Graduate Management Project

TRICARE Senior Prime HEDIS Medicare Reporting: Exploring the

Information Quality Model

by

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ABSTRACT

The use of the Health Plan Employer Data and Information Set (HEDIS) 3.0 provides the Military Health System (MHS) with a platform to demonstrate its strengths in delivering quality managed care to dual-eligible Medicare/Department of Defense (DoD) beneficiaries and to locate areas for improvement. The MHS is tasked with reporting 22 HEDIS Medicare measures to the Health Care Financing Administration (HCFA) to comply with the TRICARE Senior Prime (TSP) demonstration guidelines. This study reports on the current information model used by the MHS to collect one of these measures: Beta Blocker Treatment After a Heart Attack. The current information model used by the MHS was found insufficient to allow for administrative reporting of the targeted measure. The study formulated an alternative conceptual information model based upon the fundamentals of Total Data Quality Management (TDQM). The two models were evaluated utilizing Wang's dimensions of information quality. The alternative conceptual model was found to be vastly superior to the current information model in every dimension. The concepts used to formulate the conceptual model, if applied, would allow the MHS to develop an effective information management system for the TSP demonstration.

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CHAPTER 1

The Military Health System's (MHS) entry into the managed care environment brings with it many additional challenges and requirements. A managed care system is dependent upon an information rich decision making environment. To achieve the purposed benefits of the managed care environment, the health service organizations must have detailed cost accounting, personnel, and clinical information systems. Third party payers and more recently, individual consumers are requiring managed care organizations to provide documented evidence that cost savings are not resulting in a decreased quality of care (Meisenheimer, 1997). As a result, poor information management practices have led to devastating financial implications for managed care organizations (MCO's) (Bell, 1998). If a managed care organization does not have high quality information management systems and practices, it can not survive in this highly competitive and regulated industry.

Conditions Which Prompted the Study

<u>The MHS Meets Managed Care</u>

The MHS currently serves approximately 8.2 million active duty personnel, eligible retirees, and family members at a cost of approximately $15.6 billion-dollars-per-year (GAO, 1999b). The MHS faces the same challenges as that of the civilian health care market place; namely to control cost, maintain adequate

access, and ensure quality of services. To cope with the reality of providing health care in the late 20th century, the MHS initiated its foray into managed care through a vehicle entitled TRICARE in 1993. At the outset there were concerns by governmental officials that the MHS would not have the information management systems necessary to operate efficiently in a managed care environment (GAO, 1995).

The majority of information systems (IS) in the MHS at the time of the inception of TRICARE, now termed legacy systems, were the result of years of individual effort by services and departments to secure information valuable only to individual functions (e.g., the Medical Expense and Performance Reporting System (MEPRS)). Additionally they were designed to answer questions, which were typical of the retrospective payment health care environment. The focus was on gross counts (e.g., the number of bed days, the number of outpatient visits, etc.). Military Treatment Facility (MTF) level funding was based on patient volume, not on how much it cost to provide care to an individual patient. As such, the legacy systems where stove-piped, intended to address a single area of the health care enterprise and consequently were not designed to communicate with each other.

In 1995, the Assistant Secretary of Defense (Health Affairs) recognized the need for an integrated high-level information system to support decision-making efforts for TRICARE. This resulted in an MHS investment of over $300 million in the Corporate Executive Information System (CEIS) (Corey, Cobler,

Haynes, & Walker, 1996). Since its inception, the CEIS program has been plagued with inter-service rivalry, project delays, and cost over runs. At least three distinct efforts to improve and ensure the quality of information produced by CEIS were initiated by the TRICARE Management Activity (TMA). There is also a variety of individual efforts by the services, primarily the Army and the Air Force, to address information management issues. There is no data to conclusively verify that any of these costly efforts have resulted in sustainable improvements to the system. On the contrary, there are volumes of evidence (GAO, 1999a, 1999b, 1999c, 1999d), indicating that the inadequacies in the MHS data systems limit its ability to manage the delivery of health care at both the local and national levels.

TRICARE Senior Prime Demonstration

The Balanced Budget Act of 1997 (BBA) authorized the MHS to conduct a 3-year test, which it labeled Medicare Subvention; the MHS prefers the term TRICARE Senior Prime (TSP). The purpose of this demonstration is to address the concerns of the nearly 1.3 million Medicare eligible retired personnel and their families over the age of 65. When TRICARE was initiated retirees, upon reaching age 65, lost their right to be enrolled in TRICARE Prime. The retirees were forced to seek care on a space-available basis within the MTF, or to seek care on the civilian market using Medicare. Retirees view this as a continuation of a policy direction that began with the elimination of Civilian Health and Medical Program of the Uniformed Services (CHAMPUS)

benefits to Medicare eligibles. Furthermore, although not specifically addressed in Title 10 of the United States Code, retirees firmly believe they were promised access to lifetime medical care (AFSA, 1998).

The demonstration project is extremely important to MHS leaders. They view the potential for Medicare reimbursement as a win-win proposition for both the MHS and retirees. Retirees would enjoy the benefits of prime status and would have primary care managers, which would ensure the continuity of care. Continuity of care is extremely important when considering the chronic nature of illness in the elderly population. The MHS would also be a winner in that it would first, maintain a bond established with the retiree, and one that many within the MHS feel as an "obligation" to provide care. Secondly, the MHS would ensure its young healthcare providers have access to the geriatric population, a necessary element in the provision of a complete graduate medical education. Thirdly, the MHS would be securing an additional funding source, a factor of importance in this era of shrinking budgets.

However, if the Medicare Subvention demonstration is to succeed, then the MHS must face the task of meeting requirements set forth by the Health Care Financing Administration (HCFA). HCFA, with a few allowances, is treating the MHS as it would any other commercial managed care organization seeking to receive Medicare reimbursement. There are unique exceptions enforced by the BBA. The BBA states that the demonstration reimbursement rates will be 95% of Medicare+Choice rates, adjusted to exclude

payments for direct and indirect medical education and
disproportionate share hospitals. Additionally, 67% of the MHS
capital cost is excluded from the rate. The amount of
reimbursement is further constrained by the BBA's requirements
that the MHS ensure it is providing care at a level that is at
least equal to the level provided prior to the demonstration,
termed baseline level-of-effort (LOE). HCFA and the MHS agreed
upon a very complex formula for establishing LOE and set the
base year as 1996 and the base LOE at $172 million (GAO, 1999a).
Finally, the potential reimbursement is capped at $50 million in
the first year, $60 million in the second year, and $65 million
in the third year.

Information Please

    In May 1999, the United States General Accounting Office
(GAO) published a report entitled "Medicare Subvention
Demonstration: DoD Data Limitations May Require Adjustments and
Raise Broader Concerns." The report sent a clear signal to the
MHS that it is in danger of failing the demonstration as a
direct result of its information management processes (GAO,
1999a). The GAO report focuses on the LOE issue. It finds that
the MHS is incapable of producing the necessary data to support
LOE determinations. In fact, it draws into question the entire
methodology for establishing the baseline estimates. Perhaps
even more ominous are the inferences the GAO makes to the
broader concept of military health care. As previously
mentioned the MHS is faced with competing in the new era of
managed care. In order to do so it must be able to leverage

information to manage cost and resources and maintain access to
and quality of care. The GAO finds "the inadequacies of DoD's
data systems limit its ability, at both the site and national
levels, to manage the demonstration and *deliver health care*
[italics added]" (GAO, 1999a, p. 11). Furthermore, "these data
problems also call into question DoD's ability to manage its
overall health care system" (GAO, 1999a, p. 16).

In response to the GAO report the Office of the Assistant
Secretary of Defense, Health Affairs (OASD(HA)) took two
actions. First, it established TMA oversight, and instituted an
improvement plan, for the Medical Expense and Performance
Reporting System (MEPRS). Secondly, it appointed a program
manager for data quality at the TMA level. The Program Manager
is the head of the Data Quality Integrated Program Team (DQ
IPT). The stated purpose of the DQ IPT is to only focus on data
quality issues related to financial, clinical workload, and
enrollment data (GAO, 1999a). Obviously, these measures were
instituted to address specific concerns raised by the GAO in
their report.

HCFA + NCQA = HEDIS Medicare

HCFA is treating the MHS like any other commercial Medicare
provider regarding the requirement for reporting of specific
Health Plan Employer Data and Information Set (HEDIS) measures
related to the Medicare population. Assuming that the MHS was
able to correct its financial data, clinical workload and
enrollment data, and demonstrate that it exceeds the baseline
LOE, it still may not be able to collect Medicare reimbursement

from HCFA. The reason is that the MHS is currently unable to comply with the HCFA requirement to report all HEDIS Medicare measures as set forth by the National Committee for Quality Assurance (NCQA)(VRI, 1999).

The NCQA developed a set of standardized performance measures (now in its third iteration--HEDIS 3.0) to compare health plan performance across a wide range of issues. Beginning January 1, 1997, HCFA, under pressure from political forces, began requiring Medicare managed care plans to report performance measures relevant to the Medicare population. The reduced subset of the HEDIS measures includes metrics that appear closely aligned to evaluate all three areas of quality (viz., structure, process, and outcomes) as defined by Donabedian (1980).

The MHS began its first attempt to utilize HEDIS measurements in a non-formal manner in 1997. This first attempt brought to light many of the failings of MHS information systems. The TMA contracted with Vector Research, Inc. (VRI) to evaluate the feasibility of data collection and to collect available and appropriate measures for FY 96 data (VRI, 1997). The TMA requested that VRI breakout the measures into two separate report groupings: active duty (AD) and non-active duty (NAD). For the purposes of this discussion, the focus will only be on the NAD reports since they most closely associate with the TSP population. VRI conducted a similar analysis in 1998 for the TMA using FY97 data (VRI, 1998a). VRI has provided the TMA with a functional analysis on the feasibility of collecting

Table 1

Comparison of MHS HEDIS Reporting Efforts 1997 – 1999.

	Report/Year		
	NAD FY96[a]	NAD FY97[b]	TSP CY98[c]
Total number of potential HEDIS Measures	71	56	33
Measures Included in Report/Year	56	27	12
Number of Measures which met all HEDIS Technical Specifications	15	14	9

Note. NAD = Non-Active Duty. TSP = TRICARE Senior Prime.

[a]Data in column are derived from Military Health System FY96 HEDIS 3.0 Report for Nonactive Duty TRICARE Prime Enrollees by Vector Research, Inc., 1997, Arlington, VA: Author.

[b]Data in column are derived from Military Health System FY97 HEDIS 3.0 Report for Nonactive Duty TRICARE Prime Enrollees by Vector Research, Inc., 1998, Arlington, VA: Author

[c]Data in column are derived from Fiscal Year 1997 Health Employer Data and Information Set (HEDIS) 3.0/1998 Baseline Report for TRICARE Senior Prime Enrollees at Madigan Army Medical Center by Vector Research, Inc., 1998, Arlington, VA: Author.

HEDIS Medicare measure for the TSP population (VRI, 1999). Table 1 highlights the difficulty the MHS has had in collecting HEDIS measures.

The NCQA continuous to refine the HEDIS measurement system. Thus, the NCQA revises the number of measures from year to year,

and makes significant methodological changes in already existing measures. Therefore, direct comparison for HEDIS measures from one year to the next is not always appropriate. The important concept to observe is the MHS' significant inability to report the measures in accordance with the NCQA's technical specifications.

The MHS was under no direct financial pressure during FY96 and FY97 to report any HEDIS measure. Therefore, it exercised great discretion in picking measures, which it considered beneficial to the overall quality initiatives within the MHS. Additionally, at that time there was not a third party that mandated compliance with the NCQA HEDIS measurement methodology, allowing the MHS to utilize "HEDIS-Like Measures" [TMA terminology](TMA, 1999).

The TMA, being unable to conform to the NCQA technical specifications for the measures, utilized HEDIS-Like measures to address the spirit of the measure. This suggests that the TMA considered the measure to be highly valuable, however, available information practices did not allow for accurate reporting. The TMA opted to report 50% (36) of the HEDIS measures in FY96. Only 42% (15) of these met HEDIS technical specifications. The TMA chose to report 48% (27) of the available HEDIS measures in FY97. During this reporting period, 52% (14) met the specifications. This indicates that information management practices deprived the TMA of accurately reporting 52% and 48% respectively of the measures that the MHS deemed important to measuring quality within its health care system.

HCFA now provides a third-party control for HEDIS measurement and removes the latitude formally employed by the TMA. Thus, for the TSP demonstration HEDIS-Like measures are not an option. The first study devoted to analyzing HEDIS measurement for the TSP demonstration found that only 27% (9 of 33) of the measures met the technical requirements of the NCQA (VRI, 1998b). The number of HEDIS Medicare measures the MHS will be required to report on in 2000 is twenty-two (see Table 3 on page 45). Arguably, the MHS has not made any significant improvements over the last three years in its information management practices, which would allow for the accurate reporting of all required HEDIS Medicare measures.

Statement of the Problem or Question

The quality of data processes in the MHS does not support and, in fact, hinders business and clinical operations. The problem is obvious to the GAO, HCFA, the NCQA, and even the MHS. The MHS is faced with the task of reporting HEDIS Medicare measures in accordance with NCQA and HCFA guidelines. Currently the data processes do not allow for complete and accurate reporting of all measures. This study seeks to define a method by which the MHS can improve its information management practices to support the TSP demonstration.

Literature Review

The purposes of this literature review are to provide the reader with an appreciation for the information management

problem not only in the MHS but also in the business world at large. It will develop the operational definitions for data quality and information management, which as will be shown are varied. Finally, it will provide potential models for evaluating the TSP HEDIS measurement problem facing the MHS.

The Cost of Poor Data Quality

Napoleon Bonaparte is quoted as saying: "War is ninety percent information." The war on crime is not going well if one considers that 50% to 80% of the computerized criminal records in the United States contain incomplete, inaccurate, or ambiguous data (Strong, Lee, & Wang, 1997). This is the information age. Governments, businesses, and individuals require computer generated data. These data form information that drives political, business, and personal decision making. What is the cost if the decision making process is built upon the foundation of faulty data? Strong et al. (1997) estimated that the impact to society is billions of dollars. Redman (1998) stated that a typical mid to large size corporation looses 8% to 12% of its revenues to poor data quality and for a service organization 40% to 60% of expenses are related to poor data quality.

These costs are both direct and indirect. The direct costs are primarily related to the expense that companies incur trying to clean-up data already in their information systems. The indirect costs are derived from the impact the faulty information and information systems have on employee satisfaction and productivity, customer satisfaction, and

corporate strategic, tactical, and operational decision making. The indirect cost of poor quality data for the MHS on just the TSP project alone could total $175 million over the next three years (GAO, 1999a).

The study will assess the direct costs first. Hankins (1999) estimated the market for data cleansing efforts will be more than $300 million a year by 2000. The costs were accelerating as more companies turn their efforts to data warehousing efforts. Data warehouses are designed to take subsets of data from a company's diverse legacy information systems (viz., accounting, marketing, personnel, and inventory) and combine them into a central repository. The data warehouse forms a centralized source from which the company is able to "mine" information for corporate decision making.

It is a given that each IS will contain some level of faulty data. On an individual level, users of the systems have intimate knowledge of the data and processes feeding the systems and internalize known faults into their decision making processes (Ballou & Tayi, 1999). This level of understanding is lost to the users of the data warehouse. Therefore, either they will take the information provided by mining at face value or they will discount obviously faulty information and loose confidence in any information provided by the warehouse.

Celko & McDonald (1995) were one of the first to comment on the havoc that poor data quality would have on data warehouses. Poor data qualities in legacy systems have an exponential compounding effect on data warehouses. The authors found that

80% of the queries in a data warehouse will access the small area of the database with the most ailments. They firmly stated that companies can not ignore or trivialize problems with the legacy data. If companies fail to correct legacy data, the oversight will brutally assert itself inside the data warehouse. They warned businesses not to assume that data is correctable once warehoused. Imagine the dismay of an executive or government official to find that a hundred million dollar project is useless unless they spend millions more to correct data quality problems. Redman (1996) estimated 50% of the cost incurred in implementing a data warehouse is directly attributed to cleaning up faulty source data.

There are at least three reasons why executives are facing this dilemma in relation to their data warehouse projects. The first is because organizations have focused on quantity versus quality (Hankins, 1999). The second, is the lack of common data definitions across the system (Hemblen, 1998). The third is attempting to use data for purposes outside the scope of its original collection intent (Hannan, Racz, Jolis, & Peterson, 1997). The second and third problems are more germane to the warehouse problem. The quantity over quality problem is a root cause, which has festered to painfully manifest itself in the data warehouse.

The problem of the lack of common definitions has deep political roots. As Burzynski (1998) indicates, the MHS is formed from three services with different cultures, regulations, management priorities, and policies governing the use of

information systems. The implications for the MHS are readily apparent to the casual observer. For example, three years after implementing Ambulatory Procedure Visits in the MHS, there is still not a standard definition across the services for its use. The same is true for counting bassinet (newborn) bed days. Even the most basic items are fraught with stagnating political implications, such as the definition of a provider. Hemblen (1998) believes that the $800 million spent on the CEIS project could be wasted if the services fail to achieve standardized data definitions.

A more insidious data quality problem is the attempt to use data for other than their primary intent. Hannan et.al (1997) found that Medicare claims data found in the typical hospital administrative database is a poor source for the evaluation of the effectiveness of care. The reasons are not always obvious to the uninformed.

The administrative databases in our health care systems were designed to collect encounter data for reimbursement purposes. The most prevalent data model is based upon a financial framework developed by Joanne Finely and a group of Yale researchers (Ulman & Kominski, 1984). The purpose of this data model is to apportion hospital admissions into a set of mutually exclusive categories. The data model is not based upon a clinical framework, thus it fails to capture the elements important to determine effectiveness of care. Never the less, there are many attempts to use this data model to make quality of care determinations. The importance of the appropriate data

model can not be over emphasized. For example, the essence of the Y2K problem was the result of a poorly designed data model.

Arguably, the root of the problem is that organizations focus too much on quantity and not enough on quality. Computerization has made it very easy for organizations to collect mass quantities of data, especially in health care organizations. However, these data were collected as a by-product of some core business processes and no effort was made to treat data as products in their own right (Levitin & Redman, 1998).

Consider the difference between a checkbook and an accountant's ledger (see Figure 1). A person will record transactions in a personal checkbook as a by-product of normal everyday activities (e.g. paying the electric bill). The act of recording and capturing the data is not the focus or primary objective of the person. Most organizations have collected their data in much the same way, and as a result they have as much difficulty reconciling the data as people have balancing personal checkbooks. Compare this to an accountant's ledger, in which every entry is a core activity. The accountant follows a very well defined and prescriptive process for creating, entering, and capturing the data. There are numerous quality control mechanisms built into the process. Therefore, it is not surprising to find that the application of the personal

Individual Checkbook	V.	Accountant's Ledger

•Data capture is By-Product of Activity

•No Mandatory Quality Control

•Data capture is Product of Activity

•Mandatory Quality Control
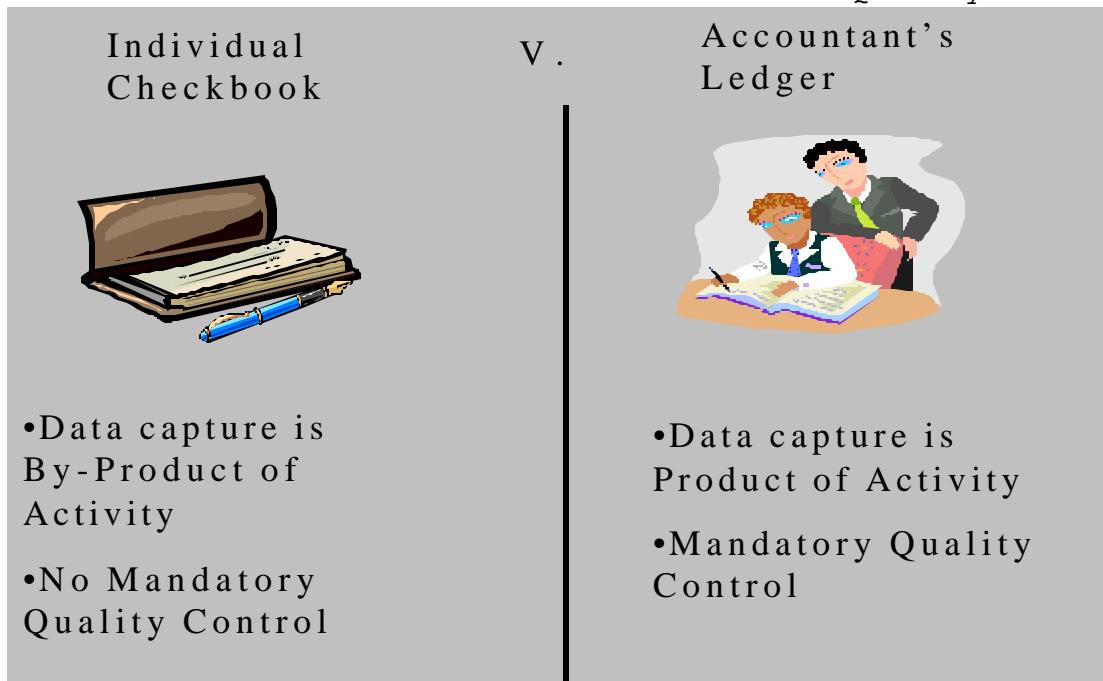
Figure 1. Checkbook vs. Ledger

checkbook approach, or by-product approach, to data collection has resulted in field level error rates ranging between 1% and 75% (Redman, 1996).

Some processes in the health care environment have well defined processes for collecting the data, however quality control practices are either not implemented or not followed. Since the inception of the Prospective Payment System, hospitals have hired thousands of medical record encoders to review medical records and convert the information to Diagnosis-Related Groups (DRG) and Current Procedural Terminology (CPT) codes. Laing (1992) was one of the first to formally study and find that the quality of the coding process is in question. Ackland & Chandraraj (1997) found in a review of coded emergency room records that there was a 73% error rate in any given field, a 61% error in diagnosis coding and a 45% error rate in procedure

coding. This was a foreign study conducted in Australia. However, the results mirror those found by Facisweski, Broste, & Fardon (1997) in their review of spinal surgery coding. These authors found a 72% error rate in coding of specific diagnosis among six U.S. hospitals. Facisweski et al., additionally highlight the great variation in the coding processes, both intra and inter-hospital.

Quality problems are not confined to encoding efforts. They are also evident in every other information system the typical health care enterprise employs. Pumphrey, Fuller, Radosta, & Dittrich (1999) found that 35% of the entries in a utilization management database used to record the status of patients were in error. The problem was caused by the utilization managers' reliance upon others to update the information as a by-product of their health care processes. The implications are staggering, imagine an administrator not being able to accurately identify the location of 35% of his/her patients! The hospital promptly identified a formal process for collecting and ensuring the quality of the data.

Poor data management practices have cost large managed care companies millions of dollars. Peter Kongstvedt, a leading authority on the managed care industry, has stated that the data quality problem is severe among managed care organizations (As reported in Bell, 1998). The cost of poor data management practices is also effecting those in the government sector. The Department of Veterans Affairs concern for the quality of their data prompted them to allocate $1 million dollars in 1999 to

correct the coding of diagnosis and medical services ("VA initiative," 1999). Additionally, the problem is effecting those who would wish to monitor the health care industry. The NCQA was faced with the dilemma of corrupt data sets, giving many managed care firms a convenient excuse to drop optional HEDIS reporting (Bell, 1998). The NCQA subsequently adopted a policy of having the MCO's pay for an audit of their data, information systems, and information management practices as a precondition to submitting data for HEDIS measurement (NCQA, 1999).

Now that some of the direct costs of poor information management practices have been explored, attention is directed toward the indirect costs. There are no simple methodologies for applying specific dollar amounts to these costs. However, logical induction gives that if information management practices produce data, which yield information, which in turn guides decision making; then deficient information management practices produce faulty data, erroneous information, and ultimately flawed or at least impaired decision making. The literature would appear to support this assumption. Redman (1998) stated that many of the problems facing today's executives have poor data quality practices at their roots.

The indirect cost of poor information management practices is levied at the strategic, tactical, and operational levels within an organization. Peter Drucker stated, "The organization of the future is rapidly becoming a reality--a structure in which information serves as the axis and as the central support

system." Ginter, Swayne, and Duncan (1998) believe that information management is of equal importance in the modern health care organization as such traditional functions of marketing, human resources, and finance. If information management is of equal importance to the strategic health of an organization one wonders why 32% of health care executives encounter errors in their information systems all, or most of, the time (Bean, 1994). If an equal number of executives faced errors in their financial reports, one wonders how long they would remain executives. Never the less, the inadequacies of information management makes it extremely difficult for organizational leaders to set and execute a strategy, or to align the organization (Redman, 1996).

Tactical decision making is equally affected by poor data management practices. Questions such as how much to spend, or how to allocate resources, are clouded by the lack of reliable information. In the typical MTF, allocation of resources is driven more by gut-level decision making than quantitative analysis of the problem. Not because the leaders lack the knowledge or desire to use such tools, but because access to believable data is not forthcoming from current information systems. Instinctively the service leaders believed the MHS could profit from, or at least break even on, the TSP initiative. However, leadership could not identify the cost of the current level of effort.

At the operational level, employees and customers are frustrated by the very systems designed to enhance their

interactions. Poor information practices are a huge employee
and customer dissatisfier (Redman, 1996). The deployment of the
Ambulatory Data System (ADS) in the MHS provides an excellent
example. The ADS was deployed without consideration of the
current business practices of the typical MTF clinic. Further,
the system was not fully tested before deployment leading to IS
and information management failures, which resulted in employee
frustration and consternation (OASD(HA), 1997).

Haung, Lee, and Wang (1999) find that quality information
leads to improved customer service, customer satisfaction, and a
stronger customer relationship. The MHS customers are
frustrated by the information management systems. This author's
own experience illustrates this point. Upon presenting to the
dental clinic for a routine examination, the author found that
he was "not in the system." However, the author had watched the
clerk only one week before dutifully going through the five
minute booking process on her terminal. She even supplied him
with written verification of the appointment. Never the less,
on the day of the expected interaction no record of the
appointment was in the system, resulting in another booking
procedure, a delay in treatment, and another day spent visiting
the dental clinic. Poor information management adversely
affects the most fundamental business practices in a health care
organization.

In concluding this section, the "dark side" to the
information age was explored. Insufficient data quality
practices are rampant through out the business world, and are

not confined to the health care sector or even to the MHS in
particular. The quality of the data poses special problems in
the health care industry because of the sheer volume of data
that are collected. It also poses special problems in the MHS
due to its political/organizational configuration. The
literature appears to support the assumption that poor data
quality practices have both direct and indirect costs to the
organization. Poor information management has a cost and, in
fact, is costing health care organizations millions of dollars.
Poor data quality practices attacks the organization at the
strategic, tactical, and operational levels. Finally, one is
strongly encouraged to agree with Huang et. al (1999) that
organizations are finding quality information as their most
valuable resource.

Defining Information Quality

    The distinction between data quality and information quality
is often times blurred and used interchangeably in the
literature. This author will attempt to make a clear
distinction for the purposes of this study. However, as these
two examples from Webster's New World Dictionary (1990)
illustrate, the task is daunting. Webster's defines data as
"facts or figures from which conclusions can be drawn." The
definition of information is "something told or facts learned;
data stored in or retrieved from a computer."

    The common definition used among those responsible for data
quality in the MHS comes from American National Dictionary for
Information Systems (1991), which states data quality is "the

correctness, timeliness, accuracy, completeness, relevance, and accessibility that makes data appropriate for use" (cited in Burzynski, 1998).

A common paradigm used to describe the relationship between data and information is: data → information → knowledge (Dertouzos, 1997). From this releationship one can descern that data are a well from which information may be drawn. However, one could hypothesize that since there is a process involved in assembling data into information, quality data does not necessarily yield quality information. The research literature and statistical texts are filled with examples of high quality data poorly presented or subjected to inappropriate analysis and thus leading to information of inferior quality. Therefore, focusing only upon the data will not improve the business organization. Attention must also be given to the processes that turn the data into information.

Defining data quality is the first step in defining information quality. Tayi and Ballou (1998) define data quality as "fitness for use", which suggests that the concept of data quality is relative. This concept of relativity is also found in Redman's (1996) definition of data quality: "A datum or collection of data X is of higher (or better) quality than a datum or collection of data Y if X meets customer needs better than Y" (p. 19).

These definitions present little practical appeal, because they offer no absolutes. These researchers imply that there is no authorative source which states whether a datum is correct or

incorrect. The answer is akin to popular art where the appraisal is in the eye of the beholder.

This author finds the above definition of data quality insufficient and will provide a contrapuntal definition. A computer is actually a simple machine. It can only understand and process a binary set of numbers containing 0's and 1's. Thus the smallest datum in our information systems is called a bit. Dertouzos (1997) stated, "Bits maybe as plentiful as the sand, but, like the sand they are useless unless fashioned" (p. 234). This fashioning of bits is based upon a model of the information the user wishes to capture.

For example, consider a person wishing to use a digital camara to place a picture in this text. The first step would be to define the requirements. For this contrived example, the requirement will be a head and shoulders portrait of the author. The requirements should lead naturally to a definition of the data model which will ultimately capture the data. If the digital camera was pointed at a dog and picture taken, the camera would faithfully take the light and covert it to binary data in the form of 0's and 1's. This data could then be reassembled by a computer to produce a picture of not the author but a dog (some people may know the difference)! Are the data wrong? No, as long as a visible picture came out the data are not corrupted. The problem is that the information model is incorrect based on the information requirements. What would happen if the operator failed to upload the image to a personal computer before trying to access it? Is the data quality bad?

No, the 0's and 1's are still faithfully stored in the digital camera in the proper sequence. The problem is an information chain and access problem. The operator failed to carry out a required sequence in the information chain, thus access to the image is denied. This again is an information quality problem. One final scenerio: what happens if the operator took a head and shoulders portrait of the author, uploaded it to the computer, but the computer rearranged the binary sequence to make the image unrecognizable. In this instance, the malfunction is a data quality problem because the integrity of the source data is defiled (Huang et. al, 1999).

Therefore, it is agruable that if the term data quality is used to denote the integrity of the binary 0's and 1's in the computer system, then there is a source of truth. It may also be surmized that data quality does not infer information quality. The two are distinct, abliet related, concepts which should not be confused.

Dr. R. Wang and associates from the Total Data Quality Management program at the Massachusetts Institute of Technology conducted extensive ontological research into the term information quality. They hypothesize that the fundamental role of the information system is to provide an accurate representation of a real-world system as perceived by the user (Huang et. al, 1999). Through extensive research efforts, they have deterimed that information quality has four domains (or categories) and sixteen dimensions as displayed in Table 2.

Table 2

Information Quality Categories and Dimensions

IQ Categories	IQ Dimensions
Intrinsic IQ	Accuracy, objectivity, believability, reputation
Contextual IQ	Relevancy, value-added, timeliness, completeness, amount of information
Representational IQ	Interpretability, ease of understanding, concise representation, consistent representation
Accessibility IQ	Access, security

Note: From "A product perspective on total data quality management" by R.Y. Wang, 1998, Communications of the ACM, 41(2), p. 60. Copyright 1998 by ACM, Inc. Reprinted by permission.

From Dr. Wang's analysis, there is only one dimension of information quality that fits the author's definition of data quality: accuracy. Therefore, when Dr. Wang defines information quality as "fitness for use by information consumers." The relative nature that the previous authors attributed to data quality is actually an attribute of information quality.

There is probably some question as to why the author is emphasizing the contrast between data quality and information quality. The answer will become more apparent when solutions for the information quality problem are explored and especially when the collection of TSP HEDIS Medicare measures is addressed. For now the conceptual difference is best explained by using an allegory from Steven Covey.

Dr. Covey provides the example of the difference between a manager and a leader. To paraphrase Dr. Covey, a good manager of a group of loggers ensures that each worker is maximizing production. The leader on the other hand is climbing a tree to make sure the loggers are in the right forest. An equal comparison exists between improving data quality and information quality.

Data quality improvements are extremely expensive and time consuming. In fact, Ballue and Tayi (1999) have developed a utility model to help organizations quantitatively determine where they could get the most bang for their data quality buck. Data quality efforts in systems as large and complex as the MHS, where you have literally thousands of transfer points, are needed. However, they are not the best place to start.

The author believes that before the organization even considers attempting to correct the data in its legacy systems, it should re-evaluate its information needs. The MHS is spending thousands of dollars to increase the quality of its data. Unfortunately, even if the data was 100% accurate and complete it still would not provide the information necessary to

answer basic business questions, simply because the legacy MHS information model does not fit the TRICARE managed care information model. In short, they have a picture the dog from the earlier illustration.

The legacy MHS information model is based on information as a by-product, the maximization of freedom of choice by each of the services, and counting widgets--the former basis of budget allocation. The TRICARE managed care information model demands that information be treated as a core business process, the maximization of standardization among the three services, and the documentation of financial cost and clinical outcome for each individual episode of care. A further discussion of models will be provided in a later section.

In summary, data quality refers to the integrity of binary bits. Data quality has an absolute reference point--did the system record, store, process, and transmit all bits of information in the correct sequence. Data quality is necessary, but not sufficient, for information quality. Information quality is a relative term based upon the consumer's determination of fitness for use. Information quality consists of four domains and sixteen categories.

Solutions for Information Quality

The literature provides a rich source of information on theory and practice in solving the information quality dilemma facing the MHS. We will begin our review with current theory to solving these issues and then move into a further discussion of the delineation between data quality and information quality.

Information Management Quality Theory

All of the current Information Management Quality (IMQ) theory is based on the foundation provided by Deming. Deming provides the conceptual design for improving quality within any organization (Walton, 1986). Deming's concepts are widely taught so they will not be detailed here. At the heart of Deming's theory are the Plan-Do-Check-Act (PDCA) cycle, process control, and continuous quality improvement. These concepts are modified and used repeatedly in various forms by a number of authors. The application of Deming to the information management problem eventually takes on the form of Total Data Quality Management (TDQM) (Buryznski, 1998; Corey et. al, 1996; Huang et. al, 1999; Wang, 1998).

The most basic model is that supplied by the Department of Defense (DoD) (Buryznski, 1998; Corey et. al, 1996). The DoD promulgates its model through the *Department of Defense (DoD) Data Quality Management Guidelines*. The steps in the DoD process are depicted in Figure 2.

There is some evidence to support the notion that the MHS has established a TDQM environment, at least at the upper echelons. Establishing a TDQM environment entails establishing a culture that regards data quality as being important. Recent GAO reports (GAO, 1999a, 1999b, 1999c, 1999d) and the TSP demonstration have certainly provided the MHS with an incentive to increase data quality. Many if not all of the service
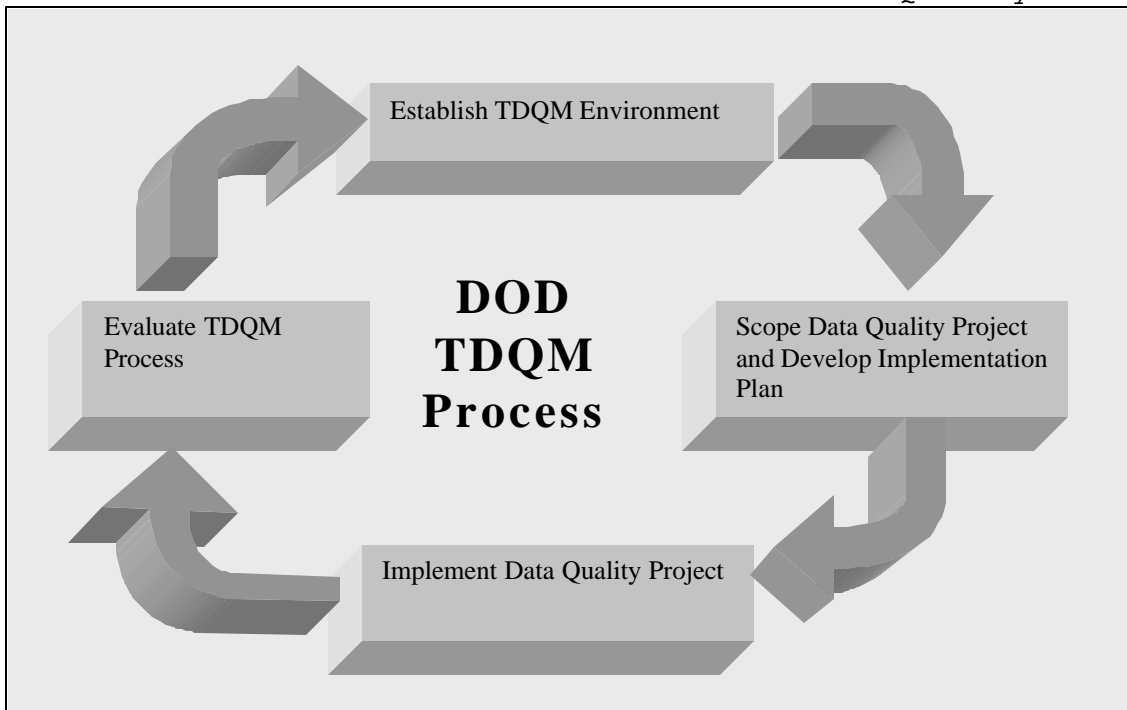
Figure 2. DoD TDQM Process

Surgeons General has spoken of the dire need to address this issue. The Assistant Secretary of Defense, Health Affairs, has issued memorandum on the importance of data quality in the MHS. There is certainly a great deal of money and manpower devoted by the TMA to address the data quality problem. However, whether all of this top-level focus is filtering down to the MTF level is not so easily discernable.

The need for top level involvement is a requirement for any successful data quality project. The concept of improving data quality means that there is a state of poor data quality. To move from the state of poor data quality to a state of good data quality, entails that a change in processes must occur. Leadership is a fundamental element of change. According to

Redman (1996), leaders are tasked with five responsibilities. The first is to understand the impact of poor data quality on the enterprise. The second is to develop an overall strategy for addressing the enterprise's data quality problem. The third is to develop and deploy a data quality policy. The fourth is to lead the change. Finally, the fifth is to support those who will lead individual projects.

Deming warned that the failure of American business to realize the benefits of his theory were due to leadership paying lip service to the ideas without conviction of the spirit. This has a corollary in the TDQM environment. Redman (1986) stated a common deadly sin was for leaders to proclaim that data quality was everyone's responsibility. This proclamation without a clear sense of direction and purpose simply lead to confusion and inaction.

Wang and Redman also indicate that there is another fundamental change that must take place, besides just realizing that data quality is important to the enterprise. The enterprise must change its view of data. Data must be considered inputs to a product. The product would be quality information. Typically, information is viewed as a by-product of congealed data derived from core business processes.

To put action to words and to begin viewing information as a product we can use Wang's (1998) TDQM model (See Figure 3). Wang provides operational definitions for each of the steps in the model. The first step, "Define" consists of three subtasks.
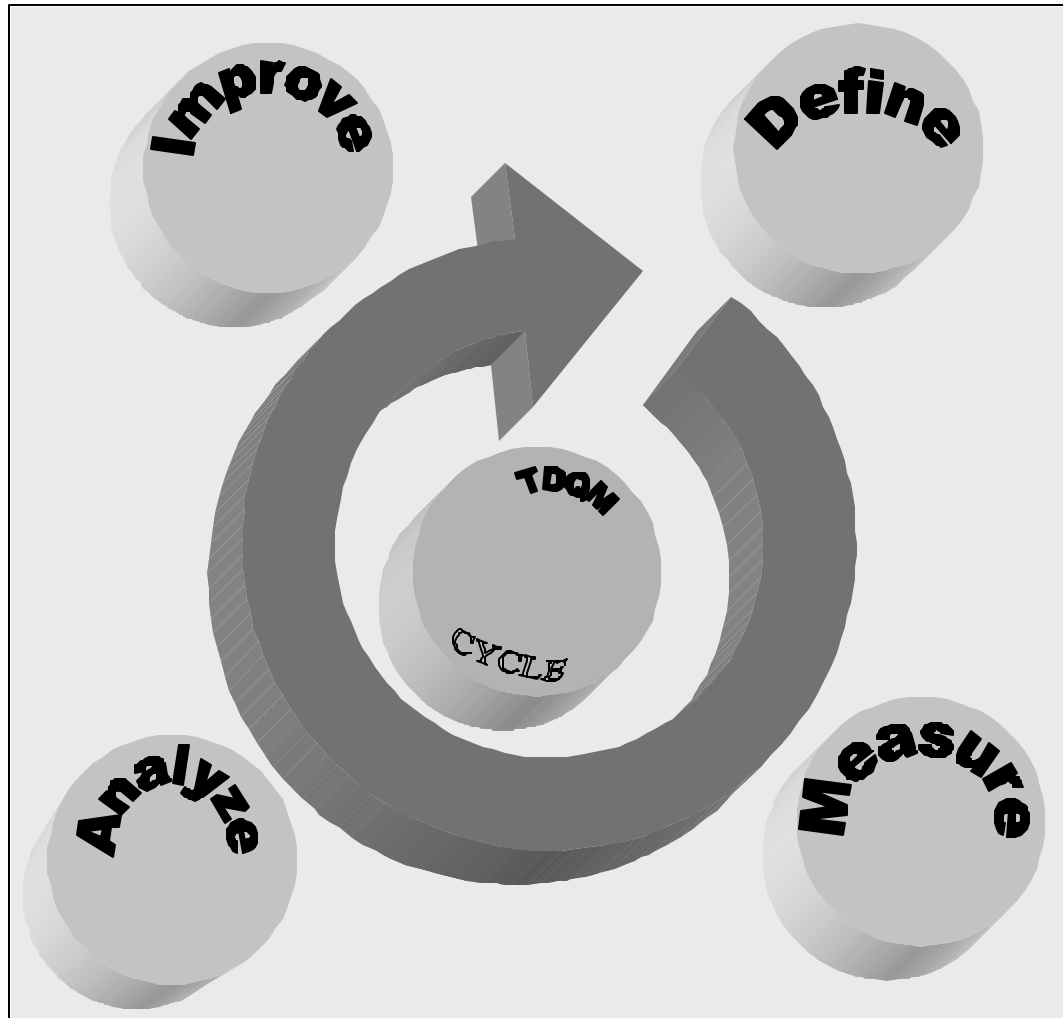
Figure 3. Wang's TDQM Model.

The first subtask is to identify elements of data that are needed by the information consumers. This is usually done through the aid of an Entity-Relation (ER) diagram. The second subtask is to determine the level of quality needed for the information. The third subtask is to define the information processes. Wang labels this the "Information Manufacturing System." Redman (1996) describes it as the "Information Chain".

The second task is to measure. Measurement comes through the development of information quality metrics. Redman utilizes the traditional Deming approach of Statistical Process Control (SPC). Redman applies metrics to the information process to establish control and then to move the system in the desired direction. This approach has a heavier focus on the information systems and data transfer between information systems. Wang (Haung et. al, 1999) broadens the scope of the metrics and shifts the focus to the end users or consumers of the information chain.

Analysis, the third task, entails discovering the root causes for the poor information quality and calculating the cost of the poor information quality to the organization. The improvement phase may utilize a variety of approaches. One approach is to modify/change the information technology (IT). This is the typical approach if the process team is headed by the IT department.   However, the IT approach should be considered in the context of the larger solution. For sustained improvement to occur two things must happen: First, the information process must be derived from a business requirement; secondly, business practices must be aligned to the information process.

Data Models

This study requires a further exploration of the differences between data quality and information quality. This exploration will take place through the description of data models and information models. Like the differences between

data quality and information quality, these terms are not clearly delineated by the literature. However, observation of the MHS leads the author to conclude that it is important to make a distinction. This section begins with a very simple diagram of a data model.

Figure 4 is a simple data flow model depicting a real world state and three connected information system (IS) states. In the real world, there are thousands of entities with thousands of characteristics per entity. The example data model is only concerned with the "Patient" entity and with five characteristics of that entity. The first IS data model (IS 1) depicts how it will store the real world information in its systems. Age is recorded in a format familiar to all, i.e. years. The format for storing weight in IS 1 is in pounds, but IS 2 and IS 3 stores the information in kilograms. The gender of the patient is converted to a numeric binary field (0 = Female, 1 = Male) format in IS 1, converted to a text field (F = Female, M = Male) in IS 2, and converted again back to the binary field in IS 3.

The simple data model provides an opportunity to explore data quality problems. The most obvious error is that IS 3 has changed the height of the patient from 68" to 69". This is a data corruption problem.

The not so obvious error is in the smoking status of the individual. The data model for each of the information systems is depicted in Table 3. Remember from Figure 4, that the patient is a smoker. Figure 4 shows that all three information

Real World	IS 1	IS 2	IS 3
Age: 35	35	35	35
Sex: Male	1	M	1
Wt: 180 lbs	180 lbs	81.8	81.8
Ht: 5ft 8in	68	68	69
Smoker	1	1	1
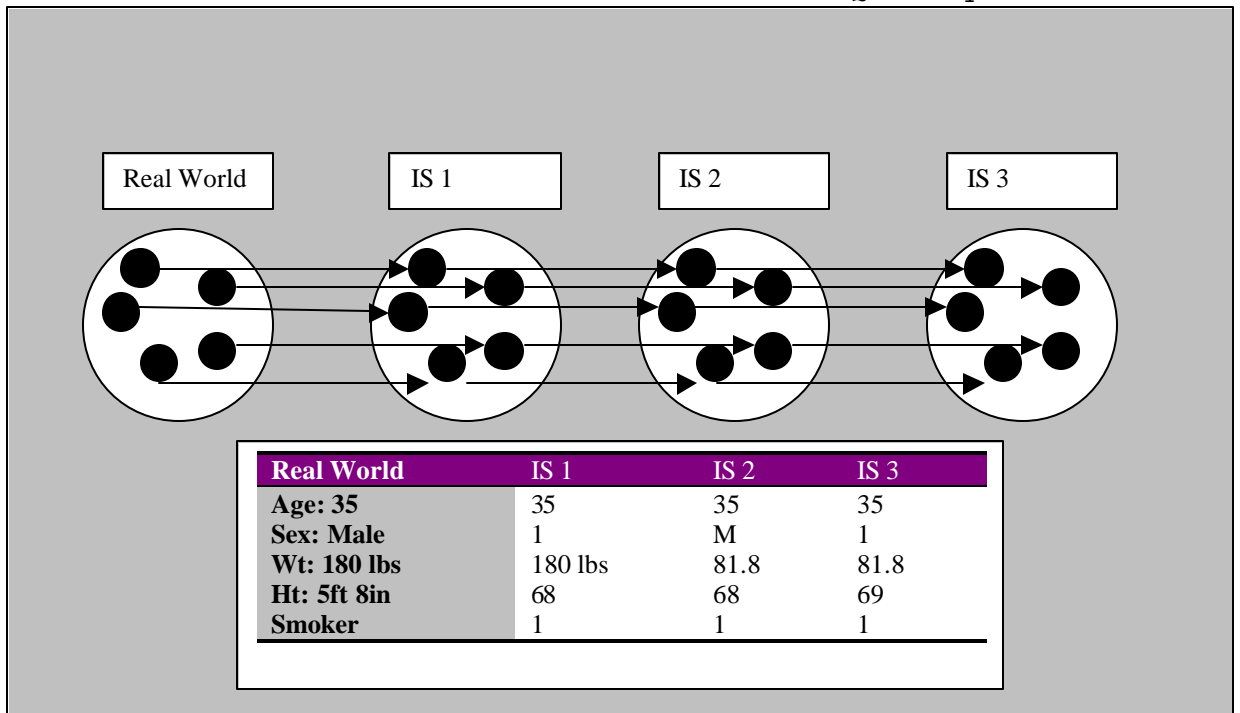
Figure 4. Simple Data Flow Model

Table 3

Example Smoking Status Data Model

	IS Rule for Capturing Smoking Status	
Information System	Smoker	Non-Smoker
IS 1	1	0
IS 2	0	1
IS 3	0	1

Note: A "0" would indicate the absence of the attribute, a "1" would indicate the presence of the attribute.

systems recorded the smoking status of the patient as "1." If
IS 2 or IS 3 are queried for the smoking status of the patient,
they would report that the patient was a non-smoker.   The
problem is that IS 2 failed to convert the data to comply with a
change in data model rules. This example points out two
important concepts. To improve the product of this system one
must know the data model for each IS and the data rules for how
it handles each characteristic.

Unfortunately, few things in the real world are simple
models. The MHS, as one of the largest health care
organizations in the world, probably has one of the largest
medical information systems in the world. Figure 5 demonstrates
the complexity of the system. Figure 5 is a simplified diagram
of one of the five major IS' in the MHS. It is a representation
of the Ambulatory Data System (ADS) which collects outpatient
encounter information. The ADS is not a single database. At
its source, the data model is designed to merge data from other
information systems (e.g., the Composite Health Care System
(CHCS) and the Defense Enrollment Eligibility Reporting System
(DEERS)) with data gleaned from a single patient encounter
occurring in one of the thousands of MTF clinics worldwide.
This encounter data is captured on an optical scanner reader
form, or entered directly into an MTF level ADS database through
a computer interface. A subset of this data is captured in a
data model called the Standard Ambulatory Data Record (SADR).
The SADR is either pushed or pulled (depending on location) to
an IBM feed node, archived, and then sent to four separate
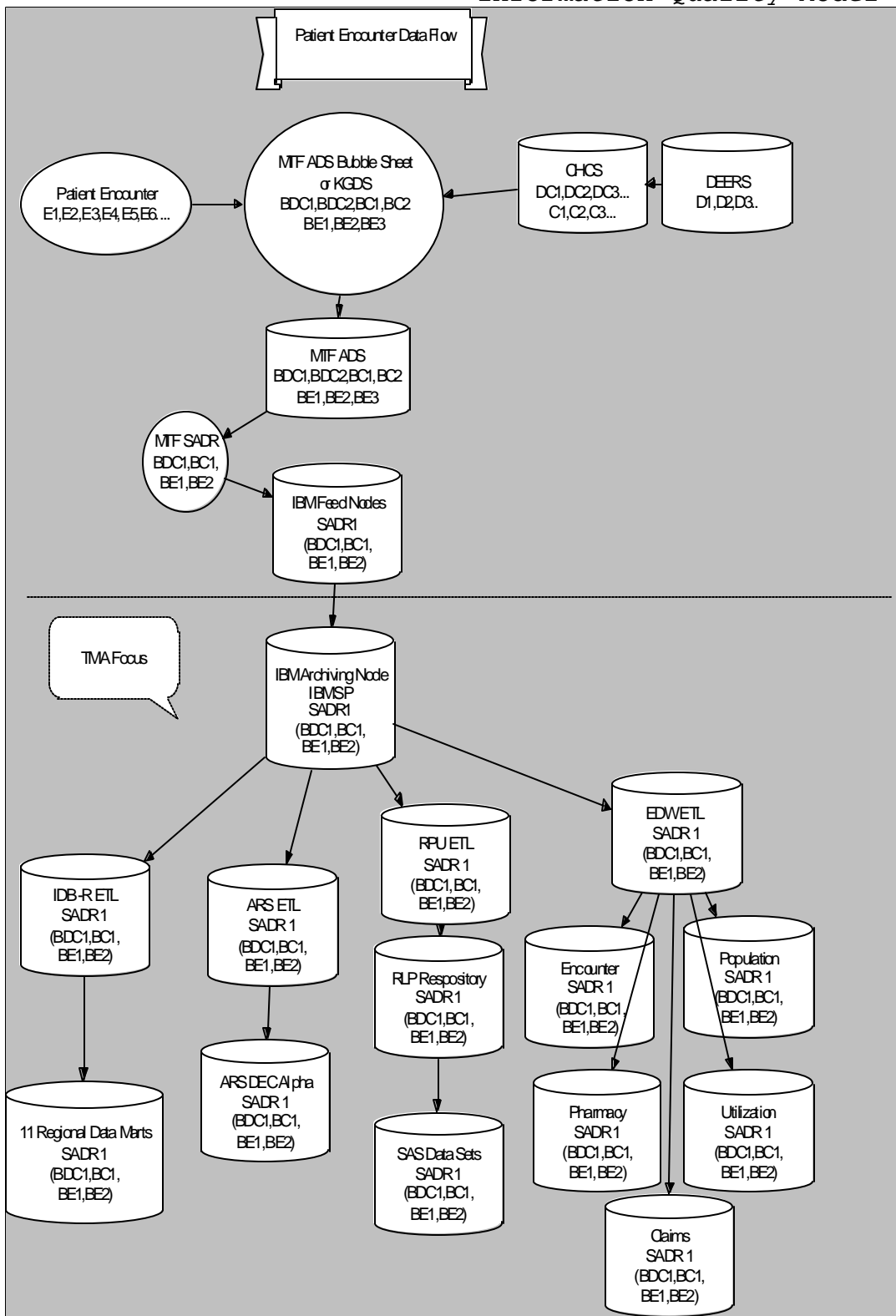
Figure 5. ADS Data Flow Diagram.

four separate information processing chains. Each IS processing chain then takes the SADR and feeds it to multiple other computer systems. The purpose of the four separate processing chains is to provide a data model appropriate for different end users.

Redman (1986) states that most data errors occur at information system interfaces. Figure 5 demonstrates the almost unfathomable number of interfaces just in this one system. The system is so complex that the problem of field level error is almost totally ignored by the TMA. The focus of TMA data quality efforts is on ensuring that there are an equal number of SADR record counts between each system. The most obvious problem encountered by users of the MHS data systems is that the number of patients seen by an MTF for a specified time frame varies from one end user IS to the next. The identified culprit is the SADR. They are either dropped or duplicated between interfaces.

To solve this "data quality" problem the MHS engages in what Redman terms "database bashing". Database bashing is comparing one database contents against another to identify lost or corrupted field level data. At the TMA level only record count integrity, or database integrity, is considered. The TMA and various other agencies will compare one end user database against another and discover that the SADR record counts are different. The number of records is important, because it is used as an indicator of workload. The TMA will engage in a time

and manpower intensive effort to find which end user system is the most incorrect. No one is completely confident of any system because the data are not evaluated with the real world model. Records are then removed or repopulated in the most errant system until the record counts between the two systems are equal.

Redman quoted Mark Twain to demonstrate the futility of database bashing, " A man with one watch knows what time it is. A man with two watches is never sure." The Air Force spent approximately half a million dollars to design a web site and institute a process which would measure and improve the process of SADR record transmittal from the MTF level to the IBM feed archive node. The Air Force daily engages in a manpower and IT intensive effort just to ensure counts are correct. Unfortunately, this process does not ensure that the counts are maintained all the way to the end user systems.

Record count integrity does not ensure field level integrity. The author does not find any comprehensive study within the MHS, which has addressed the issue of field level integrity in the SADR's. Thus even if the MHS is able to achieve a state of having equal record level counts across all systems it is unlikely that the fields between the systems would contain the same data.

To summarize, a data model describes the storage of characteristics of an entity in an information system and the flow of these characteristics across information systems. A data model allows one to conceptually view data quality as the

equality of data between information system states, beginning
with the real world state. In a relatively simple data model,
measuring and improving data quality is a time and labor
intensive task. In a system as complex as the MHS, data quality
is currently confined to measuring and improving database
integrity.

Information Model

An information model is more complex than a data model.
The purpose of an information model is to describe the processes
involved in the gathering of information. The information model
begins with the end user. It begins with the question: "What
information does the end user need to make a decision?" and then
describes all of the processes required to gather and display
the data that forms the required information. Figure 6 provides
a conceptual view of a generic information model.

The information model begins by identifying the data the
end user requires. These requirements are inclusive of all
elements needed to ensure information quality. Using Wang's
definition of information quality, we know that these elements
will include things related to the domains of intrinsic quality,
contextual quality, representational quality, and accessibility
quality.

The information model proceeds to define the processes,
which are required to gather the data. Internal to the
information model is the data model. The data model as
previously explained will describe how the data is stored in
information systems and how it flows between information

systems.   An important aspect of the information model is the

recognition that there are processes involved in moving the

information between systems. The next node in the model

describes all of the processes related to displaying data in the

form of information.   The end result is an information product.

The information product can then be evaluated by the same

elements that helped determine the requirements.
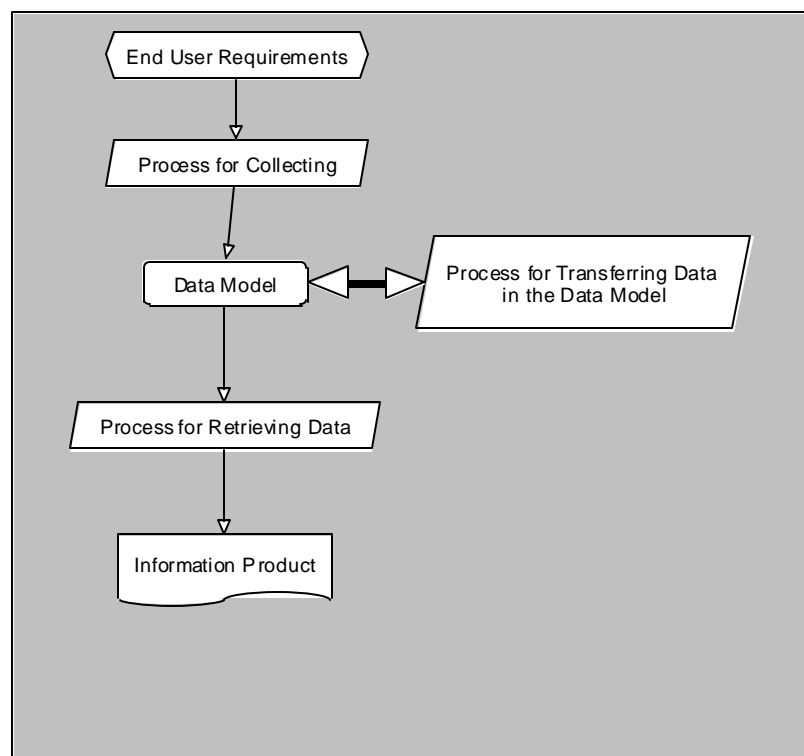
Figure 6. Information Model

Expanding on the information model, there are two different

groups involved in producing an information product--the

producers and the custodians.   The information producers are

those who create or gather data.   In the MHS, the information

producers are the MTF level personnel. The custodians are those

who design, develop, and maintain the information system

infrastructure that captures, moves, and displays the data. The

custodians of MHS data are spread throughout the entire system.

Identifying root causes for the deficient information

quality within MHS may be accomplished through the use of the

information model. Defining end user requirements is the

starting point. Defining requirements is never an easy task.

Often the end users are only vaguely aware of what they really

need. It has been said that the MHS data systems were designed

to answer any question that the GAO or other government official

may ask the MHS leaders. Like any system produced from such

broad requirements it is a jack-of-all-trades and master-of-

none.

The second root cause is process variation. Deming

postulated that the Achilles heel of quality is variation. A

convenient example is the ADS. Please refer back to Figure 5.

ADS Data Flow Diagram. The process begins with an ADS data

entry form (either electronic or hardcopy) being produced from

data stored in DEERS and CHCS. Thus, two potential sources of

variation and error are immediately identified. The MTF

healthcare provider collects the patient encounter information

on a bubble sheet or through a computer interface. It is not

unreasonable to hypothesize that each provider over the course

of a day worth of patients will have some variation in how

he/she enters the data. A further progression in this

hypothesis is that a group of providers in a given clinic will

have a slightly different process for entering the data. Each clinic within an MTF may have a slightly different process for using ADS, they most certainly will if they are still using the manual input forms. It is known that each MTF has a different process for sending the SADR up the chain. The process for moving the data from the archive node to each of the four separate end user systems is different. The process for moving the data from each node within the end user systems contains variation. Thus by the time the data flows from collection to output the amount of system variation it is subjected to is nearly overwhelming.

Try to visualize the variation as a river. The variation begins as a very small mountain stream with just a trace of sediment. As more feeder streams are added to the system (providers, MTF's, transfer points) the stream becomes wider, deeper, and muddier. By the time the end user looks at the data, he is confronted with a raging turbid river of variation. If this river, along with several other rivers of like size and turbidity, empties into a basin (a data warehouse) the result is not a pristine mountain lake; it is a stinking, swirling cesspool fraught with dangerous undertow currents.

If the view is taken that information is a product derived from a system, then it is easier to comprehend that the myopic focus on data quality is insufficient for creating information quality. Data quality is expressed through the data model. Information quality is expressed through the information model, of which the data model is only a component. The TMA's current

approach to data quality and information systems architecture is ignoring end user requirements and system variation.

Accountability is a major element missing from the MHS information model. The information producers at the MTF level are rarely accountable for the accuracy or timeliness of data they feed into the source systems. The information custodians are rarely accountable for the design of systems, which assists the producers or the consumers. Custodians strongly oppose taking on responsibility for the quality of the information fed into their systems. Alas, it appears that no one is accountable for controlling even the most obvious variation in business procedures.

Wang and Redman throughout their publications point to the requirement for the information process to be managed in its entirety. Depending on the academic school, the person or group upon whom this responsibility falls is labeled the process manager(s) or process owner(s). Whichever label is chosen, the key concept is accountability. An information process manager is a product manager. These individuals manage the information model like any other production model and consequently are accountable for the quality of the information product.

To summarize, an information model provides a systems view for information quality. The model treats information as a product derived from well defined processes, managed by an accountable individual or group. The information model describes a production process. Information systems and technology are important components of the model, but not the

models primary focus. The author finds the information model vastly superior to the data model in describing the needs of consumers and producers.

PURPOSE

The MHS is tasked with providing the 22 HEDIS Medicare measures listed in Table 4 to HCFA (HCFA, 1999). Unfortunately, it is not possible within the parameters of this study to assess the entire list of measures. This study will limit its scope to just one measure: Beta Blocker Treatment After a Heart Attack.

For the targeted measure, this study will define the current information model for collecting data and reporting the measurement to HCFA. It is known from previous studies (VRI, 1998b) that the collection of this measure has been difficult for the MHS. Therefore, this study will formulate an alternative information model. Finally, this study will compare the two models using Wang's dimensions of information quality.

It is hypothesized that a new information model that treats the TSP HEDIS Medicare measure as an information product will be vastly superior to the current information model in the MHS. The alternative model developed in this study is hoped to provide MHS leaders with a guide to building a capable information system. The results may also be used by MHS leaders as a template in developing a robust system wide information quality program to ensure the survivability of one of the worlds largest managed care organizations.

Table 4

HEDIS 2000 Medicare Measures

Domain	Measure
Effectiveness of Care:	
	• Antidepressant Medication Management (for those with a drug benefit)
	• Cholesterol Management After Acute Cardiovascular Events
	• Breast Cancer Screening
	• Beta Blocker Treatment After A Heart Attack
	• Comprehensive Diabetes Care
	• Follow-up After Hospitalization for Mental Illness
	• Controlling High Blood Pressure
	• Medicare Health Outcomes Survey
Access to/Availability of Care:	
	• Adults' Access to Preventive/Ambulatory Health Services
	• Availability of Language Interpretation Services
Use of Services:	
	• Frequency of Selected Procedures
	• Inpatient Utilization - General Hospital/Acute Care
	• Ambulatory Care
	• Inpatient Utilization - Non-Acute Care
	• Mental Health Utilization - Inpatient Discharges and Average Length of Stay
	• Mental Health Utilization - Percentage of Members Receiving Inpatient, Day/Night and Ambulatory Services
	• Chemical Dependency Utilization - Inpatient Discharges and Average Length of Stay
	• Chemical Dependency Utilization - Percentage of Members Receiving Inpatient, Day/Night and Ambulatory Services
	• Outpatient Drug Utilization (for those with a drug benefit)
Health Plan Descriptive Information:	
	• Board Certification/Residency Completion
	• Total Enrollment by Percentage
	• Enrollment by Product Line (Member Years/Months)

Note: Adapted from Health Care Financing Agency (HCFA) (1999).

Operational Policy Letter #110 (OPL99.110). Baltimore, MD:

Author.

CHAPTER 2

METHODS AND PROCEDURES

<u>Methodology</u>

This study will use a case study methodology. In describing the specifics of this approach, the first step will be to describe the current information model for the collection of the data required by the targeted measure. This step will include the identification and description of the following information model elements: the consumers, the producers, the custodians, the information systems, the information manager(s) and the current process, beginning with the initial collection of the data through to the reporting the completed measure to HCFA. The second step will be to evaluate this model using Wang's attributes of information quality: Intrinsic IQ, Contextual IQ, Representational IQ, and Accessibility IQ. The final step will be to formulate an alternative model that provides for a higher quality information product.

<u>HEDIS 2000 Technical Requirements</u>

HEDIS measurement requires the application of very complex formulae to MCO datasets. To become acquainted with the complexities involved in HEDIS measurement, this section will define the technical requirements for the targeted measure. In general, the measure is designed to evaluate appropriate follow-up care. The technical requirements form the cornerstone of the end user requirements in the information models. The HEDIS 2000 Technical Specifications (NCQA, 1999) specify in precise detail

the denominator and numerator for the measure: Beta Blocker Treatment After a Heart Attack.

Denominator

The criteria for inclusion in the denominator (target population) are as follows: 1) all members 35 years and older as of December 31 during the measurement year; 2) members who were hospitalized and discharged alive from January 1 through December 24 of the measurement year with a diagnosis of acute myocardial infarction (AMI) (ICD-9CM code 410.x1 with "x" equal to any digit); 3) members who received an ambulatory prescription for beta blockers upon discharge. The following clauses also apply: 1) the member must have no gaps in enrollment during the measurement year and must have stayed enrolled in the plan at least seven days after discharge; 2) if a member had more than one episode of AMI during the measurement year, then only the first episode is counted; 3) members' transferred to acute care facilities after December 24th are to be excluded; and, 4) if the member was re-admitted to an acute or non-acute care facility for any diagnosis within seven days after discharge, the member is excluded from the denominator.

Additionally, the NCQA strongly recommends that the MCO's exclude from the denominator those members who are identified as having had a contradiction to beta blocker therapy. Per the NCQA (1999), the following conditions allow exclusion: insulin dependent diabetes mellitus, heart block >1 degree, sinus bradycardia, heart failure, left ventricular dysfunction, and chronic obstructive pulmonary disease (COPD). Also, use of the

following prescriptions by the member indicate a
contraindication to beta blocker therapy: insulin, inhaled
corticosteriods, or leukotrien antagonists.

   Numerator

   The numerator for the measure is derived from members who
receive an ambulatory prescription for beta blockers within
seven days after discharge. A general list of allowable beta
blockers is in Table 5; a complete list of allowable medications
may be found on the NCQA website http://www.ncqa.org. The
prescription may be filled on an ambulatory basis anytime during
hospitalization, up to seven days after discharge. If the MCO
is unable to determine if the prescription is filled on an
ambulatory basis during the admission, only those members with
prescriptions filled within seven days of discharge are

Table 5

NCQA Allowable Beta Blockers

Acebutolol HCL	Carvedilol	Penbutolol Sulfate
Atenolol	Labetalol HCL	Pindolol
Betaxolol HCL	Metoprolol Succinate	Propranolol HCL
Bisprolol Fumarate	Metroprolol Tartate	Sotalol HCL
Carteolol HCL	Nadolol	Timolol Maleate

Note: Adapted from HEDIS 2000 Technical Specifications, Volume
2, by the NCQA, 1999. Washington, D.C: Author.

allowable. If the member was on an active beta blocker
prescription at the time of admission, then the member is to be
included in the numerator. Members transferred to acute care
facilities require additional scrutiny. Inclusion in the
numerator requires the MCO to determine if the member was on a
prescription from 30 days prior to admission through 7 days
after discharge.

Primary data collection was beyond the scope and resources
of this study. The study design utilized modeling and analysis
to derive its results. Technical specifications were provided
for the purpose of demonstrating the end user requirements and
also to give a glimpse into the robust data model requirements
for the information system.

CHAPTER 3

CURRENT INFORMATION MODEL
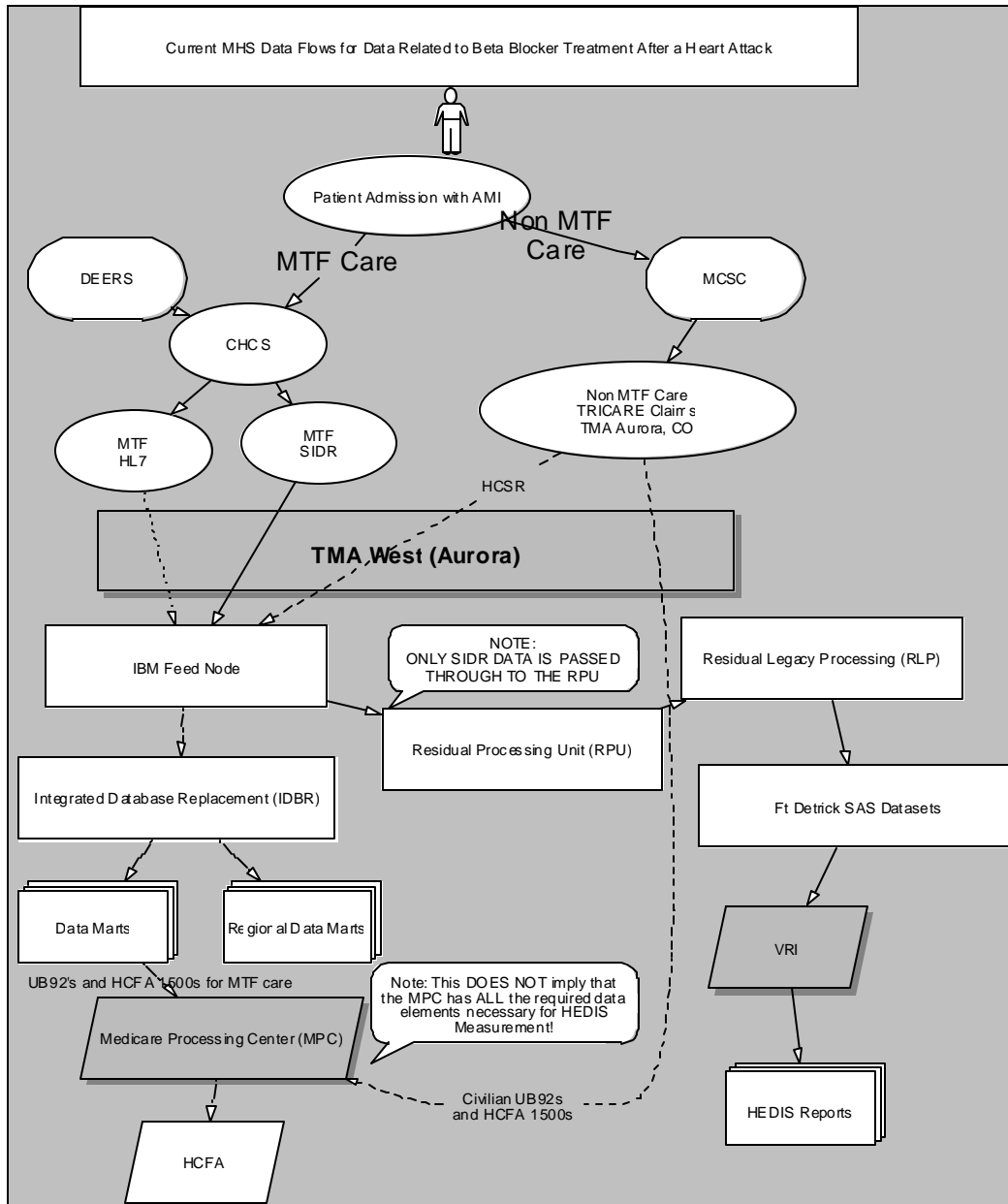
Figure 7. HEDIS Data Flow

Current Process for Collecting Data

Establishing a current data flow diagram for any MHS data system is an arduous task. Considering the turmoil within the MHS information management program offices over the last six months, what is current will depend on the source and can literally change within hours. Nevertheless, using data experts within VRI and TMA documentation (TMA, 2000), Figure 7 was developed to provide a macro view of the data flows related to the targeted measure. The three major processes that must be mapped are enrollment, claims/clinical data flow, and HEDIS report generation.

The first major step in the data flow process will begin with an eligible beneficiary enrolling into the TSP, a data flow diagram for this is found in Appendix 1. The process begins with a beneficiary sending a request for enrollment into TSP to a Managed Care Support Contractor (MCSC). The MCSC forwards the request to the Medicare Processing Center (MPC). The MPC was developed and is run by Litton PRC, a civilian contractor to the MHS. The MPC does an eligibility check on the applicant utilizing the Defense Eligibility Enrollment Reporting System (DEERS). The MPC then forwards eligible enrollee applications to HCFA. HCFA reports back to the MPC on Medicare eligibility. The MPC forwards the Medicare eligibility status back to the MCSC, which enters it into the Composite Health Care System

(CHCS). CHCS is then used to update the DEERS file with a
special TSP Medicare eligible identifier. The CHCS also
forwards the information to CEIS. This process is critical for
HEDIS Medicare reporting because it provides the only unique
identifier for the TSP population within the MHS. It is also
critical because HEDIS reporting requires patient-level data be
identified by the HCFA provided health insurance claim (HIC)
number.

The second major step in the overall process is to identify
how the claims and clinical data flow through the systems.
Figure 7 begins with an enrollee being admitted to a facility
with the diagnosis of AMI. The enrollee may be admitted either
to an MTF, a network facility, or a non-network facility. The
data flows are vastly different depending on location. A
diagram, which focuses exclusively on this process, may be found
in Appendix 2.

The MTF relies upon CHCS to produce a Standard Inpatient
Data Record (SIDR), drawing upon data elements contained within
DEERS. For the purposes of the target measure the SIDR will
only contain information related to patient identifier, date,
and diagnosis. CHCS is used to send the required pharmaceutical
data up the information chain in another format separate from
the SIDR, referred to as HL7 (Health Level 7) feeds. These
feeds are collected at the TRICARE Management Activity West, in
Aurora, Colorado (TMA West) in an information system called the
IBM Mainframe. The TMA Office of Acquisition Management and
Support (TMA AM&S) controls this system. CEIS accesses this

data via the Integrated Database Replacement (IDB-R) and is required to convert the SIDR and HL7 data to civilian industry standardized codes (UB92's and HCFA 1500's) and forward this data to the MPC.

If the enrollee was admitted at a network or non-network facility, then the MCSC forwards the data by two separate processes to two distinct locations. One data feed in an MHS format is sent via the form of a Health Care Standardized Record (HCSR) which goes to the IBM Mainframe at TMA West. The HCSR data is used to populate the CEIS, thus allowing CEIS users to view non-MTF provided services. The second feed consisting of industry standard codes in the form of UB92s and HCFA 1500's is sent directly to the MPC. The MPC is tasked with submitting the converted HCSR data (MTF care), the network claims, and non-network claims to HCFA in a civilian industry format.

The third major step is to identify how the HEDIS Medicare reports are produced. VRI is the contractor of choice for producing the HEDIS reports. VRI is granted access under contract to query the SAS datasets located on the Ft. Detrick mainframe. Ft. Detrick receives data feeds from the Residual Legacy Processing (RLP) at TMA West. These feeds contain SIDR data collected from the MTF's by CEIS, HCSR data from the Information Management Technology and Reengineering-Aurora (IMT&R-A) and processed by CEIS, and population data from a DEERS population extract (VRI, 1999).

Noticeably absent from this feed list is HL-7 or ancillary care data, which includes pharmacy data. Currently a definitive

corporate repository of ancillary data is not available. The
ancillary data retained within the IDB-R, after a monthly update
to the datamarts, is in an archived format that greatly hinders
abstraction and access.

VRI Statistical Analysis Software (SAS) programs access the
datasets at Ft. Detrick and through complex coding algorithms
extract the required information into flat files, which are
uploaded to a VRI Access® database. The VRI Access® database is
then queried to produce the required data for HEDIS report
generation.

Obviously without pharmacy data, the target measure is not
reportable using only administrative sources. (HCFA and the
NCQA provide for a modified method of collecting the measure
through sampling and medical record abstraction. However, this
method is beyond the scope of this study and is not related to
the study question.) There are other potential sources of data.
The MPC Beneficiary File maintained by LITTON PRC, may contain
many of the required elements. Additionally, there is the All
Regions Server (ARS) which is maintained by SAIC, another MHS
civilian contractor. The ARS is reported to contain detailed
National Mail Order Pharmacy (NMOP) data at the beneficiary
level and summary level (non-beneficiary level) information from
CEIS for data validation purposes. Due to constraints on
access, time, and funding these alternative data sources have
not been thoroughly evaluated by the MHS for their potential use
in HEDIS reporting and this evaluation is well beyond the scope
of this study.

With the information flow identified, it is now possible to identify the consumers, producers, custodians, information systems, and information managers. This information is provided in Table 6. The information product in this study is the HEDIS Medicare measure. Obviously, in a system as large and complex as this, there are many intermediary consumers of information. However, only the TMA, the Lead Agents, HCFA, and the NCQA

Table 6

Current Information Model Entities

Role	Entity
Consumers:	HCFA, NCQA, TMA, Lead Agents
Producers:	MTF staff, MCSC staff, MPC staff, VRI staff
Custodians:	U.S. Army Medical Information Systems and Services Agency (Ft.Detrick Mainframe)
	CHCS Program Management Office
	TMA AM&S (IBM Mainframe, IDB-R, RPU, RLP)
	CEIS Program Management Office
	Defense Manpower Data Center (DEERS)
	Litton PRC (MPC)
	VRI (HEDIS Access Database)
Information Systems:	DEERS, CHCS, MPC, MCSC Systems, IBM Feed Node, IDB-R, RPU, RLP, Ft. Detrick Mainframe, CEIS, VRI SAS extracts, VRI Access Database
Information Manager:	TMA Office of Medical Affairs (TMA OMA)?!

require a finished product. Like consumers, it is obvious in
this system that there are a number of producers and
intermediary producers. Those of greatest concern are the
producers having the greatest impact on the finished product.
Producers inputing data directly into an information system, or
those, which vastly alter received data to supply another
output, are of the most interest. The list of custodians is
very impressive. They represent politically powerful and at
times conflicting interests. The list of information systems is
also very impressive. Almost every transfer point will involve
the conversion or manipulation of data to meet the data model of
the receiving system. The final task was to identify the
Information Manager. The TMA Office of Medical Affairs was
selected as the Information Manager, only because they are the
contracting agency for the HEDIS report generation.

CHAPTER 4

CONCEPTUAL INFORMATION MODEL

CONCEPTUAL HEDIS DATA FLOW

Patient admitted to
to MTF for AMI

Patient Admitted to
Network Facility for AMI

Patient Admitted to
Non-Network Facility
for AMI

Patient uses
MTF Pharmacy

Patient uses
Network Pharmacy

Patient use
Non-Network
Pharmacy

Feedback

MTF Staff enter data into
MPC System

MCSC staff enter data
into MPC system

Note:
Ancillary data is in
the civilian format!

UB 92
HCFA 1500
Ancillary Data

UB 92
HCFA 1500
Ancillary Data

Patient uses
NMOP

Medicare Processing Center

VRI using code built into MPC

HCFA

HEDIS Reports

TMA has authority to direct
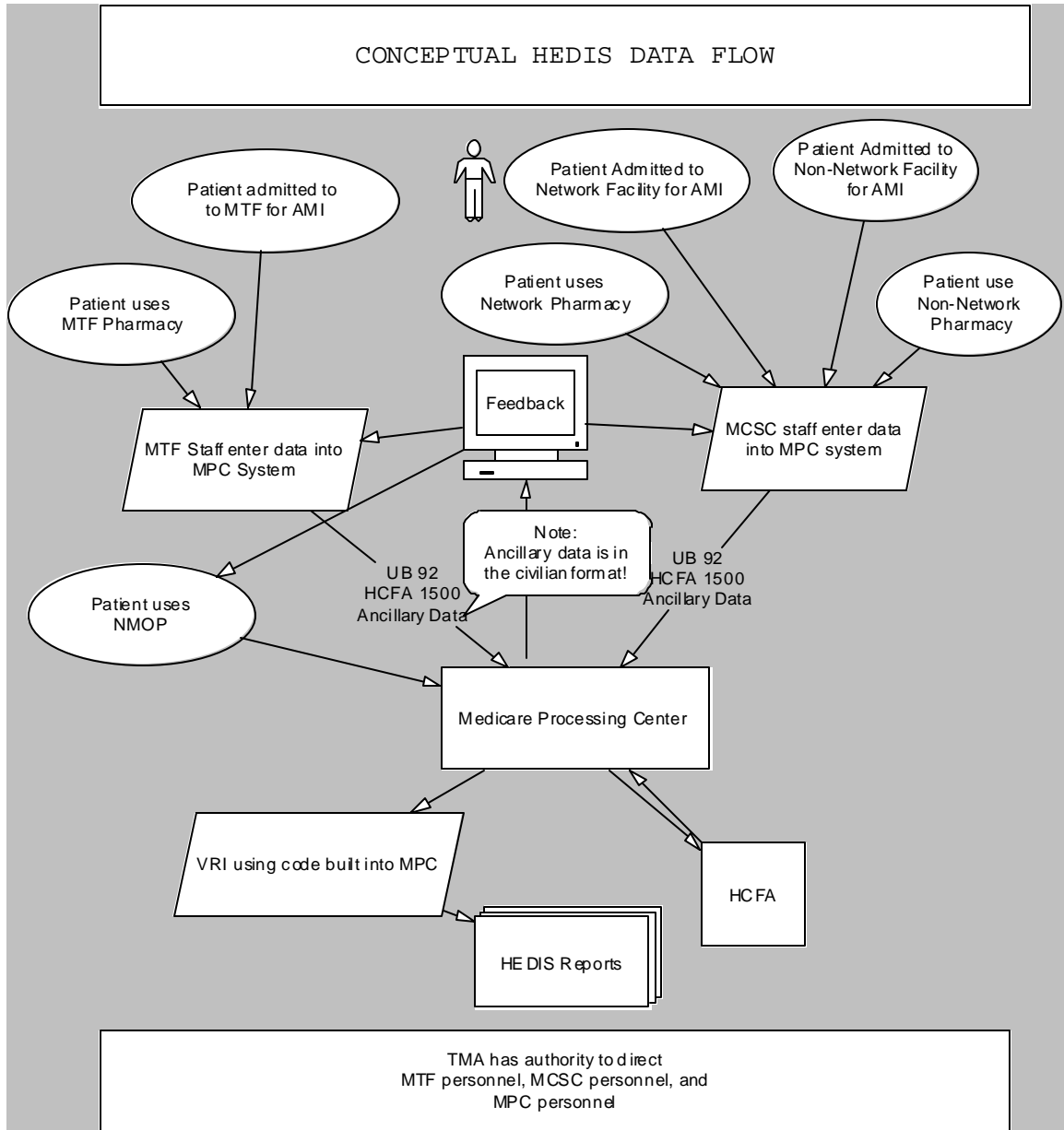MTF personnel, MCSC personnel, and
MPC personnel

Figure 8. Conceptual HEDIS Data Flow

Conceptual Model

The current information model is not sufficient to report the targeted measure. Therefore, this study will propose an alternative conceptual model, shown in Figure 8. This model utilizes a functional versus a technical approach. The chosen functional approach maps the requirements, whereas a technical approach maps the actual data elements in an entity relationship and produces the data model for each information system.

Requirements

Referring back to Figure 6, the first step in producing the information model is the identification of end user requirements. The requirements are found in detail in the HEDIS 2000 Technical Specifications (NCQA, 1999). Additionally, since the goal is to increase the quality of the product it will be necessary to state requirements related to the intrinsic, contextual, representational, and accessibility attributes of the information model.

To increase the intrinsic information quality of the model it will be necessary to identify methods that will enhance the accuracy and objectivity. Unfortunately, in the near term there is no strategy to combat the MHS information system stigma. However, building quality control measures into the system may increase the accuracy of the model. Accuracy and accountability go hand in hand. Forcing accountability for the information

entered into the system down to the MTF level will greatly
increase the accuracy of the information. To address the issue
of objectiveness it will be necessary for the MHS to get over
its "we are unique" syndrome. If the MHS requires MCSC to
capture the information in UB92 and HCFA 1500 formats, it would
appear prudent for the MHS to do the same for care provided
inside the MTF.

The greatest challenge will come from the contextual IQ
domain. There are currently three separate processes for
receiving ambulatory prescriptions: those provided at the MTF,
those provided by a MCSC or network pharmacy, and those provided
through the National Mail Order Pharmacy (NMOP) program. The
challenge is getting all three to submit their data to the same
location in the same format.

Representational IQ is really tied into the above intrinsic
and contextual requirements. The representational IQ will be
greatly increased if: 1) the number of transfer points is
decreased; 2) the number of separate information systems is
decreased; 3) the number of custodians is decreased; and 4) the
information captured at the time of the encounter is the same
and in the same formats as that which is used to calculate the
HEDIS measures.

The final requirement is the identification of an office at
the TMA level that has the authority and accountability to
function as the corporate information manager for the TSP
demonstration. This office must be empowered to fund the
system, control access and content, and must be politically

powerful enough to battle the MHS bureaucracy. This office would not function independently but instead would rely upon operational control of personnel at the MTF and MCSC sites that function to support the mission of the office.

Process for Collecting

The process for collecting the data must be well defined and standardized throughout the healthcare system. The process must treat the data as a product and not as a by-product of another activity. The proposed model would have the MTF/TMA personnel enter the data directly into the MPC system. Thus, mirroring the processes currently in place at the MCSC's. The MTF's would utilize the same business processes as the MCSCs. The MTF would consider each encounter with a TSP member as a business transaction that requires standardized civilian documentation. The NMOP would also be required to enter prescription data in the same format and via the same systems as used by the MTF's and MCSC's. To build quality into the process, it would be advantageous to have TMA TSP Information representatives at each demonstration site, each MCSC, the MPC, and working with the NMOP.

Data Model

The data model is beyond the scope of this study. It would require technical analysis of the MPC and systems used by the MCSC. The ideal data model would greatly reduce the number of information systems involved. Additionally, it would contain a

standard civilian based data model that is directly compatible with HCFA systems, eliminating the need for conversion.

Process for Retrieving

Since the MPC would ultimately contain all the data related to the members in the TSP demonstration, it follows that the HEDIS reports should rely upon this as the sole source for data. The contractor, which is responsible for collecting and reporting the measures, would develop the software programs that would be incorporated into the MPC. With the programs imbedded into the MPC it would eliminate multiple data conversion steps, representational problems, and access barriers. Additionally, the TMA, Lead Agents, and MTF's could track the status of the metric throughout the year. Thereby, allowing the MHS to possibly institute a program of continuous improvement and not be surprised by a yearly report.

The MPC system would also be the functional system for tracking enrollment and eligibility status by the MTF's and MCSC's. The MCSC will need to initially utilize the DEERS system to verify eligibility. However, once eligibility is determined the only system that would need to be updated is the MPC.

Entity Identification

Table 7 provides a conceptual view the systems and entities involved in the new information flow. The numbers of data custodians were reduced to only one, namely, the MPC. The only information system to be used, with the exception of

the initial eligibility check, is the Medicare Processing Center
system. Lastly, an information management team is identified.
They will be held directly accountable for the quality of the
information entered into and maintained by the system.

Table 7

Conceptual Information Model Entities

Role	Entity
Consumers:	HCFA, NCQA, TMA, Lead Agents
Producers:	MTF staff, MCSC staff, MPC staff, VRI staff
Custodians:	Medicare Processing Center
Information Systems:	MPC, (DEERS for initial verification)
Information Manager:	TMA Corporate TSP Information Center, with offices at each demonstration MTF site, MCSC, and MPC.

CHAPTER 5

DISCUSSION

This study developed a framework for evaluating information models through an extensive literature review. The evaluation framework is based upon the Information Quality attributes identified by Wang (Huang, et. al, 1999; Wang, Lee, Pipino, & Strong, 1998). The four attributes were assigned a subjective score based on issues identified with the information flow. Intrinsic IQ addresses the issues of accuracy, objectivity, believability, and reputation. Contextual IQ addresses the issues of relevancy, added value, timeliness, and completeness. Representational IQ addresses the issues of interpretability, ease of understanding, conciseness of representation, and consistency of representation.

Since it was discovered that the current information model was incapable of reporting the targeted measure, it was necessary to produce an alternative conceptual information model. The study will now turn its attention to utilizing the framework to evaluate both the current information model and the conceptual information model.

Current Model Evaluation

The current information model is evaluated utilizing Dr. Wang's attributes of information quality. The results are displayed in Table 8.

Table 8

Current Model Evaluation

IQ Attribute	Score	Issues
Intrinsic IQ	LOW	❏ Historically, these data have a very poor reputation among GAO and IG auditors. ❏ Direct MTF patient care data require a conversion process from HCSR format to UB92 and HCFA 1500 formats. ❏ Different processing data flows for MTF and non-MTF provided care. ❏ Lack of quality improvement processes. ❏ No identified TSP information process owners at the MTF level. ❏ TMA OMA responsible for HEDIS reporting, but lack authority to control information process.
Contextual IQ	LOW	• Target measure is not producible using only administrative data sources. • Process is time consuming, measure can only be produced yearly. • Data are incomplete, markedly lacking pharmacy data.
Representational IQ	LOW	❖ Data have multiple formats in multiple systems.
Accessibility IQ	LOW	➢ No corporate source for historical ancillary data. ➢ Archived historical data are extremely difficult to access. ➢ Multiple custodians produce barriers to accessing the data.

Evaluating the current information model utilizing Wang's attributes of information quality finds that the model scores low in every area. Most importantly, it fails to meet the requirements of the TSP demonstration. However, even if it could produce a product, the validity of the product would be in question because of the high degree of variability inherent in the model.

Conceptual Model Evaluation

It is impossible to actually evaluate the product of this model, however an analysis of the conceptual design may be conducted. Using Wang's attributes of Information Quality, the results of the conceptual model evaluation are found in Table 9.

The model receives high scores in all areas except the intrinsic IQ domain. In the short term, it is impossible to overcome the stigma attached to MHS systems by outside entities. To overcome this problem the accuracy and usefulness of the system would require independent evaluation.

Information Manager Analysis

In addition to the model evaluations already provided, there are three questions that MHS information managers should be asking.

Table 9

Conceptual Model Evaluation

IQ Attribute	Score	Issues
Intrinsic IQ	MED	❑ Historically, MHS data systems have a very poor reputation among GAO and IG auditors. ❑ Direct MTF care and non-direct MTF care would be captured in the same format. ❑ MTF and non-MTF provided care have the same information flow process. ❑ Quality improvement processes are built into the system by providing direct feedback from the MPC. ❑ The information model has well identified process owners at all levels of the system. ❑ TMA would have operational control over the process.
Contextual IQ	HIGH	• Target measure would be producible using only administrative data sources. • Process would be timely and measure could be reported monthly. • Data would be complete.
Representational IQ	HIGH	❖ Data would have a single format on a single system.
Accessibility IQ	HIGH	➤ There would be a corporate resource for all data related to the TSP demonstration. ➤ Single custodian controls access to the data.

<u>Does the model treat data as a product or as a by-product of the organization</u>?

The current model clearly treats data as a by-product of its existing operations. It is apparent from the current model's design that the MHS expected to play by different rules than those required of its contractors. The MCSC's must treat the data as a product, because it is the source of their funding. In the business world, fiscal remuneration drives the design of information systems. Conversely, the MHS appears to have hoped that it could carry out a civilian business model, which Medicare reimbursement most certainly is, without instituting comparable civilian practices into its internal healthcare system and supporting information systems. The conceptual model overcomes this bias by forcing the MHS to carryout the same business processes as the MCSC.

<u>Is quality built into the system?</u>

After multiple attempts to get a handle on their data quality improvement, the MHS remains without a definitive, workable program in place. Corey (1997) described three attributes of the MHS that adversely impacts data quality and the attempts to improve the data quality: organization, process, and personnel. There is no one political entity that has the power, and or, willingness to take control of the system. The Services refuse to accept that their individual desires should be subservient to an MHS-wide task. Each Service wants to

remain in control of their individual share of the pie. The

conceptual model overcomes this inherent nature by requiring

that a TMA level office have direct operational control over the

personnel and systems handling the TSP demonstration data.

<u>Does the model support the TSP demonstration?</u>

The current model does not fully support the demonstration. In

fact, the current model may well be a major reason for its

downfall judging from the numerous GAO reports. The current

model is unable to report the targeted measure in this study.

Further, based on past studies it is highly unlikely that the

current model will succeed in supporting many of the HEDIS

Medicare measures. The conceptual model would be able to report

the targeted measure and thus, would support the TSP

demonstration.

Chapter 6

CONCLUSSIONS and RECOMMENDATIONS

This study has evaluated the current processes for the collection of the HEDIS Medicare Measure: Beta-Blocker Treatment After a Heart Attack. It has found the current information processes to be inadequate. Thus, the measure is not reportable using only administrative systems. An alternative model for the data collection was conceptualized and assessed as vastly superior in quality to the current information model.

Unfortunately, this is not a new finding for the MHS. The MHS has known that their information management processes have been deficient in this area for at least three years. Regrettably, for the TSP demonstration there is little that can be done in the short-term to correct these problems.

This study went to great lengths to identify and review all known information systems utilized in the TSP demonstration. Never the less, it is possible, due to the sheer number and size of the information systems in the MHS, that the study failed to identify every potential information system flow for the TSP data. A single system source for all of the required data is a very remote possibility. If there were such a system, the author would seriously question the quality of its data and the quality of its information, for all of the aforementioned reasons.

The MHS is at a critical juncture. It has spent millions of dollars on information systems that do not meet user requirements. The GAO has already called into question the MHS' ability to effectively use its own information systems to manage healthcare operations. If the MHS fails the TSP demonstration, specifically because of their poor information systems, it is possible that it will loose much more than just the potential for Medicare reimbursement.

This study proposes a relatively simple model that may be used to build the types of information systems (not just data systems) that the MHS requires to survive. Some may argue that the conceptual model is a return to the stove-piped systems of the past. The author would argue that this is not the case for two reasons. First, the model is based upon an identified business process that spans the breadth of the organization. Secondly, the model aligns information systems with strategic initiatives. Therefore, it is not like MEPRS with its focus on resource management. Nor is it like CHCS with its focus on clinical data. Further, it is unlike CEIS which touts itself as a decision support system but has no user relevant focus.

Another criticism may be that the conceptual model presented here is another costly information system. The point of this criticism would be to force the MHS to fix the systems in which millions of dollars have already been invested. The fundamental flaw with this argument is that it fails to recognize the importance data models have on information quality. The very foundations of the current information systems are flawed (e.g.,

there are no common data definitions across systems). The only prudent alternative is to build systems based upon a functional data model. The data model in the alternative information model is derived from a proven TDQM methodology using data standards derived from civilian healthcare industry standards. In addition, all entities contributing to the data flows are required to use the same system.

The TSP demonstration is under assault from a number of fronts. Therefore, one may question the decision to invest additional resources toward rectifying the HEDIS reporting problem. The response is simple. HEDIS measurement is not only important to those on the outside of the organization (viz., the GAO and HCFA), it should also be very important to the leaders and healthcare providers within the MHS. HEDIS measures are designed to help the healthcare organization evaluate where they stand in comparison to other healthcare organizations. Every responsible healthcare leader must seek to improve their organization. HEDIS measurement provides an ideal way for the leader to do this. The MHS owes it to every MTF commander, every MTF staff member, and every MTF patient to accurately report HEDIS measures.

It is possible for the MHS to implement the concepts outlined in the conceptual model. However, it requires strong leadership at the highest level of the organization to overcome the inter-service and even intra-service warfare. An analysis of all the HEDIS measures, in a manner similar to that performed in this study, should be undertaken. The TSP demonstration

provides fertile ground for such an effort to begin. The TSP

demonstration was and is a major catalyst for changing business

practices within the MHS. If an information model, such as the

one presented here, were produced and implemented for all HEDIS

Medicare measures, it would provide a much-needed foundation for

system-wide improvement.

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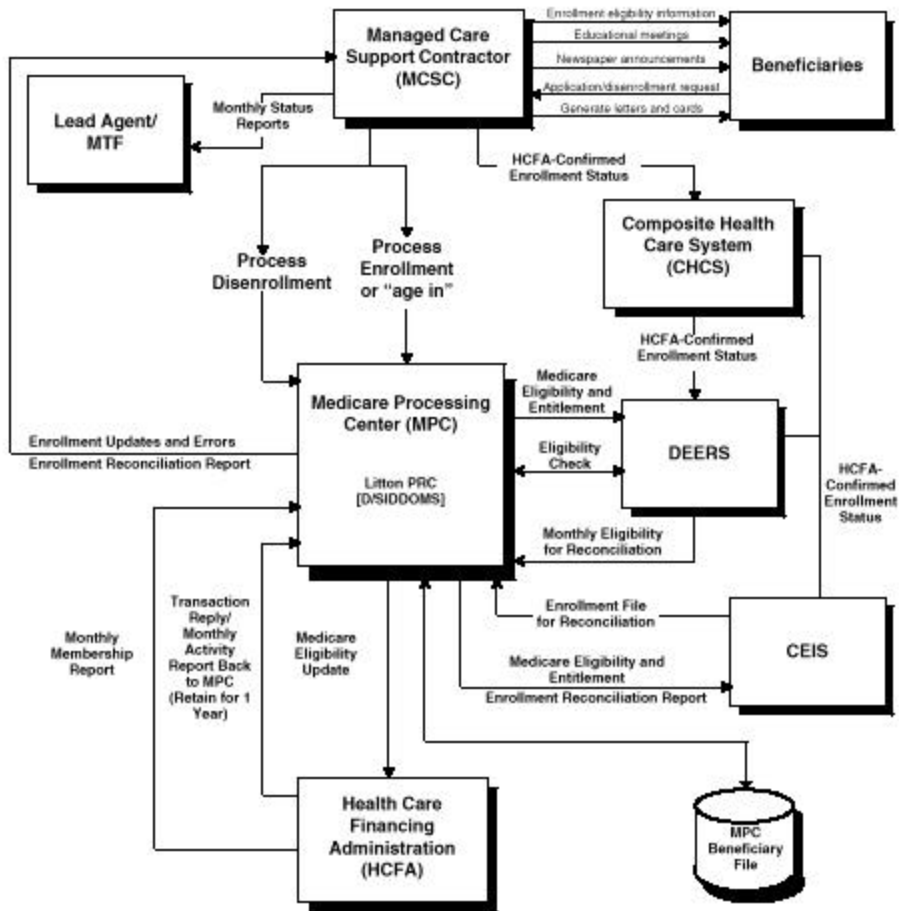
Appendix 1. TSP Enrollment Data Flow Diagram

OPM Part 7

Demonstrations

Chapter

20

Figure 2-20-N-5   Data Flow Charts

A.   TRICARE Senior Option - Enrollment Data Flow

2.20.N-43   C-151, January 11, 2000

Appendix 2. TSP Claims/Clinical Flow Diagram

OPM Part Two

Chapter
20

Demonstrations

Figure 2-20-N-5   Data Flow Charts (Continued)

B. TRICARE Senior Option - Claims/Clinical Data Flow