Multi-Criteria Decision Analysis (MCDA): Prioritizing the Use of the Medical Isotope Technetium-99m During a Supply Disruption

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Medical Isotopes

- A medical isotope (or radioisotope or radionuclide) is a small quantity of a radioactive material which is injected into a patient to detect, diagnose, evaluate, or treat illnesses.

- Canada’s regular consumption of medical isotopes:
  - ~ 30,000 nuclear medicine diagnostic scans per week
  - ~ 300 therapeutic doses administered each week
Technetium-99m

- The medical isotope technetium-99m ($^{99m}$Tc) is the most common; it is used in over 80% of all nuclear medicine scans in Canada:
  - $^{99m}$Tc isotope is attached to a variety of compounds that target specific organ systems (e.g., heart, lungs, kidneys, etc.) or go to specific disease sites in the body after injection
  - Sophisticated imaging devices (cameras) are then used to pinpoint the exact location of the disease and track its biologic activity
  - The results of these tests better inform doctors on the state of a disease in individual patients, help identify the best treatment, and monitor response to treatment
Issue and Background of $^{99m}$Tc

- Supply of $^{99m}$Tc has become increasingly uncertain due to the small number of reactors worldwide that produce molybdenum-99 ($^{99}$Mo), the precursor for $^{99m}$Tc:
  - Five reactors produce the vast majority of the world’s $^{99}$Mo, and it is not unusual for these reactors to experience significant downtime due to preventive maintenance or breakdowns
  - If the reactor at Chalk River experiences a prolonged shutdown on its own or combined with a shutdown of another major reactor, this may cause a serious disruption to the supply of $^{99m}$Tc in Canada
Project Objectives

- To develop and disseminate improved policies, protocols, and standards to inform health system decisions regarding the optimal use of $^{99m}$Tc in times of supply disruption
- To optimize network interactions and information sharing among key stakeholders
- The project does not address:
  - How to secure $^{99m}$Tc supply
  - The therapeutic use of medical isotopes
Project Overview

• A two-year project expected to conclude in March 2012

• The Medical Isotopes and Imaging Modalities Advisory Committee (MIIMAC), an independent advisory body, has been convened to develop guidance and provide advice to CADTH on project process and outcomes

• Other stakeholders (e.g., national professional organizations) and experts from across Canada will be engaged at various stages of the project to ensure relevance and strong uptake for the guidance and implementation tools when they are ready for dissemination
Project Overview

Project Planning → Environmental Scans

Current Practice Analysis → Identification of Gaps and Key Messages

Research and Guidance Development → Implementation Tools

Implementation Support & Evaluation

Knowledge Exchange
Research and Guidance Development

- Evidence assessments will be conducted and information will be synthesized into a single report
- CADTH is using a multi-criteria decision analysis (MCDA) approach for this specific project
- A key deliverable of the research phase is a national guidance document, and a tool to allow for local customization of the guidance
MCDA — Why Are We Using It?

- Project-specific approach for CADTH:
  - Complexity of project scope (involves multiple medical imaging technologies and many clinical indications)
  - A need to engage a wide range of stakeholders and consider diverse perspectives
  - Jurisdictional differences across the country (e.g., availability of alternative imaging technologies)
MCDA Process

1. Define scope of decision-making and objectives that will guide the choices to be made.

2. Select criteria that operationalize the objectives.

3. Develop relevant rating scale for each criterion and assign weights that reflect organizational values.

4. Identify possible clinical uses and collect information on them so that each clinical use can be assessed with each criterion.

5. Rate each possible clinical use by scoring each against each criterion on the basis of the information collected and applying the criterion weights to calculate a composite score.

6. Validate scores to ensure there were no errors in process or that no interpretation took place, and formulate recommendations on resource allocation.
Criteria

11 criteria selected:

1. Size of affected population
2. Timeliness and urgency of test result
3. Impact on mortality
4. Impact on morbidity or quality of life
5. Relative impact on health disparities
6. Relative patient acceptability of test
7. Relative diagnostic accuracy of test
8. Relative risks associated with test
9. Relative availability of expertise and experience required for test
10. Accessibility of alternative tests
11. Relative cost of the test
# Identifying Clinical Uses of $^{99m}$Tc

21 clinical uses identified:

| Respiratory/Renal | 1. Diagnosis of pulmonary embolism  
|                   | 2. Diagnosis of acute or chronic pyelonephritis  
|                   | 3. Renal scintigraphy for monitoring renal transplants  
|                   | 4. Evaluation of renal function — suspected obstructive uropathy  
|                   | 5. Evaluation of renal function — renovascular hypertension  
| Musculoskeletal    | 6. Diagnosis of bone infections  
|                   | 7. Evaluation of painful prostheses  
|                   | 8. Detection of metastatic disease  
|                   | 9. Avascular necrosis  
|                   | 10. Detection of fractures in young  
|                   | 11. Evaluation of a limping child  

Clinical Uses of $^{99m}$Tc (cont’d)

| Cardiovascular                      | 12. Detection and diagnosis of cardiac ischemia  
|                                   | 13. Assessment of prognosis post-myocardial infarction  
|                                   | 14. Preoperative assessment prior to non-cardiovascular surgery  
|                                   | 15. Implantable cardioverter-defibrillator (ICD) decision-making  
|                                   | 16. Assessment of cardiotoxicity in patients receiving chemotherapy  |
| Central Nervous System             | 17. Brain death imaging  |
| Other Body Systems                 | 18. Evaluation of lower gastrointestinal bleeding  
|                                   | 19. Diagnosis of acute cholecystitis  
|                                   | 20. Detection of bile leak and biliary enteric bypass patency  
|                                   | 21. Identification of sentinel nodes |
Key Project Deliverables

- Priority-Setting Framework
- National Guidance Document
- Implementation Tools
Summary

• The main objective of the project is to maximize health benefits to the population with the available supply of $^{99m}$Tc during a disruption in supply

• Applying MCDA to this project means identifying the key clinical uses of $^{99m}$Tc and establishing criteria to evaluate the relative benefits of each clinical use

• The health benefits are defined from a multitude of relevant perspectives

• The final outcome will be a ranked list of clinical uses and a tool that will permit customization of the guidance at the local level
Questions?
For More Information

CADTH Medical Isotopes Project website:
www.cadth.ca/isotopes