Data Quality Management Model (2012 update) - Retired

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Editor's Note: This practice brief supersedes the March 1998 "Checklist to Assess Data Quality Management Efforts" and the June 1998 "Data Quality Management Model" practice briefs.

Healthcare leaders face many challenges, from the ICD-10-CM/PCS transition to achieving meaningful use, launching accountable care organizations (ACOs) and value-based purchasing programs, assuring the sustainability of health information exchanges (HIEs), and maintaining compliance with multiple health data reporting and clinical documentation requirements-among others. These initiatives impacting the health information management (HIM) and healthcare industries have a common theme: data.

As electronic health record (EHR) systems have become more widely implemented in all healthcare settings, these systems have developed and employed various methods of supporting documentation for electronic records. Complaints and concerns are often voiced-whether via blogs, online newsletters, or listservs-regarding the integrity, reliability, and compliance capabilities of automated documentation processes. Several articles in the Journal of AHIMA establish guidelines for preventing fraud in EHR systems. Documentation practices are within the domain of the HIM profession, for both paper and electronic records.[1]

As a result, the need for more rigorous data quality governance, stewardship, management, and measurement is greater than ever.

This practice brief will use the following definitions:

Data Quality Management: The business processes that ensure the integrity of an organization's data during collection, application (including aggregation), warehousing, and analysis.[2] While the healthcare industry still has quite a journey ahead in order to reach the robust goal of national healthcare data standards, the following initiatives are a step in the right direction for data exchange and interoperability:

- Continuity of Care Document (CCD), Clinical Documentation Architecture (CDA)
- Data Elements for Emergency Department Systems (DEEDS)
- Uniform Hospital Discharge Data Set (UHDDS)
- Minimum Data Set (MDS) for long-term care
- ICD-10-CM/PCS, Systemized Nomenclature of Medicine-Clinical Terms (SNOMED CT), Logical Observation Identifiers Names and Codes (LOINC), RxNorm

Data Quality Measurement: A quality measure is a mechanism to assign a quantity to quality of care by comparison to a criterion. Quality measurements typically focus on structures or processes of care that have a demonstrated relationship to positive health outcomes and are under the control of the healthcare system.[3] This is evidenced by the many initiatives to capture quality/performance measurement data, including:

- The Joint Commission Core Measures
- Outcomes and Assessment Information Set (OASIS) for home health care
- National Committee for Quality Assurance's (NCQA) Health Plan Employer Data and Information Set (HEDIS)
- Meaningful Use-defined core and menu sets

Key Terms

Understanding of the following term definitions is key to ensure clarity in this article.

Data Quality Management: The business processes that ensure the integrity of an organization's data during collection, application (including aggregation), warehousing, and analysis.

Data Quality Measurement: A quality measure is a mechanism to assign a quantity to quality of care by comparison to a criterion. Quality measurements typically focus on structures or processes of care that have a demonstrated relationship to positive health outcomes and are under the control of the healthcare system.

These data sets will be used within organizations for continuous quality improvement efforts and to improve outcomes. They draw on data as raw material for research and comparing providers and institutions with one another.

Payment reform and quality measure reporting initiatives increase a healthcare organization's data needs for determining achievement of program goals, as well as identifying areas in need of improvement. The introduction of new classification and terminology systems-with their increased specificity and granularity-reinforce the importance of consistency, completeness, and accuracy as key characteristics of data quality.[4] The implementation of ICD-10 CM/PCS will impact anyone using diagnosis or inpatient procedure codes, which are pervasive throughout reimbursement systems, quality reporting, healthcare research and epidemiology, and public health reporting. SNOMED CT, RxNorm, and LOINC terminologies have detailed levels for a variety of healthcare needs, ranging from laboratory to pharmacy, and require awareness of the underlying quality from the data elements.

Healthcare data serves many purposes across many settings, primarily directed towards patient care. The industry is also moving towards an increased focus on ensuring that collected data is available for many other purposes. The use of new technologies such as telemedicine, remote monitoring, and mobile devices is also changing the nature of access to care and the manner in which patients and their families interact with caregivers. The rates of EHR adoption and development of HIEs continue to rise, which brings attention to assuring the integrity of the data regardless of the practice setting, collection method, or system used to capture, store, and transmit data across the healthcare continuum of care.

The main outcome of data quality management (DQM) is knowledge regarding the quality of healthcare data and its fitness for applicable use in the intended purposes. DQM functions involve continuous quality improvement for data quality throughout the enterprise (all healthcare settings) and include data application, collection, analysis, and warehousing. DQM skills and roles are not new to HIM professionals. As use of EHRs becomes widespread, however, data are shared and repurposed in new and innovative ways, thus making data quality more important than ever.

Data quality begins when EHR applications are planned. For example, data dictionaries for applications should utilize standards for definitions and acceptable values whenever possible. For additional information on this topic, please refer to the practice brief "Managing a Data Dictionary."[5]

The quality of collected data can be affected by both the software-in the form of value labels or other constraints around data entry-and the data entry mechanism whether it be automated or manual. Automated data entry originates from various sources, such as clinical lab machines and vital sign tools like blood pressure cuffs. All automated tools must be checked regularly to ensure appropriate operation. Likewise, any staff entering data manually should be trained to enter the data correctly and monitored for quality assurance.

For example, are measurements recorded in English or metric intervals? Does the organization use military time? What is the process if the system cannot accept what the person believes is the correct information?

Meaningful data analysis must be built upon high-quality data. Provided that underlying data is correct, the analysis must use data in the correct context. For example, many organizations do not collect external cause data if it is not required. Gunshot wounds would require external cause data, whereas slipping on a rug would not. Developing an analysis around external causes and representing it as complete would be misleading in many facilities. Additionally, the copy capabilities available as a result of electronic health data are likely to proliferate as EHR utilization expands. Readers can refer to AHIMA's Copy Functionality Toolkit for more information on this topic.[6] Finally, with many terabytes of data generated by EHRs, the quality of the data in warehouses will be paramount. The following are just some of the determinations that need to be addressed to ensure a high-quality data warehouse:

- Static data (date of birth, once entered correctly, should not change)
- Dynamic data (patient temperature should fluctuate throughout the day)
- When and how data updates (maintenance scheduling)
- Versioning (DRGs and EHR systems change across the years-it is important to know which grouper or EHR version was used)

Consequently, the healthcare industry needs data governance programs to help manage the growing amount of electronic data.

Data Governance

Data governance is the high-level, corporate, or enterprise policies and strategies that define the purpose for collecting data, the ownership of data, and the intended use of data. Accountability and responsibility flow from data governance, and the data governance plan is the framework for overall organizational approach to data governance.[7]

Information Governance and Stewardship

Information governance provides a foundation for the other
data-driven functions in AHIMA's HIM Core Model by providing parameters based on organizational and compliance policies, processes, decision rights, and responsibilities. Governance functions and stewardship ensure the use and management of health information is compliant with jurisdictional law, regulation, standards, and organizational policies. As stewards of health information, HIM professionals strive to protect and ensure the ethical use of health information.[8]

The DQM model was developed to illustrate the different data quality challenges. The table "Data Quality Management Model" includes a graphic of the DQM domains as they relate to the characteristics of data integrity, and "Appendix A" includes examples of each characteristic within each domain. The model is generic and adaptable to any care setting and for any application. It is a tool or a model for HIM professionals to transition into enterprise-wide DQM roles.

Assessing Data Quality Management Efforts

Traditionally, healthcare data quality practices were coordinated by HIM professionals using paper records and department-based systems. These practices have evolved and now utilize data elements, electronic searches, comparative and shared databases, data repositories, and continuous quality improvement. As custodians of health records, HIM professionals have historically performed warehousing functions such as purging, indexing, and editing data on all types of media: paper, images, optical disk, computer disk, microfilm, and CD-ROM. In addition, HIM professionals are experts in collecting and classifying data to support a variety of needs. Some examples include severity of illness, meaningful use, pay for performance, data mapping, and registries. Further, HIM professionals have encouraged and fostered the use of data by ensuring its timely availability, coordinating its collection, and analyzing and reporting collected data. To support these efforts, "Checklist to Assess Data Quality Management Efforts" [below] outlines basic tenets in data quality management for healthcare professionals to follow.

With AHIMA members fulfilling a wide variety of roles within the healthcare industry, HIM professionals are expanding their responsibilities in data governance and stewardship. Leadership, management skills, and IT knowledge are all required for effective expansion into these areas.

Roles such as clinical data manager, terminology asset manager, and health data analyst positions will continue to evolve into opportunities for those HIM professionals ready to upgrade their expertise to keep pace with changing practice.

Data Quality Management Model

The Data Quality Management Model was developed to illustrate the different data quality challenges. Definitions for the terms within the model are included below.[9]

Data Quality Management Domains

Application: The purpose for the data collection

Collection: The processes by which data elements are accumulated

Warehousing: Processes and systems used to archive data and data journals

Analysis: The process of translating data into information utilized for an application

Characteristics of Data Quality

Data Accuracy: The extent to which the data are free of identifiable errors

Data Accessibility: Data items that are easily obtainable and legal to access with strong protections and controls built into the process

Data Comprehensiveness: All required data items are included-ensures that the entire scope of the data is collected with intentional limitations documented

Data Consistency: The extent to which the healthcare data are reliable and the same across applications

Data Currency: The extent to which data are up-to-date; a datum value is up-to-date if it is current for a specific point in time, and it is outdated if it was current at a preceding time but incorrect at a later time

Data Definition: The specific meaning of a healthcare-related data element

Data Granularity: The level of detail at which the attributes and values of healthcare data are defined

Data Precision: Data values should be strictly stated to support the purpose

Data Relevancy: The extent to which healthcare-related data are useful for the purposes for which they were collected

Data Timeliness: Concept of data quality that involves whether the data is up-to-date and available within a useful time frame; timeliness is determined by manner and context in which the data are being used

Direct link between HIM and Patient Outcomes

The quality of healthcare across the continuum rests on the integrity, reliability, and accuracy of health information. The various methods of documentation in electronic health records can be unreliable for patient care if documentation guidelines and best practices are not followed. HIM professionals have intimate knowledge of these documentation guidelines and are invaluable resources when it comes to helping providers determine how they will create templates, formats, notes, and other data elements in the EHR.

For example, a study of 60 randomly selected patient records with 1,891 notes from the Veterans Health Administration's computerized patient record system found that 84 percent of notes contained at least one documentation error, with an average of 7.8 documentation mistakes per patient.[10] Data integrity and quality are important, but new technology can-and does-produce new, real challenges.

EHRs consist of both structured and unstructured data, leaving a variety of opportunities for error. With recent government initiatives, such as meaningful use, there is increasing pressure for healthcare entities and providers to attest to quality healthcare data. In addition, the data should be trusted to support clinical, financial, and administrative decisions.

Data quality is dependent upon secure housing as well as efficient and effective accessibility when needed. These critical factors impact the overall data quality process that enables continuous improvements toward quality patient care.

Integrity of health information is an obligation of HIM. Findings from the HIM Core Model[12] work identified several near-future and future roles (including chief knowledge officer and health record advocate) for health information managers. HIM professionals must assume a leadership role in transforming these functions. Now is the time to analyze and visualize documented and undocumented intra- and interdepartmental HIM functions to understand the current and future state of the HIM department while ensuring HIM best practices and standards are consistently maintained.

Data Quality and Patient Care

With health information technologies such as EHRs, HIEs, mobile health devices, smart room technology, computerized provider order entry, meaningful use criteria, and core measures, data is accessed with greater ease and thus must at all times be of the highest quality.

The following story illustrates how essential the quality of data is to patient care:

Regina lost her husband, Fred Holliday, to kidney cancer at a young age. During a period of time where his main oncologist was out of town, Fred was hospitalized. Regina attempted to obtain health information about his case with little success. She knew that if she had good quality data, she would be able to help in his care and hopefully help get him better. She asked for a copy of Fred's inpatient health record so she could try and understand what was happening, and was told it would take 21 days and would cost 73 cents per page. The next day she was told her husband would be sent home on a Patient-Controlled Anesthesia (PCA) pump. She and her husband were totally distraught. However, Regina tried to get a second opinion.

Once her husband was transferred, they were given an old and incomplete health record and transfer summary. The new facility where they went to seek a second opinion spent 6 hours trying to recreate his record so that they could provide proper care, which meant that her husband had to wait for 6 hours before care was provided. The physician from this new facility sent Regina back to the old facility to obtain her husband's health records. She received them only because she was now considered a courier. Her new healthcare team read the record and then Regina read the record. It was full of what Regina calls "actionable data" and if she would have had this quality data, she knows her husband would have received better care.

Regina Holliday is a major patient advocate, traveling the world and speaking about the importance of the Electronic Health Record and health IT and how good quality data is so important for providing good quality care.[11]

Checklist to Assess Data Quality Management Efforts

Use the checklist below to assess overall data quality management efforts within an organization or for an application.

Application

The purpose for data are collection.

- The application's purpose, the question to be answered, or the aim for collecting the data is clear
- Boundaries or limitations of data collected are known and communicated
- Complete data are collected for the application
- Value of the data is the same across applications and systems
- The application is of value and is appropriate for the intent
- Timely data are available

Collection

The process by which data elements are accumulated.

- Education and training is effective and timely
- Communication of data definitions is timely and appropriate
- Data source provides most accurate, most timely, and least costly data
- Data collection is standardized
- Data standards exist
- Updates and changes are communicated appropriately and on a timely basis
- Data definitions are clear and concise
- Data are collected at the appropriate level of detail or granularity
- Acceptable values or value ranges for each data element are defined; edits are determined
- The data collection instrument is validated
- Quality (i.e., accuracy) is routinely monitored

- Meaningful use is achieved via the evaluation of EHR data

Warehousing and Interoperability

Processes and systems used to archive data and data journals.

- Appropriate edits are in place
- Data ownership is established
- Guidelines for access to data and/or systems are in place
- Data inventory is maintained
- Relationships of data owners, data collectors, and data end users are managed
- Appropriate conversion tables are in place
- Systems, tables, and databases are updated appropriately
- Current data are available
- Data and application journals (data definitions, data ownership, policies, data sources, etc.) are appropriately archived, purged, and retained
- Data are warehoused at the appropriate level of detail or granularity
- Appropriate retention schedules are established
- Data are available on a timely basis
- Health information exchange is achieved as a result of interoperability of EHRs

Analysis

The process of translating data into information that can be utilized in an application.

- Algorithms, formulas, and translation systems are valid and accurate
- Complete and current data is available
- Data impacting the application are analyzed in context
- Data are analyzed under reproducible circumstances
- Appropriate data comparisons, relationships, and linkages are displayed
- Data are analyzed at the appropriate level of detail or granularity

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Appendix A: Data Quality Management Model Domains and Characteristics

Characteristic	Application	Collection	Warehousing	Analysis
Data Accuracy The extent to which the data are free of identifiable errors.	To facilitate accuracy, determine the application's purpose, the question to be answered, or the aim for collecting the data element. Standard acceptable values should be used where available. Where possible value flags and constraints	Ensuring accuracy involves appropriate education and training along with timely and appropriate communication of data definitions to those who collect data. The applications should constrain entry to allowable values where possible. For example, data accuracy will help ensure that a patient height cannot be	To warehouse data, appropriate edits should be in place to ensure accuracy, such as basic field length checks. Also, error reports are generated related to transfers to and from the warehouse. All warehouses should have a correction and	To accurately analyze data, ensure that the algorithms, formulas, programming, and translation systems are correct. For example, ensure that the encoder assigns correct codes and that the appropriate DRG is assigned for the codes entered.

	should be implemented. For example, data entry of height into EHRs should flag or highlight very small (less than 12 inches) or very tall (over seven feet) heights.	entered erroneously as five inches when it is in fact 50 inches. In addition to a primary data error, this would impact any calculated fields such as Body Mass Index (BMI).	change management policy to track any changes.	Continual data validation is important to ensure that each record or entry within the database is correct.
Data Accessibility Data items that are easily obtainable and legal to access with strong protections and controls built into the process.	The application and legal, financial, process, and other boundaries determine which data to collect. Ensure that collected data are legal to collect for the application. For example, recording the date of birth and race in the EHR is appropriate and should only occur once with verification. Then the values should roll forward.	When developing the data collection instrument, explore methods to access needed data and ensure that the best, least costly method is selected. The amount of accessible data may be increased through system interfaces and integration of systems. For example, the best and easiest method to obtain demographic information may be to obtain it from an existing system. Another method may be to assign data collection by the expertise of each team member. For example, the admission staff collects demographic data, the nursing staff collects symptoms, and the HIM staff assigns codes. Data entry should undergo a cost-benefit analysis process to determine which method provides the best data most efficiently.	Technology and hardware impact accessibility. Establish data ownership and guidelines for who may access or modify data and/or systems. Inventory data to facilitate access. In the EHR it may be advisable to establish data ownership or governance at the data element level, especially data which are reused. For example, allergies are recorded by many different clinicians and come in many forms. Who defines what an allergy is? How does this impact the use of allergies in the EHR, especially for clinical decision support?	Access to complete, current data will better ensure accurate analysis and data mining. Otherwise results and conclusions may be inaccurate or inappropriate. For example, use of the Medicare case mix index (CMI) alone does not accurately reflect total hospital CMI. Consequently, strategic planning based solely on Medicare CMI may not be appropriate.
Data Comprehensiveness All required data items are included. Ensures that the entire scope of the data is collected with intentional limitations documented.	Clarify how the data will be used and identify end users to ensure complete data are collected for the application. Include a problem statement and cost-benefit or impact	Cost-effective comprehensive data collection may be achieved via interface to or download from other automated systems. Data definition and data precision impact	Warehousing includes managing relationships of data owners, data collectors, and data end-users to ensure that all are aware of the available data in the inventory and accessible systems.	Ensure that all pertinent data impacting the application are analyzed in concert. This is especially important when EHR clinical decision support is utilized.

	study when collected data are increased. For example, in addition to outcome it may be important to gather data that impact outcomes.	comprehensive data collection (see these characteristics below).	This also helps to reduce redundant data collection.	Incomplete data can result in underreporting a numerator or denominator.
Data Consistency The extent to which the healthcare data are reliable and the same across applications.	Data are consistent when the value of the data is the same across applications and systems, such as the patient's medical record number. In addition, related data items should agree. For example, data are inconsistent when it is documented that a male patient has had a hysterectomy.	The use of data definitions, extensive training, standardized data collection (procedures, rules, edits, and process) and integrated/interfaced systems facilitate consistency. Static data should be moved between users. For example, once date of birth has been definitively established, age at the time of treatment should be calculated, not entered by a user who might make an error.	Warehousing employs edits or conversion tables to ensure consistency. Coordinate edits and tables with data definition changes or data definition differences across systems. Document edits and tables. When new data are loaded it should be checked against existing data for consistency. For example, is someone reporting a different race for a patient?	Analyze data under reproducible circumstances by using standard formulas, scientific equations, programming, variance calculations, and other methods. Compare "apples to apples." Any manipulation of data, aggregating or otherwise, should be documented thoroughly. For example, how is BMI calculated and has the formula been checked?
Data Currency The extent to which data are up-to-date; a datum value is up-to-date if it is current for a specific point in time. It is outdated if it was current at a preceding time yet incorrect at a later time.	The appropriateness or value of an application changes over time. In EHRs it is imperative that the guidelines and algorithms be up-to-date. For example, acceptable blood pressure ranges have lowered, as have target HbA1C levels.	Data definitions change or are modified over time. These should be documented so that current and future users know what the data mean. These changes should be made in accordance with data governance policies and practices. Further, they must be communicated in a timely manner to those collecting data and to the end users.	To ensure current data are available, warehousing involves continually validating systems, tables, and databases. The dates of warehousing events should be documented.	The availability of current data impacts the analysis of data. For example, analyzing the long-term incidence or prevalence of disease requires data in a different timeframe than when trying to track a disease outbreak for biosurveillance purposes. Validating data from various fiscal and calendar years should also be considered.

Data Definition The specific meaning of a healthcare related data element.	The application's purpose, the question to be answered, or the aim for collecting the data element must be clarified to ensure appropriate and complete data definitions. Does the system use the Office of Management and Budget (OMB) standard for race and ethnicity? If not, what are the definitions and acceptable values?	Clear, concise data definitions facilitate accurate data collection. For example, the definition of patient disposition may be "the patient's anticipated location or status following release or discharge." Acceptable values for this data element should also be defined. The instrument of collection should include data definitions and ensure that the application limits data collection to the allowed values.	Warehousing includes archiving documentation and data. Consequently, data ownership documentation and definitions should be maintained over time. Inventory maintenance activities (purging, updates, and others), purpose for collecting data, collection policies, information management policies, and data sources should be maintained over time also.	For appropriate analysis, display data needs to reflect the purpose for which the data were collected. Appropriate comparisons, relationships, and linkages need to be shown.
Data Granularity The level of detail at which the attributes and values of healthcare data are defined.	A single application may require varying levels of detail or granularity. For example, census statistics may be utilized daily, weekly, or monthly depending upon the application. Census is needed daily to ensure adequate staffing and food service. However, the monthly trend is needed for long-range planning. Similarly, lab test results may be trended at various levels of detail.	Collect data at the appropriate level of detail or granularity. For example, the temperature of 100° may be recorded. The granularity for recording outdoor temperatures is different from recording patient temperatures. If patient Jane Doe's temperature is 100°, does that mean 99.6° or 100.4°? Appropriate granularity for this application dictates that the data need to be recorded to the first decimal point while appropriate granularity for recording outdoor temperatures may not require it.	Warehouse data at the appropriate level of detail or granularity. For example, exception or error reports reflect granularity based on the application. A spike (exception) in the daily census may show little or no impact on the month-to-date or monthly reports.	Appropriate analysis reflects the level of detail or granularity of the data collected. For example, a spike (exception) in the daily census resulting in immediate action to ensure adequate food service and staffing may have had no impact on analysis of the census for long-range planning. Of particular note for analysis is the impact of any rounding which might be done for numerical data.
Data Precision	The application's purpose, the question	To collect data precise enough for the application,	Are warehouses receiving and storing	If the precision of the data has been altered

Data values should be strictly stated to support the purpose.	to be answered, or the aim for collecting the data element must be clarified to ensure data precision. What level of detail is needed for the data collection purpose? Are age ranges or four U.S. regions sufficient?	define acceptable values or value ranges for each data item. For example, limit values for gender to male, female, and unknown; or collect information by age ranges or allow more detailed collection to fully meet the needs.	all data elements being transferred from the source system?	in the analysis is the process understood and well documented?
Data Relevancy The extent to which healthcare-related data are useful for the purposes for which they were collected.	The applications purpose, the question to be answered, or the aim for collecting the data element must be clarified to ensure relevant data.	To better ensure relevancy, complete a pilot of the data collection instrument to validate its use. A "parallel" test may also be appropriate, completing the new or revised instrument and the current process simultaneously. Communicate results to those collecting data and to the end users. Facilitate or negotiate changes as needed across disciplines or users.	Establish appropriate retention schedules to ensure availability of relevant data. Relevancy is defined by the application. It may be appropriate for warehouses to subset data related to its relevancy for certain uses.	For appropriate analysis, display data to reflect the purpose for which the data were collected. This is defined by the application. Show appropriate comparisons, relationships, and linkages.
Data Timeliness Concept of data quality that involves whether the data is up-to-date and available within a useful time frame. Timeliness is determined by how the data are being used and their context.	Timeliness is defined by the application. For example, patient census is needed daily to provide sufficient day-to-day operations staffing, such as nursing and food service. However, annual or monthly patient census data are needed for the organization's strategic planning.	Timely data collection is a function of the process and collection instrument. In the EHR, system performance plays an important role in data timeliness. Data display should be sub-second and data entry should occur instantaneously.	Warehousing ensures that data are available per information management policy and retention schedules. For EHR or clinical data warehouses, is the data updated concurrently or does it occur in a batch process?	Timely data analysis allows for the initiation of action to avoid adverse impacts. For some applications, such as allergy-drug or drug-drug interactions, timely may be seconds. For others, such as the prevalence of a disease over time, it may be years.

	In the EHR, vitals may be taken once per visit for ambulatory care patients, but every 15 minutes or more often for critically ill patients.			

Notes

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