

Evidence-based Synthesis Program (ESP)

Electronic Health Record-Based Interventions for Improving Appropriate Diagnostic Imaging

A Systematic Review and Meta-Analysis
Review of VHA Experiences

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Our Team

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- Stakeholders: Charles Anderson, Sherrill Snuggs, David Atkins, VHA Choosing Wisely Workgroup

Overview

- VA Evidence-based Synthesis Program (ESP)
- VA-ESP Partnerships
- Current Report
- Stakeholder Perspectives
- Questions and Answers

Evidence-based Synthesis Program (ESP)

ESP Program Information

Funding: VA Office of R&D, HSR&D Service.

Products: Evidence synthesis reports on health care topics important to VA leaders, managers and policy makers for quality improvement.

Purpose: Inform VA clinical policy, develop clinical practice guidelines, future research, performance measures, and drug formulary decisions.

Sites: Four VA medical centers with systematic review expertise: Portland, West LAL, Durham, Minneapolis.

Topics: Identified by HSR&D Planning and Oversight Committee; may be nominated using form on ESP website:

<http://www.hsrd.research.va.gov/publications/esp/TopicNomination.cfm>

Evidence-based Synthesis Program (ESP)

Disclosure

This report is based on research conducted by the Evidence-based Synthesis Program (ESP) Center located at the West Los Angeles VA Medical Center, Los Angeles, CA funded by the Department of Veterans Affairs, Veterans Health Administration, Office of Research and Development, Health Services Research and Development. The findings and conclusions in this document are those of the author(s) who are responsible for its contents; the findings and conclusions do not necessarily represent the views of the Department of Veterans Affairs or the United States government. Therefore, no statement in this article should be construed as an official position of the Department of Veterans Affairs. No investigators have any affiliations or financial involvement (e.g., employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties) that conflict with material presented in the report.

Evidence-based Synthesis Program (ESP)

VA-ESP Partnerships

Planning and Oversight Committee

Representatives from HSR&D, PCS, OQP, and VISN Clinical Management Officers.

Oversees and guides strategic planning, coordinates dissemination activities, identifies priority topics, and assures quality of reports.

Technical Expert Group

Recruited for each topic to provide content expertise.

Guides topic development, reviews drafts of reports.

External Peer Reviewers

Review and comment on draft report.

Published authors, key experts in a field, may hold a range of opinions on the topic.

Evidence-based Synthesis Program (ESP)

Current Report

**Electronic Health Record-based Interventions for
Reducing Inappropriate Imaging in the Clinical Setting
(January 2015)**

Full-length report available on ESP web site:
<http://www.hsrd.research.va.gov/publications/esp/reports.cfm>

Published Article

Annals of Internal Medicine

REVIEW

Electronic Health Record–Based Interventions for Improving Appropriate Diagnostic Imaging A Systematic Review and Meta-analysis

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Goldzweig, C. L., Orshansky, G., Paige, N. M., Miake-Lye, I. M., Beroes, J. M., Ewing, B. A., & Shekelle, P. G. (2015). Electronic Health Record–Based Interventions for Improving Appropriate Diagnostic Imaging: A Systematic Review and Meta-analysis. *Annals of internal medicine*, 162(8), 557-565.

Background

- **Current Context**
 - Unsustainable increases in health care costs
 - Disproportionate increase in use of radiologic imaging as one driver

Background

Choosing Wisely campaign

American Board of Internal Medicine Foundation asked specialty groups to identify procedures or tests judged to have little value, included:

- CT for minor head injury in the ED (Am Coll of Emerg Phys)
- Imaging for nonspecific low back pain (Am Coll Phys)
- Imaging for uncomplicated headache (Am Coll Radiol)
- Cardiac stress imaging in patients without high-risk markers for coronary artery disease (Am Coll Cardiol)

More appropriate use could improve quality and reduce costs.

Reducing Inappropriate Imaging

- Different types of interventions targeted at reducing inappropriate imaging
- Expanding adoption of electronic health records, increased use of CCDS as one strategy
- Our scope focuses on CCDS

CCDS Example: Head CT

Ordering clinician first enters information about the patient

Decision Support

Please answer both questions below:

1. Did your patient experience loss of consciousness?

Yes
 No
 Unknown

2. Does any of the following apply to your patient:

- Post traumatic seizure
- Glasgow coma scale < 15 at presentation
- [Glasgow coma scale](#) deterioration >= 2 points (1 hour after presentation)
- Transfer from another hospital
- Bleeding disorder/anti-coagulant therapy
- Vomiting >= 1 episode
- Posttraumatic [amnesia](#) >= 4 hour
- [Clinical signs of skull fracture](#)

Yes
 No

This information is presented to assist you in providing care to your patients. It is your responsibility to exercise your independent medical knowledge and judgment in providing what you consider to be in the best interest of the patient.

Decision Support

Does any of the following apply to your patient:

- [Short term memory deficits](#)
- [Physical evidence of trauma above the clavicles](#)
- Acute focal neurological deficit
- Headache
- [Drug/alcohol intoxication](#)
- Had no clear history of trauma as the primary event (i.e. primary seizure or syncope)
- Unstable vital signs associated with major trauma

Yes
 No

This information is presented to assist you in providing care to your patients. It is your responsibility to exercise your independent medical knowledge and judgment in providing what you consider to be in the best interest of the patient.

Decision Support

Please select ALL of the following that apply to your patient.

Persistent anterograde amnesia (short-term memory deficit)
 Posttraumatic amnesia of 2 to < 4 hours
 Contusion of the skull
 Neurologic deficit
 Glasgow coma scale deterioration of 1 point (1 hour after presentation)
 None of the above

This information is presented to assist you in providing care to your patients. It is your responsibility to exercise your independent medical knowledge and judgment in providing what you consider to be in the best interest of the patient.

CCDS Example: Head CT

For orders not meeting criteria for all three guidelines, the following screen was presented:

Decision Support

In patients with minor head injury and based on the information you have provided, the chance of positive findings on Head CT is extremely small according to three published large prospective controlled trials.

Stiell IG, Wells GA. et al. [The Canadian CT Head Rule for Patients with Minor Head Injury](#). Lancet 2001; 357: 1391-96.

Haydel MJ., Preston CA. et al. [Indications For Computer Tomography in Patients with Minor Head Injury](#). The New England Journal of Medicine 2000; 343: 100-5.

Smits M, Dippel DWJ. et al. [Predicting Intracranial Traumatic Findings on Computed Tomography in Patients with Minor Head Injury: The CHIP Prediction Rule](#). Annals of Internal Medicine 2007; 146: 397-405.

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CCDS Example: Head CT

- Setting: Harvard-affiliated academic medical center (US HIT leader)
- Findings: adherence was 49% pre-intervention and rose to 76.5% post-intervention

From Gupta et al., 2014. Details of all examples available in full report and article

CCDS Example: Lumbar Spine MRI

Based on clinical history input, best diagnostic strategy presented to orderer based on ACP/APS guidelines for lumbar spine MRI. If not indicated, the following would be presented:

DECISION SUPPORT

Based on published evidence MRI is not recommended in the absence of clinical "red flags". If symptoms are disabling, consider consultation with the comprehensive spine center at

Clinical guidelines from the American College of Physicians and American Pain Society: Clinicians should perform diagnostic imaging and testing for patients with low back pain when severe or progressive neurologic deficits are present or when serious underlying conditions are suspected on the basis of history and physical examination (strong recommendation, moderate-quality evidence).

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CCDS Example: Lumbar Spine MRI

- Additional “accountability tools”: “near real-time” peer-to-peer telephonic consultation with a radiologist or internist when attempting to override the guidelines and quarterly practice pattern variation reports sent to individual PCPs comparing use to peers
- Setting: Harvard-affiliated academic medical center (US HIT leader)
- Findings: Guideline adherence rate increased from 78% pre-intervention to 98% post-intervention.

From Ip et al., 2014. Details of all examples available in full report and article

CCDS Example: CT Pulmonary Angiography

- Intervention: CCDS requiring physician-entered data to calculate Wells score for CT pulmonary angiography order.
 - If Wells > 4 , CT approved and ordered
 - If Wells ≤ 4 , MD required to obtain ELISA D-dimer level
 - If ELISA D-dimer > 500 ng/mL, CT approved and ordered
 - If ELISA D-dimer ≤ 500 ng/mL, CT could only be performed after MD completed consult with on-call chest radiology attending physician for approval.
- Setting: VA (Integrated healthcare setting)
- Findings: Proportion of positive examinations increased from 3.1% pre-intervention to 16.5% post-intervention.

From Soo Hoo et al., 2011. Details of all examples available in full report and article

Poll Question

Has your institution ever implemented a CCDS intervention for diagnostic radiological imaging?

- Yes
- No

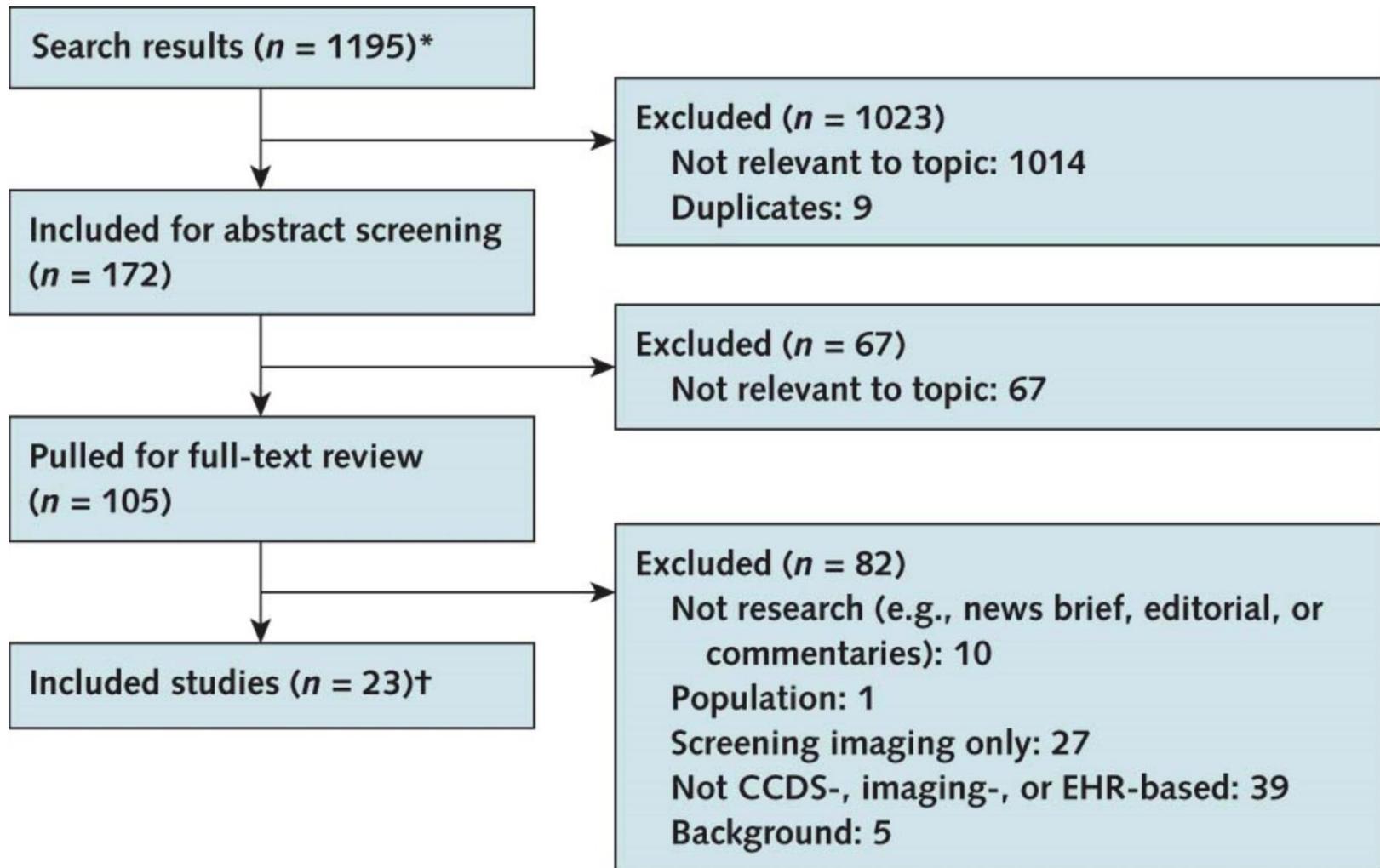
Key Questions

- **Key Question 1.** What is the effectiveness of CCDS interventions in reducing unnecessary or inappropriate imaging?
- **Key Question 2.** Do CCDS interventions vary in results by system?
- **Key Question 3.** What are the harms or potential harms associated with CCDS interventions used to reduce inappropriate imaging?

Methods

- **Data Sources:** Built on four existing broad-based reviews of health IT with a targeted search and reference mining
- **Selection, Extraction, and Quality Assessment:** Screening and abstraction by two independent reviewers with group reconciliation
- **Synthesis and Analysis:** Random effects meta-analyses were conducted as well as narrative synthesis

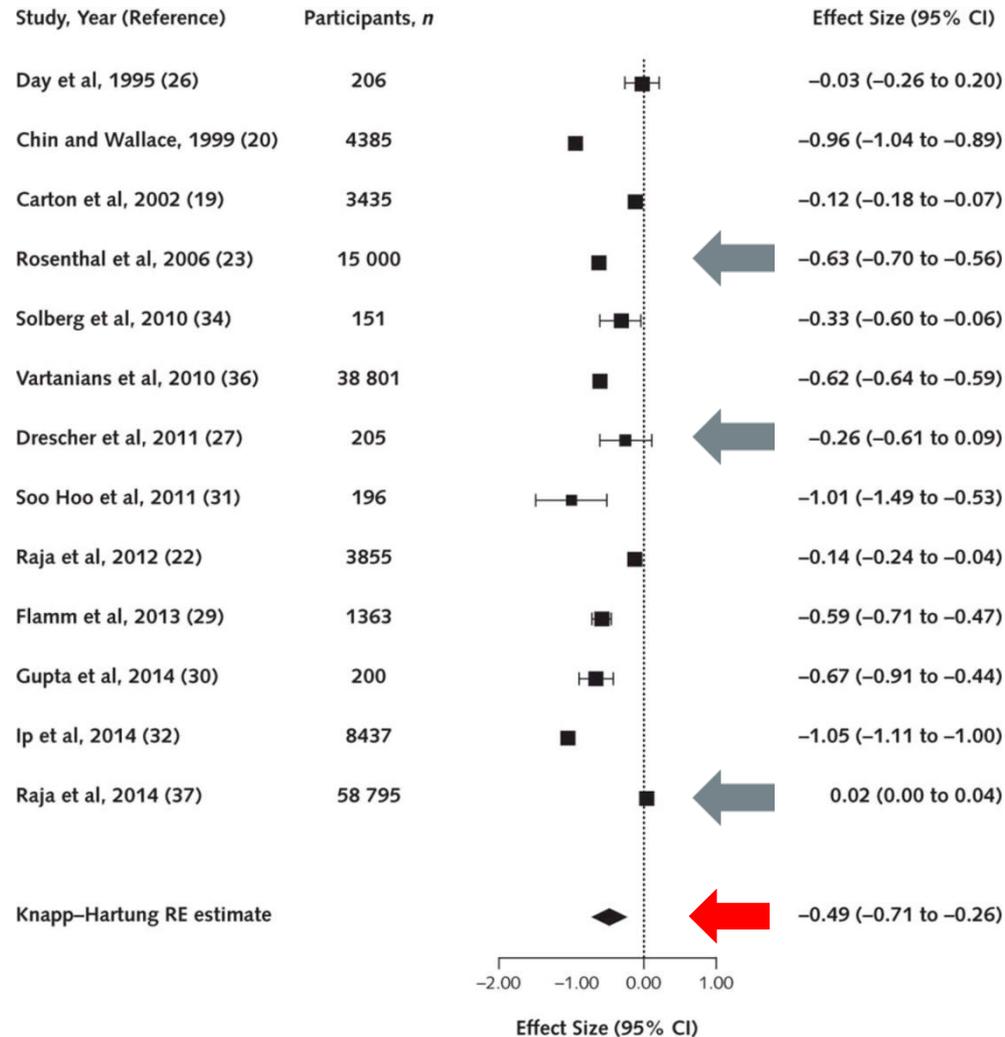
Literature Flow



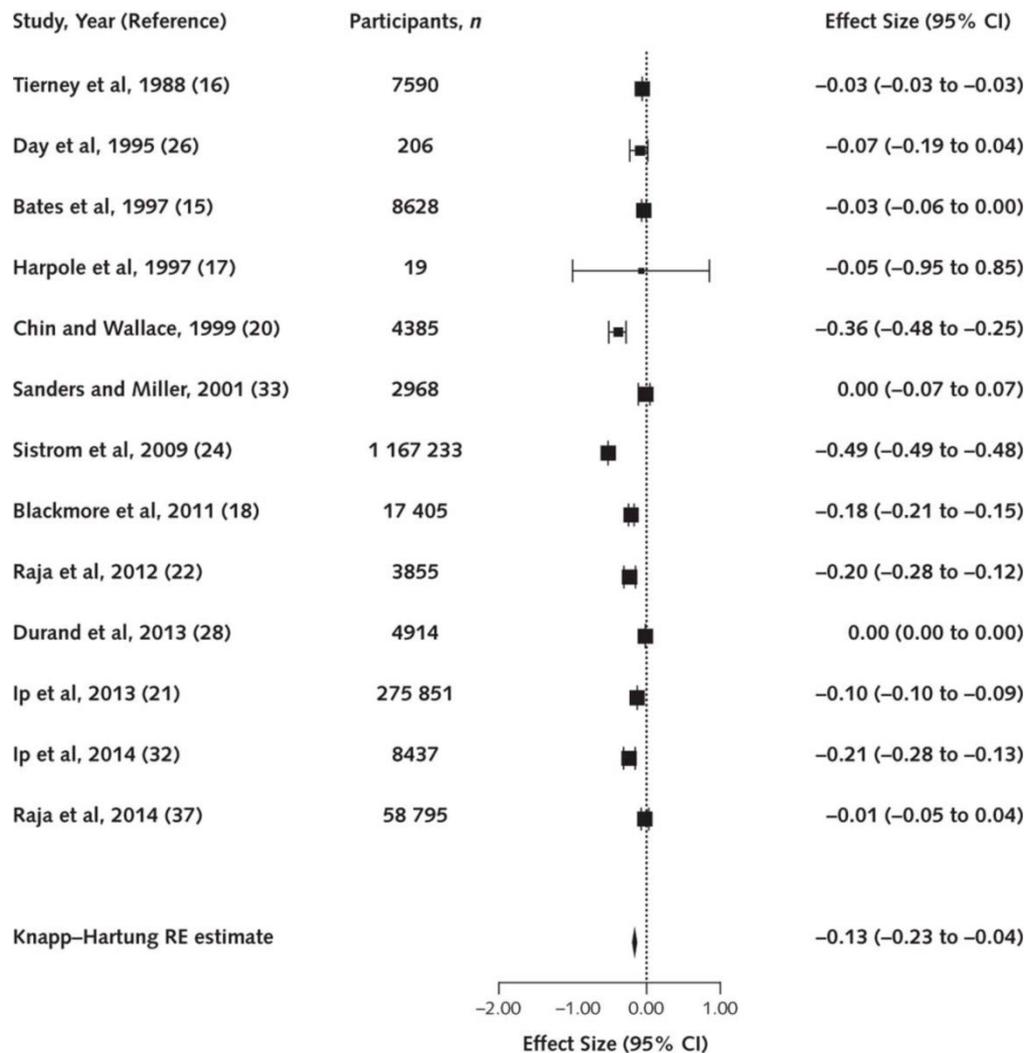
Results

- 23 studies, including 3 randomized trials, 7 time-series studies, and 13 pre–post studies that assessed the effect of CCDS on diagnostic radiologic test ordering in adults
- Outcomes reported
 - 13 reported appropriateness
 - 13 reported use
 - 5 reported both
 - 2 did not report data sufficient for inclusion in quantitative analyses
- Appropriateness and use have different effect sizes, so they were pooled separately
- Primary outcome is appropriateness

Effect of EHR-based Interventions on Appropriateness



Effect of EHR-based Interventions on Use

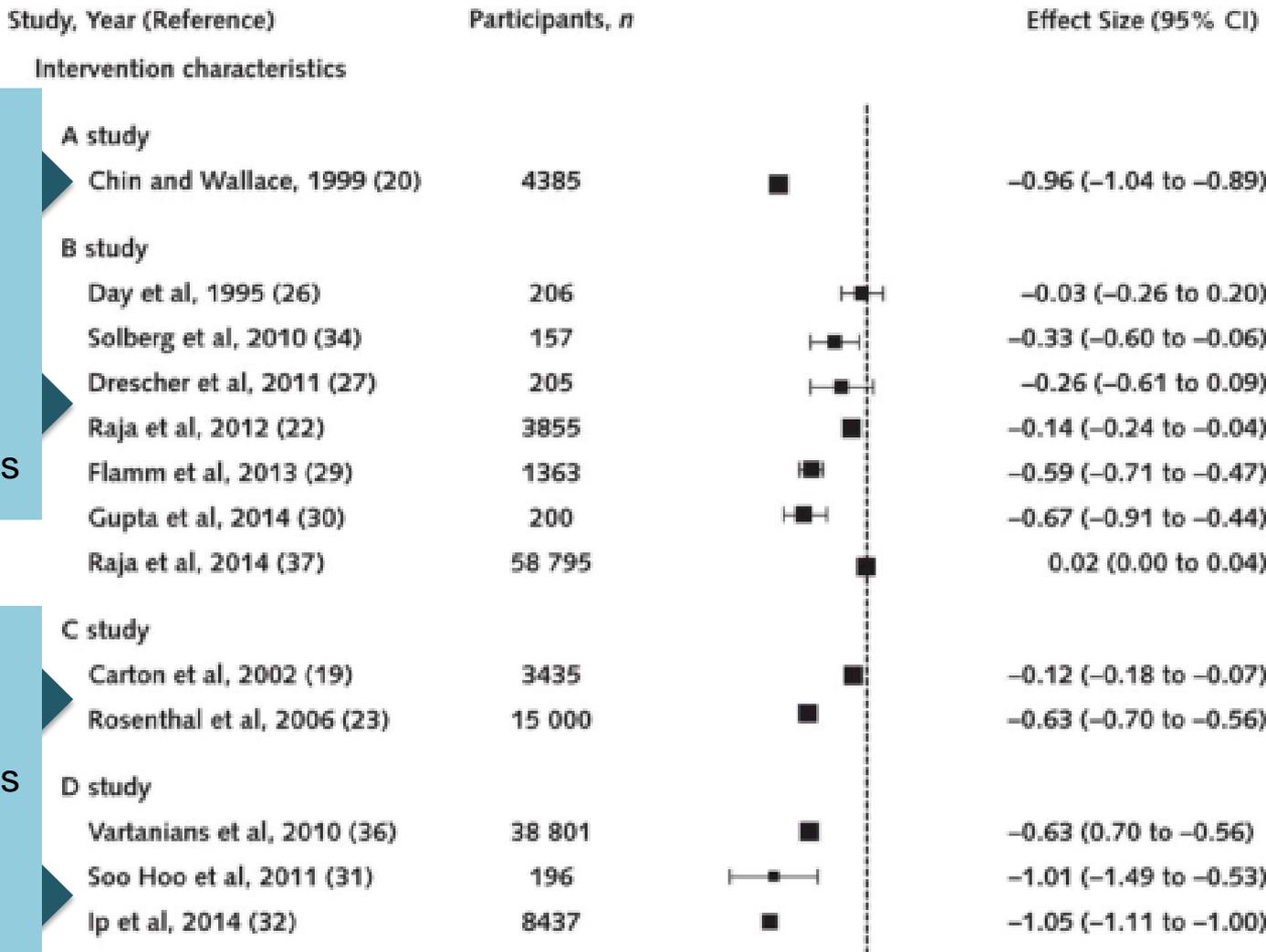


Explaining the Heterogeneity

- **Developed four hypotheses about intervention effectiveness**
 1. **Intervention type:** rank ordered by increasing effectiveness as (A) present only information; (B) include a pop-up or reminder; (C) “soft stop”; or (D) “hard stop”
 2. **Setting:** more effective in integrated systems (e.g., Kaiser or VA)
 3. **Implementation characteristics:** more effective with other implementation components (e.g., audit and feedback, academic detailing)
 4. **Target:** effectiveness will vary depending on radiographic method targeted

Effect of EHR-based Interventions on Appropriateness

Stratified by Intervention Type

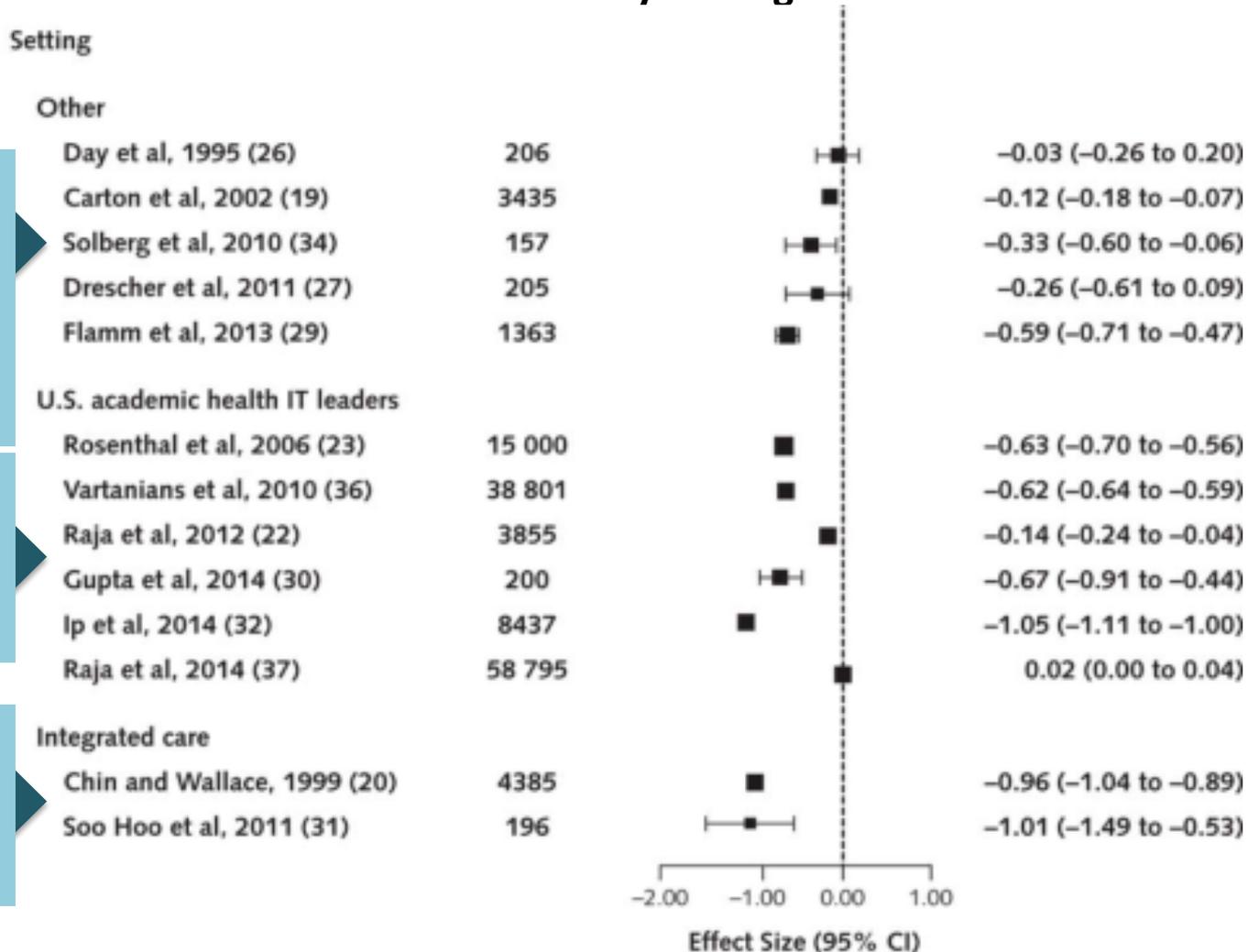


Only 1 “A” study
In Kaiser, baseline
Many “B” studies of varying effectiveness

Only 2 “C” studies of varying effectiveness
3 “D” studies, all highly effective

Effect of EHR-based Interventions on Appropriateness

Stratified by Setting



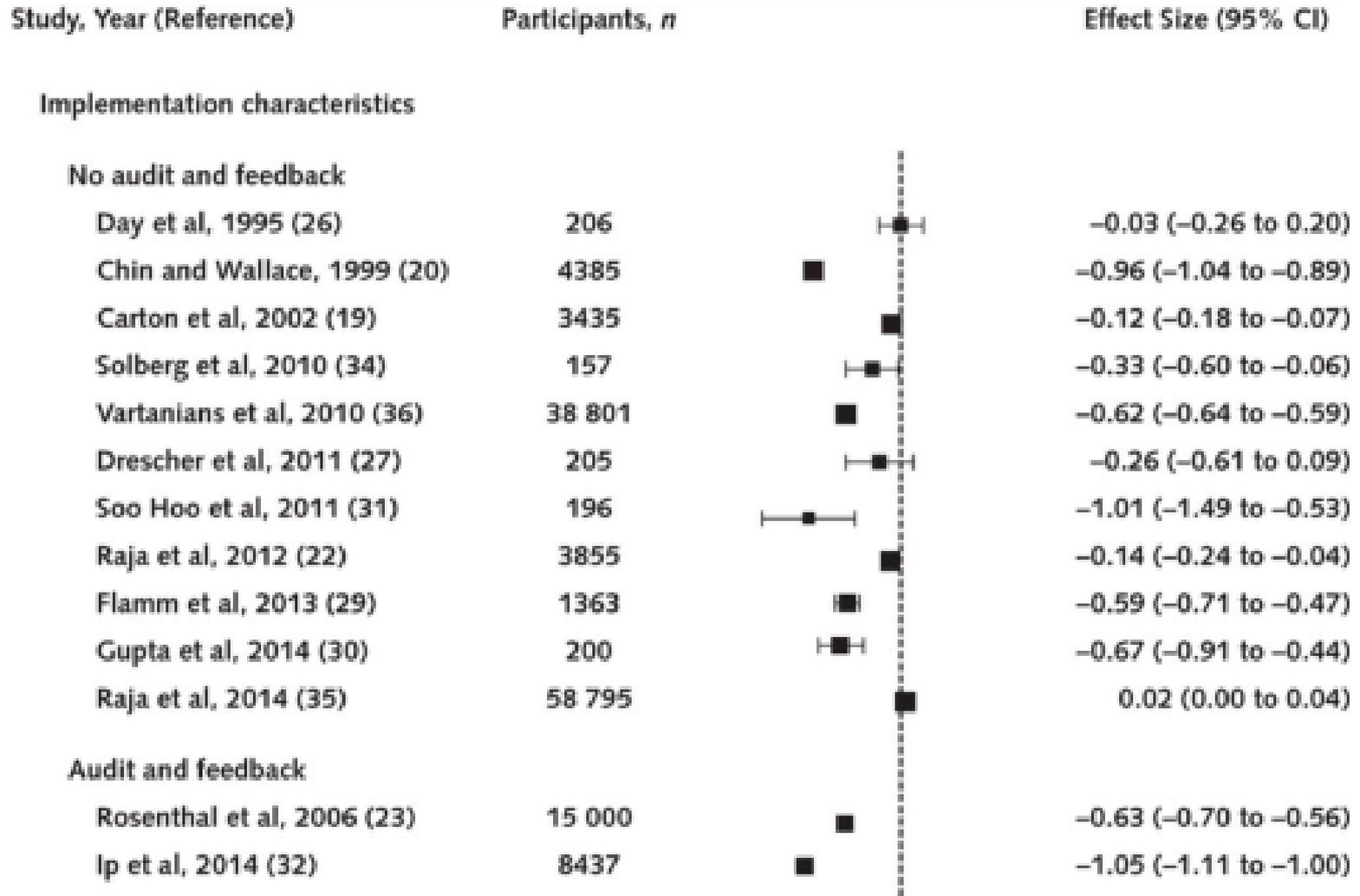
5 "Other" setting studies of varying effectiveness

6 studies, most effective but some not

2 integrated care studies both highly effective

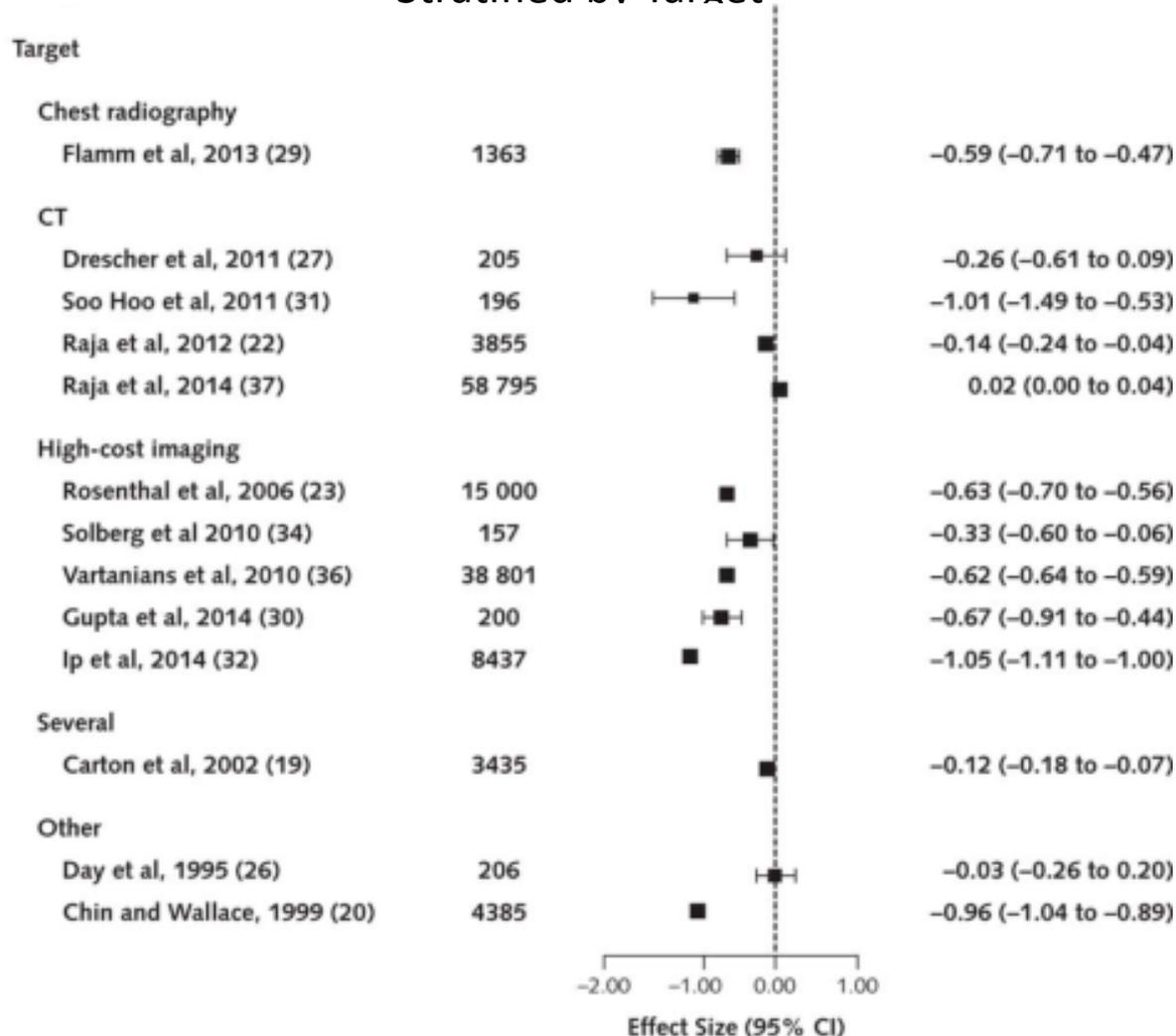
Effect of EHR-based Interventions on Appropriateness

Stratified by Implementation Characteristics



Effect of EHR-based Interventions on Appropriateness

Stratified by Target



Harms

- **Four studies reported on harms**
 - Increase in percentage of inappropriately not ordered tests, for example in one study there was an increase from 1.9% to 9.3% of patients that did not receive chest radiograph when indicated
 - Physician lack of interest due to time constraints and perceived inefficiencies

Poll Question

If your institution implemented a CCDS intervention for diagnostic radiological imaging, was the effect:

- All positive
- Mixed
- Negative
- No effect

Limitations

- Potential for publication bias
- Insufficient reporting of harms
- Poor description of context and implementation.

Conclusions

- Computerized clinical decision support that is integrated in the physician order entry system of an electronic health record can help improve the appropriate ordering of diagnostic imaging studies.
- Interventions that include a “hard stop” to prevent clinicians from ordering imaging tests classified as inappropriate and interventions in an integrated care delivery setting may improve effectiveness.
- The potential harms of computerized clinical decision-support interventions have been rarely studied.

Acknowledgements

Peer Reviewers

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REVIEW OF VHA EXPERIENCE

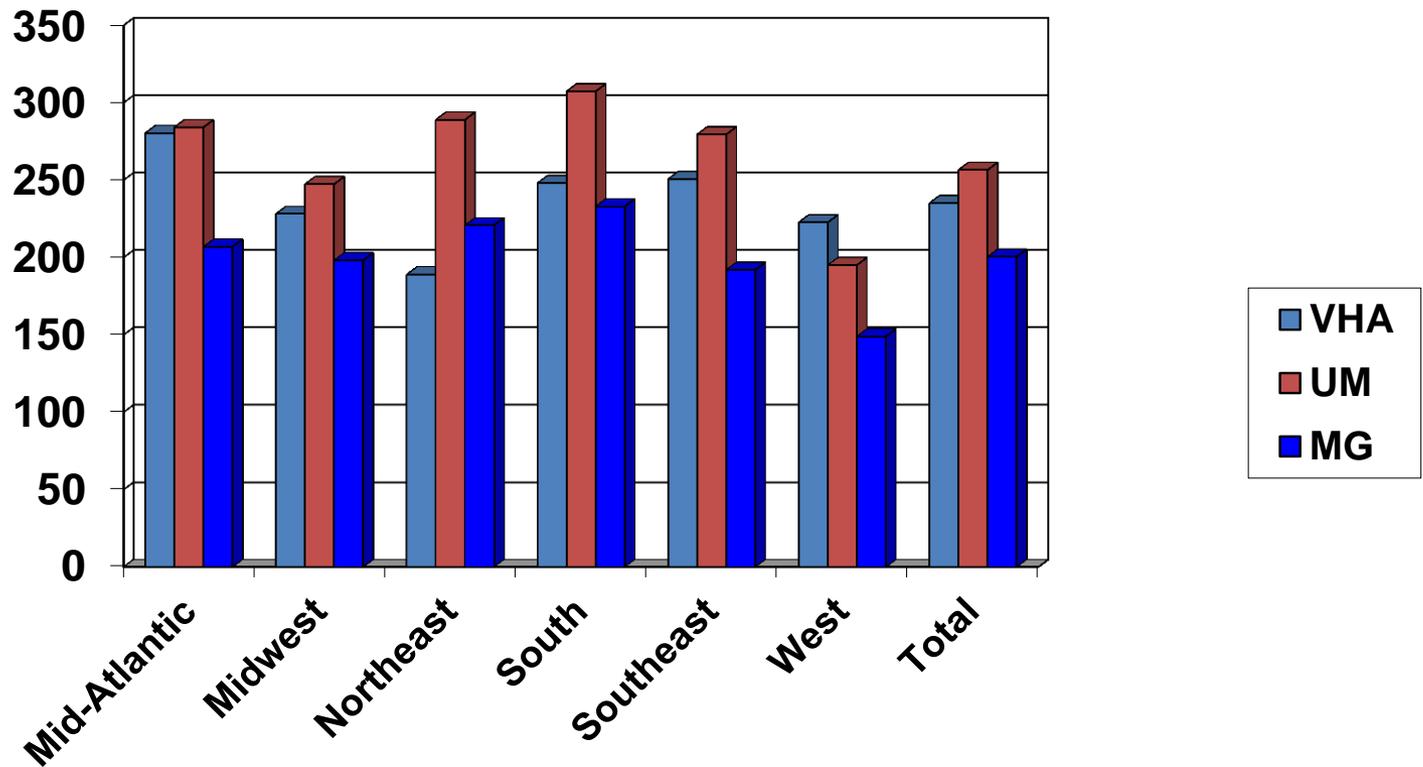
Inappropriate Utilization in VHA

- **Several studies have been done that show inappropriate utilization exists in VHA**
 - Benchmarking study
 - American Imaging Management (AIM) – benefits management company
 - OQP/Radiology Study
 - VA Utilization of MRI for LBP (under review for publication)

Benchmarking Study (AIM)

- **Completed November 2006**
- **Analysis of outpatient high-tech utilization & comparison to commercial benchmarks**
- **Key Findings**
 - High-tech imaging growing at an annual rate of 9%
 - CT utilization high relative to other high-tech modalities
 - MRI utilization relative to CT is lower than observed use in commercial benchmarks
 - Both high-tech and low-tech utilization and utilization growth showed significant regional variation
 - VHA rates were higher than managed and, in some cases, unmanaged systems

VHA Comparison to Unmanaged (UM) and Managed (MG) Markets

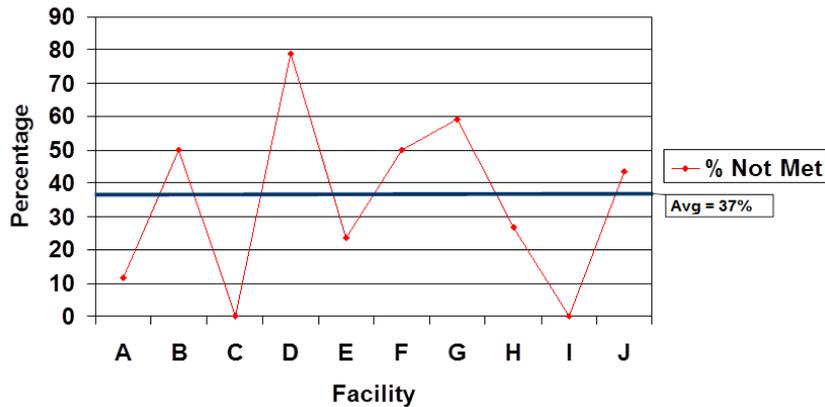


OQP/Radiology Study

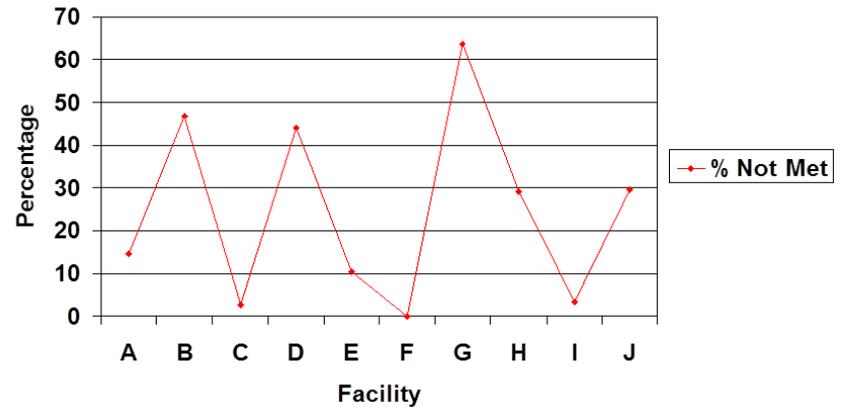
- OQP contracted with EPRP to do a review of 2000 patient records at 10 facilities
- Appropriateness review using InterQual Criteria
- Significant variation among facilities and regions
- Overall 21.4% to 46.16% of exams reviewed did not pass a first level review

Study Limited to specific exams

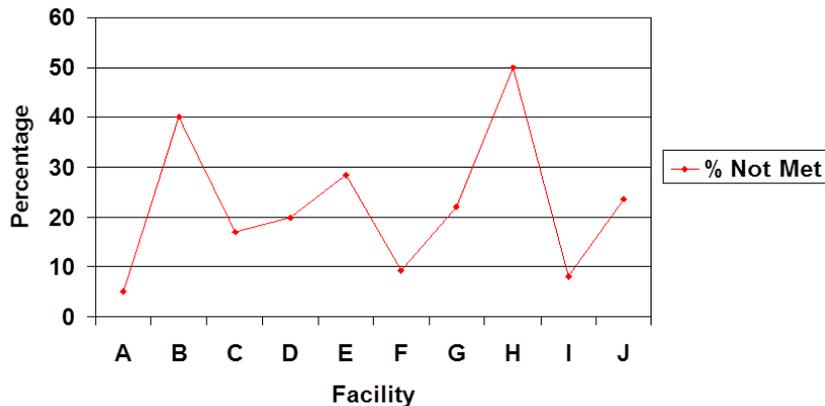
MRI Cervical Spine



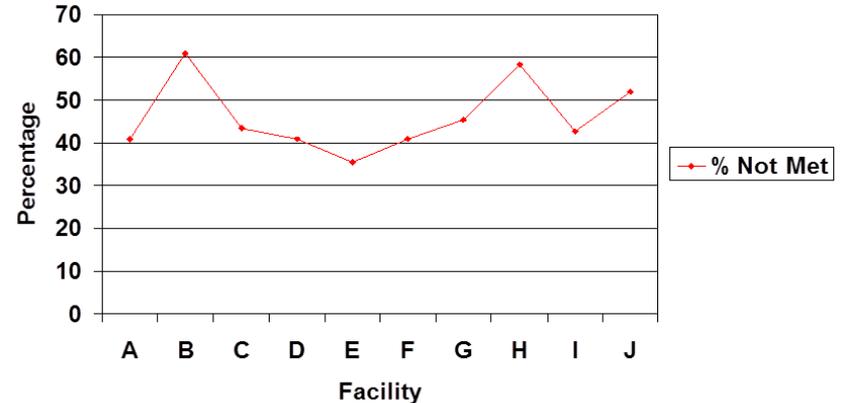
MRI Lumbar Spine



CT Chest



CT Abdomen



Remediation Efforts

- **Templates UM Nurse Review**
 - Tucson
 - Indianapolis
- **Utilization Review Nurse**
 - Las Vegas
 - Indianapolis
- **Innovation Project**
 - EHR-based intervention
- **Choosing Wisely – Low Back Pain Initiative**

Templates

- **Templates all showed initial success at both Tucson and Indianapolis (around 24% decrease in order volume)**
- **Both also saw decrease in effectiveness of templates at around 6 months**
 - Attributed to providers finding workarounds
 - Addition of UM Nurse reversed trend in Indianapolis

Utilization Review Nurse

- **Uses VHA approved InterQual Criteria**
- **Review is after order is placed instead of at the point of order entry**
 - Patient expectations
- **Las Vegas trial in 2013 showed 68% of MRI lumbar spines were inappropriately ordered**
- **Indianapolis found that the addition of a UM nurse reviewed reversed waning effect of templates**

Innovation Project

- Proof of concept
- Goal - interface decision support software with VHA EHR/IT systems
- Additional limited testing in live environment at 1 facility

Innovation Project Results

- **Pros**

- Built in to current ordering system
- No additional log in was required
- Passed orders back in cases where exam changed
- Can be customized

- **Cons**

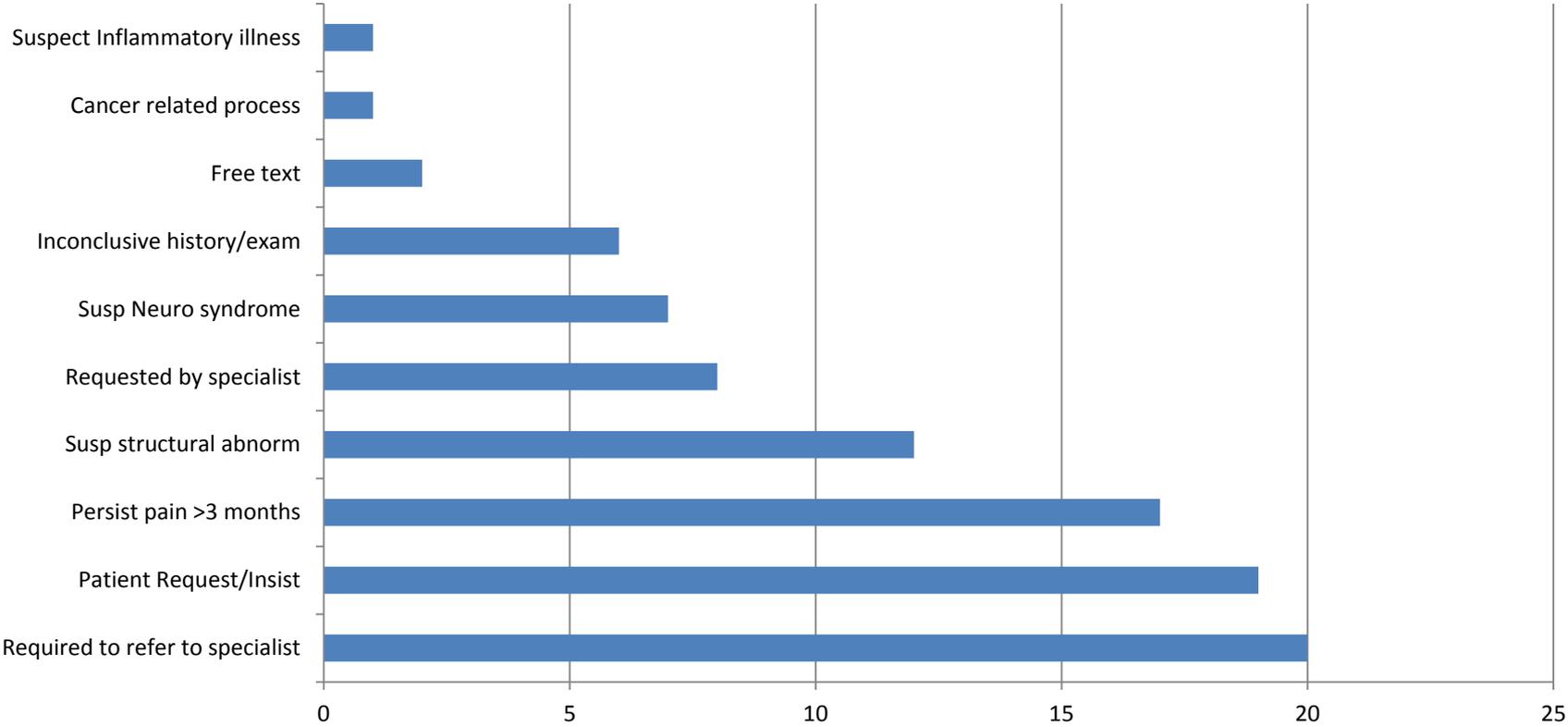
- Only ACR guidelines were included in trial, so did not have advice for many common scenarios
- Would require extensive input to customize
- users complained that the it slowed the system (anecdotal)
- Will break when CPRS updated to next version

Choosing Wisely

- Incorporated a template similar to those used in previous trials
- In addition to appropriate indications, included metrics designed to pinpoint reasons outside of set criteria studies were ordered inappropriately
- Initial 6 months showed 10% decrease in overall number of studies ordered
- Approximately 62% of all MRI lumber spine exams were ordered for low back pain

Choosing Wisely Other

Other



Conclusions

- **Templates and education have limited effectiveness**
 - Effect quickly wears off/work-around(s)
- **Addition of a UM nurse is effective, but**
 - Viewed as scarce/expensive, most facilities have not shown a willingness to provide a dedicated radiology reviewer
 - Does not provide just-in-time information at the point of order entry
- **Computerized Decision Support Software**
 - Shows promise, but needs further development/customization
 - Buy-in (physician acceptance) may be problematic
- **Utilization Review, no matter the approach, should be targeted to specific problematic procedures**

Thank you!

If you have further questions, feel free to contact:

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