CIHI's Information Quality Framework

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Table of contents

Introduction

Quality is at the heart of everything the Canadian Institute for Health Information (CIHI) does. It is embedded in our vision (Better Data. Better Decisions. Healthier Canadians.) and mandate. CIHI's strategic plan for 2016 to 2021 is focused on providing stakeholders with the information they need. This includes a specific goal to be a trusted source of standards and quality data.

Trust in the information we produce is paramount to our ongoing success and relevance. As the scope and magnitude of the decisions that are informed by CIHI's information expand to include public reporting on health system performance and large-scale health system funding allocations, the requirements and pressures on quality continue to grow.

This document provides an overview of CIHI's Information Quality Framework. This framework provides an overarching structure for all of CIHI's quality management practices related to capturing and processing data and transforming it into information products. This Information Quality Framework evolved from and replaces CIHI's previous Data Quality Framework (which was introduced in 2001 and last updated in 2009). Further information about the development of the framework is provided at the end of the document.

What is quality?

CIHI uses the term "fit for use" to define quality, in line with international standards and best practice.[1] This defines quality in the context of the users and their needs.

The terms "data quality" and "information quality" are sometimes used interchangeably. At CIHI, we consider them to be distinct but related concepts: "information quality" refers to the quality of the statistics, indicators, analytical reports, electronic reporting tools and other information products that CIHI generates, while "data quality" refers to the quality of the underlying data that is collected and used to produce these outputs.

Data quality is a prerequisite but not the only requirement for information quality. Information quality also considers how the information is accessed, presented and can be interpreted; how information from different sources fits together to paint a coherent picture; and how the processes involved in transforming data into information are effectively managed.

CIHI's quality dimensions

Figure 1 presents the 5 dimensions CIHI uses to describe and assess quality relative to users' needs.

Figure 1   5 dimensions of quality

The quality dimensions are not mutually exclusive and need to be balanced against one another to best meet users' needs. Sometimes improvements in one dimension can lead to a deterioration in another dimension (e.g., changing the data collected within a data holding would increase its relevance but affect the ability to compare over time). Trade-offs between dimensions are often made (e.g., a reduction in accuracy may be acceptable to improve timeliness). There are also other considerations that are taken into account when producing information products that can have an impact on their overall quality or that may influence decisions about potential improvement initiatives. These include cost, resource availability, collection burden, privacy, confidentiality and security.[2]

CIHI's quality principles

CIHI's quality activities are guided by a set of principles that acknowledges CIHI's role in achieving information quality, in conjunction with the other key stakeholders that are part of the information supply chain.

1. **Quality is a multi-dimensional concept.** As described above, it encompasses relevance, accuracy and reliability, timeliness and punctuality, accessibility and clarity, and comparability and coherence, all of which need to be balanced against one another to best meet users' needs.

2. **Quality is relative and based on users' needs.** The goal of quality assurance is not to achieve perfection — which is an unattainable goal — but to ensure a level of quality relative to the intended use of the information.

3. **Users must be informed about the quality of data or information so that they may assess its fitness for their use.** Quality documentation, based on regular evaluation, and other reference material (metadata) should be easily accessed by users, be clear and understandable, and also be efficiently produced.

4. **Quality is a responsibility that is shared by everyone involved in the information supply chain.** CIHI fosters a sense of stewardship and accountability for quality internally and with the many different organizations and individuals involved in the supply chain, from data providers to data users. CIHI also works with organizations to identify needs, address priority issues and guide improvement.

5. **Quality assurance occurs at every stage of the information life cycle, with a focus on issue prevention.** Each step in the journey to create an information product can impact its quality, and quality assurance mechanisms can be built into each one. Preventing issues from occurring is a key focus, as it is the most cost-effective quality assurance step. However, as not all issues can be prevented, other quality mechanisms are put in place to monitor and evaluate the information and address quality issues as they arise.

6. **Quality is a feature of organizational culture.** A successful and effective culture of quality must be communicated, nurtured and reinforced at every level, at every opportunity. All CIHI employees are aware of the role they play in ensuring quality and are trained to fulfill these roles. CIHI has a corporate Data Quality department that acts as a centre of excellence and champions and reinforces CIHI's quality culture.

7. **Standards are a foundation for quality information.** The use of common definitions and processes facilitates comparability, consistency and efficiency. CIHI collaborates with stakeholders on health information standards and supports their adoption. As it is not always feasible to standardize the data that comes to CIHI from providers (e.g., when data is provided from existing business systems), efforts are made to standardize the information during the processing and analytical phases.

8. **Quality assurance is a continuous and adaptive process.** CIHI's quality processes have evolved and will continue to evolve in response to broadening information needs and changes in health systems and the technology landscape. The continuous improvement of data and information is an iterative cycle that relies on collaboration and feedback.

The Information Quality Framework

Figure 2 shows CIHI's Information Quality Framework, which provides a structure for CIHI's information quality management practices. The overall image of an umbrella represents the holistic nature of the framework that encompasses and draws together a range of processes, practices and tools.

The information life cycle, outlining the steps taken to transform data into information, is represented first, as the central function of CIHI's business. The 4 components underneath (foundation, activities, outputs and outcomes) represent different aspects of quality management that are required to manage quality within the life cycle. While the intention is that the overall structure will remain constant, the evolution of the individual components is natural and expected, as processes and practices mature and as new ones are developed.

Figure 2   CIHI's Information Quality Framework
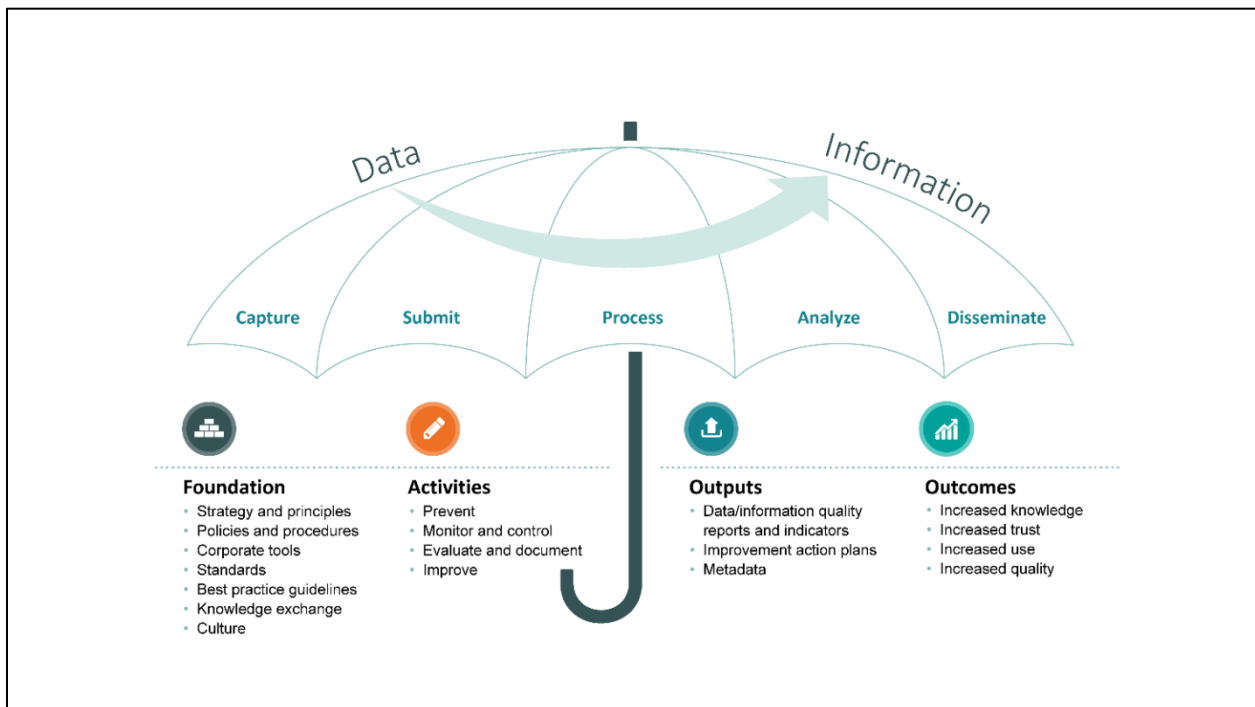
Information life cycle

CIHI's information life cycle is adapted from the high-level processes of the *General Statistical Business Process Model (GSBPM)*[3] and describes the steps for turning data into information.

While this framework and its components focus on the quality management of data and information, CIHI also has a *Privacy and Security Risk Management Framework* with an accompanying suite of policies, protocols, standards and guidelines that ensure CIHI protects the privacy of Canadians and maintains the confidentiality, security and integrity of their personal health information throughout the life cycle. More information about our privacy and security management is available on our website.

Capture

The majority of CIHI's data is created as a by-product of delivering health care and thus is used for a range of purposes prior to, during and after submission to CIHI. Creation and capture of data usually occurs through a health care provider, information professional, institution or professional organization. During this stage, the people generating the data are central to its overall quality and compliance with standards. CIHI's influence over quality at this stage consists of producing standards and supporting providers in completing and enhancing their data capture.

Submit

As CIHI receives data from many different organizations, it has standard, secure and efficient mechanisms to transfer this data, which maintain the confidentiality and integrity of the data (much of which is personal health records) while in transit and upon receipt. Data provider organizations set up processes to prepare and verify data files for submission. Many providers use the services of software vendors to create systems to capture or extract the required data and submit it to CIHI. CIHI supports high-quality data submission through the use of submission specifications, standards, tools, schedules, education and client support.

Process

Upon submission, data is put through verification, cleaning and, in some cases, transformation and aggregation activities that prepare it for use in statistical analyses. For many data sources, both CIHI and data providers are involved in iteratively cleaning and correcting any issues identified during the processing phase.

Analyze

At this stage, the fully processed data is used to conduct statistical analyses and generate outputs, which include static data tables, analytical reports, infographics and interactive reporting tools. Steps include drafting and verifying outputs; interpreting and explaining findings; when required, applying disclosure control techniques (to protect confidentiality and ensure no individuals are identifiable in publicly released information); and then finalizing the outputs. CIHI works with external stakeholders to ensure the information products will meet their needs; stakeholders also provide vital expertise and advice on the content and methods used.

Disseminate

This stage fulfills the overall goal of the information life cycle, which is to produce and distribute information products for use by CIHI's stakeholders. It includes activities leading to the release, communication and promotion of results. It also includes activities related to supporting users' understanding of the information and collaborating with stakeholders to increase their capacity to use data and analysis.

Foundation

The foundational components of the framework consist of resources, tools and practices that provide a strong base for operationalizing quality assurance activities across the organization and for understanding, assessing and communicating the quality of our data and information.

Strategy and principles

An organization's quality strategy and principles provide the overall context for its quality management. The strategy sets out the quality goals the organization wants to achieve, and the principles provide a set of basic norms or rules that can be used as a basis for its quality management activities.[4]

CIHI's current information quality strategy is detailed in the Information Quality Plan discussed below. Targeted initiatives and activities are categorized under 3 objectives. Material regarding how progress will be measured and success evaluated is in development.

CIHI's quality principles are described above and are used as guidance for processes, planning and decision-making to support continuous improvement and reach the positive outcomes identified in this framework.

Policies and procedures

Quality-related policies and procedures are implemented to ensure a consistent approach to quality assurance activities. These can be at a corporate level, to ensure consistency across the entire organization, or with an individual program or functional area to ensure effective operations and consistency within a team.

Within CIHI, information quality processes that have corporate-level policies and/or procedures include

- Assessing the quality of data sources;

- Creating and maintaining CIHI's analytical plan;

- Fulfilling data requests; and

- Disseminating information products.

New policies and procedures will be established to support the implementation of new information quality tools, and standards will be developed.

Corporate tools

CIHI creates practical tools to help carry out particular functions that occur within different teams to ensure consistency across the organization and that the end products are fit for their required purposes.

One of CIHI's most long-standing corporate tools is the Data Source Assessment Tool (DSAT). It provides a set of criteria to assess the quality of CIHI's data sources across the 5 dimensions of quality, allowing for appropriate determination of a given data set's fitness for use. Data source assessment is a corporately governed process that reflects CIHI's commitment to producing and maintaining high-quality data for a wide variety of uses.

Other corporate tools that support information quality include the

- Data quality issue tracking tool;

- Data request toolkit;

- Analytical plan submission template;

- Indicator life cycle (a new toolkit that provides a standardized approach to the development, maintenance and evaluation of indicators); and
- Iterative development life cycle (a software engineering process framework for the development, maintenance and deployment of information technology systems).

As CIHI continues to evolve its information quality focus, further corporate information quality tools will be developed.

Standards

The use of common definitions and processes ensures the capture of comparable and consistent data and facilitates analysis, interpretation and use of the information. CIHI maintains a range of standards and supports their adoption and implementation; many of our standards are available on the Data Standards section of our website. In addition, CIHI has internal analytical and methodological standards, such as a standard client linkage methodology, to support efficient and consistent analysis and reporting.

Best practice guidelines

Best practice guidelines are provided for a range of situations in which a more prescriptive standard may not be practical or reasonably applied. Examples of current corporate guidelines include the guidelines and checklist for producing quality documentation for external users; a writing and editing guide; and a checklist for conducting an analytical review of health indicators and analyses before public release. Guidelines and a checklist are in progress regarding the application of data profiling methods prior to analysis and the fact-checking of analyses.

Knowledge exchange

CIHI engages in a variety of activities to share learnings and expertise regarding quality within and outside of CIHI. Examples include

- Hosting meetings and forums to discuss quality issues; learn about quality tools, products and services; and consider new ideas;
- Making quality-related tools and information accessible internally through our intranet and externally on our website;
- Attending and presenting at conferences; and
- Providing opportunities for quality-related training and professional development.
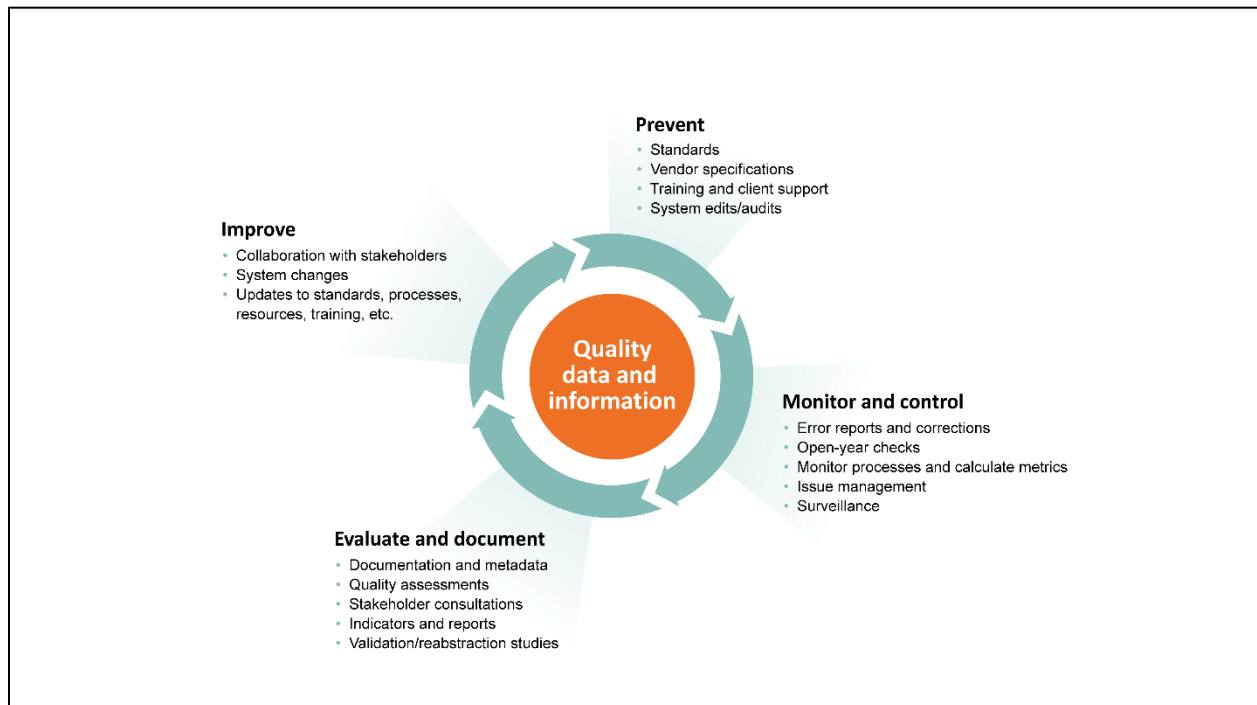
Culture

As mentioned in our quality principles, CIHI engages in activities to support and enhance a culture of quality across the organization. In addition to the activities listed above, CIHI organizes Quality Month, a series of formal and informal events and activities to engage and inform staff about quality. CIHI's corporate Data Quality department acts as a centre of excellence, provides support to teams on quality issues, and champions and reinforces CIHI's quality culture.

Activities

Many of CIHI's operational activities are focused on producing relevant, high-quality information products and on the continuous improvement of CIHI's data and information. The Information Quality Framework categorizes the different types of quality management activities, many of which utilize the foundational components listed above, which result in a focus on quality at every stage of the information life cycle.

Figure 3   CIHI's quality activities

Prevent
- Standards
- Vendor specifications
- Training and client support
- System edits/audits

Improve
- Collaboration with stakeholders
- System changes
- Updates to standards, processes, resources, training, etc.

Monitor and control
- Error reports and corrections
- Open-year checks
- Monitor processes and calculate metrics
- Issue management
- Surveillance

Evaluate and document
- Documentation and metadata
- Quality assessments
- Stakeholder consultations
- Indicators and reports
- Validation/reabstraction studies

Quality data and information

Prevent

Preventing quality issues before they occur is ideal, as fixing data after the fact is always more costly. Some components of CIHI's preventive activities include

- Standards (technical, data and clinical) to ensure consistent data is captured;

- Vendor specifications to ensure that the data that is captured and submitted complies with standards;

- Training and client support to ensure that data providers capture data accurately and according to standards; and

- System edits/audits that validate data as it comes in and either prevent erroneous data from getting into the CIHI databases or flag less serious issues.

Monitor and control

As data is submitted and analyzed, monitoring and control activities come into effect. These include the following:

- Error reports and corrections: CIHI systems validate data as it comes in, and feedback is provided to suppliers of the data so that they can correct it if needed.

- Issue management: Reports are provided to data stewards and providers that summarize basic quality issues identified by monitoring submission volumes and other consistency checks that flag unusual changes or outliers.

- Advanced surveillance methodologies based on machine learning and sophisticated statistical techniques flag anomalies that would not otherwise be detectable through routine monitoring and validation.

Evaluate and document

Once a data set or information product is considered final, different activities come into effect to evaluate and document overall quality. Some components of this include

- Producing documentation and metadata to provide information to data stewards and users regarding the production, interpretation and uses of the data;

- Assessing the quality of data sources using the DSAT;

- Evaluating indicators using the indicator life cycle;

- Conducting stakeholder consultations and evaluation surveys to seek input regarding the results, understand what quality means to them and whether the information is meeting their needs;

- Producing data and information quality metrics, indicators and reports (see below); and

- Conducting targeted validation studies (such as reabstraction studies) to evaluate specific aspects of quality.

Improve

Using the data and information is one of the key ways to improve it: the more data and information is used and shared, the more feedback and questions CIHI will receive, which will in turn allow for more and more improvements in quality, particularly with respect to relevance. Users and providers grow to appreciate the value of the data; conducting analyses makes it easier to spot suspicious data; and people pay more attention to the data when decisions are made with it.

Improvement of data and information occurs iteratively over the course of conducting quality activities. This continuous improvement cycle not only results in high-quality data and information for informed decision-making but also improves prevention, monitoring and evaluation efforts. Examples of some of CIHI's improvement activities include

- Working with data providers to enable them to resubmit corrected data;

- Collaborating with stakeholders to understand the root causes of issues and to support their own quality improvement initiatives — collaboration allows CIHI to learn how to improve information outputs to best meet stakeholders' needs and respond to new developments in the field;

- Incorporating knowledge gained from feedback into education planning, training and client support resource materials;

- Changing standards and information systems to respond to new information, address issues and ease burden on data providers; and

- Updating other processes, tools and resources.

Outputs

The outputs component of the framework describes the key artefacts produced in the course of conducting quality assurance activities and using the foundational tools noted above. The main types of information quality artefacts produced are

- Quality reports and indicators;
- Improvement action plans; and
- Metadata.

Data/information quality reports and indicators

CIHI produces a range of products regarding the quality of our information in response to the differing information needs of different types of stakeholders. The table below provides examples of the reports that are routinely produced to monitor and improve the quality of data submitted to CIHI; many of these are automatically generated by the systems built to receive and process the data.

Table 1   Regularly produced CIHI quality reports

Purpose	Report examples	Audience	Detail	Timing
Ensure each data submission is successful	CIHI Operational Reports	Data submitters	Record level	After every submission
Ensure data is complete and accurate	CIHI Operational Reports Open-year data quality checks	Data submitters Organizational, regional and provincial/territorial data managers	Organizational-, regional- and provincial-/territorial-level metrics with some record-level data	During and at the end of the data submission periods
Manage quality issues	Specialized/targeted quality reports	Organizational, regional and provincial/territorial managers and senior managers	Organizational-, regional- and provincial-/territorial-level analyses and metrics	As needed

Purpose	Report examples	Audience	Detail	Timing
Measure jurisdictional performance	Provincial/Territorial Data Quality (PTDQ) Report	Provincial/territorial executives/senior managers	Provincial/territorial indicators	Annual
Understand the content and quality of data to be used	Metadata and external user documentation Quality assessments	Data users	Various	With data release

Examples of quality reports produced by CIHI include

- Data Source Assessment Reports and quality progress reports, which are completed by all data sources in accordance with the assessment policy and procedures;

- Reports from reabstraction and other validation studies, which are done to evaluate the quality of coding and to identify systemic issues and the impact of these issues on CIHI's products;

- Peer-reviewed journal articles on quality-related topics;

- The PTDQ Report, which is shared with the deputy ministers of health and senior leaders in order to raise awareness of the importance of data quality, and which has helped to enhance both the coverage and the quality of our data; and

- Specialized analyses and quality reports providing metrics and indicators that monitor targeted areas of focus (e.g., data that is used in Ontario's funding formula).

Improvement action plans

Continuous improvement of data and information requires planning and effective management of resources to maximize quality gains. Issues identified need to be assessed and prioritized with respect to scale, impact and resources required. Perfection is not the goal, so in some cases the resources or provider burden required to fix an issue may outweigh any benefits gained.

At an operational level, the creation of a quality improvement action plan is an integrated component of Data Source Assessment Reports and is the basis for routine progress reporting. Completed yearly, these plans focus on the highest-priority items that are attainable over the next 12 months.

In addition, CIHI is also creating strategic-level action plans, such as a data acquisition strategy to focus efforts to expand and improve the coverage of CIHI's data sources to help achieve its strategic goals.

Metadata

Metadata — reference material about our data and information products — is essential for all people involved in the information life cycle. Data providers need it to understand data requirements and to capture high-quality data, and users need it so they can easily find, use and understand the data or information they need.

Key reference information about CIHI's data sources is available on CIHI's website, including jurisdictional participation and data years. CIHI's Indicator Library provides key metadata about CIHI's health system performance indicators, including definitions, methodologies and links to publicly available results.

Given the importance of metadata to the entire information life cycle, the enhancement of CIHI's metadata — to improve its accessibility, consistency and format — constitutes a goal in itself in our current Information Quality Plan.

Outcomes

The outcomes component describes the desired impacts of using the elements within the framework. Improving the quality of the data and information and ensuring it continues to meet the needs of users is an obvious key outcome; there are also other quality aims the framework can help achieve.

Increased knowledge

The resources, tools and practices found in the framework can build and enhance knowledge about the quality of CIHI's information and how it is ensured, and can inform stakeholders' own quality-related practices outside of CIHI.

Increased trust

CIHI is a widely trusted and respected organization, and the framework seeks to increase and honour this trust. Sharing our evolution toward information quality — by making publicly available such materials as this framework and its components, CIHI's Information Quality Plan and an ever-increasing range of quality reporting — works to strengthen trust by increasing both transparency and our awareness of the need for continuous consultation, growth and improvement. As well, transparency around any limitations and actions taken to address those limitations also engenders a sense of integrity, honesty and openness.

Increased use

Initiatives under the activities and outputs areas of the framework are aimed at increasing access, availability and metadata for our data and information products — encouraging their use within and outside of CIHI. Quality and use work together in a virtuous cycle: the more data and information are used and shared, the more feedback and questions CIHI will receive, which will in turn allow for more and more improvements in quality, particularly with respect to relevance.

Increased quality

Quality is foundational to CIHI's mandate and continued relevance in a changing health information landscape. By creating our Information Quality Plan that acknowledges the need for CIHI's vision of quality to evolve, and by implementing a framework to support that goal, the quality of CIHI's data and information products will be supported and enhanced and will continue to meet the ever-changing information needs of our stakeholders.

Evolving to an Information Quality Framework

Information Quality Plan, 2016 to 2021

CIHI's strategic plan is focused on providing stakeholders with the information they need. This includes a specific goal to be a trusted source of standards and quality data. To support the implementation of the strategic plan, the Information Quality Plan was developed to outline 3 quality-specific objectives, and to ensure that CIHI continues to be a trusted source of health information and that CIHI's information is fit for and meets the broadening needs of our stakeholders. The first objective in this plan is to develop and launch this new Information Quality Framework that brings together and enhances CIHI's quality management practices.

A strong quality foundation

CIHI first introduced its corporate Data Quality Framework in 2001; this has been a cornerstone of CIHI's data quality program. The framework contained a standardized assessment that is used by program areas to assess the quality of each data holding along CIHI's 5 quality dimensions and to identify areas for improvement.

In 2003, CIHI developed its first corporate data quality strategy[5] to promote data quality both internally and in health care systems more generally. This new corporate strategy was successful in creating a data quality culture at CIHI and institutionalizing key data quality processes. At a time when CIHI was expanding in size and budget, significant investments in data quality were made, including expanding the size of the corporate Data Quality department and conducting a series of special data quality studies.

In 2005, following several client requests, CIHI made the Data Quality Framework publicly available. It has since been used by many other organizations within Canada and internationally and is recognized for its comprehensiveness and high standards.

As CIHI's data holdings expanded in both size and breadth, the priority focus of CIHI's corporate quality program was on the quality of data being submitted to those individual data sources. Data quality efforts, including the framework and the assessment tool, evolved over the years to meet the changing needs of CIHI's data holdings to respond to their growth and maturation, and to changes in health systems and the technology landscape.

Considering information, not just data, quality

While developing the Information Quality Plan, it became clear that CIHI's maturity as an organization, and the growing and diversified uses of its data (such as the advent of Your Health System), required an evolution of the corporate quality program from a focus on data quality to information quality — to consider the entire life cycle of creating and acquiring data, processing it and transforming it into information products.

Data quality is still a fundamental component of information quality, but on its own it is not sufficient. While the concept of information quality was not new within CIHI, what was identified was the need for a more organization-wide approach, for more consistency in the methods and quality assurance of transforming data into information, and for best practices to be more easily shared and used.

International standards

A scan of external resources and best practices added further impetus to evolve CIHI's quality management practices toward an information quality focus, in order to keep CIHI at the forefront of quality management practices to provide high-quality health information. 2 resources produced by the United Nations were of particular impact: the GSBPM[3] and the National Quality Assurance Framework (NQAF).[1]

GSBPM and the information life cycle

The GSBPM is used by more than 50 statistical organizations worldwide (including Statistics Canada) to manage and document statistical production. It was developed to define and describe statistical processes in a coherent way, to compare and benchmark processes within and between organizations, and to make better decisions on production systems and organization of resources.

CIHI mapped its existing processes against the processes detailed in the GSBPM, thereby establishing an understanding of CIHI's current coverage of the model. From this work, CIHI developed a modified version of the model's high-level processes to describe our main life cycle for turning data into information. Further leveraging of the GSBPM in support of CIHI's work will be an ongoing activity.

NQAF and updating the quality dimensions

The NQAF was developed by an expert international working group for use by national statistical agencies (such as Statistics Canada). It consists of a flexible template and guidelines to assist with the creation or enhancement of national quality frameworks.

Although not a national statistical agency, CIHI is part of Canada's national statistical system and, as such, many components of the NQAF are relevant to CIHI. The NQAF provided the basis for evolving to an information quality focus and updating CIHI's quality dimensions. A table comparing the current dimensions against the previous version (2009) is included in Appendix A.

Appendix A: CIHI's Quality Dimensions, 2009 and 2017

Data Quality Framework, 2009		Information Quality Framework, 2017*	
Dimension	**Description**	**Dimension**	**Description**
Relevance	The degree to which the data/information meets users' current and potential future needs	**Relevance**	The degree to which information meets the current and potential needs of clients, users, stakeholders or the audience
Accuracy	The degree to which the data/information reflects what it was designed to measure	**Accuracy and reliability**	The degree to which the information correctly and consistently describes the phenomena it was designed to measure
Comparability	The degree to which the data/information is consistent over time, across jurisdictions and with other sources	**Comparability and coherence**	The degree to which information is comparable over time and across jurisdictions, produced using common standards and methods, and can be combined with other sources
Timeliness	The currency of the data/information at the time of release	**Timeliness and punctuality**	Timeliness refers to how quickly information is made available after the end of the reference period; punctuality refers to whether information is delivered on the dates announced
Usability	The degree to which the data/information can be easily accessed and understood	**Accessibility and clarity**	The degree to which information, including supplementary explanatory information and metadata, is easily obtainable and clearly presented, in a way that can be understood

Note

* Based on the UN's NQAF dimensions as found in *Guidelines for the Template for a Generic National Quality Assurance Framework (NQAF)*.[1] The descriptions are adapted from the much longer descriptions provided in the guidelines.

Appendix B: Text alternative for images

Figure 1   5 dimensions of quality

CIHI uses 5 dimensions to describe and assess quality relative to users' needs:

- Relevance: Does the information meet users' current and potential needs?

- Accuracy and reliability: Does the information correctly and consistently describe what it was designed to measure?

- Comparability and coherence: Is the information consistent over time and across providers, and can it be easily combined with other sources?

- Timeliness and punctuality: Is the information current and released on schedule?

- Accessibility and clarity: Is the information and its supporting documentation easily accessed and clearly presented in a way that can be understood?

Figure 2   CIHI's Information Quality Framework

CIHI's Information Quality Framework describes how data is transformed into information throughout the 5 phases of the information life cycle: capture, submit, process, analyze and disseminate. The 4 components of quality management each have several aspects, as follows:

1. The foundation component includes strategy and principles, policies and procedures, corporate tools, standards, best practice guidelines, knowledge exchange and culture.

2. The activities component includes prevention, monitoring and control, evaluation and documentation, and improvement.

3. The outputs component includes data/information quality reports and indicators, improvement action plans and metadata.

4. Finally, the outcomes component includes increased knowledge, increased trust, increased use and increased quality.

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