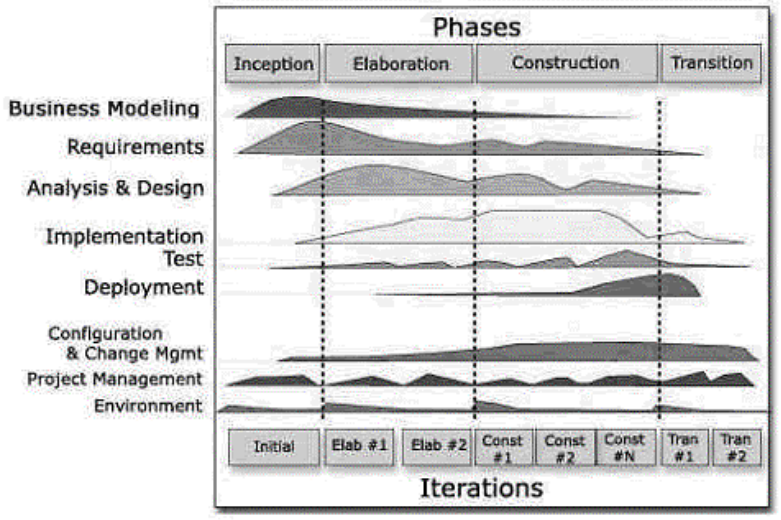

Figure 12. The Rational Unified Process (RUP) lifecycle (Ambler, 2005, p. 5)

However, with RUP, each of the phases – Inception, Elaboration, Construction, and Transition – ends with a milestone and a stakeholder decision whether to continue with the project. Furthermore, with RUP, the deliverable at the end of each lifecycle is not a final version of a product, but is instead an incremental release that is refined with successive iterations through the lifecycle. (Ambler, 2005, p. 1-16)

As soon as approval was received to proceed with the profiling data mart project, initial planning began through the use of basic project management techniques. A project differs from routine operations in that it can be considered a temporary and unique activity that is undertaken to create a specific product or service, instead of an ongoing and repetitive activity that addresses regular work. (PMI, 2000 p. 4) Project management is "a combination of steps and techniques for keeping [a project's] … goals, budget, and schedule in line." (Baker and Baker, 2000, p. 14) To accomplish a project and reach its goals, the recommended approach is to break it down into a series of steps, which is somewhat like a "divide and conquer approach." (Bennatan, 2000, p. 121) A work breakdown structure was thus established, based on the phases and tasks that would

be necessary for successful project completion. This work breakdown structure was documented with a Gantt chart, which summarizes the tasks and timelines that would be required to complete this project. (PMI, 2000, p. 78) The Gantt chart has been reproduced and made available in Appendix A (beginning on page 69).

After completing the initial planning, the data mart development was organized and managed by following the five Systems Development Life Cycle phases. The following sections describe the work that occurred during these phases.

Planning Phase. The purpose of the planning phase of a project is "to identify clearly the nature and scope of the business opportunity or problem." (Shelly et al., 2001, p. 1.20) The Planning phase for this data mart project spanned the time between receiving the project request through the investigation of the requirements and feasibility. It specifically consisted of the following tasks:

- Determining the high level goals and desired deliverables (project scope)
- Performing a preliminary investigation and feasibility study
- Delivering the planning end product: an Investigation and Feasibility Analysis Report

During this phase, it was proposed that the following types and sources of physician performance data would be made available in the profiling data mart:

- Quality peer review data: Exporting appropriate data from the VisionPro credentialing database and importing those data into the data mart on a recurring basis
- Volume data from UPI: Receiving updated data from UPI via flat files and importing those data into the data mart on a recurring basis
- Efficiency data from HDM: Exporting appropriate data from the HDM system and importing those data into the data mart on a recurring basis

The Investigation and Feasibility Analysis Report provides a complete summary of the activity that occurred within this phase and signifies its successful completion. The full report has been reproduced and made available in Appendix A (beginning on page 69).

Analysis Phase. The purpose of the analysis phase of a project is "to understand the business requirements and build a logical model of the new system." (Shelley et al., 2001, p. 1.20) The Analysis phase of the data mart project included gaining a thorough understanding and modeling of the business workflow and system requirements. It specifically involved:

- Defining the current and desired business processes
- Performing current and desired data and process modeling to illustrate process flow
- Delivering the analysis end product: a Systems Requirements Report

Three important realizations related to data sources occurred during the analysis phase of the data mart development. The first involved the addition of a secure, read-only mechanism to access the VisionPro credentialing database by that application's vendor. This read-only access capability made it possible to link VisionPro's tables directly to the data mart, making those data available on a real-time basis, instead of on an incremental import basis. The second event was the realization that the Peer Review data provided by UHC contains more efficiency data elements than are available in the HDM data system. This meant that the biannual UHC Peer Review database could be obtained and linked to the data mart, eliminating the need to perform HDM data imports on a frequently recurring basis. The third event involved securing the ability to receive quarterly Core Measures data from UHC on a recurring basis via an Access database. These data include additional elements that depict physician compliance with standardized patient care practices, which would be a valuable addition to the profiling package.

During this phase, it was thus decided that the following types and sources of physician performance data would be made available in the profiling data mart:

- Quality peer review data: Linking appropriate tables from the VisionPro credentialing database to the data mart
- Volume data from UPI: Receiving updated data from UPI via flat files and importing those data into the data mart on an annual basis
- Efficiency data from UHC: Receiving an updated Peer Review database from UHC on a biannual basis and linking to that database
- Core Measures data from UHC: Receiving updated quarterly Core Measures databases from UHC and importing those data into the data mart on an annual basis

Each of these sources of data contains a common code or key for identifying the data for each individual physician. This code, which is a physician's unique ID number, would make it possible to link the appropriate data from each of the sources to each physician and, in turn, create a set of comprehensive profiling reports for each one. However, transformation of the code to a common format would have to occur to properly link the data from the various sources.

The Systems Requirements Report summarizes the activity that occurred within this phase and signifies its successful completion. The report has been reproduced and made available in Appendix B (beginning on page 76).

Design Phase. The purpose of the design phase of a project is "to create a blueprint for the new system that will satisfy all documented requirements." (Shelly et al., 2001, p. 1.20) For this project, this phase consisted of identifying and documenting all of the activity that would occur within the system. Specifically, it involved:

- Identifying all outputs, inputs, and processes

- Prioritizing requirements and dividing them into delivery phases
- Defining the testing requirements
- Identifying methods to ensure security
- Delivering the Design end product: a Systems Design Specification Report

The Systems Design Specification Report summarizes the activity that occurred within this phase and signifies its successful completion. In addition to this report, documentation that was developed during this phase includes:

- A data dictionary
- A star schema diagram
- A file server architecture diagram
- Instructions for Importing UPI Data into the Data Mart and a description of the related import macro
- Instructions for Importing UHC CM Data into the Data Mart and a description of the related import macro
- Instructions for Updating UHC PR Data to link to the Data Mart

These documents have been reproduced and made available in Appendix C (beginning on page 81).

Implementation Phase. For this data mart project, this phase consisted of the actual, hands-on construction of the data mart. It specifically consisted of:

- Building the system
- Testing the system and delivering a test plan: Testing the Data Mart
- Documenting the system

- Training the users and creating two user guides: Connecting to the Share Directory and Using the Data Mart
- Performing a system evaluation
- Delivering the Implementation end products: phase 1 of a functioning data mart system and a System Evaluation Report

These documents have been reproduced and made available in Appendix D (beginning on page 94).

Maintenance Phase. This phase included the delivery of the completed system and the successful generation of one cycle of profiling reports. It specifically consisted of:

- Maintaining the system by serving as a training/troubleshooting resource for users and by updating the system data when available from the originating sources
- Establishing a mechanism for capturing enhancement requests by delivering a form: Requesting a Change
- Delivering the Maintenance end product: the generation of the following six Physician Profiling Reports for one re-credentialing period
  - Practitioner List
  - Reappointment List
  - Vision Peer Review Profile report
  - UPI Volumes Profile report
  - UHC Attesting/Procedure Profile report
  - UHC Core Measures Profile report

The Requesting a Change form and samples of the Profiling Reports have been reproduced and are available in Appendix E (beginning on page 100). Note that the data have been stripped from the reports to preserve physician and patient confidentiality.

3.2.4 – Design Research Methodology: Evaluation

The Microsoft Access-based profiling data mart was planned and managed by following the Systems Development Life Cycle waterfall methodology using project management tools. The project was completed and met its goals. A detailed discussion of the research evaluation is provided in Chapter 4 – Analysis of Results.

3.2.5 – Design Research Methodology: Conclusion

This design research project demonstrated that an Access-based data mart could solve the physician profiling report generating problem. The research also demonstrated the need to deliver highly summarized reports. A detailed discussion of the research conclusions is provided in Chapter 5 – Conclusion.

3.2.6 – Further Ensuring Research Relevance and Rigor

To further ensure that design research is relevant and rigorous, Hevner et al. (2004) developed "a set of [seven] guidelines for conducting and evaluating good design-science research." (p. 3) Carlsson (2006) supports these guidelines by asserting that each one "should be addressed in some manner for IS design science research to be complete…. [and to result in] a purposeful IT artifact created to address an important organizational problem." (p. 196) The seven design research guidelines (Hevner et al., p. 9) are summarized in Table 4, along with a description of how they were incorporated into this project's methodology.

Table 4. Design Research Guidelines

Guideline	**Description**
1. Design as an Artifact	The design research activity should result in an artifact in the form of a construct, model, method, or instantiation. This design research project resulted in the development of a profiling data mart artifact.
2. Problem Relevance	The design research activity should result in a technological solution to a business problem. This research project focused on solving a profiling report generating problem.
3. Design Evaluation	The usefulness and quality of a design research artifact should be rigorously evaluated. The functionality and usefulness of the profiling data mart was evaluated by end users.
4. Research Contributions	The design research activity should contribute to the overall body of design artifacts or methodologies. This research project demonstrated that an Access-based data mart could solve the identified profiling report problem.

Guideline	**Description**
5. Research Rigor	The design research activity should rigorously follow development and evaluation methods. This research project adhered to the SDLC waterfall methodology and project management techniques.
6. Design as a Search Process	The design research activity should search for and consider all appropriate approaches to creating the resulting artifact. This research project was initiated with a review of existing and potential solutions and resulted in a new artifact.
7. Communication of Research	The design research activity should be presented effectively both to technology-oriented and management audiences. The results of this research project will be shared with appropriate audiences.

Chapter 4 – Analysis of Results

The development of the Microsoft Access-based profiling data mart was a design research project. As Hevner et al. (2004) explain, design research is a problem-solving process, where an artifact is created to broaden the "knowledge and understanding of a design problem and its solution." (p. 6) The main difference between design and design research is the contribution to the knowledge base of "foundations and methodologies" that occurs with design research. (Hevner et al., p. 5)

Vaishnavi and Kuechler (2007) explain that design research "changes the state of the world through the introduction of novel artifacts" that adds to a "body of knowledge" and is "transmitted to the community where it can provide the basis for further exploration." They conclude that meeting these components – creating an artifact, contributing knowledge, and communicating results – "may be all that is required of a successful project." (p. 7-8)

4.1 – Design Research Methodology: Evaluation

This design research project demonstrates that an Access-based data mart system can be specifically and successfully used to solve the physician profiling report generation problem. This research was relevant as it addressed an important, real-world business situation. The resulting system did successfully meet each of its original goals …

- To make the gathering of information and creation of reports a less time-intensive process
- To augment the profiling information and make it more comprehensive for the Credentialing Committee's review

… especially when evaluated within the context of the initial project scope:

- To combine the existing sources of profiling data into one system

- To use this one system to generate the same reports that are currently used, but to make it possible to run the reports based on Credentialing Committee meeting/physician re-credentialing dates instead of individual physician names
- To designate the quality specialist as subject matter expert and project champion who would be responsible for approving the progress and completion of the system

However, with regard to the users of the profiling data mart system:

- The specialists who were responsible for generating and assembling the profiling reports were very pleased with the efficiency of the system and the ease of use, but
- The members of the Credentialing Committee who reviewed the reports were overwhelmed with the amount of additional information.

The data mart design research was rigorous in that it was performed according to an established design research process steps and satisfied design research guidelines, while adhering to Systems Development Life Cycle and project management methodologies. The research resulted in the creation of an instantiation: a technologically functional Access-based data mart. This technologic solution was needed to streamline and augment a medical center's problematic profiling report generating process, which was time- and labor-intensive and complicated. The data mart system met its goals within the prescribed scope: the system worked efficiently and accurately. However, the additional profiling reports delivered too much information to optimally support the Credentialing Committee's knowledge and decision-making needs. The research thus demonstrated that an Access-based data mart could successfully serve as an effective, low-cost solution for the profiling report generating problem, but it also demonstrated the need to condense or summarize the content of the reports.

The results of this design research project could lead to further research, such as determining appropriate report content to optimally facilitate Credentialing Committee decision-making. Finally, the results of this research is being communicated to technologically-oriented audiences through clear and concise documentation of the specific activity that occurred during the stages of the Systems Development Life Cycle and to healthcare-oriented audiences through system demonstrations and presentations.

4.2 – Review of Significant Events

During the data mart development, a number of significant events occurred. Almost immediately at the onset of the project, an upgrade was applied to the VisionPro credentialing database during the early stage of the data mart development. VisionPro was the primary source of physician data for the data mart, and one of its tables served as the pivotal fact table for the star schema. In other words, VisionPro was crucial for the success of the data mart. The upgrade that was applied to VisionPro created data integrity issues within some of the tables that were linked to the data mart. The issues were eventually fixed, but it illuminated the realization that the ongoing functionality of the data mart would be dependent on the integrity of the data in this primary source system. As a result, the need to maintain the integrity of the VisionPro system and its impact on the ongoing functionality of the data mart was carefully communicated to the appropriate parties.

In addition, the medical center moved to new facilities while the data mart was being developed. This move was an enormous endeavor, requiring complete commitment throughout the organization to ensure a successful and safe outcome. As a result, the data mart and numerous other non-mission-critical projects were given reduced focus or placed on hold. This meant that the progress of the data mart development was occasionally stalled. Even though the

delay was well understood, it was still important to periodically communicate the project status with the users and keep them abreast of the development status.

Finally, the specialist who identified the business need for the system and served as the project champion retired from the medical center as the development was being completed. This specialist was the primary advocate for the system, and her continued involvement was going to be important for the ongoing use and success of the system. The remaining users appreciated that the system provided a streamlined ability to generate reports, but it was also important to reinforce the regulatory requirements regarding physician profiling information and how the data mart would help meet these requirements.

Despite these events, the physician profiling data mart project ended with the delivery of an operational data mart system. A set of six profiling reports was successfully generated from the system; these reports that could be run on demand for any designated Credentialing Committee meeting/physician re-credentialing timeframe and capture all physicians who were due for re-credentialing during that timeframe. The six reports consisted of:

- Practitioner List
- Reappointment List
- Vision Peer Review Profile report
- UPI Volumes Profile report
- UHC Attesting/Procedure Profile report
- UHC Core Measures Profile report

The content of these reports accurately matched the content from the originating sources. The users were especially pleased with having the ability to generate reports for all physicians due for

re-credentialing within a given re-credentialing timeframe, instead of having to identify the individual physicians and selectively run each one's reports during that timeframe.

However, the Credentialing Committee was not enthusiastic about the additional report content. When the new reports were first presented to the Committee, the amount of information was overwhelming, as the inclusion of new sources of data resulted in a package of reports per physician that totaled a dozen or more pages, with each page packed full of tables and numbers. The Committee recognized that evolving regulations required a more comprehensive review of physician performance, but what it needed to accomplish this review was a more concise summary of comprehensive performance. In other words, the project was technically successful – and the suggestion that an Access-based data mart could solve the profiling report generation problem was shown to be correct – but it was not completely successful as it provided too much information to facilitate action.

The profiling data mart and resulting reports were demonstrated to a Joint Commission physician consultant, who was onsite at the medical center for a mock survey visit. The consultant offered a very positive review of the system and reports, and he agreed that they would serve well as a source of detailed performance information. The consultant also provided specific suggestions for rolling up the existing information into a concise executive summary report that could be presented to the Credentialing Committee. This executive summary report would meet the regulatory requirements for a comprehensive performance review, and the detailed reports could serve when necessary for a more in-depth examination of performance activity.

In the end, this design research project was initiated to demonstrate that an Access-based data mart would solve the medical center's profiling report generating problem. The goal of the

project was to create a product that would pull together data from disparate sources into one system, which is knowledge combination. The planned deliverable of this project was the ability to generate the same reports that were already being generated from the separate sources but in an easier fashion, plus to add new reports that would add more comparative information to the physician profiling package. Because the data mart project met its stated goals, it could be considered a success. However, these goals should have been clearly communicated to all users of the system, including the Credentialing Committee, instead of relying solely on the specialist/champion's approval. Because communication with this Committee was minimal, the members were not prepared for the additional content, and their reaction was not enthusiastic. Therefore, because the project did not meet its implicit goal of converting information into actionable knowledge, or knowledge internalization, the project was not entirely successful.

Nevertheless, the results of this research – the technologic success and ease of use, but lack of Committee acceptance of the new reports – would not have been discovered without completing this effort. These results serve as feedback, or "circumscription" as designated in Vaishnavi and Kuechler's design research methodology, and can be used to redefine the awareness of the problem and resulting suggestion for future research iterations.

Chapter 5 – Conclusion

5.1 – Design Research Methodology: Conclusion

The design research presented in this paper was both relevant and rigorous. The research began with recognition of the importance of the physician profiling process and the need to streamline the generation of profiling reports. Profiling is an essential component of the physician credentialing/re-credentialing process that is carried out in hospitals and medical centers across the country, as it facilitates the monitoring of the safety and competence of physician performance.

This monitoring of physician performance is important for a number of reasons. A hospital or medical center must ensure that its physicians are providing safe care to its patients in order to maintain public trust and to reduce the risk of legal liability. The physician profiling process is also required for regulatory compliance. Through profiling, and through the credentialing/re-credentialing process, a medical center can demonstrate its ongoing surveillance of physician performance and help ensure the safety of the care it provides to its patients.

5.2 – Research Summary and Findings

This research began with an awareness of the difficulty that existed at one medical center with the assembling of profiling reports. The reports were being generated from different systems via a time- and labor-intensive process. These reports were ultimately reviewed by a committee that used the information to support its physician reappointment decision-making. A review of practices at other medical centers revealed that this difficulty in generating profiling information was not unique, nor was there a universal method to streamline the process. Compounding this problem was the reality that few resources were available at the medical center to simplify the report generating process.

A suggestion was made that a Microsoft-Access data mart would solve the profiling report generating problem. A review of literature supported this suggestion.

The research entered the artifact development stage, where an Access data mart was designed and constructed according to the well-established Systems Development Life Cycle waterfall methodology.

An evaluation of the resulting artifact revealed that the data mart met its goals and was technologically successful. After formal testing, it was determined that the system was able receive and link data from a variety of sources and accurately and easily generate a set of comprehensive profiling reports. In other words, the system facilitated the combination concept of knowledge management, where multiple sources of explicit information were combined to create new explicit information. Thus, this research demonstrated that an Access-based data mart could successfully solve the profiling report generation problem and, because of the affordability and flexibility of this technology, this same approach could be adopted at other medical centers.

However, an evaluation of the new profiling reports that the data mart generated revealed that the additional information was too overwhelming to support committee decision-making. In other words, the reports did not meet the knowledge management concept of internalization, as the explicit information in the reports did not result in the production of new tacit knowledge among the committee members to enhance their decision-making.

In conclusion, though, this design research was fruitful and worthwhile. The technologic success of the data mart resulted in the generation of new knowledge about a new approach that other medical centers could consider for solving their physician profiling report generating problems. Likewise, the lack of committee acceptance of the new reports also resulted in new knowledge about the need to further summarize the content of the reports for committee use.

Neither of these findings could have been realized without the actual creation of the data mart and use of the new data mart reports; these findings serve as a starting point for further research.

5.3 – Communication of Findings and Next Steps

A design research effort is not complete until its findings are communicated to the appropriate audiences. In the case of this design research effort, the findings are being shared to both technical and healthcare professionals. Documentation of the design, development, and implementation of the data mart has been prepared for review by the technical professionals; this documentation is deliberately descriptive but concise. Demonstrations and presentations on the basic concepts and resulting reports from the data mart are being shared with healthcare professionals. As a result, the body of knowledge about the appropriate use of Microsoft Access data marts for physician profiling has been enlarged and made available to generate additional research activities.

Specific to Regional Medical Center, this design research effort is already beginning a second iteration. Discussions are underway with a broader group of users, including members of the Credentialing Committee, to reevaluate the optimal content of the profiling reports and to determine how to present this content in the most useable fashion. In other words, the profiling data mart artifact from this research effort was evaluated to build knowledge that is already being used for a new research effort and to create a new artifact. Thus, the design research knowledge building cycle continues.

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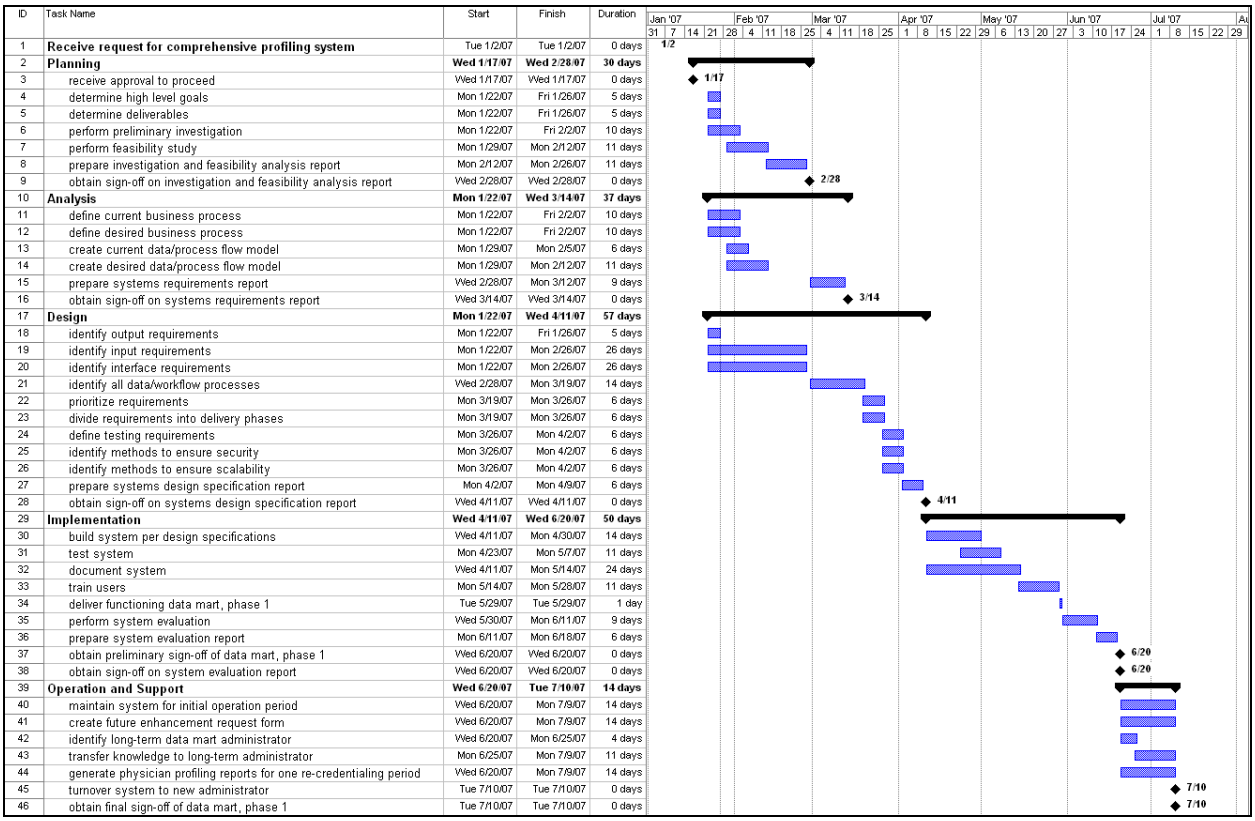
Appendix A: Systems Development Life Cycle *Planning* Phase Documents

This appendix contains the following documents that summarize the activity within and successful completion of the Systems Development Life Cycle (SDLC) Planning Phase of the data mart project:

- Project Plan (Gantt chart)
- Investigation and Feasibility Analysis Report



ID	Task Name	Start	Finish	Duration
1	**Receive request for comprehensive profiling system**	Tue 1/2/07	Tue 1/2/07	0 days
2	**Planning**	**Wed 1/17/07**	**Wed 2/28/07**	**30 days**
3	receive approval to proceed	Wed 1/17/07	Wed 1/17/07	0 days
4	determine high level goals	Mon 1/22/07	Fri 1/26/07	5 days
5	determine deliverables	Mon 1/22/07	Fri 1/26/07	5 days
6	perform preliminary investigation	Mon 1/22/07	Fri 2/2/07	10 days
7	perform feasibility study	Mon 1/29/07	Mon 2/12/07	11 days
8	prepare investigation and feasibility analysis report	Mon 2/12/07	Mon 2/26/07	11 days
9	obtain sign-off on investigation and feasibility analysis report	Wed 2/28/07	Wed 2/28/07	0 days
10	**Analysis**	**Mon 1/22/07**	**Wed 3/14/07**	**37 days**
11	define current business process	Mon 1/22/07	Fri 2/2/07	10 days
12	define desired business process	Mon 1/22/07	Fri 2/2/07	10 days
13	create current data/process flow model	Mon 1/29/07	Mon 2/5/07	6 days
14	create desired data/process flow model	Mon 1/29/07	Mon 2/12/07	11 days
15	prepare systems requirements report	Wed 2/28/07	Mon 3/12/07	9 days
16	obtain sign-off on systems requirements report	Wed 3/14/07	Wed 3/14/07	0 days
17	**Design**	**Mon 1/22/07**	**Wed 4/11/07**	**57 days**
18	identify output requirements	Mon 1/22/07	Fri 1/26/07	5 days
19	identify input requirements	Mon 1/22/07	Mon 2/26/07	26 days
20	identify interface requirements	Mon 1/22/07	Mon 2/26/07	26 days
21	identify all data/workflow processes	Wed 2/28/07	Mon 3/19/07	14 days
22	prioritize requirements	Mon 3/19/07	Mon 3/26/07	6 days
23	divide requirements into delivery phases	Mon 3/19/07	Mon 3/26/07	6 days
24	define testing requirements	Mon 3/26/07	Mon 4/2/07	6 days
25	identify methods to ensure security	Mon 3/26/07	Mon 4/2/07	6 days
26	identify methods to ensure scalability	Mon 3/26/07	Mon 4/2/07	6 days
27	prepare systems design specification report	Mon 4/2/07	Mon 4/9/07	6 days
28	obtain sign-off on systems design specification report	Wed 4/11/07	Wed 4/11/07	0 days
29	**Implementation**	**Wed 4/11/07**	**Wed 6/20/07**	**50 days**
30	build system per design specifications	Wed 4/11/07	Mon 4/30/07	14 days
31	test system	Mon 4/23/07	Mon 5/7/07	11 days
32	document system	Wed 4/11/07	Mon 5/14/07	24 days
33	train users	Mon 5/14/07	Mon 5/28/07	11 days
34	deliver functioning data mart, phase 1	Tue 5/29/07	Tue 5/29/07	1 day
35	perform system evaluation	Wed 5/30/07	Mon 6/11/07	9 days
36	prepare system evaluation report	Mon 6/11/07	Mon 6/18/07	6 days
37	obtain preliminary sign-off of data mart, phase 1	Wed 6/20/07	Wed 6/20/07	0 days
38	obtain sign-off on system evaluation report	Wed 6/20/07	Wed 6/20/07	0 days
39	**Operation and Support**	**Wed 6/20/07**	**Tue 7/10/07**	**14 days**
40	maintain system for initial operation period	Wed 6/20/07	Mon 7/9/07	14 days
41	create future enhancement request form	Wed 6/20/07	Mon 7/9/07	14 days
42	identify long-term data mart administrator	Wed 6/20/07	Mon 6/25/07	4 days
43	transfer knowledge to long-term administrator	Mon 6/25/07	Mon 7/9/07	11 days
44	generate physician profiling reports for one re-credentialing period	Wed 6/20/07	Mon 7/9/07	14 days
45	turnover system to new administrator	Tue 7/10/07	Tue 7/10/07	0 days
46	obtain final sign-off of data mart, phase 1	Tue 7/10/07	Tue 7/10/07	0 days

Project Plan (Gantt chart)

Physician Profiling Data Mart:
Investigation and Feasibility Analysis Report

A need exists to streamline the process of preparing the profiling reports that are used to support the physician reappointment process and to augment the content of these reports. A data mart or similar system has been proposed that would, ideally, combine data from multiple sources and generate comprehensive reports. This report summarizes the investigation and feasibility of the proposed physician profiling data mart solution.

High level goals and desired deliverables (project scope)
The physician profiling data mart would, optimally, include data from the following sources, in order of priority:

1. Quality data from VisionPro's Peer Review module: summary/counts of quality events and reviews by indicator type by individual physician
2. Volume data from UPI: procedural activity by individual physician as compared to the activity within the respective divisions
3. Efficiency data from HDM: Mean LOS per DRG by individual physician as compared to mean LOS per DRG from CMS
4. Core Measures Compliance data from UHC's CM database: compliance with CM indicators by individual physician as compared to the compliance within the respective divisions
5. Other suitable data from sources to be determined

The data mart would, ideally, deliver a report on demand that would combine these data for all physicians due for reappointment within a specified date range; each individual physician's content would be distinct and easily separated from other physicians' content.

Investigation
A thorough review of current practice revealed that only two of the five proposed data sources are presently used for physician profiling: 1) quality and 2) volume data. Quality data is usually obtained by running a VisionPro Peer Review report for each individual physician who is due for reappointment, exporting the report into Word, then manually reformatting, printing, and filing the report in each physician's paper Credentialing file. Volume data is obtained from UPI and comes as set of 22 Excel files; these files are manually manipulated and reformatted into separate reports for each individual physician; the individual reports are printed and filed in each physician's paper Credentialing file.

Interviews with vendors and data analysts and a review of literature revealed the following findings pertinent to the proposed data mart system:

1. Quality data from VisionPro Peer Review
    a. The VisionPro database serves as the medical center's master physician data repository. The unique identifier for each physician is formatted as follows: #99999 (a 5-digit code preceded by a pound sign).
    b. The VisionPro database vendor, GetProof, applied a major upgrade to the system in October 2006. As a result of the upgrade, the integrity of the data in the Peer Review module was corrupted due to an inaccurate mapping of provider events in

Investigation and Feasibility Analysis Report

the database and inadequately addressed field changes. Furthermore, the original Peer Review reports (built and run via an embedded Crystal Reports application within VisionPro) are no longer functional, and new reports are inadequate as they do not contain sufficient information.

c. As part of the data mart investigation, a new Peer Review report was created in Crystal Reports according to custom specifications by a medical center specialist, and the report was imported into the VisionPro application. However, the data integrity issues still exist and must be fixed by the vendor before this new report can be used. In addition, the medical center will still have to contract with the vendor to create a new report similar to the custom one created by the specialist to ensure ongoing vendor support of the report with future upgrades.
d. A conference call with a GetProof/VisionPro report consultant revealed the following:
    i. If the medical center wanted to use VisionPro data outside of the application – such as by linking a table in the proposed data mart or running a Crystal Reports report using VisionPro data outside of the VisionPro application – it would have to connect to the data using the default database administrator user account. This administrator account has full database privileges (read, write, and delete capabilities for all front and back end objects), which poses a significant data integrity and security risk. The medical center should instead create a new database user account having limited read-only data privileges, provided the medical center's license allows; this new account must be hard-coded and is separate and different from the VisionPro application user accounts. Unfortunately, this new account would not be included or supported with any future upgrades, which would create a vulnerable situation for long-term use.
    ii. Crystal Reports does not support the combining of multiple databases and data sources into one report; specifically, if the medical center tried to join a VisionPro table with a data mart table, whether within or out of the VisionPro application, the result would yield an equi-join output that would match only first occurrences (left or right joins would not be possible), which would result in inaccurate reporting information.
    iii. The best immediate solution might be to manually run the quality/peer review reports in VisionPro to generate the desired data and export these data to a flat-file format, then import this file manually into the proposed data mart system.

2. Volume data from UPI

   A meeting with a UPI database analyst revealed the following:

   a. UPI is an external data source that contains physician volume information. UPI identifies each physician using the same unique identifying code number that the VisionPro database uses – in fact, UPI is the originating source that assigns the code number to each new physician. However, the UPI database does not format the number with the leading pound sign and does not always pad the number with leading zeros, thus not all numbers are five digits in length.

b. The UPI volume data is available in a flat-file format on a fiscal year basis only. Specifically, physician and division volumes for July-June are provided each August. While it is possible to get volumes for the first half of a fiscal year (July-December) in February, these same data would be included in the full year data that would be provided in August, which would create the potential for double-counting the volumes that occurred during the July-December timeframe.
c. It is not possible to link the UPI system's data tables to an external database, such as the proposed data mart.
d. UPI provides its volume data by CPT code (a standardized procedural coding system), but it frequently precedes the standard 5-digit CPT codes with its own unique prefixes. It would be necessary to trim the UPI prefixes from the standardized 5-digit CPT codes to accurately use these data.
e. The best immediate solution might be to 1) obtain the UPI data in a single, flat-file format each year, instead of receiving a set of 22 separate files and to 2) manually import UPI's fiscal year flat-file data into the proposed data mart on an annual basis each fall.

3. Efficiency data from HDM
   A week-long training session with the HDM vendor revealed the following:
   a. HDM identifies each physician using the same unique identifying code number that the VisionPro database uses; however, HDM does not format the number with the leading pound sign and does not always pad the number with leading zeros, thus not all numbers are five digits in length.
   b. It is not possible to link the HDM data tables to an external database, such as the proposed data mart.
   c. It is possible to create and manually run a report in HDM that would provide mean DRG and LOS data, plus CMS' mean DRG and LOS data, for each individual physician and respective service; the data from this report could be exported in a variety of flat-file formats.
   d. The best immediate solution might be to manually run, export, then import the HDM flat-file data into the proposed data mart on a recurring basis.
4. Core Measures Compliance data from UHC CM database
   a. UHC is an external organization that provides outcomes data and supports best practice opportunities. UHC identifies each physician using the same 5-digit code as used in VisionPro, but it does not format the code with the preceding pound sign.
   b. UHC provides Core Measures compliance data via an Access database. The database should be available via manual download on a quarterly to semi-annual basis; however, this database download site is accessible for only a limited number of users, and the download is not always available on a regular basis.
   c. The database is open architecture, and the data tables are freely accessible.
   d. The best immediate solution might be to establish a recurring download process and link the appropriate table(s) from the UHC CM database into the proposed data mart.

5. Other Measures from Sources To Be Determined
    a. Other potential measures that might support the physician profiling process include patient satisfaction scores and other clinical indicators, such as readmission and mortality rates.
    b. These specific measures have not yet been well defined, nor have the sources for these data been well defined.
6. Internal resources
   Two specific individuals are available, by role and interest, in participating in the ongoing use and support of the data mart once delivered.

Conclusions and recommendations from the investigation:
Feasibility of the Physician Profiling Data Mart system
It is not possible to automatically link data from all of the five desired sources into one data mart system and run all-inclusive reports from within or outside of the VisionPro application. However, it would be possible to create a partial, manually updated data mart that would still successfully streamline the physician profiling report generating process, given the following considerations:

1. For quality data, the medical center should run the new, custom peer review reports in VisionPro as soon as this system's data integrity issues are resolved.
    a. This peer review report generating process should flow more efficiently since these reports have been rebuilt to automatically include all physicians who are scheduled for reappointment during a designated timeframe, such as a three-month span, instead of having to identify, select, and run a report on each individual physician who is due for review. In addition, the new report includes a roster of all physicians who are due for reappointment during the specified timeframe, which should help ensure that none of the physicians are inadvertently missed during recredentialing review period.
    b. A similar report that lists only key information – such as physician name and number, credentialing status, and reappointment date – could be created and manually run from the VisionPro system on a recurring basis, such as quarterly. The data from this report could be exported as a flat-file, then imported into the proposed data mart. This process would serve as a way to keep an updated list of current physicians in the data mart and allow users to run comprehensive reports from the data mart based on physician reappointment date ranges.
2. For volume data, the best immediate solution would be to manually import UPI's fiscal year flat-file data into the proposed data mart on an annual basis each fall.
3. For efficiency data, the best immediate solution would be to manually run, export, then import the HDM flat-file data into the proposed data mart on a recurring basis, such as quarterly or annually each fall.
4. The Core Measures compliance data is not yet regularly available for download. Given this limitation, and given the number of other higher data priorities, the inclusion of these data should be delayed for another phase of the data mart development process.
5. 'Other' data types are still too ill defined; given this fact, plus given the number of other higher data priorities, the inclusion of these data should be delayed for another phase of the data mart development process.

Because the data mart will require multiple manual imports and exports of data on a recurring basis, it will be imperative to create appropriate user documentation to ensure 1) the complete and accurate transfer of data among the systems on an ongoing basis and 2) the efficient generation of profiling reports.

Appendix B: Systems Development Life Cycle *Analysis* Phase Documents

This appendix contains the following documents that summarize the activity within and successful completion of the Systems Development Life Cycle (SDLC) Analysis Phase of the data mart project:

- Systems Requirements Report

Physician Profiling Data Mart:
Systems Requirements Report

The medical center uses a variety of physician profiling reports to support the physician reappointment process. This process is becoming increasingly important for compliance with regulatory standards. A need exists to streamline the process of preparing these reports and augment their content. Due to a lack of available personnel and budget resources, a data mart solution would provide the simplest, most immediate solution to combine data from the multiple sources and facilitate the generation of the reports. This document summarizes the current business process and data flow involved in the generation of the profiling reports, along with the changes that would occur with the data mart solution.

Business Process

The Credentialing Committee meets every month to review the performance of each physician whose credentials expire on that given month and determine whether to grant the physician privileges for another two years. Preparation for this meeting begins three months in advance, when staff members assemble a variety of physician performance documents and forward them to the appropriate medical department chairs for review. The chairs then provide additional input and/or recommendations to the committee.

The following sections summarize the current and desired process for preparing the physician performance reports for each monthly committee meeting.

Page 1 of 4

Current Business Process

Event: Monthly Credentialing Committee Meeting

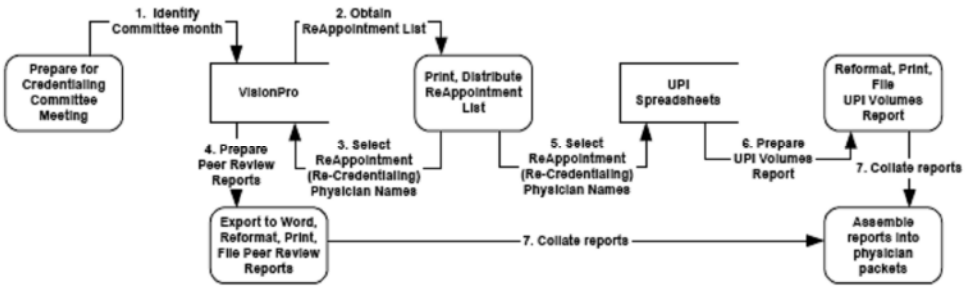
Subprocesses: Report Preparation (3 months prior to meeting)

- VisionPro Re-Credentialing List (performed by a Credentialing Specialist)
  - Open VisionPro
  - Run the Re-Credentialing List to identify the physicians for the given month
  - Print and forward the list to a Quality Improvement Specialist
- VisionPro Peer Review Reports (performed by a Quality Improvement Specialist)
  - Open VisionPro
  - Open the Peer Review Report
  - Manually select each of the 60-100 physicians on the Re-Credentialing List
  - Run the VisionPro Peer Review report
  - Export and save the report in Word
  - Apply a page break in Word between each physician's content
  - Print the Word report
  - Separate the Word report by physician
- UPI Volume Reports (performed by a Quality Improvement Specialist)
  - Receive 20+ UPI physician/division volume spreadsheets every 6 months
  - Apply a page break between each physician's/division's content
  - Print the spreadsheets
  - Separate the spreadsheets by physician/division
- Adhoc Reports (performed by a Quality Improvement Specialist)
  - Receive any related adhoc reports
- File Reports (performed by a Credentialing Specialist)
  - File the reports in the appropriate physician folders

Result: Physician Performance Reports

Current Business Process Data Flow:

This data flow diagram illustrates the specific steps and flow of data using the current process to create reports for Credentialing Committee meetings. Note that the current process includes data from only two sources: VisionPro Peer Reviews and UPI Volumes.



Proposed Business Process

Event: Monthly Credentialing Committee Meeting

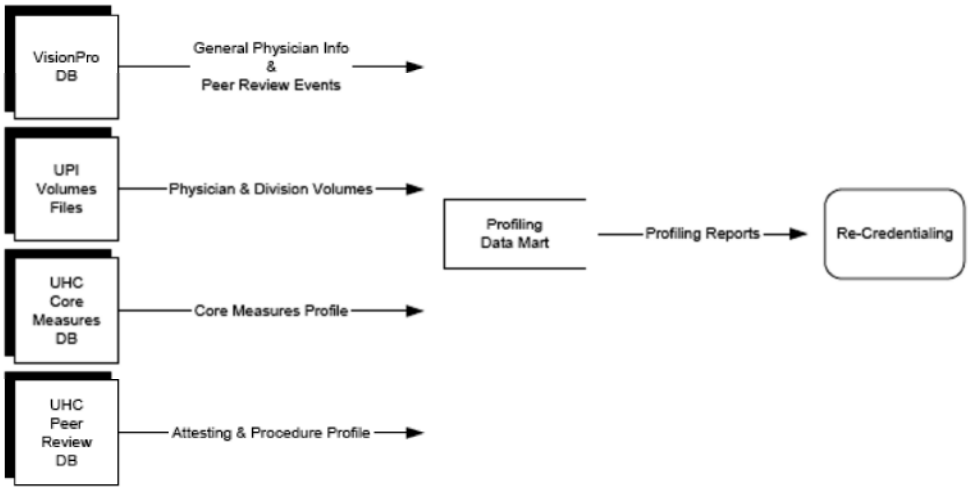
Subprocesses: Report Preparation (3 months prior to meeting)

- Data Mart Reports (performed by a Credentialing or Quality Improvement Specialist)
  - Open the Data Mart
  - Run/print the Reappointment List report
  - Run/print the Vision Peer Review Profile report
  - Run/print the UPI Volumes Profile report
  - Run/print the UHC Attesting/Procedure Profile report
  - Run/print the UHC Core Measures Profile report
  - Separate the reports by physician
- Adhoc Reports
  - Receive any related adhoc reports
- File Reports (performed by a Credentialing Specialist)
  - File the reports in the appropriate physician folders

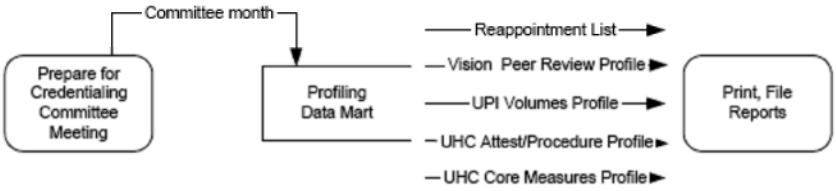
Result: Physician Performance Reports

Proposed Business Process Context Diagram:

This context diagram provides a high-level overview of the sources and flow of data into and out of the proposed data mart solution. Note that the proposed process includes data from four sources: VisionPro Peer Reviews, UPI Volumes, UHC Core Measures, and UHC Peer Review Comparisons. These additional sources provide a more comprehensive view of physician performance.



Proposed Business Process Data Flow:
This data flow diagram illustrates the specific steps and flow of data into and out of the proposed data mart solution to create reports for Credentialing Committee meetings.



Proposed Data Mart Solution Requirements
The proposed data mart system should comply with the following design requirements:

1. User Interface. The system should let the user run profiling reports for all physicians due for re-credentialing during any given timeframe by entering a re-credentialing date range.
2. Input Processes. The data mart should contain data from the following sources:
    a. VisionPro – general physician information, peer review events
    b. UPI – physician and division volumes
    c. UHC – core measures compliance
    d. UHC – peer review comparisons

    These sources are readily available and provide a more comprehensive view of physician performance. All data input from these sources should occur "behind the scenes" by a system administrator. The specific instructions for achieving this input should be clearly documented. The user should not enter any additional data.
3. Output Reports. The profiling reports should contain the same data and similar layout as is currently available from each originating source.
4. Data. The specific method for maintaining data from each source should be clearly documented. The common key to linking data from each source should be the physician's UPI number, with the VisionPro number serving as the master. The data mart system's data elements should be clearly documented in a Data Dictionary or similar tool.
5. System Architecture. The data mart system should be built using Microsoft Access, due to its cost (none to minimal) and availability. The data mart system should be housed on a secure share directory on the medical center's network; the system administrator should control access to this directory.

Appendix C: Systems Development Life Cycle *Design* Phase Documents

This appendix contains the following documents that summarize the activity within and successful completion of the Systems Development Life Cycle (SDLC) Design Phase of the data mart project:

- Systems Design Specification Report
- Data Dictionary
- Entity Relationship Diagram (Star Schema Diagram)
- File Server Architecture Diagram
- Importing UPI Data into the Data Mart instructions and macro documentation
- Importing UCHCM Data into the Data Mart instructions and macro documentation
- Updating UHC PR Data to link to the Data Mart instructions

Physician Profiling Data Mart:
Systems Design Specification Report

The medical center uses a variety of physician profiling reports from various sources to support the physician reappointment process. The proposed data mart system will streamline the process of preparing these reports. Based on review of available sources and priorities, the system will initially obtain VisionPro Peer Review data, UPI Volume data, UHC Peer Review Comparisons data, and UHC Core Measures data. The system will allow users to generate profiling reports based on physician re-credentialing date.

System Components
The initial phase of the Physician Profiling Data Mart will meet the following specifications.

Data
The data mart system will be built using Access 2000+, as this software is readily available without cost for the users. The system will accept data from the four sources as it exists in the originating systems. Data input will consist of linking tables from VisionPro, importing and appending data into tables from the UPI flat files, and importing and appending tables from the two UHC sources. To help differentiate the originating sources of data, the name of each table in the data mart will be appended with the appropriate prefix: Vpro, UPI, UHCPR, UHCCM. The system will not require nor facilitate manual data entry or transactions.

A Data Dictionary describes the specific data mart tables and fields. An Entity Relationship Diagram (Star Schema Diagram) illustrates the relationship between the tables. A File Server Architecture diagram illustrates the physical storage and links between the data mart components. Written instructions will document how to update the UPI, UHCPR, and UHCCM data.

Legacy Issues
The common key among all data sources is the physician's unique number, which is known as the UPI#. Because the data mart will receive data from various sources, an inconsistency exists in the format of this number among the sources. The medical center has determined that the UPI# as stored in the VisionPro system is the officially accepted, master number. Thus, the VisionPro practitioner table, PRACENT, will serve as the master or key table to relate the data from all other sources. The data mart system will convert the numbers from the other sources to match the VisionPro format.

Output
The content for the output – the profiling reports – will match the content as exists in the originating sources. The format of the reports may be modified to ensure a consistent look and usability.

User Interface
Each user will access the data mart system by opening the data mart file in Microsoft Access. When a user opens the data mart system, he will be able to access only a report menu that display

Systems Design Specification Report

upon startup. The user will be able select a report, enter a re-credentialing timeframe, and view/print the report. All other system objects, such as tables and toolbars, will be hidden.

Approximately ten users will access and use the data mart system. Because of this low volume, performance will not be an issue.

Security
The data mart system will be housed on a secure network share directory. The system administrator will coordinate with Information Services to limit access to this share directory. The IS department will back up the system no less than once a week.

Testing
The process for data mart testing will consist of the following steps: run random reports, compare the content and accuracy of these reports the same reports run from the originating systems.

Scalability
The data mart system will be able to incorporate data from other future sources, as long as 1) the data can be imported or linked as an Access table and 2) the data contains physician UPI# to enable accurate relationships.

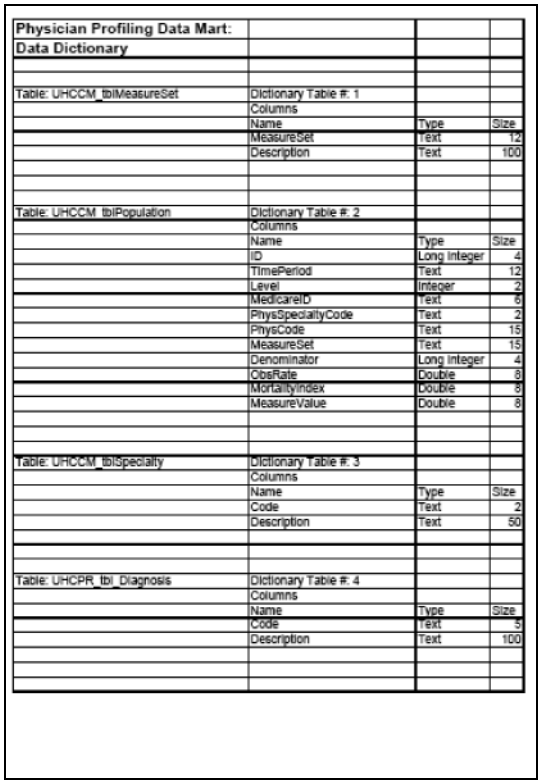
Support
The system is not mission critical. It will be used on an episodic basis by a limited number of users. The system administrator will be provide system support during business hours.

Environmental Requirements
Each user's workstation will need to have Microsoft Access 2000 or newer to be able to access the data mart file.

Implementation Requirements
Initial implementation will begin with allowing one user to access the data mart and run profiling reports. Other users will then be introduced to the system. Initial training will be informal and hands-on. A set of user instructions will be developed for print or online access during a future phase of development.

Time and Cost Estimates
The original proposed project plan for the data mart system will need to be modified, due to 1) significant issues that have developed during a recent upgrade to the VisionPro system and 2) heightened focus on the medical center's move to a new campus. Instead of trying to re-create a timeline, the developer and users have agreed on a fluid development schedule, as the current report generating process is still functional, if burdensome.

The system will not require additional budget or costs.



Physician Profiling Data Mart: Data Dictionary			
Table: UHCCM_tblMeasureSet	Dictionary Table #: 1		
	Columns		
	Name	Type	Size
	MeasureSet	Text	12
	Description	Text	100
Table: UHCCM_tblPopulation	Dictionary Table #: 2		
	Columns		
	Name	Type	Size
	ID	Long Integer	4
	TimePeriod	Text	12
	Level	Integer	2
	MedicareID	Text	6
	PhysSpecialityCode	Text	2
	PhysCode	Text	15
	MeasureSet	Text	15
	Denominator	Long Integer	4
	ObsRate	Double	8
	MortalityIndex	Double	8
	MeasureValue	Double	8
Table: UHCCM_tblSpecialty	Dictionary Table #: 3		
	Columns		
	Name	Type	Size
	Code	Text	2
	Description	Text	50
Table: UHCPR_tbl_Diagnosis	Dictionary Table #: 4		
	Columns		
	Name	Type	Size
	Code	Text	5
	Description	Text	100

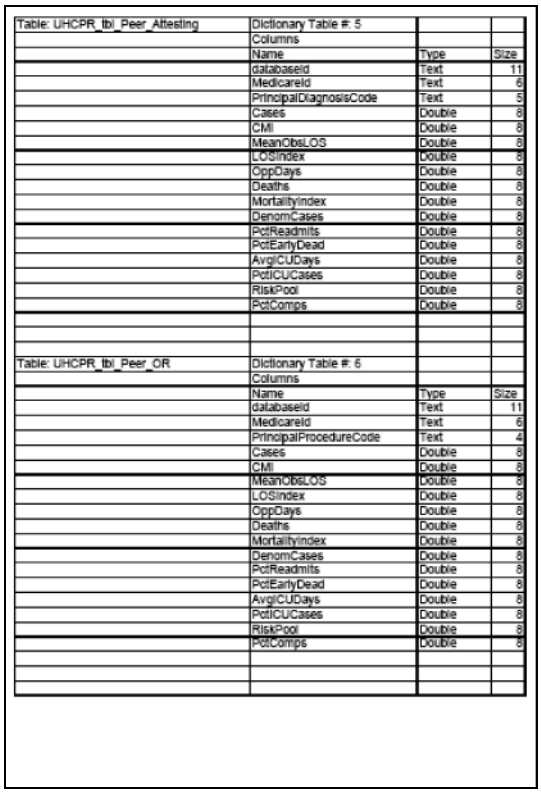


Table: UHCPR_tbl_Peer_Attesting	Dictionary Table #: 5		
	Columns		
	Name	Type	Size
	databaseId	Text	11
	MedicareId	Text	6
	PrincipalDiagnosisCode	Text	5
	Cases	Double	8
	CMI	Double	8
	MeanObsLOS	Double	8
	LOSIndex	Double	8
	OppDays	Double	8
	Deaths	Double	8
	MortalityIndex	Double	8
	DenomCases	Double	8
	PctReadmits	Double	8
	PctEarlyDead	Double	8
	AvgICUDays	Double	8
	PctICUCases	Double	8
	RiskPool	Double	8
	PctComps	Double	8
Table: UHCPR_tbl_Peer_OR	Dictionary Table #: 6		
	Columns		
	Name	Type	Size
	databaseId	Text	11
	MedicareId	Text	6
	PrincipalProcedureCode	Text	4
	Cases	Double	8
	CMI	Double	8
	MeanObsLOS	Double	8
	LOSIndex	Double	8
	OppDays	Double	8
	Deaths	Double	8
	MortalityIndex	Double	8
	DenomCases	Double	8
	PctReadmits	Double	8
	PctEarlyDead	Double	8
	AvgICUDays	Double	8
	PctICUCases	Double	8
	RiskPool	Double	8
	PctComps	Double	8

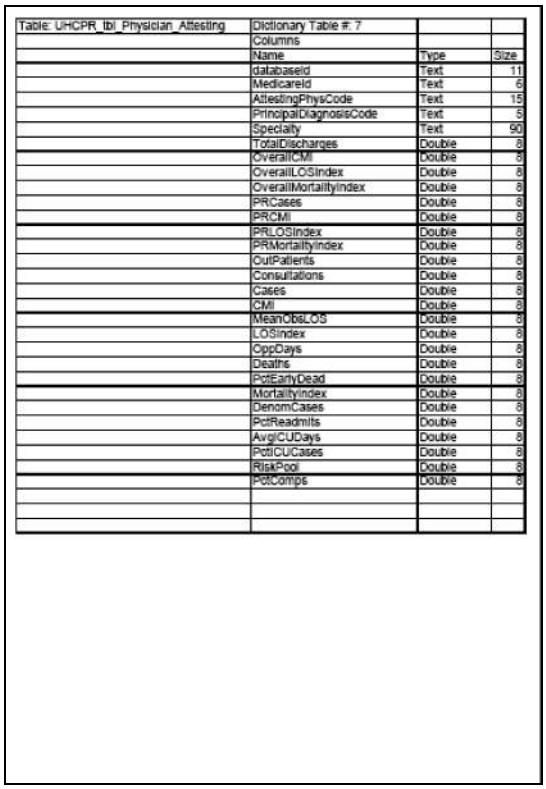


Table: UHCPR_tbl_Physician_Attesting	Dictionary Table #: 7		
	Columns		
	Name	Type	Size
	databaseId	Text	11
	MedicareId	Text	6
	AttestingPhysCode	Text	15
	PrincipalDiagnosisCode	Text	5
	Specialty	Text	90
	TotalDischarges	Double	8
	OverallCMI	Double	8
	OverallLOSIndex	Double	8
	OverallMortalityIndex	Double	8
	PRCases	Double	8
	PRCMI	Double	8
	PRLOSIndex	Double	8
	PRMortalityIndex	Double	8
	OutPatients	Double	8
	Consultations	Double	8
	Cases	Double	8
	CMI	Double	8
	MeanObsLOS	Double	8
	LOSIndex	Double	8
	OppDays	Double	8
	Deaths	Double	8
	PctEarlyDead	Double	8
	MortalityIndex	Double	8
	DenomCases	Double	8
	PctReadmits	Double	8
	AvgICUDays	Double	8
	PctICUCases	Double	8
	RiskPool	Double	8
	PctComps	Double	8

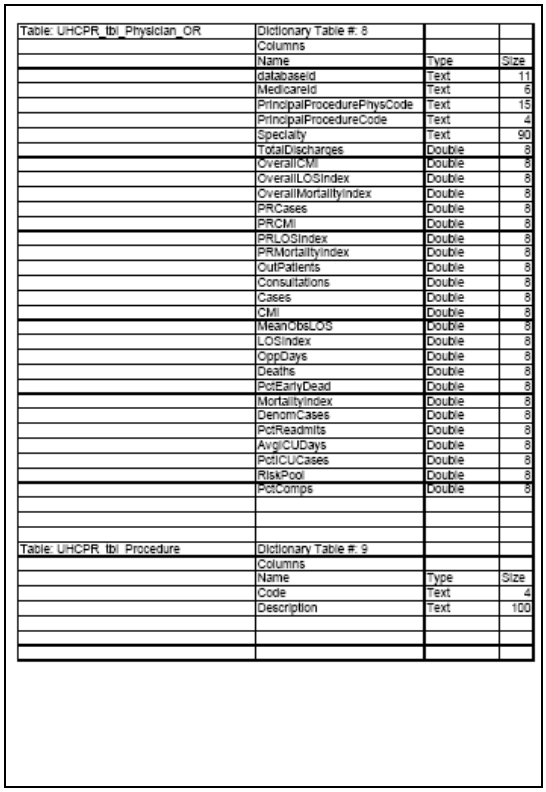


Table: UHCPR_tbl_Physician_OR	Dictionary Table #: 8		
	Columns		
	Name	Type	Size
	databaseId	Text	11
	MedicareId	Text	6
	PrincipalProcedurePhysCode	Text	15
	PrincipalProcedureCode	Text	4
	Specialty	Text	90
	TotalDischarges	Double	8
	OverallCMI	Double	8
	OverallLOSIndex	Double	8
	OverallMortalityIndex	Double	8
	PRCases	Double	8
	PRCMI	Double	8
	PRLOSIndex	Double	8
	PRMortalityIndex	Double	8
	OutPatients	Double	8
	Consultations	Double	8
	Cases	Double	8
	CMI	Double	8
	MeanObsLOS	Double	8
	LOSIndex	Double	8
	OppDays	Double	8
	Deaths	Double	8
	PctEarlyDead	Double	8
	MortalityIndex	Double	8
	DenomCases	Double	8
	PctReadmits	Double	8
	AvgICUDays	Double	8
	PctICUCases	Double	8
	RiskPool	Double	8
	PctComps	Double	8
Table: UHCPR_tbl_Procedure	Dictionary Table #: 9		
	Columns		
	Name	Type	Size
	Code	Text	4
	Description	Text	100

Data Dictionary

Table: UHCPR_tbl_UHC_Attesting	Dictionary Table #: 10		
	Columns		
	Name	Type	Size
	databaseId	Text	11
	PrincipalDiagnosisCode	Text	5
	Cases	Double	8
	CMI	Double	8
	MeanObsLOS	Double	8
	LOSIndex	Double	8
	OppDays	Double	8
	Deaths	Double	8
	MortalityIndex	Double	8
	DenomCases	Double	8
	PctReadmits	Double	8
	PctEarlyDead	Double	8
	AvgICUDays	Double	8
	PctICUCases	Double	8
	RiskPool	Double	8
	PctComps	Double	8

Table: UHCPR_tbl_UHC_OR	Dictionary Table #: 11		
	Columns		
	Name	Type	Size
	databaseId	Text	11
	PrincipalProcedureCode	Text	4
	Cases	Double	8
	CMI	Double	8
	MeanObsLOS	Double	8
	LOSIndex	Double	8
	OppDays	Double	8
	Deaths	Double	8
	MortalityIndex	Double	8
	DenomCases	Double	8
	PctReadmits	Double	8
	PctEarlyDead	Double	8
	AvgICUDays	Double	8
	PctICUCases	Double	8
	RiskPool	Double	8
	PctComps	Double	8

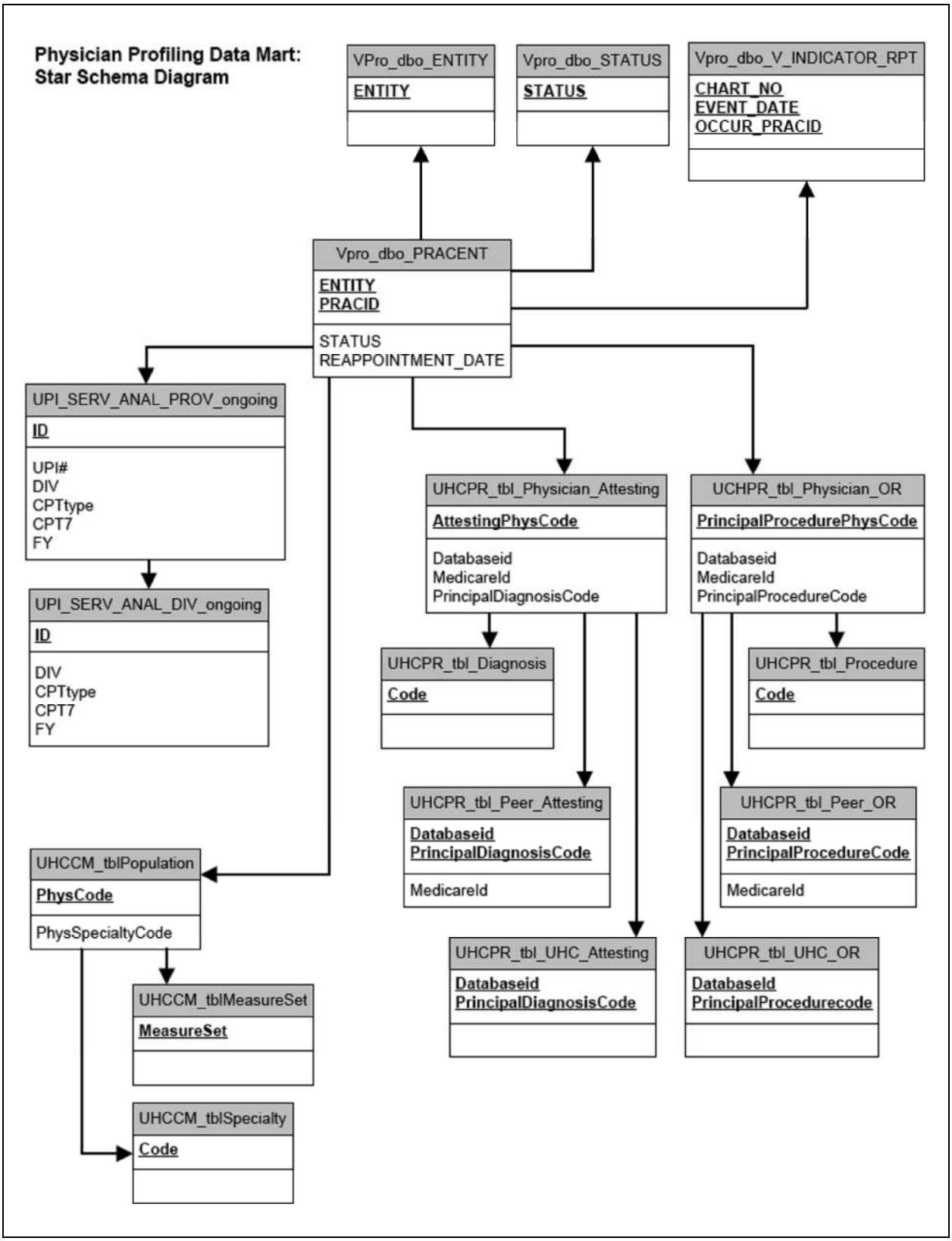
Table: UPI_SERV_ANAL_DIV_ongoing	Dictionary Table #: 12		
	Columns		
	Name	Type	Size
	ID	Long Integer	4
	Group#	Text	50
	Period	Text	50
	Groupname	Text	50
	LocationCat1	Text	50
	Division	Text	255
	CPTtype	Text	255
	CPT7	Text	255
	CPTdescription	Text	255
	CPT	Text	255
	Volume	Long Integer	4
	YTD$	Double	8
	FY	Text	50

Table: UPI_SERV_ANAL_PROV_ongoing	Dictionary Table #: 13		
	Columns		
	Name	Type	Size
	ID	Long Integer	4
	Group#	Text	255
	Period	Text	255
	Groupname	Text	255
	LocationCat1	Text	255
	Division	Text	255
	Provider	Text	255
	UPI#	Text	255
	CPTtype	Text	255
	CPT7	Text	255
	CPTdescription	Text	255
	CPT	Text	50
	Volume	Long Integer	4
	YTD$	Double	8
	FY	Text	50

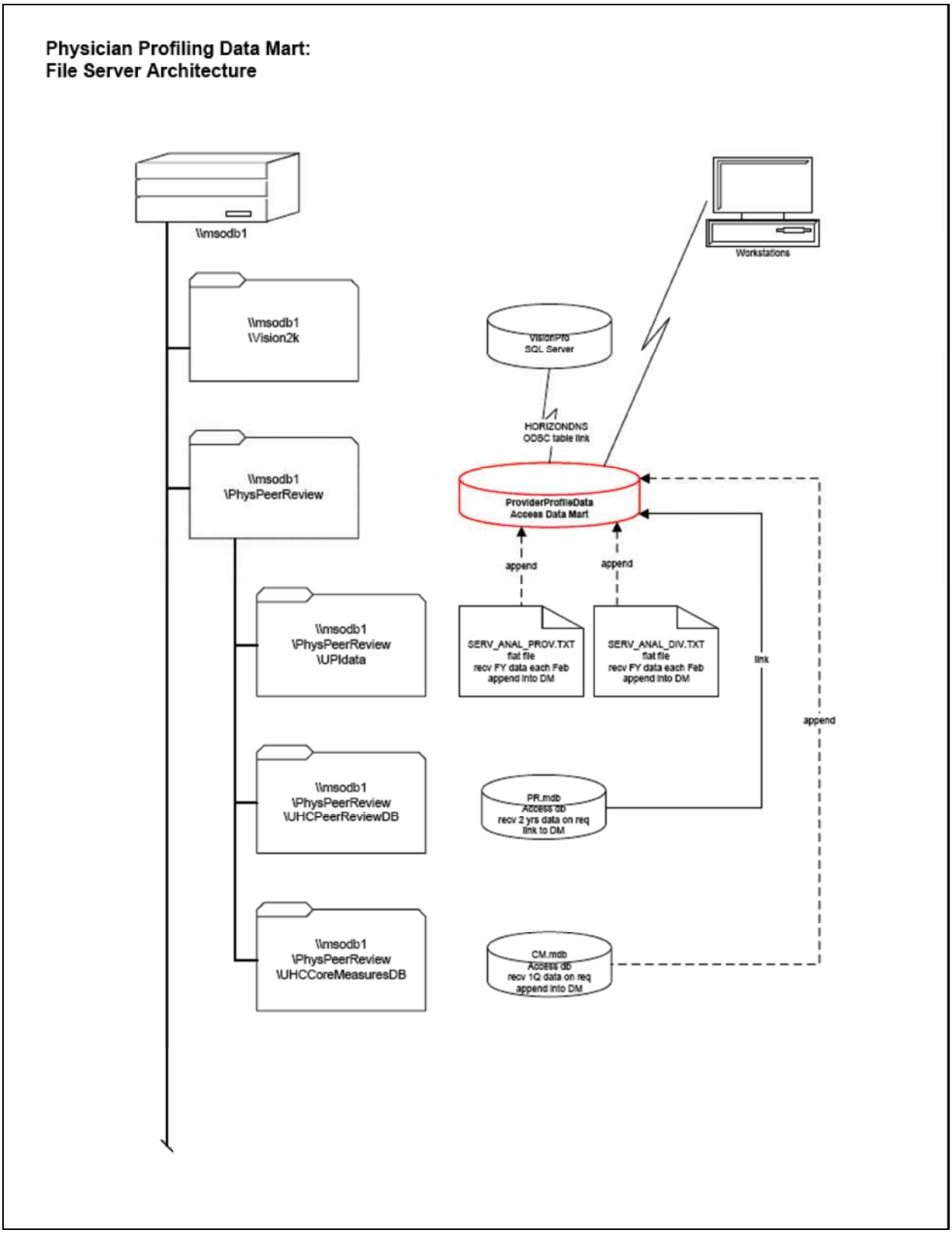
Table: Vpro_dbo_ENTITY	Dictionary Table #: 14		
	Columns		
	Name	Type	Size
	ENTITY	Text	4
	DESCRIPTION	Text	40
	ADDR1	Text	60
	ADDR2	Text	60
	ADDR3	Text	60
	ADDR4	Text	60
	ENTTYPE	Text	4
	NPDB_ID	Text	15
	NPDB_NAME	Text	40
	NPDB_TITLE	Text	40
	NPDB_PHONE	Text	30
	NPDB_SENT	Text	1
	QP_ENT	Text	40
	DEF_LIC_ST	Text	2
	NCQA	Text	1
	JCAHO	Text	1
	NPDB_EXT	Text	6
	NPDB_MAILBOX	Text	12
	NOTES	Memo	-
	LAST_CHANGE	Date/Time	8
	NPDB_PASSWD	Text	20
	NPDB_CC	Text	40
	NPDB_CC_EXPDT	Text	6
	NPDB_MBOX	Text	20
	NPDB_CC_NAME	Text	100
	NPDB_CC_ADDR1	Text	40
	NPDB_CC_ADDR2	Text	40
	NPDB_CC_CITY	Text	28
	NPDB_CC_STATE	Text	2
	NPDB_CC_ZIP5	Text	5
	NPDB_CC_ZIP4	Text	4
	IS_AGENT	Text	1
	AGENT_DBID	Text	20
	EMAIL	Text	50
	EMAIL2	Text	50
	DISABLE	Text	1
	PRIMARY_ENT	Text	1

Table: Vpro_dbo_PRACENT	Dictionary Table #: 15		
	Columns		
	Name	Type	Size
	PRACNO	Text	10
	ENTITY	Text	4
	NAME	Text	40
	PRACID	Text	10
	ENTDEPT	Text	4
	ENTSECT	Text	4
	STATUS	Text	4
	STATUS_DATE	Date/Time	8
	APPLICATION_DATE	Date/Time	8
	DATA_ENTRY_DATE	Date/Time	8
	CRED_STATUS	Text	4
	DEPT_APPROVE_DATE	Date/Time	8
	CRED_COMMITTEE_DATE	Date/Time	8
	EXEC_COMMITTEE_DATE	Date/Time	8
	BOARD_DATE	Date/Time	8
	COMPLETE_DATE	Date/Time	8
	SENT_DATE	Date/Time	8
	NOTES	Memo	-
	ADMIT_PRIVS	Text	1
	REAPPOINTMENT_DATE	Date/Time	8
	APPL_FEE	Double	8
	ORIG_APPT_DATE	Date/Time	8
	LAST_APPT_DATE	Date/Time	8
	DELEGATED	Text	1
	PROV_APPT_END	Date/Time	8
	DUESYEAR	Text	4
	PRACTYPE	Text	1
	LAST_CHANGE	Date/Time	8
	TERMINATE	Text	50
	TERM_DATE	Date/Time	8
	REAPSTAT_START_DATE	Date/Time	8
	SPECIALTY	Text	4
	PRIMARY_ENT	Text	1
	DUES_AMT	Text	10
	APP_SIGN_DT	Date/Time	8
	UDFDATA2	Text	40
	UDFDATA3	Text	40
	UDFDATE1	Date/Time	8
	UDFDATE2	Date/Time	8
	UDFCHK1	Text	1
	DEPT_CODE_KEY	Long Integer	4
	SECTKEY	Long Integer	4
	NO_ADMITTING	Text	1
	NO_SEDATION	Text	1
	NO_PRESCRIBE_DRUGS	Text	1
	UDFDATA1	Text	50

Table: Vpro_dbo_STATUS	Dictionary Table #: 16		
	Columns		
	Name	Type	Size
	STATUS	Text	4
	DESCRIPTION	Text	40
	LAST_CHANGE	Date/Time	8
Table: Vpro_dbo_V_INDICATOR_RPT	Dictionary Table #: 17		
	Columns		
	Name	Type	Size
	ENTITY	Text	4
	ENT_DESC	Text	40
	ATTEN_PRACNO	Text	10
	OCCUR_PRACNO	Text	10
	INDICATOR_CODE	Text	7
	INDICATOR_ID	Long Integer	4
	IND_DESC	Text	225
	GROUP_CODE	Text	3
	GROUP_DESC	Text	40
	CHART_NO	Text	50
	MEETING_DATE	Date/Time	8
	DISCHARGE_DATE	Date/Time	8
	EVENT_DATE	Date/Time	8
	ADMIT_DATE	Date/Time	8
	DIAGNOSIS	Text	200
	REVIEW_DATE	Date/Time	8
	OCCUR_PRACID	Text	10
	OCCUR_NAME	Text	40
	ATTEN_PRACID	Text	10
	ATTEN_NAME	Text	40
	CONC_CODE	Text	4
	CONCLUSION	Text	60
	REVIEW_TYPE	Long Integer	4
	PEER_CODE	Text	10
	REVIEWER_NAME	Text	40
	PEER_BODY	Text	45
	ACT_CODE	Text	4
	ACTION	Text	60
	STATUS_CODE	Text	4
	REVIEWER_COMMENTS	Memo	-
	STATUS_DESC	Text	60
	ACTIONS	Memo	-
	CONCLUSIONS	Memo	-
	FINDINGS	Memo	-
	RECOMMENDATIONS	Memo	-



Star Schema Diagram



File Server Architecture Diagram

Physician Profiling Data Mart:
Importing UPI Data into the Data Mart

UPI sends two files twice a year that contain physician/division volume data:
February: files contain data from the previous six months (July-December)
August: files contain volume data from the previous twelve months (July-June)

A six-month overlap exists with the files sent in February and August (ie, July-December data are included in each set). Therefore, disregard the files received in February to avoid duplicating this partial-year in the data mart. ***Import only the August files into the data mart***, as these files contain volume data for a full fiscal year.

How to import the annual UPI data:

1. Obtain the following two files from UPI:
SERV_ANAL_PROV_mmyy.TXT
SERV_ANAL_DIV_mmyy.TXT
(mmyy = month and year of file creation, ex 0107 = January 2007, 0807 = August 2007)

2. Place these two files in the following folder:
\\msodb1\PhysPeerReview\UPIdata

3. Copy and rename the files by removing "_mmyy" from the name, as follows:
SERV_ANAL_PROV.TXT
SERV_ANAL_DIV.TXT
Keep the original files in the folder as backups.

4. Open the data mart.
Unhide the hidden tables, queries, and macros, as follows:
Click Tools on the menu bar > Options > View tab
In the Show section, click to select "Hidden objects"

5. Run the macro "UPI_Import_DIV-PROV"

6. Hide the hidden tables, queries, and macros, as follows:
Click Tools on the menu bar > Options > View tab
In the Show section, click to deselect "Hidden objects"

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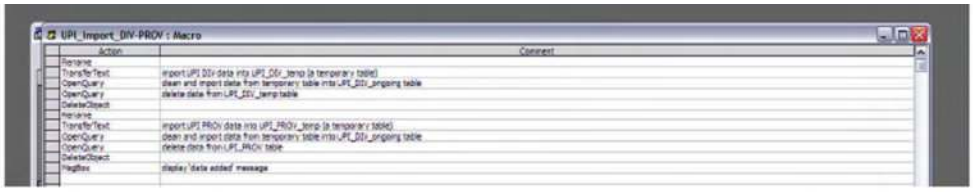
Importing UPI Data into the Data Mart instructions

Physician Profiling Data Mart:
UPI_Import_DIV-PROV Macro Description

This macro helps to automate the import of annual UPI volume data into the data mart.

Before running this macro, it is absolutely imperative that the new UPI DIV and PROV data files are properly saved and renamed as explained in the instructions entitled "Importing annual UPI Data into the Data Mart".

Note that this macro and the related tables and queries are hidden.



Actions to import DIV data
Rename
Table UPI_SERV_ANAL_DIV_temp to UPI_SERV_ANAL_DIV_tempOLD

TransferText
Import UPI file \\msodb1\PhysPeerReview\UPIdata\SERV_ANAL_DIV.TXT
Into table UPI_SERV_ANAL_DIV_temp
Using spec UPI_DIV

OpenQuery
UPI_DIV_AppendNewData to clean* and import data from temp table to ongoing table
(* add headings, convert CPT7 codes to CPT5; prompts for new data fiscal year)

OpenQuery
UPI_DIV_DeleteTempData to delete data from temp table
(must keep table to maintain query integrity, but delete data to prevent accidental reimporting)

DeleteObject
Table UPI_SERV_ANAL_DIV_tempOLD

Repeat each action to import PROV data
Rename > TransferText > OpenQuery > OpenQuery > DeleteObject

Display message that the import is done
MsgBox
"Data successfully added to DIV & PROV tables"

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Importing UPI Data into the Data Mart macro documentation

Physician Profiling Data Mart:
Importing UHC CM Data into the Data Mart

UHC sends a Microsoft Access database that contains one quarter of Core Measures (CM) compliance data via their website's Secure Data Exchange. It is necessary to append the data from the UHC database tables into the data mart tables.

How to import the quarterly CM data:

1. Download the following database file from UHC:
CM_yyyyqq.mdb
(yyyyqq = year and calendar quarter of data, ex 2007Q1 = 2007 Quarter 1 January-March)

2. Place this files in the following folder:
\\msodb1\PhysPeerReview\UHCCoreMeasuresDB

3. Copy and rename the file by removing "_yyyyqq" from the name and keeping only the "CM":
CM.mdb
Keep the original file in the folder as backups.

4. Open the data mart.
Unhide the hidden tables, queries, and macros, as follows:
Click Tools on the menu bar > Options > View tab
In the Show section, click to select "Hidden objects"

5. Double-check the field size of the MeasureSet fields in tblMeasureSet (12), tblPopulation (15) in the data mart, as the fields must be large enough to receive new data. The size of the MeasureSet codes are subject to change as new measures are added, thus it is important to accommodate the change in size.

5. Run the macro "UHCCM_Import_MeasureSet-Population-Specialty"

6. Hide the hidden tables, queries, and macros, as follows:
Click Tools on the menu bar > Options > View tab
In the Show section, click to deselect "Hidden objects"

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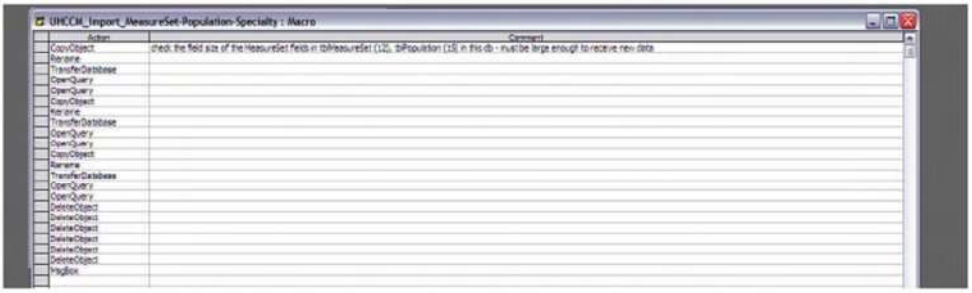
Importing UCHCM Data into the Data Mart instructions

Physician Profiling Data Mart:
UHCCM_Import_MeasureSet-Population-Specialty Macro Description

This macro helps to automate the import of quarterly Core Measures data into the data mart. Note that this macro and the related tables and queries are hidden.

Before running this macro, it is absolutely imperative that the new CM database file is properly saved and renamed as explained in the instructions entitled "Importing CM Data into the Data Mart".



Actions to import CM tblMeasureSet data into the data mart table
CopyObject
Copy table UHCCM_tblMeasureSet to UHCCM_tblMeasureSet_bu

Rename
Rename table UHCCM_tblMeasureSet_temp to UHCCM_tblMeasureSet_tempOLD

TransferDatabase
Import CM table tblMeasureSet to the datamart table UHCCM_tblMeasureSet_temp

OpenQuery
UHCCM_MeasureSet_AppendNewData to import data from the temp table to the ongoing table

OpenQuery
UHCCM_MeasureSet_DeleteTempData to delete data from the temp table
(must keep table to maintain query integrity, but delete data to prevent accidental reimporting)

Repeat each action to import tblPopulation and tblSpecialty data
CopyObject > Rename > TransferDatabase > OpenQuery > OpenQuery

Delete objects
DeleteObject – six separate actions
Delete _bu and _tempOLD tables for tblMeasureSet, tblPopulation, tblSpecialty

Display message that the import is done
MsgBox
"Done. If no errors appeared, this worked fine - otherwise, check the results!"

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Importing UCHCM Data into the Data Mart macro documentation

Physician Profiling Data Mart:
Updating UHC PR Data to link to the Data Mart

UHC sends a Microsoft Access database that contains two years of Peer Review (PR) compliance data via their website's Secure Data Exchange. The data mart links to the tables in the UHC database. To link to the new data, it is as simple as "swapping" the old UHC PR database with the new one.

How to link to the new PR data:

1. Download the following database file from UHC:
PR.mdb

2. Place the file in the following folder:
\\msodb1\PhysPeerReview\UHCPeerReviewDB
Because an existing version of the UHC PR database already exists in this folder with the same name, you may either first delete the existing database or simply overwrite it.

3. Make a copy of the new PR.mdb, appending the timeframe to the name, as follows:
PR_thruyyyymm.mdb (ex PR_thru200712.mdb for data through December 2007)
Keep this copy in the folder as a backup.

4. Open the data mart.
Confirm that the UHCPR tables link correctly to the new database tables.

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Updating UHCPR Data to link to the Data Mart instructions

Appendix D: Systems Development Life Cycle *Implementation* Phase Documents

This appendix contains the following documents that summarize the activity within and successful completion of the Systems Development Life Cycle (SDLC) Implementation Phase of the data mart project:

- Testing the Data Mart instructions
- Connecting to the Share Directory instructions
- Using the Data Mart instructions
- System Evaluation Report

Physician Profiling Data Mart:
Testing the Data Mart

The Physician Profiling Data Mart system contains profiling data from a variety of sources:

- VisionPro Peer Review
- UPI Volumes for physicians and divisions
- UHC Core Measures compliance comparisons
- UHC Peer Review outcomes and effectiveness comparisons

The system lets the user run reports from each of these sources by reappointment data range or by individual physician number.

To test that the data mart is operating **accurately**:

1. Run each of the reports twice: once for a reappointment date range, then again for a single physician.
2. Compare the contents of each of the reports to the content of the same reports from the originating sources.
3. Document the comparison in the grid below by indicating whether the report is an exact match ("ok") or different (specify the difference) from the originating sources.

Data Mart Report	**Timeframe Used (beginning-ending dates)**	**Individual Physician (UPI#)**	**Comparison to Originating Source**
Practitioner List	NA	NA	
Reappointment List		NA	
Vision Peer Review Profile			
UPI Volumes Profile			
UHC Attesting/Procedure Profile			
UHC Core Measures Profile			

How would you rate the **ease of use**: hard to use…….ok…….easy to use

Comments: _____

_____

Page 1 of 1

Testing the Data Mart instructions

Physician Profiling Data Mart:
Connecting to the Share Directory

The Physician Profiling Data Mart system is housed in a secure network share directory: PhysPeerReview on msodb1 .

You can access the directory either through a mapped network drive or through a shortcut that you can create on your desktop.

How to connect to the share directory through a mapped network drive:

1. Right-click on your My Computer Icon
2. Select Map Network drive
3. In the Map Network Drive window, select an unused drive letter from the Drive drop down list; ex. P:
4. In the Folder box, type "\\msodb1\PhysPeerReview" (without the quotes)
5. If you would like the drive to be remapped every time you log in, check the Reconnect at Logon Box
6. Click OK

How to connect to the share directory through a desktop shortcut (preferred method):

1. Right-click on any blank spot on your desktop; select New > Shortcut
2. In the Create Shortcut window, type "\\msodb1\PhysPeerReview" (without the quotes); click Next
3. Type in a new name for your shortcut or accept the default by clicking on Finish

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Connecting to the Share Directory instructions

Physician Profiling Data Mart:
Using the Data Mart

The Physician Profiling Data Mart system contains profiling data from a variety of sources:

- VisionPro Peer Review
- UPI Volumes for physicians and divisions
- UHC Core Measures compliance comparisons
- UHC Peer Review outcomes and effectiveness comparisons

The system lets you chose whether to print profiling reports for all physicians who are due for reappointment for any timeframe or for one specific physician.

How to run reports in the data mart:

1. Open the data mart by clicking the icon on your computer desktop.
2. Microsoft Access Opens and the Provider Profile Reports menu appears.

3. Click the button next to the report that you want to run.
4. A message box appears that asks you to enter a starting reappointment date.

If you want to run reports for all physicians who are due for reappointment for a given month, enter the beginning date of that month – ex. type 01/01/2009 for January 2009 reappointments – then click the OK button.

If you want to run a report for only one specific physician, leave the box blank and click the OK button.

Using the Data Mart instructions

5. A second message box appears that asks you to enter an ending reappointment date.

If you want to run reports for all physicians who are due for reappointment for a given month, enter the ending date of that month – ex. type 01/31/2009 for January 2009 reappointments – then click the OK button.

If you want to run a report for only one specific physician, leave the box blank and click the OK button.

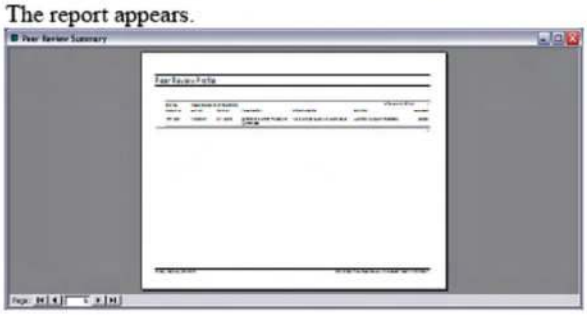
6. A third message box appears that asks you to enter a provider number.

If you want to run reports for all physicians who are due for reappointment for a given month, leave the box blank and click the OK button.

If you want to run a report for only one specific physician, type the UPI# using the pound sign and 5-digit format – ex. #00999 – then click the OK button.

7. A final message box appears that asks for your login information. This is a security feature that controls access to the VisionPro database. Type your Login ID and Password, then enter the OK button.

8. The report appears.



Physician Profiling Data Mart:
System Evaluation Report

The Physician Profiling Data Mart was created to achieve two goals: 1) to collect and consolidate performance data from multiple sources and 2) to generate comprehensive reports that will summarize the safety and effectiveness of each physician's practice.

The data mart system contains profiling data from a variety of sources:

- VisionPro Peer Review
- UPI Volumes for physicians and divisions
- UHC Core Measures compliance comparisons
- UHC Peer Review outcomes and effectiveness comparisons

The system lets the user chose whether to print profiling reports for all physicians who are due for re-credentialing for any timeframe or for one specific physician on demand.

As the following summary demonstrates, the system meets its goals:

System availability: During its brief life, the system has proven to be readily available. Because the system is built in Microsoft Access, it can be added/used at any workstation at no or minimal additional cost (an Access license is required only for newer workstations having an asset tag in the 100000 series; older workstations do not require a separate license).

Accuracy of output: During the system testing period, a variety of reports were run from the data mart system, and the content of these reports matched the content from the originating sources.

Timeliness of information: The data mart system links directly to the VisionPro source, thus these data are real-time. However, for the remaining three data sources (UPI, UHC CM, and UHC PR), the timeliness of the data in the data mart system is dependent on the timeliness with which these sources send us their data. Only a minimal time lag exists between the time the originating sources send the data and the time that it is imported into the data mart system. Thus, although some of the data are not as current as desired in the data mart system, it is no less current in this system than when running reports from the originating sources.

System security: Because the system is housed in a secure network share directory, only specified individuals have access to it. Furthermore, before running a report, the system prompts the user to enter VisionPro login information. Thus, a dual layer of security exists.

Completeness of documentation: System documentation has been provided that describes the data base architecture, data update process, system use, and enhancement requests.

Ease of use: The system lets the user run a variety of reports from four different sources; the format of the output allows easier separation of each physician's content. The reports provide a more comprehensive summary of physician performance than had been previously available. However, because this system makes more content available, it will next be necessary to create an executive summary report that rolls up the key points of each physician's performance.

Page 1 of 1

System Evaluation Report

Appendix E: Systems Development Life Cycle *Maintenance* Phase Documents

This appendix contains the following documents that summarize the activity within and successful completion of the Systems Development Life Cycle (SDLC) Maintenance Phase of the data mart project:

- Requesting a Change form
- Samples of the Profiling Reports

  (Note that data have been stripped to preserve physician and patient confidentiality)

  - Report Menu
  - Practitioner List
  - Reappointment List
  - Vision Peer Review Profile
  - UPI Volumes Profile
  - UHC Attesting/Procedure Profile
  - UHC Core Measures Profile

Physician Profiling Data Mart:
Requesting a Change

The data mart system contains profiling data from a variety of sources:

- VisionPro Peer Review
- UPI Volumes for physicians and divisions
- UHC Core Measures compliance comparisons
- UHC Peer Review outcomes and effectiveness comparisons

The system lets you chose whether to print profiling reports for all physicians who are due for reappointment for any timeframe or for one specific physician.

If you need a change or enhancement to the system, please provide the appropriate information and submit this form to the system administrator.

☐ Add a new report: _____

☐ Add a new way to run an existing report: _____

☐ Change the content or format of an existing report: _____

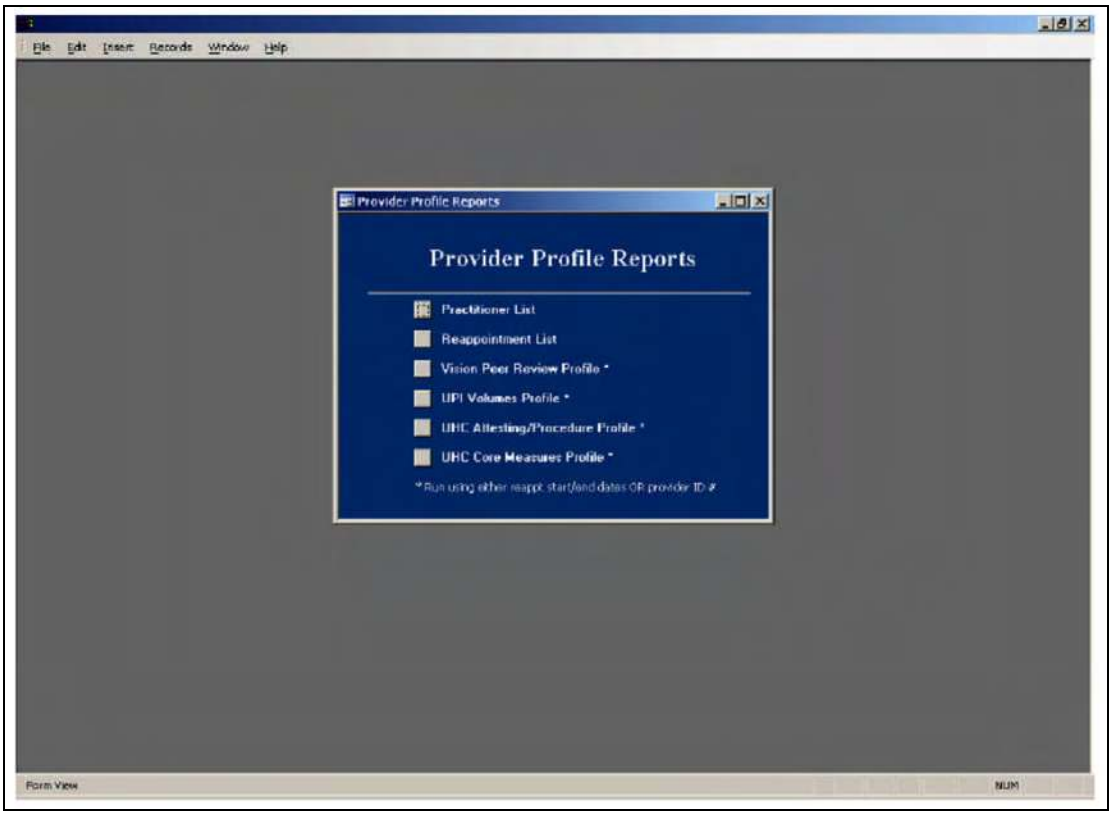
☐ Add or remove a user: _____

☐ Other: _____

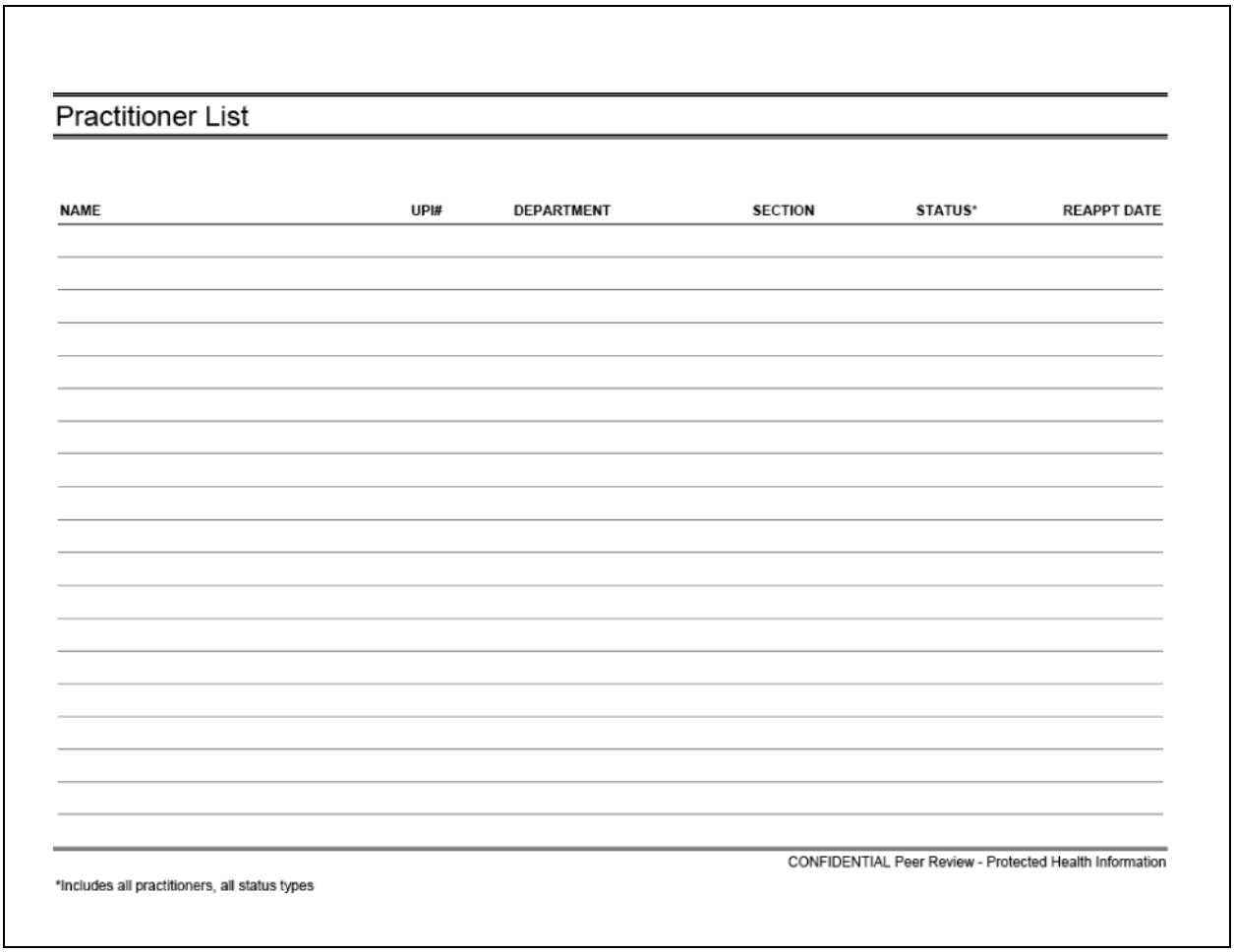
_____
Name

Page 1 of 1

Requesting a Change form



Data Mart Report Menu



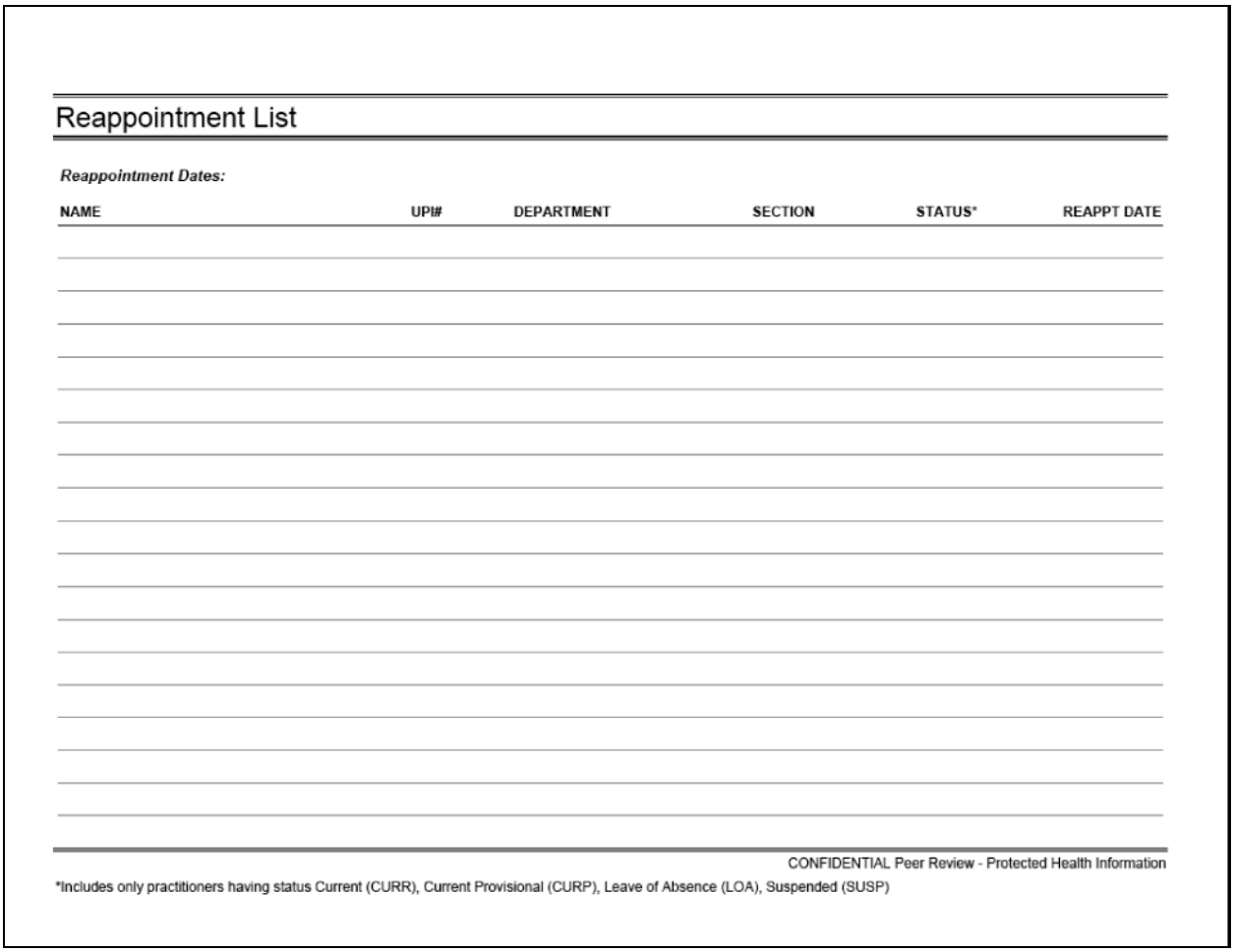
Practitioner List

NAME	UPI#	DEPARTMENT	SECTION	STATUS*	REAPPT DATE

CONFIDENTIAL Peer Review - Protected Health Information

*Includes all practitioners, all status types

Practitioner List report



Reappointment List

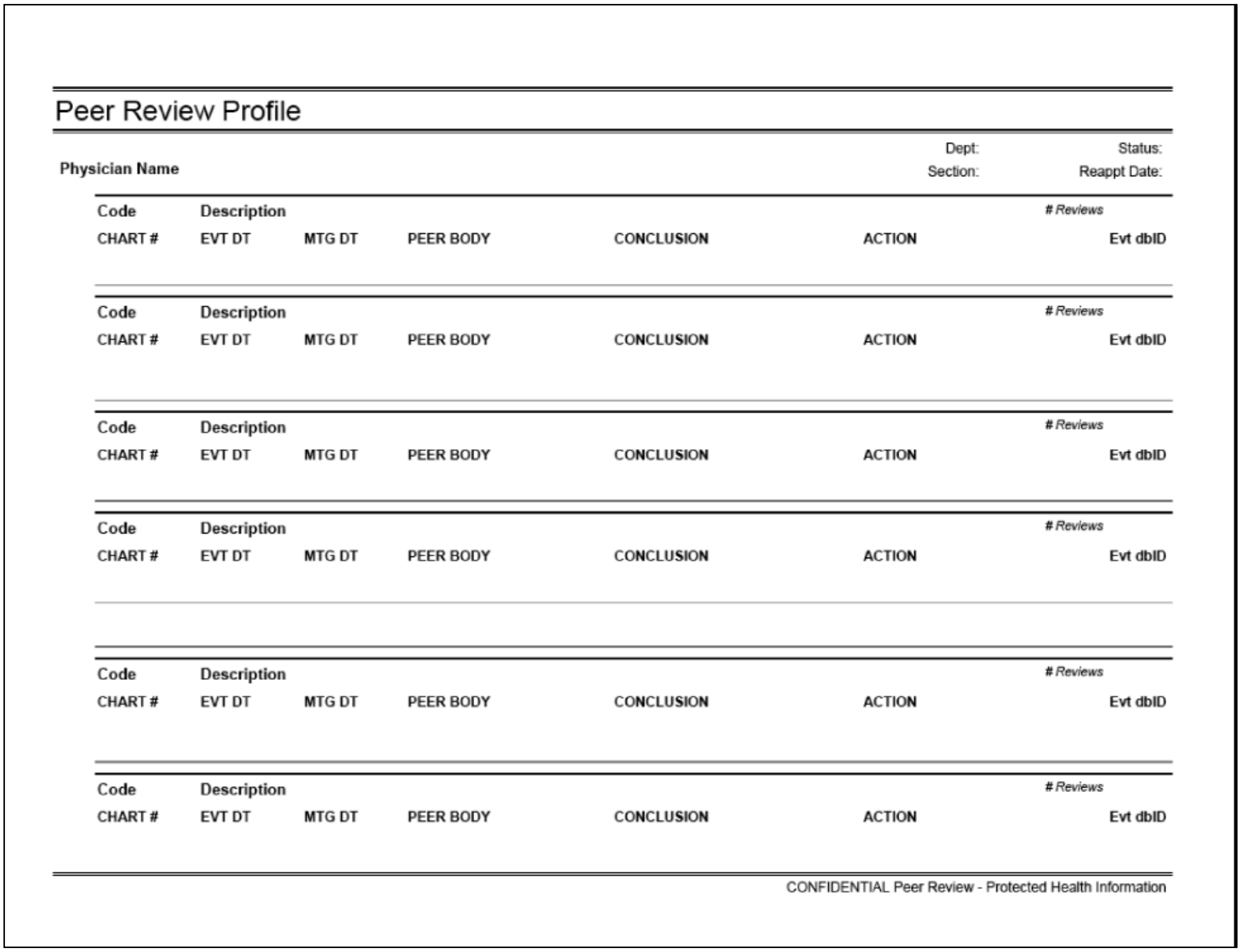
Reappointment Dates:

NAME	UPI#	DEPARTMENT	SECTION	STATUS*	REAPPT DATE

CONFIDENTIAL Peer Review - Protected Health Information

*Includes only practitioners having status Current (CURR), Current Provisional (CURP), Leave of Absence (LOA), Suspended (SUSP)

Reappointment List report



Peer Review Profile

Physician Name		Dept:	Status:
		Section:	Reappt Date:

Code	Description					# Reviews
CHART #	EVT DT	MTG DT	PEER BODY	CONCLUSION	ACTION	Evt dbID

Code	Description					# Reviews
CHART #	EVT DT	MTG DT	PEER BODY	CONCLUSION	ACTION	Evt dbID

Code	Description					# Reviews
CHART #	EVT DT	MTG DT	PEER BODY	CONCLUSION	ACTION	Evt dbID

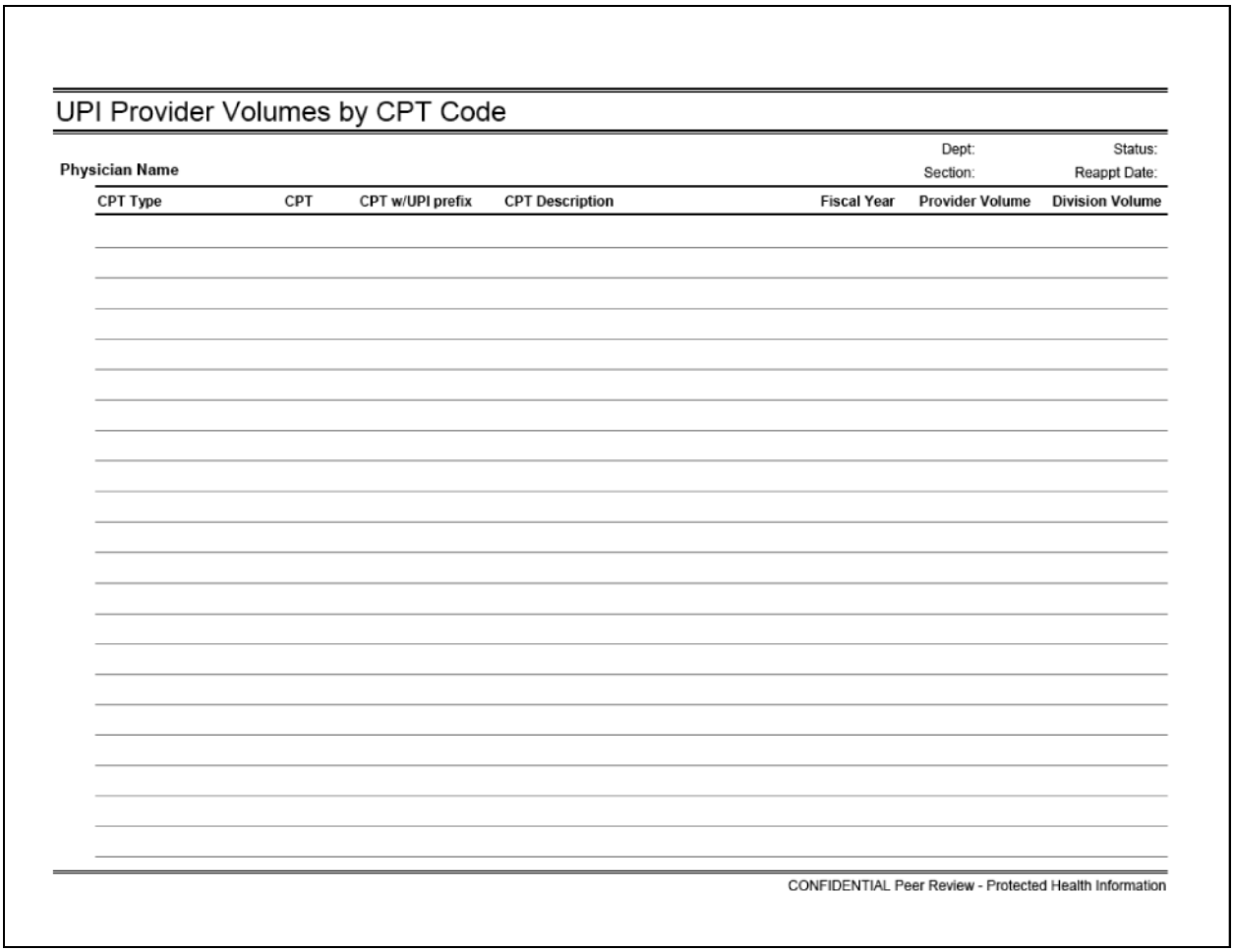
Code	Description					# Reviews
CHART #	EVT DT	MTG DT	PEER BODY	CONCLUSION	ACTION	Evt dbID

Code	Description					# Reviews
CHART #	EVT DT	MTG DT	PEER BODY	CONCLUSION	ACTION	Evt dbID

Code	Description					# Reviews
CHART #	EVT DT	MTG DT	PEER BODY	CONCLUSION	ACTION	Evt dbID

CONFIDENTIAL Peer Review - Protected Health Information

Vision Peer Review Profile report



UPI Provider Volumes by CPT Code

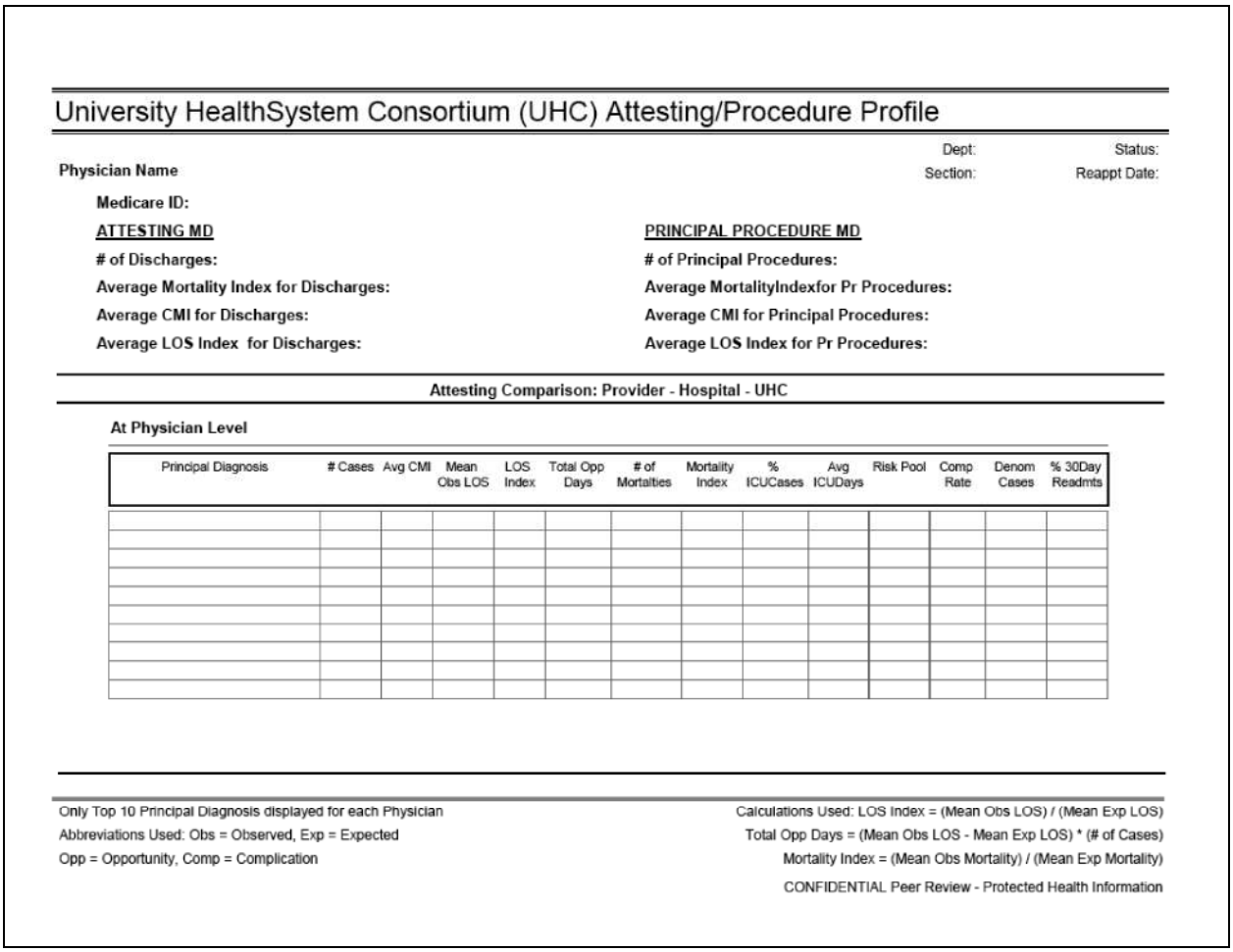
Physician Name

Dept: Status:
Section: Reappt Date:

CPT Type	CPT	CPT w/UPI prefix	CPT Description	Fiscal Year	Provider Volume	Division Volume

CONFIDENTIAL Peer Review - Protected Health Information

UPI Volumes Profile report



University HealthSystem Consortium (UHC) Attesting/Procedure Profile

Dept: Status:

Physician Name Section: Reappt Date:

Medicare ID:

ATTESTING MD

# of Discharges:

Average Mortality Index for Discharges:

Average CMI for Discharges:

Average LOS Index for Discharges:

PRINCIPAL PROCEDURE MD

# of Principal Procedures:

Average MortalityIndexfor Pr Procedures:

Average CMI for Principal Procedures:

Average LOS Index for Pr Procedures:

Attesting Comparison: Provider - Hospital - UHC

At Physician Level

Principal Diagnosis	# Cases	Avg CMI	Mean Obs LOS	LOS Index	Total Opp Days	# of Mortalties	Mortality Index	% ICUCases	Avg ICUDays	Risk Pool	Comp Rate	Denom Cases	% 30Day Readmts

Only Top 10 Principal Diagnosis displayed for each Physician

Abbreviations Used: Obs = Observed, Exp = Expected

Opp = Opportunity, Comp = Complication

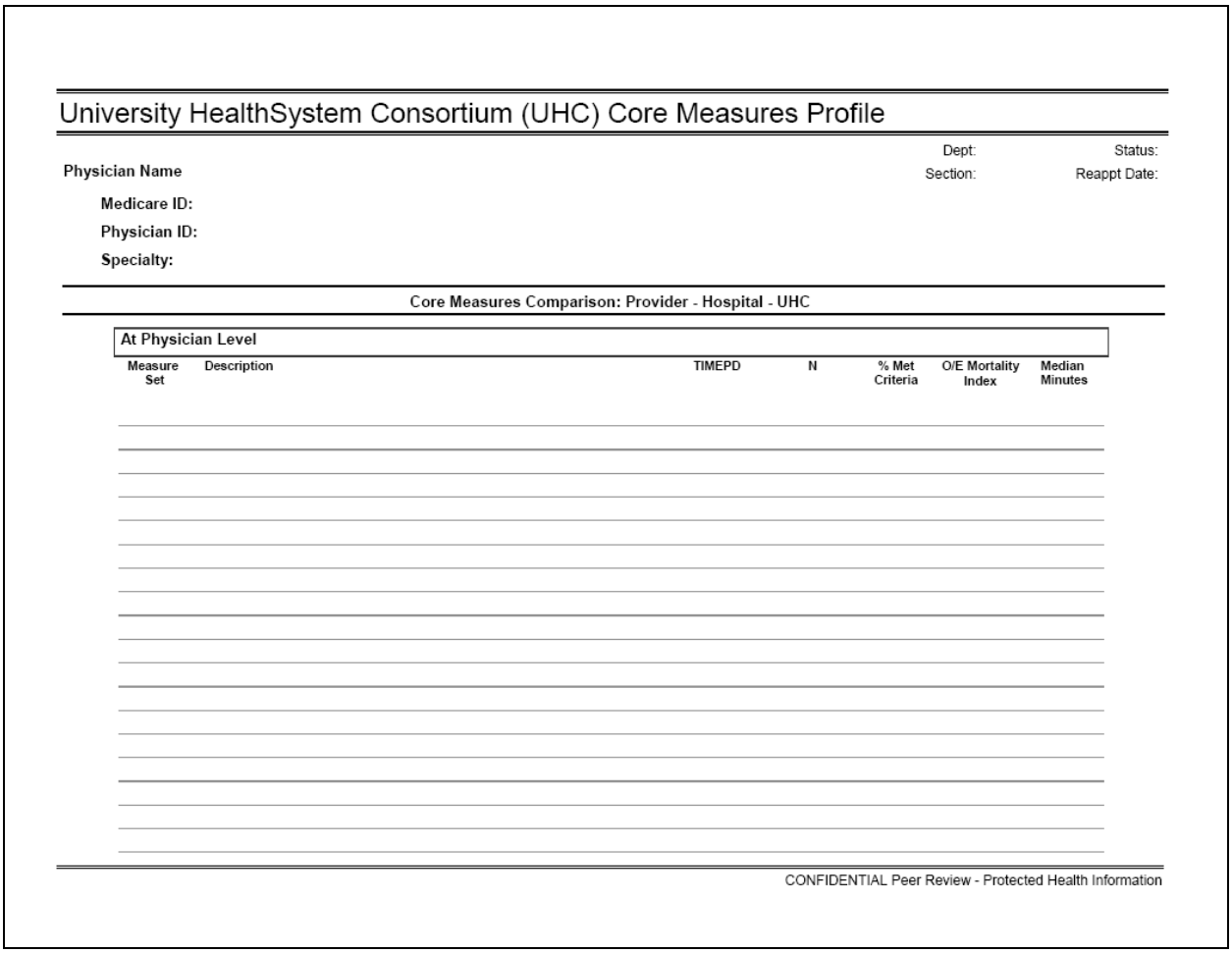
Calculations Used: LOS Index = (Mean Obs LOS) / (Mean Exp LOS)

Total Opp Days = (Mean Obs LOS - Mean Exp LOS) * (# of Cases)

Mortality Index = (Mean Obs Mortality) / (Mean Exp Mortality)

CONFIDENTIAL Peer Review - Protected Health Information

UHC Attesting/Procedure Profile report



University HealthSystem Consortium (UHC) Core Measures Profile

Dept: Status:

Physician Name Section: Reappt Date:

Medicare ID:

Physician ID:

Specialty:

Core Measures Comparison: Provider - Hospital - UHC

At Physician Level

Measure Set	Description	TIMEPD	N	% Met Criteria	O/E Mortality Index	Median Minutes

CONFIDENTIAL Peer Review - Protected Health Information

UHC Core Measures Profile report

Annotated Bibliography

Adamson, C. (2006). *Mastering data warehouse aggregates*. Indianapolis: Wiley Publishing, Inc.

Adamson's book can easily serve as a practical resource for data warehouse and analyst professionals, as it provides a wide summary of concepts in a clear and concise manner. The explanations of star schema architecture, fact and dimension tables, and the extract-transform-load process were especially helpful.

Ambler, S. (2005). *A manager's introduction to the rational unified process*. Retrieved August 8, 2008, from http://www.ambysoft.com/downloads/managersIntroToRUP.pdf

Ambler wrote this white paper to serve as a high-level overview to RUP. The paper served as a resource to help determine whether the interactive waterfall methodology used during the data mart development was actually RUP. It was apparent from this paper that, while similarities existed between the two methodologies, some significant differences existed between them.

Baker, S., Baker, K. (2000). *The complete idiot's guide to project management (second edition).* Indianapolis: Alpha Books.

While this book is a rather elementary introduction to project management, it was still useful during the planning, development, and implementation of the data mart. It was a helpful reference for tips on project scheduling/preparing the Gantt chart and managing risks.

Becerra-Fernandez, I., Gonzalea, & Sabherwal, R. (2004). *Knowledge management: Challenges, solutions, and technologies*. Upper Saddle River, NJ: Pearson Education, Inc.

This textbook was an extremely helpful introduction to knowledge management. It began by providing basic definitions and concepts, such as the data-information-knowledge continuum, tacit vs. explicit knowledge. It then progressed to offering solid suggestions for building and using a knowledge-sharing system within an organization, such as capturing knowledge, data mining, knowledge creation.

Bellinger, G. (2004). *Knowledge Management – Emerging Perspectives*. Retrieved April 13, 2008, from http://www.systems-thinking.org/kmgmt/kmgmt.htm

Bellinger's article provided focus on key concepts of knowledge management and how they could apply to the data mart. For example, such statements as "it only becomes knowledge … when one is able to realize and understand the patterns and their implications" illuminated the realization that the data mart reports should help identify patterns and implications in physician performance.

Benbasat, I., and Zmud, R. (1999). *Empirical research in the information systems: The practice of relevance.* MIS Quarterly. Retrieved April 5, 2008, from http://find.galegroup.com.dml.regis.edu/itx/retrieve.do?contentSet=IAC-Documents&resultListType=RESULT_LIST&qrySerId=Locale%28en%2C%2C%29%3AFQE%3D%28au%2CNone%2C8%29benbasat%3AAnd%3AFQE%3D%28ke%2CNone%2C8%29research%3AAnd%3ALQE%3D%28AC%2CNone%2C8%29fulltext%24&sgHitCountType=None&inPS=true&sort=DateDescend&searchType=AdvancedSearchForm&tabID=T002&prodId=AONE&searchId=R22&currentPosition=9&userGroupName=regis&docId=A54711026&docType=IAC

These authors zeroed in on what was required to make design research relevant. This article served as a helpful resource in that it stressed such considerations as the need to

focus on actual business need and practice, strive to be pragmatic rather than academic, and communicate clearly and concisely.

Bennatan, E. M. (2000). *On time within budget (third edition)*. New York: Wiley.

With this book, Bennatan provides another practical overview of project management. Bennatan's discussion of the work breakdown structure was specifically used during the planning phase of the data mart development project.

Bertrand, A. (2008). *What are the limitations of MS Access?* Retrieved February 24, 2008, from http://databases.aspfaq.com/database/what-are-the-limitations-of-ms-access.html

In this article, Bertrand succinctly identified the limitations of Access, such as restricted size and security. This was important to consider when deciding whether it would be appropriate to use Access as the data mart vehicle. Further research indicated that these limitations would not be problematic for this project.

CAHM - *Comprehensive accreditation manual for hospitals*: The Official Handbook. (2008). Oakbrook Terrace, IL: The Joint Commission on Accreditation of Healthcare Organizations.

The CAHM contains The Joint Commission's standards with which accredited hospitals must comply. This manual served as a reference for medical staff and credentialing regulations.

Carlsson, S. (2005) *Developing information systems design knowledge: A critical realist perspective*. The Electronic Journal of Business Research Methodology. Retrieved April 14, 2008, from http://www.ejbrm.com/vol3/v3-i2/v3-i2-art1-carlsson.pdf

In this article, Carlsson explained that design research should not be so highly specific as to prevent findings from being adapted for other uses. Carlsson also stressed the need for

practical approaches over theoretical. He also referred heavily to Hevner's research framework, which helped confirm the realization that Hevner's work should reviewed for this research endeavor.

Carlsson, S. (2006). Towards an Information Systems Design Research Framework: A critical realist perspective. Retrieved April 14, 2008, from http://wesrac.usc.edu/wired/bldg-7_file/6B_1.pdf

This paper was a rewriting of Carlsson's 2005 work. It re-emphasized the need to strive for practical, usable results from a design research effort.

Chambliss, M., Rasco, T., Clark, R. & Gardner, J. (2001). *The mini electronic medical record: A low-cost, low-risk partial solution*. Journal of Family Practice. Retrieved May 2, 2008, from http://find.galegroup.com.dml.regis.edu/itx/retrieve.do?contentSet=IAC-Documents&resultListType=RESULT_LIST&qrySerId=Locale%28en%2C%2C%29%3AFQE%3D%28ke%2CNone%2C16%29microsoft+access%3AAnd%3ALQE%3D%28RE%2CNone%2C3%29ref%3AAnd%3ALQE%3D%28AC%2CNone%2C8%29fulltext%24&sgHitCountType=None&inPS=true&sort=DateDescend&searchType=AdvancedSearchForm&tabID=T002&prodId=AONE&searchId=R2&currentPosition=27&userGroupName=regis&docId=A81136238&docType=IAC

Chambliss et al. described how they were successfully able to use Microsoft Access for a specific medical application, an electronic medical record for residents. The results helped confirm the suggestion that Access would work to house the data mart.

Chenoweth, T, Schuff, D., & St. Louis, R. (2003). *A method for developing dimensional data marts*. Communications of the ACM, 24(12), 93-98.

Chenoweth et al. provided a succinct list of eight steps to consider when building a data mart. For example, step 1 consisted of "analyze the user environment;" step 2 was "develop the logical model;" step 3 being "choose the database management system;" and so on. The authors provided helpful star-schema illustrations. This article proved to be another concise resource for the actual data mart development.

Chung, L. (2004). *Microsoft Access or Microsoft SQL Server: What's right in your organization?* Retrieved February 24, 2008, from http://download.microsoft.com/download/5/d/0/5d026b60-e4be-42fc-a250-2d75c49172bc/Access_Whats_Right.doc

Chung's article discussed the benefits and limitations of Access. It provided some specific points to consider when determining whether Access would be a viable solution for the data mart.

CMS – Centers for Medicare and Medicaid Services (2008). *Conditions of participation for hospitals: Medical staff*. Retrieved February 23, 2008, from http://a257.g.akamaitech.net/7/257/2422/12feb20041500/edocket.access.gpo.gov/cfr_2004/octqtr/42cfr482.22.htm

Hospitals must comply with CMS' Conditions of Participation to remain in good standing with this federal agency. It was helpful to review the medical staff standards to know exactly what was required from the original source.

Dictionary.com. (2008). *Artifact*. Retrieved May 12, 2008, from http://dictionary.reference.com/browse/artifact

Design research resources refer to the creation of an artifact as a key component of the design research process. It was helpful to get a basic definition of 'artifact' to know exactly what one is.

Flynn. E., Ramersad, G., & Santelli, S. (2003). *Peer review and use of quality data in physician reappointment white paper*. Oak Brook, IL: University HealthSystem Consortium.

Flynn et al. wrote an extremely helpful overview of the peer review process and the need for data-driven performance monitoring. The authors provided a no-nonsense discussion of legal risks and hospital responsibilities.

Gallagher, D., Nelson, T., and Proctor, S. (2005). *Data mart*. Retrieved April 14, 2008, from http://searchsqlserver.techtarget.com/sDefinition/0,,sid87_gci211900,00.html

This very brief article provided a detailed definition of data mart and was especially helpful in identifying the differences between a data mart and data warehouse.

Greeley - The Greeley Company. (2008). *The physician profile reporter software.* Retrieved February 23, 2008: http://www.greeley.com/content/66290.pdf

This vendor report was essentially a marketing piece for the company's profiling software. It was worthwhile to determine what off-the-shelf solutions were available, and at what cost.

Harvard Medical International. (2005). *The doctor defined: The paperwork behind patient safety*. Retrieved April 27, 2008: http://www.hmiworld.org/hmi/issues/May_June_2005/forum.html

This Harvard article summarized and reinforced the need for profiling. It described an early legal case that set the precedence for hospital liability for poor physician practice.

Hevner, A., March, S., Park, J., & Ram, S. (2004) *Design science in information systems research*. MIS Quarterly. Retrieved April 5, 2008, from http://find.galegroup.com.dml.regis.edu/itx/retrieve.do?contentSet=IAC-Documents&resultListType=RESULT_LIST&qrySerId=Locale%28en%2C%2C%29%3AFQE%3D%28au%2CNone%2C6%29hevner%3AAnd%3AFQE%3D%28ke%2CNone%2C6%29design%24&sgHitCountType=None&inPS=true&sort=DateDescend&searchType=AdvancedSearchForm&tabID=T002&prodId=AONE&searchId=R1&currentPosition=1&userGroupName=regis&docId=A114743804&docType=IAC

Hevner is frequently cited by authors of other design research articles. This specific article by Hevner et al. was hugely helpful and a served as a major reference and resource for the data mart design research project. Hevner's framework for IS research helped clarify the concepts of research relevance and rigor and their associated components. The seven design research guidelines served as a model to help ensure that the data mart design research project was, indeed, a research effort and not simply a design project.

IBM – International Business Machines. (2005). *Components of a star schema*. Retrieved April 14, 2008, from http://publib.boulder.ibm.com/tividd/td/TEDW/SC32-1497-00/en_US/HTML/srfmst.htm

This very brief article helped explain the concept of a star schema, which was important to grasp for the development of the data mart.

Inmon, B. (1999). *Data mart does not equal data warehouse*. Retrieved February 23, 2008, from http://www.dmreview.com/dmdirect/19991120/1675-1.html

Inmon's article helped explain and reinforce the difference between a data mart and a data warehouse, such as their various features and limitations.

Inmon, W. H. (2005). *Building the data warehouse*. Indianapolis: Wiley Publishing, Inc.

This book by Inmon was read in its entirety in an effort to better understand warehousing concepts. Inmon discussed the evolution of data management, from decision support to warehousing; the pros and cons of data warehouses verse data marts; warehouse design; how to manage specific data structures and delivery; the consideration of end users, and the role of executive information systems.

Isken, M. W., Littig, S. J., & West. M. (2001). *A data mart for operations analysis*. Journal of Healthcare Information Management. Retreived 4/14/2008, from http://www.himss.org/content/files/ambulatorydocs/DataMartForOperationsAnalysis.pdfs

Isken et al.'s article provided an extremely helpful discussion about how one medical center built and used an Access data mart for a specific hospital business need. The explanation of their experience, such as identifying their data sources and architecture, helped conceptualize how the profiling data mart might be designed and developed.

Järvinen, P. (2005). *Action research as an approach in design science*. Retrieved April 14, 2008, from http://www.cs.uta.fi/reports/dsarja/D-2005-2.pdf

This article was somewhat complex and required multiple passes to glean valuable information from it. Järvinen agreed with many other design research authors on the concepts and importance of creating an artifact, evaluating the outcome, and the contribution of the effort. This author cited Hevner, Vaishnavi and Kuechler, and Simon, which contributed to the quest to find articles by or information on these individuals.

Jennex, M. (2008) *Exploring system use as a measure of knowledge management success*. Journal of Organizational and End User Computing. Retrieved February 24, 2008, from http://find.galegroup.com.dml.regis.edu/itx/retrieve.do?contentSet=IAC-

Documents&resultListType=RESULT_LIST&qrySerId=Locale%28en%2C%2C%29%3AFQE%3D%28ke%2CNone%2C20%29knowledge+management%3AAnd%3ALQE%3D%28RE%2CNone%2C3%29ref%3AAnd%3ALQE%3D%28AC%2CNone%2C8%29fulltext%24&sgHitCountType=None&inPS=true&sort=DateDescend&searchType=AdvancedSearchForm&tabID=T002&prodId=AONE&searchId=R1&currentPosition=12&userGroupName=regis&docId=A172134579&docType=IAC

Jennex provided good reinforcement of knowledge management concepts. Among the most important concepts: the importance of getting the right information to the right users to improve organizational performance.

The Joint Commission. (2008). *Accreditation programs - hospitals*. Retrieved February 23, 2008, from http://www.jointcommission.org/AccreditationPrograms/Hospitals/

The Joint Commission is a predominant regulatory agency in healthcare. The primary purpose of referring to this article was to capture a definition of The Joint Commission's role directly from the source.

Kraenzle Schneider, J., Schneider, J. & Lorenz, R. *Creating user-friendly databases with Microsoft Access*. Nurse Researcher. Retrieved May 2, 2008, from http://find.galegroup.com.dml.regis.edu/itx/retrieve.do?contentSet=IAC-Documents&resultListType=RESULT_LIST&qrySerId=Locale%28en%2C%2C%29%3AFQE%3D%28ke%2CNone%2C16%29microsoft+access%3AAnd%3ALQE%3D%28RE%2CNone%2C3%29ref%3AAnd%3ALQE%3D%28AC%2CNone%2C8%29fulltext%24&sgHitCountType=None&inPS=true&sort=DateDescend&searchType=AdvancedSearchForm&tabID=T002&prodId=AONE&searchId=R2&currentPosition=4&userGroupName=regis&docId=A137361406&docType=IAC

This article was written as an instructional tool to help nursing researchers create and use Access databases to support their research endeavors. It reinforced the concept that Access could serve as the repository structure for the profiling data mart.

Kuechler, B., Vaishnavi, V., & Kuechler, W. (2007). *Design [Science] Research in IS: A Work in Progress*. Retreived April 5, 2008, from http://isworld.org/researchdesign/DESRISTfinal_w.htm#ISDRcurrentIssues

This article was embedded within Vaishnavi and Kuechler's design research website. Although it was not specifically referred to within the body of this thesis, it nevertheless served as an excellent introductory reference to IS design research concepts and deserves inclusion in this bibliography. The authors provided a strong discussion and explanation of design research.

Levinson, M. (2007). *ABC: An Introduction to Knowledge Management*. CIO. Retrieved April 13, 2008, from http://www.cio.com/article/print/40343

Levinson's article provided additional discussion and views on knowledge management concepts, such as tacit vs. explicit knowledge and the role of technology.

Marwick, A.D. (2001). *Knowledge Management Technology*. IBM Systems Journal. Retrieved April 13, 2008, from http://www.research.ibm.com/journal/sj/404/marwick.html

Marwick wrote a useful, fairly detailed article on knowledge management concepts. Key explanations included knowledge transformation processes (socialization, externalization, combination, and internalization) and how technology can help capture the knowedge and facilitate the transformations. Specific examples included speech recognition, search, and summarization technologies.

McKay, J., and Marshall, P. (2005). *A review of design science in information systems.* Retrieved April 14, 2008, from http://www.utas.edu.au/infosys/publications/research/phil_research/A_Review_of_Design_Science_in_Information_Systems.pdf

McKay's article was helpful in that it provided additional background on design science concepts. A key discussion point: "the task of IS researchers is not to seek ultimate truths or grand theories … [but to transform] situations into more desired states, taking account of context and the uses for which people may appropriate such systems."

Meyer, D. (2000). *The Enterprise Data Warehouse Verses the Data Mart*. Retrieved 4/14/2008, from http://www.donmeyer.com/art1.html

This brief article from a data warehousing consultant listed considerations for appropriate use of a data mart.

Midas+. (2008). *Midas+ Seeker*. Retrieved February 23, 2008, from http://www.midasplus.com/skr.asp

In this brief article, the Midas+ vendor provided information on this profiling application. It was important to review this resource to determine if it would be appropriate to use at Regional.

O'Connor, M. E. (2002). *Medical staff appointment and delineation of pediatric privileges in hospitals*. Pediatrics. Retrieved April 13, 2008, from http://find.galegroup.com.dml.regis.edu/itx/retrieve.do?contentSet=IAC-Documents&resultListType=RESULT_LIST&qrySerId=Locale%28en%2C%2C%29%3AFQE%3D%28ke%2CNone%2C21%29medical+credentialing%3AAnd%3ALQE%3D%28AC%2CNone%2C8%29fulltext%24&sgHitCountType=None&inPS=true&sort=Dat

eDescend&searchType=AdvancedSearchForm&tabID=T002&prodId=AONE&searchId=R2&currentPosition=4&userGroupName=regis&docId=A90622304&docType=IAC

This article appeared in a healthcare journal. It succinctly explained the general steps of the credentialing/re-credentialing process.

ODMH – Ohio Department of Mental Health. (2008). *Consumer Outcomes Data Mart*. Retrieved 4/28/2008, from http://www.mh.state.oh.us/oper/outcomes/data.mart.index.html

The Ohio Department of Mental Health's consumer data mart website was thoroughly reviewed to learn about their data mart approach and, specifically, what features were useful as an end user.

Open Source Analytics. (2008). *Data mart vs data warehouse – The Great Debate*. Retrieved February 23, 2008, from http://opensourceanalytics.com/2006/03/14/data-mart-vs-data-warehouse-the-great-debate

This article provided a basic introduction and definitions on data warehouses and data marts. It explained the Kimball concept (a bottom-up approach of a data warehouse as a collection of data marts) vs. the Inmon concept (a top-down approach of a data warehouse feeding subject oriented data marts). It provided seven blog-like postings from individuals debating the virtues of data warehouses vs. data marts.

Orlikowski, W., Barley, S., & Robey, D. (2001*). Technology and institutions: What can research on information technology and research on organizations learn from each other?* MIS Quarterly. Retrieved 4/6/2008 from http://find.galegroup.com.dml.regis.edu/itx/retrieve.do?contentSet=IAC-Documents&resultListType=RESULT_LIST&qrySerId=Locale%28en%2C%2C%29%3

AFQE%3D%28au%2CNone%2C10%29orlikowski%3AAnd%3AFQE%3D%28ke%2CNone%2C10%29technology%24&sgHitCountType=None&inPS=true&sort=DateDescend&searchType=AdvancedSearchForm&tabID=T002&prodId=AONE&searchId=R4&currentPosition=7&userGroupName=regis&docId=A79150669&docType=IAC

Orlikowski et al. focused on the practical application of IS research. One of the more helpful and relevant concepts reinforced the need to consider how information systems affect and shape an organization, and how an organization affects the development and use of technologies. IS design research should consider these consequences.

PMI Project Management Institute. (2000) *A guide to the project management body of knowledge*. Newton Square, PA: Project Management Institute

This resource captures the essence of the "knowledge and practice" of project management. It was reviewed during the planning phase of the data mart development to help ensure a proper work breakdown structure.

Pratte, D. (2001). *Data marts deliver fast results, but proceed with caution*. CNET Networks, Inc. Retrieved 4/14/2008, from http://articles.techrepublic.com.com/5100-10878-1032212.html

Pratte wrote a relatively simple article explaining the characteristics and differences between data warehouses and data marts. He cautioned that collaboration should occur if multiple departments decided to build independent data marts. This reinforced the need to make sure that Regional's centralized IS department was aware of the profiling data mart's existence and general specifications. By notifying the IS department, it helps enable collaboration in the event that other departments would also want to develop stand-alone data marts in the future.

Samara, K. (2007) *A Framework for Discovering KM Forces: The Fifth Element*. Journal of Knowlede Management Practice. Retrieved 8/7/2008, from http://www.tlainc.com/articl129.htm

This article provided another review of knowledge management concepts. It was especially helpful in providing concise definitions for socialization, externalization, combination, and internalization processes.

Shelley, G. B., Cashman, T. J., & Rosenblatt, H. J. (2001) *Systems analysis and design (Fourth edition).* Boston: Course Technology

Shelley et al. wrote this textbook in practical, concise manner. It clearly identifies and describes the activities that should occur during the various phases of systems analysis and design, including methods to ensure that the phases are successfully completed. This book has remained at close reach to serve as reference throughout the development of this data mart project.

Simon. A. (1998). *90 days to the data mart*. New York: John Wiley & Sons, Inc.

Simon's book is almost a recipe for building a data mart. He begins with an explanation of concepts, provides an overview of the development process, identifies prerequisites, and then specifically describes each phase and associated tasks. The book was read in entirety and provided guidance during the actual development of the profiling data mart.

Tiwana, A. (2002). *The Knowledge Management Toolkit (Second Edition)*. Upper Saddle River, NJ; Pearson Education, Inc.

This textbook served as a succinct reference and refresher on knowledge management concepts. It provided guidance on the role the data mart should play in providing information and knowledge to the users. However, despite having this resource, the users

were insufficiently defined during this project, as focus was placed on the mid-level users (the specialists who would use the data mart to prepare profiling report packets) instead of the end users (the Credentialing Committee members).

Titin. (2008). My thoughts on Family Medicine and Health Informatics. Retrieved April 14, 2008, from http://titin.net/2008/03/15/design-research-in-information-systems/

Titin maintains a blog on family medicine and healthcare informatics. A quote was used from this source because of its simplicity: "Design research is somewhat similar to any other research. The only difference is that research come up with an artifact then test it as opposed to coming with a hypothesis." While this thesis used ample other scholarly, peer-reviewed resources for concepts, these sentences helped to explain the overall design research process at a very elementary level.

UHC – University HealthSystem Consortium (2005). *Peer review and credentialing workshop*. Oak Brook, IL. : University HealthSystem Consortium.\

UHC provided this booklet of speaker presentations from its 2005 workshop. The booklet was reviewed in entirety in an effort to find profiling best practices or adoptable solutions from other academic medical centers. The review of the presentations instead led to the realization that there were no simple solutions or standardized approaches, and that many other medical centers seemed to be experiencing the same difficulties as Regional.

Utley, C. (2008). *CIO Briefings*. Retrieved 4/28/2008, from http://www.ciobriefings.com/whitepapers/StarSchema.asp

Utley provided another perspective on the features, similarities, and differences between data marts and data warehouses, which helped with the decision to proceed with a data mart for this research effort. His discussion on data normalization (to remove data

repetition), denormalization (to increase speed), and data architecture (star and snowflake schemas, fact and dimension tables) was especially helpful.

UTMB – University of Texas Medical Branch. (2007). *Data Marts: Overview*. Retrieved 4/14/2008, from http://www2.utmb.edu/datamarts

This website described the data marts that are available for operational data reporting at UTMB. It helped confirm the appropriate use of a data mart for the profiling reporting problem.

Vaishnavi, V. and Kuechler, B. (2007). *Design Research in Information Systems*. Association for Information Systems. Retrieved March 30, 2008, from http://www.isworld.org/Researchdesign/drisISworld.htm

This site served as the launching point and primary resource for design research for this profiling data mart research project. The site introduced and provided a thorough overview of IS design research, including the process steps – awareness of problem, suggestion, development, evaluation, and conclusion – and outputs. Vaishnavi and Kuechler explained the difference between design research and general design. The author/editors also provided numerous references and resources for further study. This site was among the most helpful of all of the documents that were reviewed and used for this thesis.

Whitten, J. L., Bentley, L. D., & Dittman, K. C. (2001). *Systems analysis and design methods (5th edition).* New York: Irwin/McGraw-Hill

This textbook was used primarily to review the phases of the Systems Development Life Cycle waterfall methodology.

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