

Canadian Medical Imaging Inventory Service Report

The Age of Imaging Equipment in Canada

Context

Newer imaging technologies can provide faster and more accurate diagnoses compared to older equipment, resulting in improved health outcomes and quality of life for patients.¹ At the same time, advanced imaging equipment — particularly CT, MRI, and PET-CT — is expensive to install and maintain.² This has led to the use of some imaging equipment in Canada that may be beyond their optimal life expectancy.³

Compared to newer equipment, older imaging equipment may be less operationally reliable, use higher doses of radiation, have reduced diagnostic capabilities, and permit a lower throughput of patients.⁴ Older imaging equipment may also be more likely to break down¹ and may be more challenging to maintain and repair.⁵ As well, according to anecdotal reports from participants of the Canadian Medical Imaging Inventory (CMII), locating spare parts can be difficult and time-consuming, and puts pressure on wait lists that may already exceed jurisdictional recommended targets. This may lead to delays in the diagnosis and treatment of patients.²

In many instances, equipment upgrades can be purchased that help extend the life of imaging equipment. However, as equipment ages, technical incompatibilities and obsolescence can render these updates as unfeasible.^{3,6} Eventually, all imaging equipment needs to be replaced because of wear and tear, technological disinvestment, and changes in clinical practice.⁷

Overall, capacity in imaging services has not kept pace with the growth in demand. Canada has fewer CT and MRI per capita than most Organisation for Economic Co-operation and Development countries.² Yet patient referrals have risen by more than 31% for CT and 62% for MRI over the past 10 years.² The COVID-19 pandemic has further amplified the need for change in the provision of diagnostic imaging and has triggered calls for investment in new equipment to manage backlogs and lengthening wait lists.⁸⁻¹⁰

Collecting information on the age of equipment can indicate where new equipment might be needed and the range of potential life expectancies for the equipment. The information may also provide insight into inequalities in accessing newer equipment.¹¹ All of this information can be used by decision-makers for strategic capital planning purposes.

Objective

This report summarizes information on the age of Canada's armamentarium of advanced imaging equipment. The key objectives are, as follows:

- to determine the average age of equipment by modality type
- to determine the overall volume of equipment that may need to be considered for replacement by modality type.

About This Document

This document summarizes information identified through the CMII and a limited literature search. The data are analyzed within the context of guidelines published by the Canadian Association of Radiologists (CAR)³ and by the European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industries (COCIR)¹² that provide guidance for the life cycle of imaging equipment. CAR endorses general rules on the lifespan of imaging modalities based on exam volume, whereas COCIR provides guidance on the replacement of imaging equipment based on age profiles.

Results

The CMII collects data on the age of imaging equipment at the unit level. Information on a total of 1,522 units at 455 sites across Canada included data on the first year of operation. The age of imaging units was estimated by calculating the number of years since the first year of operation.

Overall Age of Units by Modality Type

The average age of CT, MRI, and PET-CT units across Canada is 8 years, with the oldest units approximately 20 years old. The average age of imaging units by modality type is presented in [Table 1](#). In all categories, single-photon emission computed tomography (SPECT) is the outlier and this may be because of a gradual replacement of SPECT with SPECT-CT. Indeed, the oldest SPECT unit is 33 years old.

Table 1: Average Age of Imaging Units by Modality, 2019 to 2020

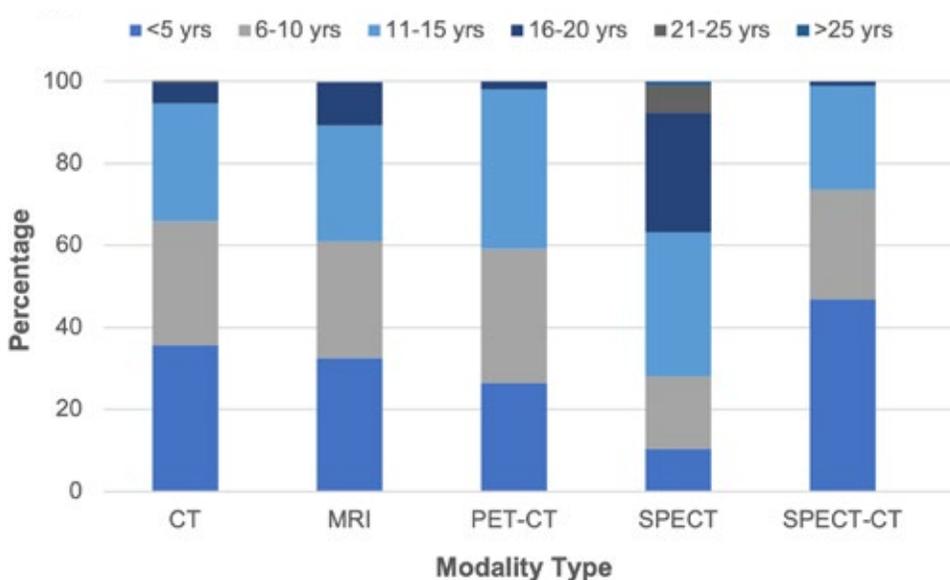
Modalities	Number of sites	Number of units	Average age (years)	Minimum age (years)	Maximum age (years)
CT	369	549	8.1	0	23
MRI	288	378	8.6	0	20
PET-CT	46	57	8.2	0	17
SPECT	174	305	13.2	1	33
SPECT-CT	160	271	6.6	0	17

CT = computed tomography; MRI = magnetic resonance imaging; PET = positron emission tomography; PET-CT = positron emission tomography-computed tomography; SPECT = single-photon emission computed tomography; SPECT-CT = single-photon emission computed tomography-computed tomography.

Note: Data derived from the survey question: “What year did (or will) the [modality] unit become operational?” subtracted from 2020. Those to be installed were not included in this table.

Most of Canada’s advanced imaging equipment has been in operation for 10 years or less: 65.9% of CT units, 60.9% of MRI units, 59.2% of PET-CT units, and 73.6% SPECT-CT units. The exception is SPECT, where 28.0% of the units have been in operation for 10 or fewer years. A summary of age categories is presented in [Figure 1](#).

Figure 1: Percentage Age Ranges of Imaging Units in Years, 2019 to 2020



CT = computed tomography; MRI = magnetic resonance imaging; PET = positron emission tomography; PET-CT = positron emission tomography-computed tomography; SPECT = single-photon emission computed tomography; SPECT-CT = single-photon emission computed tomography-computed tomography.

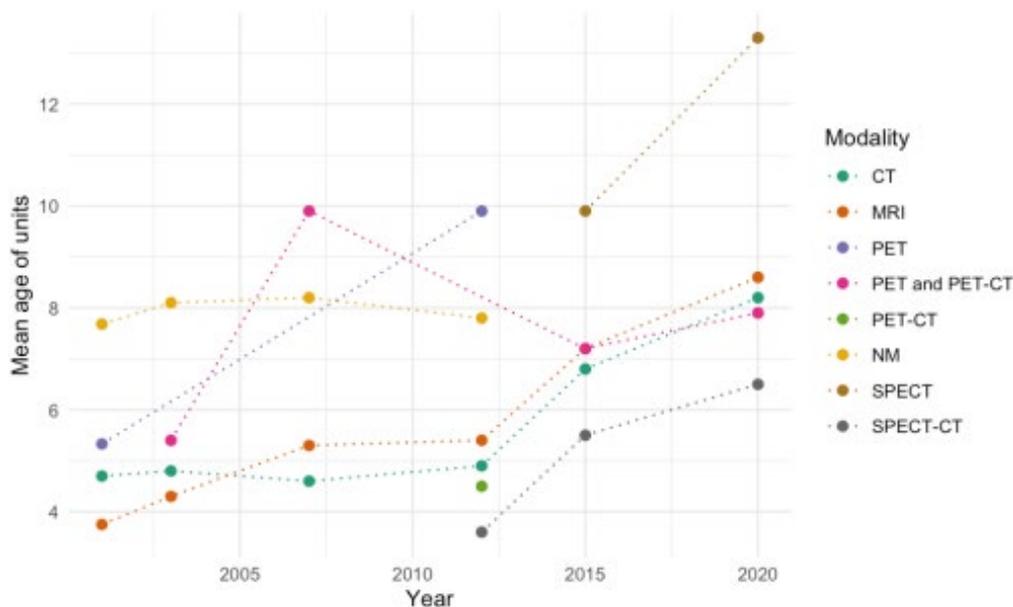
Note: The age for each unit calculated from the survey question: "What year did (or will) the [modality] unit become operational?" subtracted from 2020.

Trends Over Time

Trends over time show a progressive aging of imaging equipment in Canada, presented in [Figure 2](#). Data are available for CT and MRI throughout the period of the inventory (2001 through 2019 to 2020). PET and PET-CT were reported separately until the survey of 2012 and combined for the survey of 2015 and after. As of 2019 to 2020, PET units have largely been replaced by PET-CT units. As mentioned previously, a similar, although slower, replacement appears to involve the substitution of SPECT with SPECT-CT. In the earlier iterations of the survey, SPECT units were reported in combination with planar cameras under the category "nuclear medicine" and data on SPECT-CT were collected only for the later years of the inventory.

For all modalities, the mean age of equipment has risen over time. In 2001, the mean age for a CT unit was 4.7 years;¹³ in 2012, 4.9 years;¹⁴ and in 2019 to 2020, 8.2 years.² In 2001, the mean age of an MRI unit was 3.8 years,¹³ in 2012, 5.4 years;¹⁴ and in 2019 to 2020,² 8.6 years. The mean age of the pooled categories of PET and PET-CT rises throughout, from 5.4 years in 2003¹⁴ to 7.9 years in 2019 to 2020.² In earlier iterations of the survey, SPECT units were reported together with planar units. In 2012, SPECT was first reported separately; that year, the mean age of SPECT units was 9.9 years,¹⁴ and, in 2019 to 2020, 13.3 years.² The average age of SPECT-CT units in 2012 was 3.6 years¹⁴ and in 2019 to 2020 it was 6.5 years.²

Figure 2: Aging and Succession of Imaging Equipment Over Time, 2001 to 2019 to 2020



CT = computed tomography; MRI = magnetic resonance imaging; NM = nuclear medicine; PET = positron emission tomography; PET-CT = positron emission tomography-computed tomography; SPECT = single-photon emission computed tomography; SPECT-CT = single-photon emission computed tomography-computed tomography.

The trend on aging imaging equipment is not unique to Canada and is experienced in Europe, particularly with CT, MRI, and PET-CT.⁵

Canadian Association of Radiologists Lifecycle Guidelines

CAR, founded in 1937, is a professional Canadian medical association dedicated to medical imaging excellence in patient care.^{3,15} The CAR life cycle guidance is intended to provide assistance to decision-makers on when and under what conditions imaging equipment should be newly introduced or considered for replacement or upgrade.

The CAR guidelines³ propose life expectancies for imaging equipment according to use – classified as either high, medium, or low, based on the number of examinations per year. For the 5 modalities of interest in this report (CT, MRI, PET-CT, SPECT, and SPECT-CT), the CAR guidelines propose life expectancies of 8, 10, and 12 years for high-, medium-, and low-usage machines, respectively. Using CAR’s standards to stratify the age of Canada’s imaging equipment shows that in 2019 to 2020, 34.2% of CT units, 39% of MRI units, 40.8% of PET-CT units, 72% of SPECT units, and 26.4% of SPECT-CT units were older than 10 years (the medium-use category). The age of imaging units by modality type relative to CAR guidance is presented in [Table 2](#).

The CAR guidelines also recommended that the maximum life expectancy and clinical relevance for any imaging equipment should not be expected to exceed 15 years.³ As of 2019 to 2020, 5.5% of CT units, 10.7% of MRI units, 2% of PET-CT units, 36.7% of SPECT units, and 1.1% of SPECT-CT units were older than 15 years.

Table 2: The Age of Canadian Imaging Equipment Relative to CAR Guidance, 2019 to 2020

Modality 2019 to 2020					
Guidance	CT no. of units and percentages	MRI no. of units and percentages	PET-CT no. of units and percentages	SPECT no. of units and percentages	SPECT-CT no. of units and percentages
Totals	549	378	57	305	271
Life expectancy of modalities (assuming medium use) in years	10	10	10	10	10
% of units beyond 10 years	34.2%	39.0%	40.8%	72.0%	26.4%
% of units exceeding 15 years	5.5%	10.7%	2.0%	36.7%	1.1%

CT = computed tomography; MRI = magnetic resonance imaging; PET = positron emission tomography; PET-CT = positron emission tomography-computed tomography; SPECT = single-photon emission computed tomography; SPECT-CT = single-photon emission computed tomography-computed tomography.

The European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industries – Golden Rules

COCIR is a European-based trade association that represents medical imaging, radiotherapy, health-related information, and communication technologies and electromedical industries.¹⁶ The COCIR guidelines are intended to assist with procurement decisions and are based on 3 “golden rules”¹² for evaluating medical equipment lifespan based on age profiles. The golden rules are outlined in [Table 3](#).

Table 3: COCIR’s Three Golden Rules for Evaluating the Lifespan of Medical Equipment

COCIR’s Golden Rules	
1	At least 60% of the installed imaging equipment should be less than 5 years old. Equipment in this age category is considered state-of-the-art technology, with opportunities for upgrades.
2	No more than 30% of the installed equipment should be between 6 and 10 years old. Equipment within this age category is considered fit for use but needs a replacement strategy to be developed.
3.	No more than 10% of the age profile should be more than 10 years old. Equipment older than 10 years is outdated and needs to be replaced.

According to COCIR’s first golden rule, as of 2019 to 2020, 35.7% of CT units, 32.6% of MRI units, 26.5% of PET-CT units, 10.3% of SPECT units, and 46.8% of SPECT-CT units are 5 years old or newer. The second golden rule, as of 2019 to 2020, has mostly been achieved in Canada, with 30.2% of CT units, 28.3% of MRI units, 32.7% of PET-CT units, 17.7% of SPECT units, and 26.8% of SPECT-CT units being between 6 and 10 years old. This, however, is because the aging of

units has increased the representation of those 10 years or older. COCIR's third golden rule has not been achieved with any of these modalities. [Table 4](#) provides detailed information on the breakdown of the age categories of imaging equipment according to the COCIR criteria.

Table 4: The Age of Canadian Imaging Equipment Relative to COCIR's Golden Rules, 2019 to 2020

Modality, 2019 to 2020					
Guidance	CT no. of units and percentages	MRI no. of units and percentages	PET-CT no. of units and percentages	SPECT no. of units and percentages	SPECT-CT no. of units and percentages
Totals	549	378	57	305	271
0 to 5 years (At least 60% of equipment should be in this range)	35.7%	32.6%	26.5%	10.3%	46.8%
6 to 10 years (No more than 30% should be in this range)	30.2%	28.3%	32.7%	17.7%	26.8%
> 10 years (No more than 10% should be older than 10 years)	34.1%	39.1%	40.8%	72%	26.4%

CT = computed tomography; MRI = magnetic resonance imaging; PET = positron emission tomography; PET-CT = positron emission tomography-computed tomography; SPECT = single-photon emission computed tomography; SPECT-CT = single-photon emission computed tomography-computed tomography.

Conclusion

The CMII data indicates that, in accordance with CAR and COCIR guidance, Canada has equipment that is older than recommended. Canada also has lower numbers of newer equipment. Subsequently, the age of Canada's imaging equipment may be affecting the ability for the timely diagnosis and treatment of patients. Investment in new equipment may help to manage existing demand and the anticipated accelerated growth brought about by an aging population, technological innovation, and an increase in publicly funded clinical indications. When considering this growth, the acquisition of new imaging equipment should not be viewed in isolation but rather within the context of human resource constraints, education and training opportunities, current utilization of existing equipment, and the availability of supporting technologies such as cyclotrons and radiopharmaceuticals for PET-CT.

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