Appropriateness in Canadian Medical Imaging

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Overview

- Appropriateness misconceptions
- Appropriateness guideline development
- Canadian appropriateness studies
- Practical issues
- Bottom line
- Summary
Background

- The Health Council of Canada alleged up to 30% of Canadian imaging inappropriate*

- Published Canadian data that was not cited documents a much lower rate of <3%

- The Health Council of Canada was eliminated in April 2013 and the document is no longer available online

*Imaging in Canada, Health Council of Canada
*Picano E. Sustainability of medical imaging. BMJ 2004;328:578-580
Welcome to the appropriateness games
Background

- In Canada, appropriateness discussions focus primarily on CT (cost, dose issues)
- CT radiation dose is being mitigated by dose reduction strategies on new scanners
- Cost control and re-allocation of savings are the current driver of appropriateness studies
- There is a small but growing body of Canadian research
Canadian CT Appropriateness

- Canadians’ receive CT’s at a rate of 121 scans per 1000 Canadian per year (CIHI**)
- The US rate is almost double at 228 CT scans per 1000 persons per year *
- Given the similar health profile between Canada and the US, the over use of CT is likely more prevalent in the US
- Therefore, Canadian data is needed

*OECD Health Data, 2010 **Statistics Canada, 2009
Canadian CT use is increasing

- CT offers greatly improved diagnostic accuracy compared to other modalities:
  - CT is available, quick and accepted
  - CT can image patients in most settings
  - CT is compatible with most monitoring devices and life support systems
  - CT dose has been substantially reduced
  - Compared to MR, Canada is relatively well resourced by CT scanners
Diagnostic power: Chest X-ray

- The chest radiograph measures ray attenuation from the x-ray source to the detector.
- This creates a “superimposition image” with confusing overlap of structures.
- Large amount scatter radiation leads to poor contrast resolution.
- Combined, these effects create diagnostic confusion amongst expert observers.
CT is a cross sectional technique that acquires 800-1500 views over 360 degrees and reconstructs “point” attenuation.

Ten times better contrast resolution due to reduced x-ray scatter.

This produces images equivalent to gross anatomic dissection in vivo.

Therefore, most diseases that lead to anatomic abnormalities are detectable using CT.
CT Pulmonary Angiogram
Evidence for improved diagnostic accuracy of CT

- Solid nodule diameter for 95% detection:*
  - 15 mm for the chest radiograph
  - 6 mm for chest CT

- Improved detection on CT is secondary to:
  - Cross sectional perspective eliminates overlap of structures improving nodule detection
  - Improved contrast sensitivity due to collimated beam and associated reduced scattered x-rays

Appropriateness is different

- Right test to right patient at right time
- This involves not only the test but the setting (population) and the timing
- Appropriateness requires evaluation of relevant outcomes
- Appropriateness research requires a team approach involving radiologists and clinicians
Guidelines have been developed by many imaging societies (CAR, ACR, RCR) to aid selection of imaging examinations.

- Designed to provide a diagnostic imaging path for clinicians.
- Focused on clinical questions; e.g. suspected pulmonary embolism.
- Augmented by clinical decision rules; e.g. Wells criteria for acute PE.
Guidelines also consider radiation dose, resource availability and cost.

However, guidelines are recommendations and do not supplant good clinical judgment.

Guidelines are based on evidence (data) derived from the literature.

Data quality is graded.
Evidence levels

- Level 1
  - High quality randomized controlled trial with statistically significant difference
  - Systematic review of level 1 studies

- Level 2
  - Lesser quality randomized control led trial
    (<80% follow up, no blinding, imperfect randomization)
  - Systematic review of level 2 studies or inconsistent results from level 1 trials
Evidence levels

- Level 3
  - Case controlled studies
  - Retrospective comparative studies
  - Systematic review of level 3 studies

- Level 4
  - Case series

- Level 5
  - Expert opinion
Synthesis of evidence

- Evidence is reviewed by content experts
- Recommendations developed using a Delphi process to establish agreement
- Guidelines are updated on a cycle depending on the rate of development of new information or equipment
- Guideline development is an expensive and time consuming process
Radiology evidence for imaging

- Due to limited radiology clinical trials, many radiology guidelines have substantial level 5 evidence, expert opinion
- Much of the published evidence arises from tertiary referral academic centres that investigate biased populations
- High profile guidelines (e.g. lung nodules) may be based on stronger evidence; e.g. National Lung Screening Trial
Level 1 Evidence

- National Lung Screening Trial* was a 110 million dollar randomized controlled clinical trial in high risk smokers with the primary outcome lung cancer mortality


- Entry criteria; 55 to 74 years, 30 pack year smoking history, less than 15 years since smoking cessation

NLST Results

- Lung cancer deaths:
  - LDCT 247/100,000
  - CXR 309/100,000

- Relative reduction in lung cancer mortality of Low Dose CT vs CXR:
  - 20% (CI, 6.8-26.7%, p=0.004)

- Based on these results the data safety monitoring board terminated the trial early

- Conclusion: CT lung cancer screening works in this study population
Appropriateness Issues

- Patient population/Entry criteria
- Cumulative radiation risk
- Prevalence and downstream costs of incidental findings
- Cost
Controversies

- Entry criteria
- Cumulative radiation risk
- Prevalence of incidental findings
- Cost
  - Prevalence of lung cancer during study period was 3.4%!
Controversies

- Entry criteria
- Cumulative radiation risk
- Prevalence of incidental findings
- Cost
  - Prevalence of lung cancer during study period was only 3.4%!
Canadian Appropriateness

- **Butler et al, CARJ 2004**
  - Audit 2374 consecutive CT, MR, US exams
  - Setting: Single Canadian academic centre
  - Review: Single radiologist assessor using 7 point scale assessing 6 appropriateness questions
  - Low scoring exams (<3/7) reassessed by investigators
  - 2.5% of exams had one or more questions with score <3/7 (inappropriate) after reassessment
Canadian Appropriateness

- Eddy et al, BCMJ, 2013:
  - Randomly selected 2000 CT and MR requisitions from BC 2010-2011
  - Analyzed scan requests using CAR guidelines and meta analysis of other guidelines
  - Classified requisitions into appropriate, indeterminate, inappropriate categories using initial computer analysis followed by re-review two independent reviewers
  - 2% of requests deemed inappropriate based on requisition data
Canadian Appropriateness

Turner et al, Canadian Respiratory Journal, 2006

- Prospective, consecutive analysis of 454 chest CT scans
- Setting: single tertiary care teaching hospital with respirology and thoracic surgery
- Before and after survey of clinical diagnosis by ordering physician assessing change in diagnosis
- CT scan results lead to a change in first choice diagnosis in 48% of chest CT scans
Appropriateness: Bottom line

- Canadian published data has a low frequency of inappropriate exams (<3%)
- Practically, clinician education & clinical interaction is key
- Guidelines are only part of the solution
- Appropriateness is best assessed locally using audit tools
- Appropriateness is a key indicator in a quality assurance program
Local Solutions

- Review all CT requisitions
- Introduce systems to eliminate duplicate, misleading and no information requisitions
- Inappropriate requisitions are valuable teaching tools for ordering physicians providing a spring board for discussion including rounds, seminars, curbside consults
- Document inappropriate requests using clinical audit
Summary

- Appropriateness is a major component of quality.
- Current Canadian data suggests CT and MR requisitions have a low level of inappropriate exams (<3%).
- Local data is essential.
- Your attendance at this session is part of the solution.
Thank you