Meeting Summary
Diagnostic Imaging Meeting
Feb 6-7, 2012

Sponsored by:

The Canadian Institute for Health Information
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1. INTRODUCTION

In February 2012, the Canadian Institute for Health Information (CIHI) in partnership with the Institute of Health Economics (IHE) sponsored a two day meeting of content, administrative and research experts to identify the breadth of diagnostic imaging studies that CIHI might feasibly undertake with its data or with data that could be easily obtained. The purpose of this report is to summarize the meeting proceedings and the recommendations stemming from the discussion.

2. CONTEXT FOR THE MEETING

Diagnostic imaging (DI) is an essential and growing component of the provision of general and specialized medical care and treatment within Canada's health care system. The increasing demand for and rising costs associated with DI are being driven by factors such as the availability of increasingly sophisticated forms of DI, an increasing reliance on DI for clinical decision-making, as well as increasing patient demand. This rising demand for DI services and capacity, combined with the imperatives around cost containment, has made DI an important area for research and analysis.

Nevertheless, our ability across the healthcare system to undertake systematic and meaningful analysis has been hindered by lack of comprehensive data on the actual use of these technologies across Canada. To address these gaps, CIHI is interested in leveraging its data holding to shine a more focussed spotlight on this important area of health care services. To that end, the specific objectives of the meeting were to:

1. To identify what kinds of analyses/studies could be undertaken with existing CIHI data (or easily obtainable data) that would shed light on the utilization and costs of diagnostic imaging in a way that allows decision-makers to act on this knowledge; and
2. To determine what data would be helpful to obtain that could be used to answer questions concerning the utilization and costs of diagnostic imaging

Meeting participants included twelve invited participants, five CIHI staff and three members of the IHE. Attempts were made to engage participants from different geographical areas across Canada and who had expertise in DI research, service provision or policy-making. A list of participants can be found in Appendix A.

3. SETTING THE STAGE FOR DISCUSSION (BACKGROUND INFORMATION)

To assist participants in understanding what data are available (or not available in the case of privately delivered services), CIHI provided participants with a summary of data captured through CIHI's databases (Appendix B) and a summary of DI data availability by location of services (Appendix C).

Data on the use and cost of diagnostic imaging is collected from a myriad of sources including physician payment systems, MIS (financial systems), discharge data for inpatient and outpatient visits, CIHI's medical imaging survey and radiology information systems. The comprehensiveness and consistency of these data are determined by a number of variables including the type of DI modality, physician payment methods, government policies, and whether the service is publically or privately funded. For example, in BC, radiologists are remunerated for CT scans through fee-for-service but through a global budget for x-rays. These physician payment systems vary by jurisdiction. The combination of these variables applied across thirteen provinces and territories results in an uneven, patchwork of data that makes pan-Canadian research and analysis challenging.

An emerging source of data on DI stems from the implementation of Radiology Information Systems (RIS), Picture Archiving and Communication Systems (PACS), and Diagnostic Imaging Repositories (DI-r) at the hospital, regional or provincial level. These systems represent an important source of medical imaging data in Canada. Typically, a PACS is a local system where images are collected from the imaging modalities and stored at the hospital or health authority level. The RIS is the coordinating system which connects the various PACS and enables regional and provincial integration and dissemination of data. The DI-r generally refers to the provincial repository/database of imaging studies.

Canada Health Infoway funds the regional and provincial implementation of RIS, PACS and DI-r. To ensure the compatibility and comparability of RIS/PACS/DI-r across Canada, Infoway also publishes and promotes standards which facilitate the sharing of DI information regardless of where the images or reports are acquired or created. Some provinces have integrated their diagnostic imaging systems into their EHR systems while other provinces do not have provincial level repositories for this information. Currently, CIHI does not have access to data from these systems. If CIHI and its partners wish to undertake analyses of diagnostic imaging in Canada, the data from these systems could potentially play an important role.

4. DI MODALITIES OF INTEREST

The initial scope of the workshop focused on five modalities: x-rays, ultrasound, CT, MRI and bone densitometry. After some discussion, the group made the following recommendations around the scope of interest.

- Bone densitometry should not be included as it falls under screening rather than diagnostics.
- PET should be included in the modalities due to its growing use in cancer and cardiac care. Not all jurisdictions currently have access to PET scans; however, this was seen as an opportunity to be proactive and to be able to study use in existing settings. This could be used for planning in the new settings prior to implementation.
- Include Nuclear Medicine due to the issues of comparative effectiveness and isotope shortage.
- Add Echocardiography to the list of modalities to study. In smaller centres it may be included in ultrasound. A great deal of this work is performed by private clinics/MD clinics.
- Do not include hybrid technologies at this point.

In addition, the recommendation was made that the size of the impact on the system should be considered when deciding which modalities and types of modalities to include. For example, it may be more helpful to look at imaging of specific types (e.g., x-ray spine) rather than the "general" modality.

5. PRESENTATIONS

To begin the dialogue, two of the participants were asked to do presentations on their perspectives as users of data on diagnostic imaging. Kim McGrail was asked to speak to important questions from her perspective as a researcher and some of the challenges she faced in conducting research in this area. Mike Nader was asked to address important questions that he has as a decision-maker and the challenges that he faces in accessing and using data related to DI. Following these two presentations, Greg Zinck, CIHI Manager, MIS and Costing was asked to do a presentation on CIHI data holdings.

A RESEARCHER PERSPECTIVE

Kim McGrail examined potential research questions from three perspectives: the patient; the provider and the system.

The patient perspective	- Ensuring the patient receives the correct diagnosis and care and as quickly and accurately as possible - Minimizing multiple testing for the same patient / condition - Consideration of longer-term outcomes for patients – e.g. radiation exposure - Receiving findings (incidentalomas) from tests that are abnormal yet not of clear clinical significance possibly leading to further testing that may not be necessary
The provider perspective	- Impact of Clinical Practice Guidelines on ordering practices - Understanding what drives providers to use / rely on imaging (including predictive characteristics, e.g. age) - GP vs. specialist use of / referral for imaging - Relationship of imaging to use of other health care resources (e.g. lab testing)
The system perspective	- Impact of imaging as a contributing factor to cost drivers - Looking at over-use / under-use / misuse of imaging - Waiting and consequences of long wait times - Role of private payment and queue jumping

DECISION-MAKER PERSPECTIVE

Mike Nader discussed potential questions in the context of 5 key performance areas for evaluating Diagnostic Imaging: Financial, Efficiencies, Productivity, Utilization and Accessibility.

Financial	Capital equipment age is of paramount concern from a financial perspective. What is a reasonable length of time to run equipment? Other systems use 5 years as a guide. What should the Canadian system use?
Efficiencies	Efficiencies are measured using either cost per exam or workload units or some combination of the two. Measurement of cost per exam requires a standard definition of what is included in an exam. Workload units are used, but can often be gamed. Both exams and workload should be included in measurement of efficiency to address the complexities of the system.
Productivity	Activity can be measured as Full Time Equivalents (FTE)/ year. The definition of an FTE can vary. AHRA technical benchmarking looked at type of hospital. This provides a low benchmark that could be used until variations by jurisdiction (hours/vacation time) are better understood.
Utilization	Decision-makers want to know how many tests are done. This is measured as exams per 1000 population. Examining this by patient/population

characteristics, such as age would provide more actionable information.

Accessibility	▪ Are patients receiving tests in a timely manner? What are the wait times for specific modalities? Long wait times can have consequences beyond patient outcomes. If the patient had exam done in private system due to waits in public system may incur additional cost to system. Sometimes exams get done a second time by the public system after already done in private system and at other times the patient will miss the appointment in public system. In addition, the same patient could be on the list for the same exam in several organizations.
	▪ Wait times for getting the exam done are only one part of the process. Turnaround times that include both getting the exam done and getting the results should be measured.

In addition to the priority KPI areas that have been covered, Mike made some observations about how DI information could be useful

- Diagnostic Imaging should be a topic that is included in provider/ pt satisfaction surveys. It would be helpful to have one survey that was used across Canada.
- Information on utilization and long term outcomes from radiation exposure could be used to support staff and patient safety.
- It would be helpful to explore how information on Diagnostic Imaging could assist with Accreditation compliance.
- How could Diagnostic Imaging information be used to support the Quality Assurance process? Currently this is a provincial process that relies on peer review and requires significant time and resources.

CIHI'S DATA HOLDINGS

CIHI collects data and information on DI in a number of its databases and through the Medical Imaging Technologies Survey. Greg Zinck spoke to each of the data holdings – what is captured, what's missing in the data capture and the limitations associated with each data source. The databases include:

Discharge Abstract Database (DAD)	Patient level data for acute inpatients and surgical daycare patients – limited availability of diagnostic imaging interventions
National Ambulatory Care Reporting System (NACRS)	Patient level reporting for emergency departments, day surgery and ambulatory patients – capture of DI interventions for provinces that participate in Level 3
Canadian MIS Database (CMDB)	Financial and statistical data at the health authority/hospital level.
National Physician Database (NPDB)	Fee for service data by physicians collected at individual fess code level
Pilot Program for Physician Billing Data	Pilot program in SK and AB to capture billing data linkable to other CIHI databases

Canadian Patient Cost Database	Patient-level hospital cost data (AB and ON with some sites in BC)
Medical Imaging Technologies in Canada (MIT)	Data from national survey of imaging equipment
Medical Radiation Technologists Database (MRTBD)	Provider-level health human resource data MRTs
CIHI Provincial Wait times Data	Aggregate wait time data for MRI and CT at provincial level

6. IDENTIFICATION OF ANALYTIC QUESTIONS

Following the three presentations, participants were asked to reflect on what they had heard and to identify important analytical questions that could addressed with CIHI's data or easily accessible data. These questions were captured on flip chart paper and then grouped into the categories listed below. A summary list of the questions is provided in Appendix D.

- Efficiency/cost effectiveness
- Access/waiting
- Utilization
- Outcomes
- Practice guidelines
- Policy impact
- Practitioner behavior
- Appropriateness
- Patient Safety
- Patient Experience

Each of the questions was then discussed with a focus on data availability (both within CIHI and outside sources), feasibility of conducting the analysis, and the extent to which the question is of a high, medium or low priority. Some of the questions were considered to be more of a "research" nature that should be undertaken through grant funded research rather than CIHI.

7. CONCLUSIONS AND RECOMMENDATIONS

At the completion of the second day, the discussions were brought to a close with some summary conclusions and recommendations for CIHI in proceeding with DI analysis. The conclusions and recommendations that emerged from the dialogue are described below.

Get the basics figured out

There was agreement that there should be a focus on developing analysis that will provide a comprehensive picture of the volumes, locations, and costs of DI services across Canada. Without this type of basic analysis, it will be difficult to conduct analysis in the areas of appropriateness, policy impact, etc. This type of analysis may require some focused attention on data definitions and standardization – e.g. how is an "exam" defined? How do the different jurisdictions define FTE?

Data gaps and limitations notwithstanding, there may be opportunities to bring together different data sources (including RIS data) to build this type of analysis.

Tackling the appropriateness question is important but difficult at this point in time

One of the earliest and most important questions raised in the discussions was the topic of appropriateness – is a particular test appropriate? What's the right sequencing of tests for a disease? What about the use of multiple exams? Despite the importance of these types of questions, it was felt that the data currently available do not necessarily support analysis which will answer these questions.

However, there may be opportunities to conduct targeted small area variation studies to promote discussions about variations in practice and appropriateness of use. Participants recommended that it might be worthwhile to look at variations in practice where clinical practice guidelines have been widely accepted (e.g., Ottawa ankle rules, CT scan for low back, and CT head rules).

Explore the potential for accessing RIS/DI-r data and combining with our other data sources

There was a great deal of discussion about the potential opportunities for using RIS/PAC/DI-r data for analysis. Three of the participants represented jurisdictions that have varying degree of access to RIS/PAC data (AB, SK and BC) at a provincial level. The issue with RIS data is that different vendor systems have been implemented across jurisdictions and there have been limited coordinated efforts to standardize data definitions across systems. In addition, many of the data fields in a RIS tend to be text not codified data. It was agreed that while RIS data may be a potentially rich source of data, that there needs to be a better understanding of what may or may not be available in the systems.

Recommendations

1. Focus on analysis that will provide a comprehensive, pan-Canadian view of DI volumes, utilization by population and cost;
2. Lobby for improved consistency of data definitions especially in the area of wait times;
3. Explore opportunities for conducting small area variation analysis in targeted areas where there are established clinical practice guidelines;
4. Explore the potential for accessing RIS/PAC through partnerships at the provincial or health authority level.

8. NEXT STEPS

The following next steps were agreed upon at the conclusion of the meeting.

1. Write and circulate workshop report and meeting evaluation.
2. Conduct follow-up meeting with internal CIHI staff and meeting partners to develop an action plan. Next steps to consider include:
   - Identifying potential analysis that can be done by CIHI based on priorities identified at the meeting;
   - Connecting with CIHR, CADTH and F/P/T Health Technology Strategy (HTS) Policy Forum;
   - Identifying key interested partners who should be included in future planning;
   - Setting up a small planning/strategy working group for moving agenda forward;
   - Developing data development strategy to support future analysis.

PARTICIPANT LIST

Invited Participants

Joan Berezanski, Executive Director Clinical Advisory & Research Branch, Alberta Health and Wellness

Rhonda Boudreau, Program Development Officer, Canadian Agency for Drugs and Technologies in Health

Dr. Derek Emery, Associate Professor, Radiology and Diagnostic Imaging, University of Alberta

Dr. Tom Feasby, Dean and Professor, Faculty of Medicine, University of Calgary

Peter Froese, Executive Director, Diagnostic Imaging, Edmonton Zone, Alberta Health Services

Dr. Kim McGrail, Researcher, Centre for Health Services Policy and Research, University of British Columbia

Mike Nader, Executive Director, Medical Imaging, Providence Health Care, Vancouver Coastal Health, Fraser Health and Provincial Health Services Authority

Patrick O'Byrne, Director, Hospitals and Specialty Care, Acute and Emergency Services Branch

Dr. Brian H. Rowe, Associate Dean (Clinical Research), Faculty of Medicine & Dentistry and Professor, Department of Emergency Medicine, University of Alberta,

Jacqueline Singer, Medical Radiology Technologist, Graduate Student

Dr. Eugene Wen, Vice President, Chief Statistician, Workplace Safety and Insurance Board, Ontario

Ron Wood, President and CEO, ProMed Associates, Ltd., Medical imaging consultant

CIHI Participants

Marilee Allerdings, Manager, Research and Analysis, Western Office

Nancy Gault, Client Affairs Manager (BC & Yukon), Western Office

Darren Gerson, Manager, Health Research Analysis

Anne McFarlane, VP, Western Canada and Developmental Initiatives

Greg Zinck, Manager, MIS and Costing

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John Sproule, Senior Policy Director, Institute for Health Economics

Andy Chuck, Health Economist & Manager, Decision Analytic Modeling Unit

Christa Harstall, Director, Health Technology Assessment Program

CIHI DATABASES AND CAPTURE OF DIAGNOSTIC IMAGING DATA

	Database	Capture of Diagnostic Data	Mandatory	Provinces	Private Pay/Facilities	Comments
1	Discharge Abstract Database (DAD) Coding: CCI	• Patient-level data • Nuclear medicine (NM), computed tomography (CT), magnetic resonance imaging (MRI), type of physician performing the procedure (e.g. radiologist)	No	All except QC, where abstracts are captured in the HMDB	• The DAD contains abstracts from Workers Compensation, RCMP, Military, delivered in publically funding facilities • Procedures delivered in Private facilities not necessarily captured	• Capture of diagnostic imaging data is not mandatory for each abstract. • As many as 20 interventions may be coded for each abstract, though only coding the main intervention is mandatory.
2	National Ambulatory Care Reporting System (NACRS) Coding: CCI	• Patient-level data for provinces that collect at Level 3 only • NM, CT, MRI • Number of scans, date of exam, type of interpreting physician	Yes, for NACRS Level 3 (ED, Day Surgery, Other Ambulatory Care)	ON AB, YT, Some sites in NS, one site in SK, one in MB	• N/A for ED	• In provinces which collect NACRS Level 1 or 2, diagnostic imaging data is not available. • For Level 3, one main intervention and 9 other interventions may be coded. If there are more than 10 interventions, diagnostic imaging information may be excluded.
4	Canadian MIS Database (CMDB) Doded according to the MIS Standards, except in QC	• Health authority and hospital level **financial data** • Costs are per department; average cost per exam.	Yes	All except: Limited reporting in YT and NU, ON reports to MoH by hospital, QC has its own standards	• "Presently, all jurisdictions in Canada provide data to the CMDB with the exception of Nunavut. Submitting jurisdictions provide data for virtually all public hospitals under their purview. The CMDB has historically received submissions from some private hospitals in Canada. Certain specialized private hospitals are not	• No wait time information or patient-level data.
		• Health authority and hospital level **statistics** • PET, NM, plain film, CT, MRI, mammography, ultrasound and echocardiography, angiography, cardiac catheterization • Number of exams per in-patient	Yes			

	Database	Capture of Diagnostic Data	Mandatory	Provinces	Private Pay/Facilities	Comments
		or outpatient (no patient specific data) captured as statistics. Work load is occasionally reported			included in the database."	
5a	National Physician Database (NPDB)	• Physician billing data, collected from P/T databases • Services at the fee code level are grouped to 120 common categories according to the National Grouping System for pan-Canadian reporting	No	All (Territories are not participating fully)		• Fee-for-service data by physician in the NPDB is collected at the individual fee code level. Aggregate APP level data is reported by specialty in most provinces. NL, PEI, NS, NB, BC report APP payments by physician. • Complicated by various funding systems (fee for service, salary, global, public/private).
5b	Linkable Patient Level Physician Billing Data-- PILOT	• Patient-level billing data • Linkable to other databases where patient identifiers are available • Also included in the NPDB at the physician level • For internal exploration only – not available to external researchers	No	SK, AB	•	• Complicated by various funding systems (fee for service, salary, global, public/private).
6	Canadian Patient Cost Database (CPCD)	• A total of 49 hospitals in 3 provinces provide patient-level case costing data. • Data has been used to develop RIWs, but it will soon be available publicly as the Canadian Patient Cost Database (CPCD)	No	ON, AB, 2 facilities in BC	• Not available from private facilities.	
3	Medical Imaging Technologies in	• Technology data by institution • Annually: CT, MRI, PET • Bi-annually: Nuclear Medicine (NM), Bone Mineral Densitometry	No	All	• Private facilities surveyed, but a challenge to obtain response due to voluntary nature of survey.	• The primary objective is to obtain an inventory of selected medical imaging equipment. • Utilization rates are calculated

	Database	Capture of Diagnostic Data	Mandatory	Provinces	Private Pay/Facilities	Comments
	Canada (MIT) Survey Data	(BMN), cardiac catheterization, angiography, lithotripsy • Number of installations, number of procedures, age and type of device.			• Non-reporting facilities accounted for approximately 3.2% of total machines • Respondents did not report *funding sources* for 256 machines, or 15.3% of total machines	based on machines reported.
7	Medical Radiation Technol-ogists Database	• Information on medical radiation technologists • Demographic/educational information, hours of work, health region and location of employment, areas of practice • Data collected from CDN Assoc. Of Medical Radiation Technologists (CAMRT). Registration with CAMRT is voluntary in BC & Territories	No	All, though data elements and collection rates vary between provinces	• Canadian medical radiation technologists register (except where voluntary) with the CAMRT regardless of where they practice (hospital, independent imaging clinic, etc.)	• If there is an insufficient number of technologists to operate imaging equipment, the equipment will be underutilized
8	CIHI Provincial Wait Times Data	• Aggregate wait time data for MRI and CT at a provincial level • 50th and 90th percentile waits in days by province • For first six months of each fiscal: April 1st through September 30th for 2008, 2009, 2010 onwards	Yes	All 10p provinces submit this data to CIHI	• Includes provincially funded facilities	• Collected from provincial wait time registries and submitted to CIHI • There are no pan-Canadian benchmarks for MRI and CT
9	RIS/PACS (Not a CIHI Data Holding – Potential Data Source)	• Patient-level DI information, including patient characteristics, the imaging modality used, and patient images. • Also collect billing data, DI workload and workflow.	Yes, where applicable	BC, AB, SK, MB, ON, NS, NL, QC	• Varies by province - some provinces don't have private imaging facilities; others have varying levels of integration of independent facilities in their RIS/PACS.	• Ongoing research in this area; information may be incomplete

SUMMARY OF DI DATA AVAILABILITY – BY LOCATION OF SERVICE

Location of Service	Data Available CIHI	Data Available to Ministries	Data Available to Hospitals/HAs	Other Data Availability
Hospital in-patient	– DAD: may capture CT scan through CCI coding - it is not mandatory data capture; DAD contains patient level diagnosis. Will include WCB, RCMP, etc – MIS: Financial data – cost data per department; Statistical data – number of exams per in-patient (no patient level data). Workload is occasionally reported. Territories not fully participating – Case-costing data: 49 hospitals in 3 provinces provide patient-level case costing data – NPDB – Physician aggregate fee-for-service data. No facility or patient identifiers. FFS data supplied to CIHI are not uniform or complete (see handout on FFS). There is a pilot in SK and AB to submit patient level FFS with patient identifiers to CIHI – Wait time data: aggregate wait time data (some exclusions) – MIT: Number of selected high tech imaging devices (CT, MRI, NM, PET, PET/CT, SPECT/CT, NM, Angiography, Cath. Lab., Bone Densitometers), their year of installation, technical characteristics and utilization (# of exams, weekly hours of operation). However, no breakdown of exams between in-patients and out-patients.	– DAD: info same as CIHI for all facilities that are publically funded – MIS: same as CIHI – RIS PAC: access to data not uniform across provinces – FFS: will have record-level, patient identified FFS data for DI fees that are paid for by the Ministry. The extent to which DI is paid for by FFS varies by Province, type of fee (professional fees versus technical fees), DI modality, and location of test	– DAD: info for own facilities – MIS: same as CIHI for own facilities – RIS PAC data – Radiology fees typically funded through global budget (see Appendix B)	

Location of Service	Data Available CIHI	Data Available to Ministries	Data Available to Hospitals/HAs	Other Data Availability
Hospital out-patient	– NACRS Level 3: CCI coding for DI mandatory for reported visits. In ON, data would be captured for DI in EDs and some outpatient clinic visits (chemotherapy and radiation visits), renal dialysis and cardiac catheterization visits. In AB, data would be captured for EDs and all outpatient visits. NACRS (3) also captures: date of exam, discharge diagnosis and reason for visit to ED – MIS: Financial data – cost data per department; Statistical data –Number of exams per outpatient (no patient level data). Workload is occasionally reported – Case-costing data: 49 hospitals n 3 provinces provide patient-level case costing data – NPDB – Physician aggregate fee-for-service data. No facility or patient identifiers. FFS data supplied to CIHI are not uniform or complete (see Appendix A). There is a pilot in SK and AB to submit patient level FFS with patient identifiers to CIHI – Wait time data: aggregate wait time data (some exclusions) – MIT: Number of selected high tech imaging devices (CT, MRI, NM, PET, PET/CT, SPECT/CT, NM, Angiography, Cath. Lab., Bone Densitometers), their year of installation, technical characteristics and utilization (# of exams, weekly hours of operation). However, no breakdown of exams between in-patients and out-patients. – MIT: median or typical wait time for elective out-patient examinations by selected types of high tech imaging devices. Excludes follow-up	– NACRS: same as CIHI – MIS: same as CIHI – RIS PAC data – not uniform across provinces – FFS: In BC MSP pays professional fee only; technical fee and non-wage funded through HA global budget	– NACRS: same as CIHI for own facilities – MIS: same as CIHI for own facilities – RIS PAC data – Radiology fees typically funded through global budget	FFS: CCSI, WCB, RCMP, OOP, etc – will have data for FFS not available to CIHI, Ministry or HA (?)

Location of Service	Data Available CIHI	Data Available to Ministries	Data Available to Hospitals/HAs	Other Data Availability
	examinations to original procedures.			
Community/ Private Facility (Publically funded service)	– MIS does not have data for private facilities, but there is data for community services that are run by regional health authorities – MIT: Number of selected high tech imaging devices (CT, MRI, NM, PET, PET/CT, SPECT/CT, NM, Angiography, Cath. Lab., Bone Densitometers) in free-standing facilities, their year of installation, technical characteristics and utilization (# of exams, weekly hours of operation). Some facilities would report percentage of funding by source, including public sources. – NPDB – Physician aggregate fee-for-service data. No facility or patient identifiers.	– MIS does not have data for private facilities, but there is data for community services that are run by regional health authorities – FFS data	– HA may have access to RIS PAC data if external DI clinic is integrated into the HA RIS PAC system	– FFS: CCSI, WCB, RCMP, OOP, etc – will have FFS data not available to CIHI, Ministry or HA
Community/ Private Facility (paid for by patient)	– None – MIT: Number of selected high tech imaging devices (CT, MRI, NM, PET, PET/CT, SPECT/CT, NM, Angiography, Cath. Lab., Bone Densitometers) in free-standing facilities, their technical characteristics and utilization (# of exams, weekly hours of operation), Some facilities would report percentage of funding by source, including private sources. However, out-of-pocket payments by patients are not requested separately from payments by private health insurance and payments by other private industry.	– none	– none	– none

SUMMARY LIST OF ANALYTIC QUESTIONS

Type of Question	Question	Availability of Data (CIHI)
Efficiency/cost effectiveness	What is the distribution of workload for technologists/radiologists and clerical staff (exams or wlu per FTE/hour by type of site (number of beds, acuity, etc)) ?e.g., 25-50-90 percentile	variable/partial-dependent on provider type
Access/Waiting	Does capacity influence utilization?	high
Efficiency/cost effectiveness	What is average DI cost of major disease groups, e.g. stroke, head trauma?	partial
Efficiency/cost effectiveness	Wait time by different views (diagnosis, priority level)	partial
Efficiency/cost effectiveness	Role of payment schemes in utilization - can it impact the use	partial
Utilization	What is the nature of variability both on small and large scales, amongst modalities, ordering practices and clinical outcomes (tied to appropriateness).	partial
Utilization	What are the annual volumes (number of scans, etc) of service for 2010/11 per jurisdiction per modality (age and sex adjusted per 1,000 population)	partial
Outcomes	Survival or mortality rate difference between stroke patients who had more DI than less DI	partial
Access/Waiting	Does funding/compensation impact access	partial
Access/Waiting	Outlier analysis/MRIs over six months	partial
Practice Guidelines	How many DI exams ordered that don't meet publishes guidelines (LBP, acute knee, ankle rules, etc/how many meet them	partial
Policy Impact	What are the variations/comparisons in ordering practices (GP vs specialist, rural vs urban, academic vs tertiary vs community)	partial
Practitioner Behaviour	Is there a peer effect on DI requests among MDs and how would you measure it?	partial
Efficiency/cost effectiveness	description of pathways to a diagnosis by modality and cost (based on average cost)	low
Appropriateness	Sequence of exams, in what order, what end point	low
Appropriateness	What are effective tools for communicating to physicians	NDI
Appropriateness	Measure the number of MRIs and CTs for low back pain, headache e.g. by hospital	low

Type of Question	Question	Availability of Data (CIHI)
Utilization	What are current referal patterns by clinical programs/modality and how will these change in the future	low
Utilization	Do primary care networks influence ordering practices	low
Utilization	Measure how many different imaging tests (and if they are abnormal) for patients with angina, headache, low back pain for example	low
Utilization	Measure the number of skull xrays and chest x-rays per hospital and the ab(n) rate	low
Outcomes	Potential economic benefit/outcomes from DI	low
Access/Waiting	What is the relationship of access/waiting between CT, MRI and ultrasound	low
Practice Guidelines	What is the cost-benefit of implementing on-line ordering	low
Policy Impact	Implications of different approaches to MRI and CT funding on costs and access, then lessons for funding PET	low
Patient Safety	How much radiation is safety, does CT increase cancer risk	low
Patient Safety	trends in population radiation exposure	low
Practioner Behaviour	Population: ED MDs; Intervention: CPG; C: non-CPG; Outcome: CT scan head, ankle x-ray	low
Practioner Behaviour	What are the barriers to the adoption of validated radiology ordering decision rules in clinical practices	low
Patient Experience	What are the barriers for patients to accept decision rules for imaging	low
Patient Experience	What are effective public education strategies for appropriate use of DI - is there data to support	low
Access/Waiting	What is the right way to measure DI waiting time?	not related to availability of data
Policy Impact	What's the best way to evaluate DI funding and instrument utilization	?
Policy Impact	What images should be abandoned or de-listed (e.g. skull x-ray for head injury)	low
Policy Impact	How do we assure data quality and get confidence in the data for policy makers	not related to availability of data
Policy Impact	policy maker/public literacy on DI appropriateness	low
Patient Safety	How many CT scans can be replaced by MRI to reduce radiation to the patient	low