Canadian Terminology Standards Certification Curricular Competencies

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Editors:
Kelly J. Abrams, MPA, CHIM
Vice President, Canadian College of Health Information Management
Beverly Knight, CSMLS
Standards Manager Clinical Systems Interoperability / Interopérabilité des Systèmes Cliniques
Canada Health Infoway

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Canadian Health Information Management Association
99 Enterprise Dr. S., Lower Level
London, ON N6N 1B9
Canada
www.echima.ca

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INTRODUCTION AND EXPLANATORY NOTES

PREAMBLE

The *Canadian Terminology Standards Certification Curricular Competencies* document provides the curriculum content for accredited Terminology Standards (TS) Certification programs within Canada. This document is used for program development, program review, and for the creation of the Canadian TS certification examination. The skills listed can be developed at any level for continuing education, program development for decision makers, and for increasing core competencies in health information management and health informatics programs; however, the main intent of this document is for use in the creation and ongoing accreditation of Canadian Terminology Standards Certification programs.

ABOUT US

Canadian Health Information Management Association. The Canadian Health Information Management Association (CHIMA) represents approximately 5,000 Health Information Management (HIM) professionals across Canada. CHIMA is the national association that represent leadership and excellence in health information management.

Canadian College of Health Information Management. The Canadian College of Health Information Management (CCHIM) is a federally chartered college with a long standing history of program accreditation standards development and maintenance, and learning content development. CCHIM is also the certifying body for the HIM profession and is responsible for the national certification examination and HIM credentialing. CHIMA and CCHIM are separate legal entities, although they are often referred to collectively as CHIMA.

Canada Health Infoway. Canada Health Infoway (*Infoway*) is an independent, not-for-profit organization funded by the federal government. *Infoway* jointly invests with every province and territory to accelerate the development and adoption of information and communications technology projects in Canada. Fully respecting patient confidentiality, these secure systems will provide clinicians and patients with the information they need to better support safe care decisions and manage their own health. Accessing this vital information quickly will help to foster a more modern and sustainable health care system for all Canadians.

PURPOSE OF THIS DOCUMENT

This document was developed to support post-secondary curricular development specialists and professors/instructors in the creation of a standardized program for a Canadian Terminology Standards certification. A thorough review of the competencies and curricular considerations will guide users (e.g., educational content development experts, professors) in determining the core curriculum to be offered in the appropriate academic setting. Users will then undertake the process of mapping individual competencies to specific courses to be offered, aligning each competency to course objectives, and the development or selection of appropriate existing activities and assignments to support achievement of the competencies at the required Bloom's taxonomic level.

The Terminology Standards certification program is aimed at anyone working in eHealth with an interest in or job related to terminologies, EHR interoperability, and/or coding classification. The length of the program will be dependent on its academic setting; however, it is expected that the programs will be developed with working students in mind. It is expected that the program will be offered in French and English. The estimated start date for program delivery and student intake (based on estimates from two academic institutions) is 2017 or 2018. Program accreditation and national certification will be administered by the Canadian College of Health Information Management.

BACKGROUND OF CERTIFICATION DEVELOPMENT

In 2013, based on a recommendation from national stakeholders, Canada Health Infoway and the Canadian Health Information Management Association (CHIMA) partnered together in the development of a Canadian clinical terminology professional certification. The work was informed by input from a national advisory group (see Appendix A) that was established to support this effort. The 2009 and 2014 Health Informatics and Health Information Management Human Resource sector studies supported and reinforced the need for action on Terminology Standards skill development (O'Grady, 2009; Prism Economics & Analysis [Prism], 2014). The Prism 2014 report states, "the most significant change [between 2009 and 2014] is the increased importance of coding and classification roles, in particular the more advanced terminology roles" (p. 21) and a survey by Canada Health Infoway "found that almost a third of the current vacancies for terminology specialists are taking more than seven months to fill" (p. 59).

We are pleased to share that both the Regenstrief Institute and the International Health Terminology Standards Development Organization have supported the work towards launching a terminology standards professional certification in Canada. This support and stakeholder engagement

was a critical success factor for this certification. We have collaborated with key stakeholders in Canada (identified in Appendix A, National Advisory Stakeholder Group) **and incorporated feedback from an open review process** on this exciting initiative that will help to address the current gap of trained and experienced human resources in the use of controlled terminologies to support the implementation and maintenance of e-health solutions.

BENEFITS OF A CERTIFICATION IN TERMINOLOGY

Highlights of the benefits associated with the decision to move forward with a specialty certification in Terminology Standards include:

- Development of national core learning content;
- Standardization of specified content;
- A recognized national credential to highlight the specialized expertise/knowledge in this area;
- Confidence in the credential by potential employers through the requirement for ongoing continuing education to maintain the currency of the credential;
- Quality assurance, continuous improvement, and ongoing support for educational programs through the accreditation process.

HOW TO USE THIS DOCUMENT

The learning outcomes within the *Canadian Terminology Standards Certification Curricular Competencies* document are not stated as outcomes or objectives, but rather as learning content. To provide clearer guidance on the expected level of cognitive learning per learning content area, the document has been developed to state the specific item of content and the learning level at which it should be taught. Curricular considerations are included to support consistency in academic program development. The academic programs themselves; however, will determine how to teach the content at the appropriate level.

The curriculum has been grouped according to the following core domains:

1.0 Foundations of Controlled Terminologies

2.0 Management of Controlled Terminologies

3.0 Application of Controlled Terminologies

4.0 Foundations of Interoperability Standards

5.0 Application of Interoperability Standards

The order of presentation does not infer an order of importance; however, it is expected that the foundational learning items will be taught before moving into the application and management competencies.

These learning outcomes represent the minimum standards for entry to practice as a certified Terminology Standards specialist. Programs may enhance this foundation, as needed, according to jurisdictional requirements and in keeping with available resources.

UNDERSTANDING THE STRUCTURE OF THE TS CURRICULAR COMPETENCIES DOCUMENT

DOMAINS

There are five domains for the Terminology Standards (TS) Certification Program. A domain is defined here as a grouping of core knowledge competencies. Competencies are the knowledge, skills and abilities in TS that a graduate is expected to have upon entry to practice (adapted from COACH core competencies v3.0 and CHIMA LOHIM v3 documents). The domain names and descriptions include:

1.0 Foundations of Controlled Terminologies (CT)**:** Knowledge and understanding of the types of CT standards in use including specific core and non-core CTs. As the Health Informatics and Information Management (HIIM) field continues to evolve, the specific core and non-core CTs may change; however, some terminologies such as SNOMED CT, LOINC, pan-Canadian LOINC Observation Code Database (pCLOCD) will continue to be core.

2.0 Management of Controlled Terminologies: Knowledge and skills in managing CT standards as an asset in organizations/jurisdictions. This competency covers development, publishing/distribution, maintenance and deprecation of CT contents, services and tools

3.0 Application of Controlled Terminologies: Knowledge and skills in adopting and implementing CT standards in organizations/jurisdictions. This competency covers analysis, evaluation, planning, design, implementation, use and support CTs in health IT applications

4.0 Foundations of Interoperability Standards: Basic understanding of the types of Interoperability standards in use, with emphasis on the role and relationship of CTs in these Interoperability standards

5.0 Application of Interoperability Standards: Application of knowledge and skills in adopting and implementing interoperability standards in organizations/jurisdictions, with emphasis on *appropriate use of CTs* in the standards and solution development lifecycles.

BREAKDOWN OF TERMINOLOGY STANDARDS DOMAINS

The five Terminology Standards Domains address two topic areas – Controlled terminology (CT) standards and interoperability standards. The comprehensive academic competencies are strongly linked to the unique requirements to be successful in health informatics/health information management (HI/HIM) professions.

For detailed information related specifically to Health Informatics or Health Information Management, respectively, please see the CHIMA LOHIM v3 at: https://www.echima.ca/uploaded/pdf/CCHIM/LOHIM_V3-June%202015.pdf or the COACH HI core competency document v3.0 at: https://www.coachorg.com/en/resourcecentre/resources/Health-Informatics-Core-Competencies.pdf or the Global Health Workforce Council's (GHWC) Global Academic Curricula Competencies for Health Information Professionals at: http://www.ahima.org/about/global/global-curricula.

COMPETENCIES

These learning content items are the required student learning outcomes specific to the Canadian Terminology Standards Certification and vary from domain to domain. General types of skills and knowledge are a significant asset to support the three Terminology Standards job roles, and are therefore important to highlight. For a description of the general skills and knowledge that should support the TS certification, see Appendix B. General Knowledge Required to Support Terminology Standards Learning Content.

CURRICULAR CONSIDERATIONS

The curricular considerations are examples of topics to be taught to achieve the desired learning outcomes. By design, these are flexible enough to provide guidance yet allow for jurisdiction and organization specific needs to be met.

BLOOM'S TAXONOMIC LEVEL

Bloom's Taxonomy has three specific domains: cognitive, affective, and psychomotor. The cognitive domain used within this document has six levels: 1) remembering, 2) understanding, 3) applying, 4) analysing, 5) evaluating, and 6) creating. This hierarchical structure enables educators to develop learning objectives and assessments based upon an appropriate cognitive level. Examples of the types of skills found within each level are shown in the chart and diagram below.[1] (This content has been adopted from the GHWC Global Academic Curricula Competencies for Health Information Professionals.)

BLOOM'S TAXONOMY Revised for Global Curricula Mapping[2]			
Level	**Category**	**Definitio**	**Verbs**
1	Remember	Recall facts, terms, basic concepts of previously learned material	Choose, Define, Find
2	Understand	Determine meaning and demonstrate clarity of facts and ideas	Collect, Depict, Describe, Explain, Illustrate, Recognise, Summarize
3	Apply	Use differing methods, techniques and information to acquire knowledge and/or solve problems	Adhere To, Apply, Demonstrate, Discover, Educate, Identify, Implement, Model, Organise, Plan, Promote, Protect, Report, Utilize, Validate
4	Analyze	Contribute to the examination of information in part or aggregate to identify motives and causes	Analyse, Benchmark, Collaborate, Examine, Facilitate, Format, Map, Perform, Take part In, Verify
5	Evaluate	Make judgments in support of established criteria and/or standards	Advocate, Appraise, Assess, Compare, Comply, Contrast, Determine, Differentiate, Engage, Ensure, Evaluate, Interpret, Leverage, Manage, Mitigate, Optimize, Oversee, Recommend
6	Create	Generate new knowledge through innovation and assimilation of data and information	Build, Compile, Conduct, Construct, Create, Design, Develop, Forecast, Formulate, Govern, Integrate, Lead, Master, Propose, Solve

1 Additional Resources and References: http://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/
http://epltt.coe.uga.edu/index.php?title=Bloom%27s_Taxonomy
http://ww2.odu.edu/educ/roverbau/Bloom/blooms_taxonomy.htm
http://www.celt.iastate.edu/teaching-resources/effective-practice/revised-blooms-taxonomy/

2 Layout for the levels and categories was adapted from Lorin W. Anderson and David R. Krathwohl's *A Taxonomy For Learning, Teaching, and Assessing,* Abridged edition, Allyn and Bacon, Boston, MA 2001.

The following tables indicate the competencies identified relating to each of the five domains, along with the taxonomy level and curricular considerations.

1.0 FOUNDATIONS OF CONTROLLED TERMINOLOGIES

Description: Knowledge and understanding of the types of Controlled Terminologies (CT) and Terminology Standards (TS) in use including specific core and non-core CTs. As the Health Informatics and Health Information Management (HI/HIM) field continues to evolve, the specific core and non-core CTs may change; however, some terminologies such as SNOMED CT, LOINC, pan-Canadian LOINC Observation Code Database (pCLOCD) will continue to be core.

	Competency	Bloom's Level	Curricular Considerations
1.1	Describe why a standardized approach to information management and data governance is important in today's environment.	2 (Understand)	Introduction and contextualization of the program of study including the roles of CT and the stakeholders who use and manage CTs
1.2	Describe the concepts of Information Management, Data Governance and related concepts including, but not limited to, Master Data Management, Metadata Management, Risk Management, entities entitled to collect data under legislation.	2 (Understand)	Describe data governance and management of health information - how it supports clinical (primary/direct care use) practice, interoperability, secondary use (e.g., billing, alerts, decision support, analytics), consumer/client populations
1.3	Apply the meaning of the terms ontology, taxonomy, description logic, terminology modeling, metadata (defined as data about data and within the context of specific terminology) and their relationship to the core terminology standards.	3 (apply)	Consider the distinctions and meaning between similar terms

	Competency	Bloom's Level	Curricular Considerations
1.4	Identify Standards Development Organization (SDO) that develop, manage or impact the use of controlled terminology including Governance and Licensing requirements Minimum terminology standards (and SDO) for inclusion: • Core: SNOMED CT (IHTSDO), ICD (WHO), LOINC (Regenstrief), pCLOCD (Canada Health Infoway) • Non-Core: include but not limited to, HL7 code systems (HL7), CPT (AMA), interRAI Assessments, ISO TC 215, nursing and other domain specific terminologies	3 (apply)	Identify each SDO including history and development of specific core CT standards (SNOMED CT, ICD, LOINC, pCLOCD), intellectual property issues language implications (i.e., availability in FR and EN) and how each is made available and consumable Identify licensing requirements for implementing each core CT standard as well as each SDO governance model and development process for creating new content. For non-core terminologies (HL7 Code systems, CPT, nursing and others), identify intellectual property issues, how each standard is available and any licensing requirements as well as the governance model and development process for creating new content. Emphasis for this learning content should be on standards used in Canada to support data analysis and interoperability.
1.5	Explain the design principles of specific core and non-core terminology standards including Canadian adaptations Minimum terminology standards for inclusion (based on what is being used in Canada for data analysis and interoperability): • Core: SNOMED CT, ICD, LOINC, pCLOCD • Non-Core: An understanding of other terminologies including but not limited to HL7 code systems, CPT, interRAI Assessments, Analyzenursing and other domain specific terminologies	2 (understand)	Explain the detailed in depth structure of specific core CT standards (SNOMED CT, ICD, LOINC) as well as how they are used in electronic systems. Explain how Canada-specific adaptations (i.e. SNOMED CT extensions, pCLOCD, ICD-9, ICD-10-CA and CCI) and future ICD-11 have been modified and used in Canada. Explain the current state of trends, issues and example implementation in CT standards landscape Describe the differences between terminology and classification standards

	Competency	Bloom's Level	Curricular Considerations
1.6	Explain Controlled Terminology (CT) usage in data capture, exchange and reuse in specific health care domains including but not limited to laboratory, diagnostic imaging, procedures, oncology, primary care, nursing, mental health, drugs. CT usage includes purpose, domain coverage, subsets (e.g., allergies, diagnosis, interventions, adverse reactions), interface terminologies, maps, cross maps, retrieval and documentation.	2 (understand)	Explain the role of controlled terminologies in the following scenarios: • concept representation and links to alternative terms (synonyms including terms in different languages), • interoperability, • clinical decision support, and • health system use • purpose and domain coverage Describe use cases for clinical terminologies and classification system usage in health care and health IT systems including comparison of gaps, comparability, and complementarity Explain and define the purpose of cross maps between standards and the difference with simple maps Learners will need to have an understanding of user interface display and structured documentation (e.g., problem lists, pick lists, radio buttons and graphical notations [i.e. the link between clinical documentation and assignment of clinical terminology])

	Competency	Bloom's Level	Curricular Considerations
1.7	Apply knowledge in the technical design for terminology standards.	3 (apply)	Apply the Desiderata for CT by Cimino (1998). http://www.cs.man.ac.uk/~jeremy/HealthInf/RCSEd/terminology-desiderata.htm Examples of technical design include SNOMED CT features of concept models, description logic, post-coordination, expression constraint language, and compositional grammar; and LOINC concept models and attribute builds Explain the difference between pre- and post-coordination and considerations related to data capture, exchange and reuse Model expressions using SNOMED CT Compositional Grammar Model a simple query using SNOMED CT Expression Constraint Language
1.8	Evaluate basic CT tools for development, management and use.	5 (evaluate)	Understand purpose and use of CT tools Evaluate options and make a recommendation in the selection and use of the following specific tools: • browsing, searching • mappings, • management (e.g. requests for change, versioning, deprecating) • subsets, • authoring, • query tools

	Competency	Bloom's Level	Curricular Considerations
1.9	Apply CT tools to be used for advanced development, management and use.	3 (apply)	Apply knowledge and skills in the roles and use of the following specific tools including the relationship of use case to tool functionality • modelling (for extensions/post coordination) • classifiers, • conformance tools (e.g., terminology meaning,) [emerging] • validation • visualization tools • expression builders

2.0 MANAGEMENT OF CONTROLLED TERMINOLOGIES

Description: Knowledge and skills in managing Controlled Terminologies (CT) and Terminology Standards (TS) as an asset in organizations/jurisdictions. This covers development, publishing/distribution, maintenance and deprecation of CT contents, services and tools.

	Competency	Bloom's Level	Curricular Considerations
2.1	Determine methodologies for the development and management of controlled terminologies	5 (evaluate)	Building on the competencies from section 1.0: Evaluate and apply critical thinking to recommend a methodology for CT management including: governance structure/process, management of requests for change, prioritization, versioning, roles, responsibilities & processes for sustained use of CT, management of risks, issues & decisions, and lessons learned Evaluate and apply critical thinking to recommend a methodology for Controlled Terminologies including; needs identification, standards selection, benefits evaluation, development, quality assurance, publication, distribution, and deprecation processes; and selection of terminology development and maintenance tools
2.2	Demonstrate terminology knowledge by contributing to the development, implementation and support of an operational/human resources including workflow and tools to manage CT in the organization/jurisdiction	3 (apply)	Apply terminology understanding in the solution including: • the development of roles and responsibilities in the development process • managing and adjudication during consensus in the development process • development of assessment templates

	Competency	Bloom's Level	Curricular Considerations
2.3	Demonstrate terminology knowledge by contributing to the development, implementation and support of CT services, tools and technical infrastructure, to manage CT	3 (apply)	Apply terminology services, tools and resources to help articulate clinical, business, and technical needs within use cases, requirements, test cases, etc. Example: There is a need to incorporate terminology considerations to a technical solution (e.g., FHIR, application programming interface or API). Assignment could include a case study
2.4	Perform quality assurance/improvement of CT in the organization/jurisdiction, including quality audit of the CT content and usage.	4 (analyze)	Facilitate quality assurance/improvement of CT services and tools in use (The focus is from the perspective of the organization/jurisdiction that has developed the product and how they are going to continue to maintain it)

	Competency	Bloom's Level	Curricular Considerations
2.5	Using methodologies as per section 2.1, evaluate, develop, publish/distribute and maintain CT content as part of the CT development life cycle.	6 (create)	*Recommend* specific CT content for an area of domain coverage that includes consideration for; concepts, relationships, subsets, maps, cross maps and concept modelling *Development* covers the modeling and creation of specific CT contents including but not limited to LOINC and SNOMED CT expressions and extensions, modeling, implementation guides, lessons learned material, best practices and technical reference material *Publish/distrib*ute covers human readable and computable content and includes the release of specific CT contents such as subsets, maps, terminology metadata, and relevant statistics (e.g., size of subsets, actual usage statistics),rules and documentation (e.g. transitive closure table and implementation guide) *Maintain* covers specific CT content revisions, updates and versioning, and deprecation

	Competency	Bloom's Level	Curricular Considerations
2.6	Develop and implement a CT strategy to ensure compliance with policies and governance on CT implementation and management including: • Knowledge of governance and best practice in Terminology • Risks and issues with mitigation strategies	6 (create)	Consider the requirements/use case scenarios for the use of organizational, jurisdictional, pan-Canadian, and international terminology Address management of terminology at an organizational, jurisdictional, and/or health system-wide level Establish organizational/jurisdictional policies to support governance of CT implementation Incorporate governance and best practice considerations including; Clinical engagement, collaboration, innovative thinking, sustainability planning, communication Lead and facilitate steering/advisory committees and working groups for stakeholders on the governance of specific CT in the organization/jurisdiction Risk and issues includes project risks when implementing a terminology; the competency includes understanding methodologies to identify and mitigate risk
2.7	Develop learning resources and deliver educational/ training sessions for multiple audiences on the development, application and management of the content of specific CT services and tools used in the organization/jurisdiction	6 (create)	Collaborate with instructional designer/developer to create audience-appropriate educational tools and resources to enable knowledge transfer to the following scenarios: Educate clinicians, physicians and others on the benefits of clinical terminologies without training them on the inner workings of the CT Train those who will be working with and implementing the CT

3.0 APPLICATION OF CONTROLLED TERMINOLOGIES

Description: Knowledge and skills in adopting and implementing Terminology Standards in organizations, including: analysis, evaluation, planning, design, implementation, use and support of Controlled Terminologies in health IT applications.

	Competency	Bloom's Level	Curricular Considerations
3.1	Evaluate and recommend CT services and tools used in other jurisdictions to support adoption of CT within an health IT application.	5 (evaluate)	Focus on the organization/jurisdiction that has implemented CT services and tools and the ongoing support Evaluate how an organization has implemented CT services and tools and ongoing support mechanisms. Recommend improvements. (Case study)
3.2	Compile requirements and develop a business case for the adoption of a specific TS within an existing/planned health IT applications in the organization.	6 (create)	Develop terminology requirements (e.g. business requirement and use case analysis) Develop Terminology Standards options analysis Develop Cost Analysis (e.g. licencing, CT development & maintenance costs) Develop Value / Benefit Analysis

	Competency	Bloom's Level	Curricular Considerations
3.3	Determine organizational/jurisdictional readiness and technical feasibility to adopt a specific TS within existing/planned health IT applications in the organization/jurisdiction; e.g. Terminology implementation options and selection	5 (evaluate)	Engage with administrators, clinical users and support staff on the adoption of a specific TS within health IT applications in the organization/jurisdiction (Be able to understand the different perspectives of those this person will liaise with), including: • Document terminology current state • Investigate terminology options • Identify the terminology desired future state for data capture, primary and secondary use • Identify barriers to adoption and tools to manage the barriers (including existing health care practices and policies) • Identify gaps & impact of those gaps on existing systems and stakeholders Evaluate strategies and approaches to implement TS into existing systems with an understanding of the impact to the end users (ie minimize impact to user) and build the knowledge of why this is important to the leadership, clinicians, and project team
3.4	Evaluate technical design and implementation of health IT applications to incorporate CT standards including appropriate methods for CT-encoded data entry, storage, retrieval, and analysis	5 (evaluate)	Determine applicable terminology solution based on • awareness of meaning based retrieval & value of description logic • an examination of how data capture and meaning based retrieval play a role in decision support • an examination of how transitive closure, concept subsumption & equivalency and information model play a role in retrieval and analysis

	Competency	Bloom's Level	Curricular Considerations
3.5	Evaluate types of data capture including but not limited to devices, mobile apps ensuring appropriate binding and/or transformation to CTs in support of patient safety and quality of care.	5 (evaluate)	Contribute to the evaluation of user interface requirements and solutions for data capture in collaboration with physicians and other clinicians and consumers (e.g., wearable apps) (Reference: User Interface Guidelines for Clinical Coding of Data)
3.6	Facilitate alignment between terminology development, maintenance, and implementation activities and project activities through collaboration with project management	5 (evaluate)	Evaluate use case to support the analysis of CT Identify and document terminology requirements for Request for Information/Request for Proposal Apply a standard change management framework to enable adoption Contribute to a communication plan including tools such as briefing notes, status updates, decision making option analysis material
3.7	Provide and manage ongoing support of specific CTs implemented in health IT applications in the organization and jurisdiction including use, revisions, updates and deprecation of CT contents.	5 (evaluate)	Leverage Maintenance best practices Understand triggers for change to CT standards and ramifications for application change management Ensure requirements for master data management (shared information applied across organization/jurisdictions e.g., single source of truth and maintenance of information) are met
3.8	Evaluate the implementation and post-implementation use and impact of specific CTs in health IT applications in the organization/jurisdiction and provide recommendations for optimization.	5 (evaluate)	Leverage different evaluation methodologies Determine and recommend benefits evaluation (e.g., What are the quantitative and qualitative benefits?) Note: in this context, optimization is defined as application of continual improvement

	Competency	Bloom's Level	Curricular Considerations
3.9	Develop terminology strategic roadmaps and operational/implementation plans ensuring alignment with health system plans and strategies	6 (create)	Roadmaps and plans should include design that will accommodate requirements for a phased, staged or full implementation approach to terminology services.
3.10	Develop learning resources and deliver educational/training sessions for multiple audiences on the types of CT standards in use and implementation and adoption of specific CT standards in health IT applications in the organization/jurisdiction.	6 (create)	Collaborate with instructional designer/developer to create audience-appropriate sessions including the development of interactive workshop resources Train multiple audiences on the use of specific CT standards implemented in health IT applications in the organization/jurisdiction including internal team members and external stakeholders

4.0 Foundations of Interoperability Standards

Description: Basic understanding of the types of interoperability standards in use, with emphasis on the role and relationship of CTs in these interoperability standards.

	Competency	Bloom's Level	Curricular Considerations
4.1	Demonstrate knowledge in the purpose, history, development, and lifecycle of interoperability standards	3 (apply)	Demonstrate and apply knowledge of the role of standards development organizations in the development of interoperability standards and methodologies Apply foundational knowledge of interoperability standards such as the meaning and differences in syntactic interoperability and semantic interoperability Demonstrate and apply knowledge of Standards Development Documentation Framework (SDDF) Demonstrate and apply knowledge of IHE Integration Profiles and development lifecycle Reference: Interoperability for Dummies
4.2	Identify the role of CTs (i.e., why they are being used) in interoperability and metadata standards including but not limited to architecture, CIHI EMR content standards, EMR-to-EMR data exchange specifications, and ISO 17909 metadata repository standards	3 (apply)	Identify three key forms of interoperability (directed, query-based and consumer-mediated exchange) Include: • A Canadian focus with international overview • Architecture includes HIAL and infostructures • Why is description logic important for interoperability?

	Competency	Bloom's Level	Curricular Considerations
4.3	Explain messaging and clinical document standards.	2 (understand)	Describe how controlled terminology is used in all types of messaging standards and terminology binding including: • HL7 meaning of concept representation (concept identifiers, codes, designations) • HL7 messaging standards - HL7 V2.x and V3 and Fast Healthcare Interoperability Resources (FHIR), HL7 core principles • Document standards include, for example, Clinical Document Architecture (CDA) and Consolidated CDA (C-CDA) including metadata standards, cross-Enterprise document sharing (XDS and XDS-i) • Include data types and how they are used with coded terminology • Document ontology (LOINC) for report naming and use with terminology services • The role of value sets in information exchange including the definition methods, versioning and coding strength conformance Describe the role of Object Identifiers (OIDs) including how they are generated, managed and applied. Understand the options of sharing "null or negative" values in information exchange

	Competency	Bloom's Level	Curricular Considerations
4.4	Explain why clinical information models and modeling are important or relevant to interoperability, the electronic health record and terminology standards.	2 (understand)	Explain how representation of meaning in information models and terminology standards support one another and may overlap Examples include HL7 RIM, HL7 CDA templates, Clinical Information Model Initiative (CIMI) Explain impact of information model and modelling to long term data utility and patient safety.
4.5	Demonstrate knowledge in interoperable EHR standards.	2 (understand)	Describe the most up-to-date Infoway and provincial eHealth/EHR blueprint and the role of repositories/ registries (e.g. Where you need to be aware of provincial EHR solutions). To include consideration and different approaches to terminology application with data being sent outside of the point of care system and also received by the point of care system and the implications to terminology use and data management, etc. SDOs to include (but not limited to): • ISO (e.g. ISO/TS 18308 architecture, EN 13606 communication) • HL7 (e.g., EHR/PHR functional model and related profiles) • IHTSDO (including collaboration mechanism) • Regenstrief • OpenEHR • IHE (e.g., XDS document sharing infrastructures) • CEN (European Committee for Standardization) • GS1 (Personal identification)

	Competency	Bloom's Level	Curricular Considerations
4.6	Explain the implementation of interoperability standards that includes integration process and profiles.	2 (understand)	Examples include the technical frameworks, structured and synoptic reporting, and data governance Describe the use of the IHE integration methodology and profiles in different clinical and IT infrastructure domains
4.7	Explain the use of CT in imaging interoperability.	2 (understand)	Examples to discuss include: • Encapsulated Data such as ▪ DICOM and structured reporting ▪ Imaging, use of images, jpegs ▪ IHE XDS-I exchange of images/reports ▪ Audio files and other formats. • Others including scanned documents. Clinical domains include but are not limited to radiology, pathology, cardiology, eye care, gastroenterology, dermatology and wound care images from point of care in all sectors
4.8	Explain the use of CT in interoperability in emerging technologies	2 (understand)	Examples to discuss include: • Telehealth/Telemedicine • Medical devices • Mobile Health • Robotics • Patient entered monitoring
4.9	Demonstrate knowledge in specific interoperability tools for development, implementation, use, maintenance and evaluation of interoperability standards.	3 (apply)	Examples to apply include archetype editor, FHIR tools, Infoway Tools and Solutions such as HL7 explorer and message builder/validator/ReMixer, Terminology Gateway, V2-V3 mapper, CDA validator and OID repository and HL7 OID registry, IHE connect-a-thon tools HL7 OID registry can be found here: https://www.hl7.org/oid/index.cfm

	Competency	Bloom's Level	Curricular Considerations
4.10	Analyze published interoperability documentation and related resources to verify alignment of terminology standards and services	4 (analyze)	Includes data governance, information around maintenance of specifications, standards, and value sets will be changeable and fluid. Need to consider changeability and fluidity in course creation Examples include interoperability blueprints/roadmaps, adoption lifecycle, data governance, information around maintenance of specifications/standards and value sets, implementation guides, testing and certification, technical reference manuals and field experience/evaluation reports Published documents include Infoway Blueprint, Jurisdictional and international documents

	Competency	Bloom's Level	Curricular Considerations
4.11	Demonstrate knowledge of the current trends and issues in the interoperability standards landscape in Canada and North America.	3 (apply)	Describe the vision for healthcare interoperability in Canada, key interoperability patterns, key standards and the role of healthcare providers, software vendors, provincial and federal agencies in realizing the vision. Contrast with vision(s) of health care interoperability in the US, key interoperability patterns, key standards and the role of healthcare providers, software vendors, state and federal agencies in realizing the vision. (References: Federal Health IT Strategic Plan 2015-2020, Healthcare Services Platform Consortium (HSPC) and the Common Well Alliance.) Identify areas of relevance and/or implications for Canadian stakeholders. Survey other international initiatives. Review the ways that Canadian, US and other international stakeholders are represented within key SDOs (e.g. HL7, IHTSDO), identify advantages and disadvantages of different approaches in terms of national objectives. Discuss initiatives such as the Joint initiative council, HL7 Healthcare Standards Integration Working Group, their objectives and their relevance to Canada. Examine the impact of innovation (e.g. FHIR standard) on different initiatives and collaborations above.

	Competency	Bloom's Level	Curricular Considerations
4.12	Demonstrate knowledge of conformity assessment process and standards relating to interoperability.	3 (apply)	Demonstrate an understanding of ISO 17025 (testing) and ISO 17065 (certification) standards This learning content includes specification (conformance profiles), governance, testing and tools, certification, and regulation, ISO work on map quality assessment and Terminology Implementation Maturity

5.0 APPLICATION OF INTEROPERABILITY STANDARDS

Description: Application of knowledge and skills in adopting and implementing interoperability standards in organization/jurisdictions, with emphasis on *appropriate use of CTs* in the standards and solution development lifecycles.

	Competency	Bloom's Level	Curricular Considerations
5.1	Collaborate and support the adoption of interoperability standards through their lifecycle stages	4 (analyze)	This learning content is not done in isolation so team work, communications, critical thinking need to be considered for this learning content item Apply specific interoperability tools and solutions in the development, implementation, use, maintenance and evaluation of interoperability standards in the organization/jurisdiction Includes the planning, evaluation, selection, adoption, adaptation, development, implementation, use, maintenance of specific interoperability standards (case examples from projects to demonstrate)
5.2	Evaluate specific interoperability standards for adoption in the organization/jurisdiction	5 (evaluate)	This learning content item speaks to the process around planning for specific interoperability standards rather than the understanding of the planning itself. Includes environment scan, business case and requirements, stakeholder engagement, establishing governance, and privacy/security policy
5.3	Analyze the ***selection*** of specific interoperability standard for adoption in the organization/jurisdiction	4 (analyze)	Contribute to the development of CDA implementation guide, Contribute to the construction of template and assembling of specifications. Terminology bindings to IHE Integration Profiles Includes specification, creation, testing and acceptance of the CT within the standard artifact

	Competency	Bloom's Level	Curricular Considerations
5.4	Manage the ***implementation*** of specific Interoperability standards in the organization/jurisdiction	5 (evaluate)	Assess the terminology standards component and provide terminology support to the technical team including: • Perform gap analysis, HL7 messaging field repurposing mapping and analysis, to determine which Interoperability profiles fit best with their plan, strategic assets.". • Support deployment of the standard artifact, validation & conformance, troubleshooting and performance tuning
5.5	Collaborate in the ***maintenance*** of specific interoperability standards adopted in the organization/jurisdiction	4 (analyze)	Facilitate the use of tools and solutions for specific interoperability standards adopted in the organization/jurisdiction that include help desk, user support, troubleshooting and user feedback Facilitate the use of Conformity Assessment tools, content validators Including such work processes as quality improvement/assessment, performance monitoring, quality reporting, updates, deprecation and disaster recovery
5.6	Perform the post-implementation ***evaluation*** of specific interoperability standards adopted in the organization/jurisdiction with the jurisdictional and federal benefits evaluation framework	4 (analyze)	Learning content to include the assessment of the results of interoperability, its usage and user satisfaction, and benefits in care quality, productivity, access and cost

	Competency	Bloom's Level	Curricular Considerations
5.7	Recommend the ***creation, distribution, and update*** of the documentation on specific interoperability standards adopted in the organization/jurisdiction	5 (evaluate)	Support the development of key messages for specific audiences Participate in an open review and present to student peers Create a presentation at the executive level for groups unfamiliar with terminology topics including executive briefs, user manuals, implementation guides, and technical reference manuals Where would the student look for resources? How do they consider authenticity and authority of the learning resource authors? • Consider a web quest to search out materials from legitimate and appropriate sources

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APPENDIX A. NATIONAL ADVISORY STAKEHOLDER GROUP

(In alphabetical order)

Kelly Abrams (co-chair), Vice President, Canadian College of Health Information Management

Salve Achacoso, Manager of Health Business Consulting, TELUS Health

Russ Buchanan, Terminology Practice Lead, Gevity Consulting

Hélène Clement, Executive Lead in Clinical Data Management Services at eHealth Ontario, COACH Representative

Marguerite Foote, Manager EHR Standards, Newfoundland & Labrador Centre for Health Information

Dr. Andrew Grant, Professeur, Université de Sherbrooke

Sharilyn Kmech, Director of Clinical Terminologies, Communication & Learning, Health Information Management, Alberta Health Services

Beverly Knight (co-chair), Standards Manager Clinical Systems Interoperability / Interopérabilité des Systèmes Cliniques, Canada Health Infoway

Dr. Francis Lau, Professor, School of Health Information Science, University of Victoria

David Markwell, Head of Education, IHTSDO (ex officio member)

Michael Nusbaum, President MH Nusbaum & Associates Ltd., ITAC Health representative

Sue Schneider, Director of eHealth Standards, eHealth Ontario

Dr. Shapoor Shayegani, Instructor, Centre for Distance Education

Dr. Leonie Stranc, Information Standards Specialist, Manitoba eHealth

Ginette Therriault, Program Lead Classifications & Terminologies, Canadian Institute for Health Information

APPENDIX B. GENERAL KNOWLEDGE & SKILLS REQUIRED TO SUPPORT TS LEARNING CONTENT

- Understand the Canadian health care system and eHealth environment
- General understanding of the importance of information management and information governance
- General understanding of Protection of Health Information and Privacy Laws
- General understanding of Business Analytics
- Apply strategies and techniques to facilitate the adoption of health information tools
- Demonstrate effective change management and problem solving skills in relation to the implementation of health information related processes and projects
- Apply critical thinking skills
- Recognise limits to knowledge and know how to go about finding how to go about finding and critically appraising needed information
- Demonstrate strong analytical skills
- Demonstrate information literacy
- Demonstrate leadership skills
- Demonstrate team building skills
- Demonstrate the ability to be a team player
- Demonstrate advocacy skills
- Demonstrate effective interpersonal skills including listening, oral, and written communication skills
- Facilitate effective communication between various healthcare stakeholders and disciplines
- Participate in the health information environment through association membership and/or credentialing, certification, continuous education
- Demonstrate the ability to be self-directed
- Demonstrate the ability to rapidly assimilate large volumes of information

APPENDIX C. CORE TS ROLES USED TO CREATE LEARNING CONTENT

Terminology Specialist

The role of the Terminology Specialist is to develop and maintain mappings and subsets between healthcare related data and clinical terminology systems (including SNOMED CT and LOINC) and classifications. The Terminology Specialist will work in a multi-disciplinary team in multiple care settings with clinicians, other health care providers, Terminology Technical Specialists, Project Managers, Business Analysts Terminology Specialists and vendors as well as in close interaction with the client or implementer. A key component to this role is the ability to apply domain knowledge and terminology expertise to tailor and integrate mapping and subset development, best practices to specific clinical project or operational context by applying a quality assurance framework.

Terminology Technical Specialist

The Terminology Technical Specialist is responsible for the technical and/or tooling aspects of terminology development, implementation, mapping, subsets, terminology analytics, maintenance, versioning, and deprecation. The Terminology Technical Specialist is also responsible for the creation and maintenance of tools, databases, and tables. The Terminology Technical Specialist will work in a team setting with clinicians, project teams, operational teams, business analysts, mapping specialists and terminology specialists providing knowledge transfer to clients and team members, implementation support, development of terminology deliverables and overall maintenance of mappings or other products. A key function of this role is the ability to contribute to data quality development and maintenance by enabling the primary and secondary functional aspects of developing, implementing, and managing terminology products.

Terminology Advanced Specialist

The role of the Terminology Advanced Specialist is to lead terminology activities related to developing, adopting/adapting, implementing and managing mappings and subsets. The Terminology Specialist demonstrates applied knowledge of strategies and tactics to use coded terminology for decision support and identifying and targeting patient populations to proactively provide improved care; provides knowledge transfer to clients and team members; implementation support; develops terminology deliverables and performs overall maintenance of mappings or other products. The Terminology Specialist is responsible for the terminology aspects of the project(s) and will work in a team setting with clinicians, health care providers, architects, project managers, business analysts and other terminology specialists as well as close interaction with the client or implementer. A key component of this role is the ability to tailor the terminology approach to a specific project or operational context by applying a quality assurance framework.

APPENDIX D. OPERATIONAL DEFINITION OF KEY TERMS

In order to support a consistent understanding of terms used in this document, a number of key concepts have been operationally defined:

Controlled Terminology (CT) - CTs are a structured set of terms representing systems concepts. CTs are limited to a purpose and scope to facilitate consistent expression of meaning and reuse of information. In the health care context, they enable electronic health information exchange within and across clinical information systems and related applications. Adapted from the Standards in Biomedical Informatics (Hammond & Cimino 2014) and ISO Standard 1087.

Concept: A unit of thought constituted through abstraction on the basis of properties common to a set of objects.

Term: Designation of a defined concept in a special language by the linguistic expression.

Terminology: Set of terms representing the system of concepts of a particular subject field.

Nomenclature: System of terms that is elaborated according to pre-established naming rules.

Dictionary: Structured collection of lexical units, with linguistic information about each of them.

Vocabulary: Dictionary containing the terminology of a subject field.

Interoperability Standards - Published data exchange schema and /or formats that would provide the ability of different information technology systems and software applications to communicate, exchange data, and use the information that has been exchanged (HIMSS, 2015).

Secondary Use – Secondary use of data refers to any use of the data collected for one purpose (for example, the provision of health care to a patient, which is considered the primary use of the data) to inform another purpose (such as a quality improvement initiative, which is considered a secondary use of the data). Health information laws in Canada regulate which secondary uses of health data are permissible. Generally, they permit the use of health data, whether paper or electronic, for management and planning of the health system (CIHI, 2013).

Health System Use – Health system use of health data collected at the point of care to strengthen the health system. Health system use of data generally comprises the use of health information to support clinical programs (for example, through decision-support or quality improvement initiatives), health system management, population and public health, and health research. (Note; Health system use of data is a subset of secondary use of data, a term commonly used in the privacy community.) (CIHI, 2013).

Information Governance (IG) – IG is a framework for managing information throughout its lifecycle and supporting the organization's strategy, operations, regulatory, legal, risk and environmental requirements (AHIMA, 2015).

Data Governance (DG) – DG is the responsibility of the business unit. It is the policies, processes, and practices that address the accuracy, validity, completeness, timeliness and integrity of data (data quality) (AHIMA, 2015).

Master Data Management (MDM) – MDM is defined here as the technology, tools, and processes required to create and maintain consistent and accurate lists of master data (Microsoft, 2016).