Centre universitaire de santé McGill

McGill University Health Centre

Technology Assessment Unit of the McGill University Health Centre (MUHC)

Recommendation checklist for:

Report number 87: Magnetic resonance imaging-guided radiotherapy for cancer patients undergoing radiotherapy at the MUHC

DATE: November 18, 2021

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RECOMMENDATION PROCESS

TAU has developed a framework to facilitate the translation of evidence into recommendations using a structured, transparent process.

STEP 1:

- The decision-aid checklist incorporates 23 decision criteria relevant to the decision-making process (Appendix A).
- TAU research staff complete the health technology assessment and record their findings for each decision criterion in the tool.
- They also rate whether the findings were favourable for each decision criterion (see illustration). Options include Yes, No, Maybe, and Need more information.

Criterion	Findings of the Health Technology Assessment Report	Do these findings favour the approval of VA-ECMO for cardiac arrest at the MUHC? [Completed by TAU]
Quality of the evidence	The quality of the evidence is low. A number of propensity score adjusted studies have been published, but these have several limitations.	No
Safety of the technology	No comparative studies. A meta-analysis of case series found a high rate of complications with VA-ECMO.	No

GOAL: To ensure a systematic approach to considering different factors relevant to the decision-making process.

STEP 2:

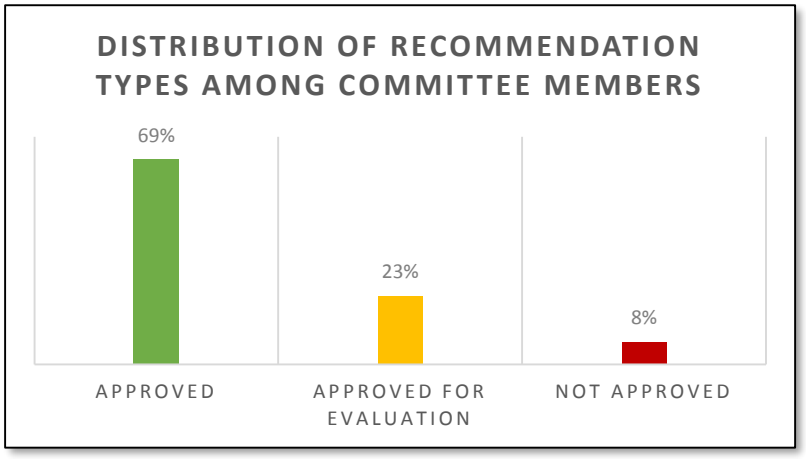
- Each committee member is sent the technology assessment report and a link to the decision-aid tool, to be completed online.
- After reading the report, each committee member rates how important they consider each criterion in shaping the final recommendation, within the context of the policy question (see illustration). Options include Very important, Somewhat important, and Not at all important.
- Committee members will then be asked to provide a recommendation and their reasons for it. **This is a tentative recommendation**; the final recommendation will be issued at the TAU Policy Committee meeting through consensus after discussion of the principal issues.

Criterion	Findings of the Health Technology Assessment Report	Do these findings favour the approval of VA-ECMO for cardiac arrest at the MUHC? [Completed by TAU]	How important is this criterion in shaping the final recommendation? [Completed by each committee member]
Quality of the evidence	The quality of the evidence is low. A number of propensity score adjusted studies have been published, but these have several limitations.	No	Very important
Safety of the technology	No comparative studies. A meta-analysis of case series found a high rate of complications with VA-ECMO.	No	Very important

GOAL: To provide a visual means for arriving at a final recommendation, by juxtaposing the importance rating for each criterion against the results of the health technology assessment. For a technology to be approved, a majority of criteria considered important should also have received favourable findings.

STEP 3:

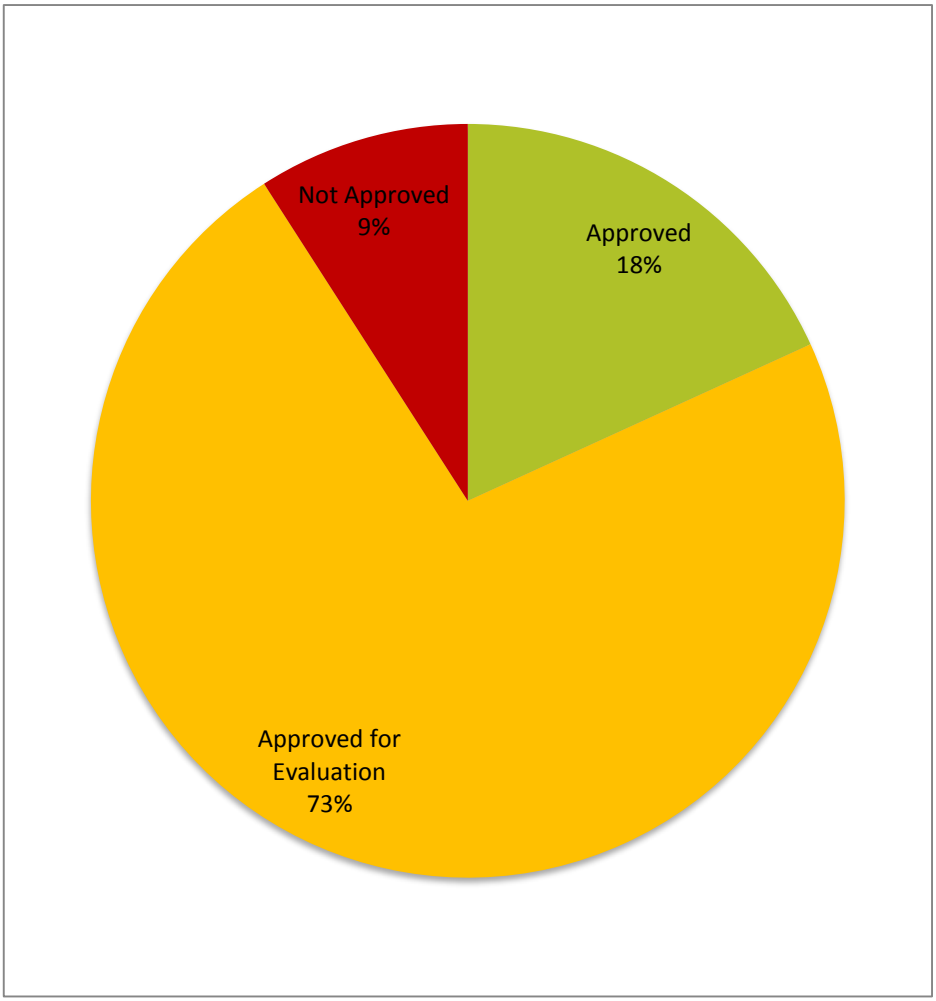
- At the meeting, the distribution of importance ratings and recommendations across the committee will be presented (see illustration).
- Committee members will have the opportunity to express their views and justify extenuating reasons, until a consensus on the final recommendation is reached.
- All reasons will be explicitly documented.



GOAL: To create a structured and transparent decision-making process.

1. PRELIMINARY RECOMMENDATION FROM CHECKLIST FOR MRI-LINAC

- The checklist used by the committee is available here: https://survey.alchemer.com/s3/6605874/Decision-aid-Tool-MRI-Linac
- 11 committee members completed the decision-aid checklist. The figure below shows the distribution of preliminary recommendations.



2. DISCUSSION AT THE TAU POLICY COMMITTEE MEETING

- The meeting was attended by 10 Policy Committee members and one invited member, Dr. Tarek Hijal, Director of the Radiation Oncology Division at the MUHC and requestor of the evaluation (Appendix C).
- The main issues discussed were:
    - High cost & lack of data on downstream outcomes
        - "I think given the financial commitment required to put in place this new technology, I would like to have more cost info before giving a final approval or not approve."
        - "Were it not for cost-efficiency issues, it would be easy to recommend the acquisition of this technology. I am also concerned by the lack of data showing advantages in terms of clinical results over CTgRT."
    - Patient convenience
        - "As a patient I want a procedure that is quick, does not take many sessions and is acceptable during the procedure as well as effective in the long term."

3. FINAL RECOMMENDATION FOR MRI-LINAC

RECOMMENDATIONS

- The TAU Policy Committee, made up of stakeholders from across the McGill University Health Centre (Appendix C), reviewed the evidence and issued the following recommendation: Approved for evaluation
- This recommendation was reached based on the following:
    - MRgRT offers functional advantages over CTgRT including real-time image guidance with better soft tissue contrast, avoidance of fiducial placement, and ability to perform adaptive treatments;

  - More precise delivery of high-dose radiotherapy in fewer treatments sessions would increase patient convenience and increase the hospital's capacity to treat other patients;
  - High quality comparative-effectiveness evidence for downstream outcomes is still needed, but these outcomes are not expected to be worse than those with CTgRT;
  - Given the high acquisition and operating costs, acquisition of one MRI-Linac device is conditional on approval from the Ministère de la Santé et des Services Sociaux.

- Upon acquisition, it is necessary that data be systematically collected, including data on patient selection criteria and downstream clinical outcomes;
- This recommendation should be reviewed in 2 years when new evidence from the clinical trials becomes available.

RECOMMANDATIONS

- Le comité consultatif de TAU, composé de parties prenantes de tout le Centre Universitaire de Santé de McGill, a examiné les preuves et a émis la recommandation suivante : Approuvé pour l'évaluation
- Le comité est parvenu à cette recommandation sur la base des éléments suivants :
  - La radiothérapie guidée par IRM (RTgIRM) offre des avantages fonctionnels par rapport à la radiothérapie guidée par tomodensitométrie (RTgI par TDM), notamment le guidage par imagerie en temps réel avec un meilleur contraste des tissus mous, l'élimination du placement de repères radio-opaques (fiduciaires) et la possibilité d'effectuer des traitements adaptatifs ;
  - L'administration plus précise d'une forte dose de radiothérapie en moins de séances de traitement serait plus commode pour les patients et augmenterait la capacité de l'hôpital à traiter d'autres patients ;
  - Des preuves d'efficacité comparative de haute qualité pour les résultats cliniques sont toujours nécessaires, mais ces résultats ne devraient pas être moins bons que ceux obtenus avec la RTgI par TDM ;

    - Compte tenu des coûts d'acquisition et d'exploitation élevés, l'acquisition d'un appareil IRM-Linac est conditionnelle à l'approbation du Ministère de la Santé et des Services Sociaux.

- Lors de l'acquisition, il est nécessaire de colliger systématiquement les données, y compris les données sur les critères de sélection des patients et les résultats cliniques ;

- La présente recommandation devrait être revue dans 2 ans lorsque de nouvelles données issues des essais cliniques seront disponibles.

4. AGGREGATE DISTRIBUTION OF RATINGS FROM CHECKLIST

Table 1. Distribution of importance ratings for each decision criterion across the committee members for MRI-Linac (n=11)

Decision Criterion	TAU findings	Favours approval?	% considering criterion		
			Very Important	Somewhat	Not at all
Magnitude of effectiveness	**Magnetic resonance guided radiotherapy (MRgRT) involves a new hybrid technology that combines magnetic resonance (for imaging) and linear accelerator (for radiotherapy delivery) functions in a single machine, and therefore called MRI-linac machines. They have recently been approved by Health Canada with the anticipation that such machines will eventually become standard of care since they offer:** • Better visibility of soft tissue, which improves delineation of tumour margins and avoid the placement of fiducial marker • Adaptive planning by real-time imaging • Gating system (i.e., movement-tracking of the tumour and OAR and hence, radiation is only delivered when the tumour is in the treatment field) All these improvements would lead to more precise and higher dose delivery to the tumour while reducing toxicity to healthy tissue. **Survival and toxicity:** • No studies reported the occurrence of grade ≥4 toxicity. • In indirect comparisons, the reported toxicity and survival rates for MRgRT compared well with that of other modalities.	Maybe	82%	18%	0%
Quality of evidence	We identified 20 published observational studies and 6 trials that evaluated the clinical effectiveness and/or patients' tolerance of MRI-linac • The majority of the primary studies had small sample size. • Only one study had a control group, but the number was very small (n=9 in each arm).	No	55%	27%	18%
Safety	• Single-arm studies reported no grade 4 toxicity. • The only controlled study showed reduction of toxicity, but not statistically significant due to small size	Maybe	73%	27%	0%
Patient preference	• Patient tolerance evaluation showed that patients appreciated their active role in respiratory gating during the treatment. Coldness, paraesthesia, anxiety, and disturbing noise sensations were most reported and should be considered for future improvement.	Maybe	18%	82%	0%

Decision Criterion	TAU findings	Favours approval?	% considering criterion		
			Very Important	Somewhat	Not at all
Impact on patient convenience	• MRgRT can improve patient convenience by reducing the overall number of treatments. For example, prostate cancer patients used to be treated with 44 fractions over 9 weeks while liver cancer patients used to have 6 weeks of treatment. Since MRI-Linac allows greater precision to deliver high dose radiation, the number of sessions can be safely reduced to five sessions over a period of 1 – 2 weeks. The overall patient experience has been positive. It is difficult to see liver and prostate tumors with CTgRT that it requires the use of fiducial markers (implanted with needle by interventional radiologists) before treatment of these tumors. MRI can improve imaging precision and can avoid this invasive technique.	Maybe	45%	55%	0%
Patient-reported outcomes	• MRgRT was overall well tolerated. • Patients and physicians reported good cosmesis post MRgRT in low risk breast cancer patients.	Yes	55%	45%	0%
Net cost	• MRgRT resulted in an increase in the direct clinical cost by $1,316 (18%) compared to CTgRT and each adaptive treatment would cost $529. However, increased MRgRT costs could be diminished by omitting CT simulation ($322 saved) or shortening treatment from 5 to 3 fractions ($1,815 saved).	No	60%	30%	10%
Costs avoided (increased hospital efficiency)	• Unclear	Need more info	18%	73%	9%
Impact on budget of other department	• Not likely to impact budget of other departments	Maybe	0%	91%	9%
Cost-effectiveness	• A US study estimated 7% reduction in grade ≥2 genitourinary and/or gastrointestinal toxicity is required for MRgRT using 5-fractions of SBRT to be cost-effective using a threshold of $100,000 USD ($123,730 CAD) per quality adjusted life years (QALY) and a 14% reduction using $50,000 USD ($61,865 CAD) per QALY. • A Dutch study estimated the cost of 5-fraction MRI-linac was €62,500 ($89,681 CAD) if complications were reduced to no complications compared to standard linac. • INESSS conducted a probabilistic analysis, which indicated that over a 10-year horizon there is an 80% probability that the incremental cost of an MRI-linac device compared to a conventional linac would vary between $11.7M and $20.1M CAD for the Elekta Unity system and from $12.7M to $18.4M CAD for the MRIdian system.	No	55%	18%	27%

Decision Criterion	TAU findings	Favours approval?	% considering criterion		
			Very Important	Somewhat	Not at all
Availability of local expertise	• The MUHC already has the required team (radiation technologists or therapists, radio-oncologists, and medical physicists). Nevertheless, trainings are necessary including: (1) training specific to each role in the workflow, (2) MR and radiation safety training for all professionals including the cleaning staff, and (3) vendor specific training to learn the online workflow and anticipate problems. •The centre needs to establish safety protocols and the relevant MRI zones. Also, the radiation beam rotates beneath the floor, so this needs to be considered in radiation safety calculations if the beam exit points towards the shielding door. As well, one must consider the adjacent linac when installed the MRI-linac because stray magnetic fields can affect the bending magnet lookup tables on adjacent linacs.	Yes	36%	55%	9%
Disruptiveness	• The MUHC already has the required team (radiation technologists or therapists, radio-oncologists, and medical physicists). Nevertheless, trainings are necessary including: (1) training specific to each role in the workflow, (2) MR and radiation safety training for all professionals including the cleaning staff, and (3) vendor specific training to learn the online workflow and anticipate problems. •The centre needs to establish safety protocols and the relevant MRI zones. Also, the radiation beam rotates beneath the floor, so this needs to be considered in radiation safety calculations if the beam exit points towards the shielding door. As well, one must consider the adjacent linac when installed the MRI-linac because stray magnetic fields can affect the bending magnet lookup tables on adjacent linacs.	Maybe	27%	64%	9%
Need to generate local evidence	• Most published studies are uncontrolled and small. If the MUHC acquire MRI-linac, a large controlled-study should be designed to evaluate if MRI-Linac could improve survival rate and lower toxicities compared to other modalities.	Yes	45%	36%	18%
Impact on cross-institution collaboration	• The adoption of MRI-Linac is believed to increase the potential for cross collaboration between departments and institutions locally and internationally. The MUHC could participate in the MOMENTUM international registry should they acquire Unity Elekta or collaborate with ViewRay centers around the world.	Yes	18%	55%	27%
Satisfaction of personnel	• Our interviews with users were very positive. With better soft tissue visualization, they believe that MRgRT could (1) create opportunities to treat people who otherwise would be difficult to treat with the standard radiation technology, (2) increase patient's	Yes	36%	55%	9%

Decision Criterion	TAU findings	Favours approval?	% considering criterion		
			Very Important	Somewhat	Not at all
	convenience by shortening treatment duration as it can deliver high dose radiations with high precision and reduce the total number of treatment.				
Impact of innovativeness of the technology	• Hybrid MRI-linac offers considerable advantages including (1) better visibility of soft tissue, which improves delineation of tumour margins and avoid the placement of fiducial marker, (2) adaptive planning by real-time imaging, and (3) gating system (i.e., movement-tracking of the tumour and OAR and hence, radiation is only delivered when the tumour is in the treatment field).	Yes	27%	55%	18%
Benefit of the technology to society	• Adoption of MRgRT should focus on the potential of treating cancers that otherwise cannot be treated with CTgRT. A UK study modelled MRI-linac demand and found that MR-linac could service 4.2% of all cancer patients and cover 16% of the country's fraction burden.	Yes	27%	64%	9%
Burden on other healthcare centres/services	• Time-driven activity based analysis showed that If 5 fractions of stereotactic body radiotherapy (SBRT) would be given, MRgRT would treat 52.4% fewer patients than CTgRT. Given the already long waiting time in Quebec, reduction of the patient volume by half is the challenge when considering MRgRT to replace CTgRT.	No	27%	55%	18%
Need for the technology	• Based on MRI-linac clinical indications, a UK simulation study found that MR-linac could service 4.2% of all cancer patients and cover 16% of the country's fraction burden. Currently the MUHC has 7 units of Linac, which are due to be replaced in 2024. Based on the UK simulation, acquisition of one unit of MRI-linac is justified with focus on the potential of treating cancers that otherwise cannot be treated with CTgRT.	Yes	55%	36%	9%
Ethical considerations	• There do not appear to be a any ethical issue, but selection of patients might be an issue when the machine is limited in number.	Maybe	36%	45%	18%
Stakeholder pressure	• The radio-oncologists at the MUHC are interested in the acquisition of an MRI-linac system to replace their linear accelerators in 2024. They believe MRI-linac would improve targeting to decrease treatment margins and reduce the need of daily replanning capabilities.	Maybe	18%	36%	45%
Availability of external funding	• There is a potential source of external funding from the MUHC Foundation for acquiring MRI-Linac. Nonetheless, hospital budget is required for the installation, maintenance, and operational costs.	Maybe	18%	64%	18%
Number of patients	• It is estimated that 50-500 patients would be affected annually at the MUHC	Yes	64%	36%	0%

Decision Criterion	TAU findings	Favours approval?	% considering criterion		
			Very Important	Somewhat	Not at all
affected by technology	• Based on MRI-linac clinical indications, a UK simulation study found that MR-linac could service 4.2% of all cancer patients and cover 16% of the country's fraction burden.				

APPENDIX

APPENDIX A: DECISION CRITERIA USED IN CHECKLIST

Domains	Criteria
Clinical benefit	Magnitude of effectiveness
	Quality of the evidence
	Safety of the technology
Impact on Patient	Patient preference
	Impact on patient convenience
	Patient-reported outcomes
Value for money	Net cost
	Costs avoided (increased hospital efficiency)
	Impact on budget of other departments
	Cost-effectiveness
Feasibility	Availability of local expertise
	Disruptiveness
	Need to generate local evidence
	Impact on cross-institution collaboration
	Satisfaction of personnel
	Impact of innovativeness of the technology
Impact on healthcare system /society	Benefit of the technology to society
	Burden on other healthcare centres/services
	Need for the technology
Ethical considerations	Ethical considerations
Strategic considerations	Stakeholder pressure
	Availability of external funding
	Number of patients affected by technology

APPENDIX B: TYPES OF RECOMMENDATIONS ISSUED BY THE TAU POLICY COMMITTEE

Type of recommendation	Explanation
Approved	• Evidence for relevant decision criteria, including efficacy, safety, and cost, as well as context-specific factors such as feasibility, is sufficiently strong to justify a recommendation that the technology be accepted, used and funded through the institutional operating budget
Approved for evaluation	• There is a *probability* that relevant decision criteria, including efficacy, safety, and cost, as well as context-specific factors such as feasibility, are favorable but the evidence is not yet sufficiently strong to support a recommendation for permanent approval. • The evidence is sufficiently strong to recommend a *temporary* approval for the purposes of evaluation, funded through the institutional operating budget.
Not approved	• There is insufficient evidence for the relevant decision criteria, including efficacy, safety, and cost; • The costs of any use of the technology (e.g. for research purposes) should not normally be covered by the institutional budget.

APPENDIX C: TAU POLICY COMMITTEE MEMBERS

Member Name	Position	Representing
Nisha Almeida	Manager, Health Technology Assessment Unit	Health Technology Assessment Unit
James Brophy (Chair)	Professor of Medicine & Epidemiology	Medicine
Julio Flavio Fiore Jr	Assistant Professor	Clinical Epidemiology
Rona Fleming	Patient Partner	Patient Partnership Office
Chantal Guévremont	Pharmacist and Coordinator, Pain Medication Management Program (PGTM)	Pharmacy & Therapeutics Committee
André Guigui	Financial Advisor – Coûts par parcours de soins et de service (CPSS), Financing and Budgets	Finance
Claudine Lamarre	Associate Director- Adult sites, MUHC Professional Services	Upper Administration
Jesse Papenburg	Pediatric Infectious Disease Specialist and Medical Microbiologist	Council of Physicians, Dentists and Pharmacists
William Parker	Clinical Chief, Department of Medical Physics,	Multidisciplinary Council
Kit Racette	Patient Partner	Patient Partnership Office
Invited member		
Tarek Hijal	Director of the Division of Radiation Oncology, MUHC	Expert consultant and requestor of the evaluation