ACR Assist Tools for Clinical Decision Support Reporting:

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CDS for Reporting: What and Why
CDS for Reporting – What is It?

- It is *not* Clinical Decision Support (CDS) for ordering, (Appropriate Use Criteria).
- It *is* CDS for radiologists – guidance to assist reporting.
- Is *not* Artificial Intelligence (although beginning to use some of its technology).
ACR Assist converts radiologic knowledge and algorithms into useable guidance integrated into workflow.

Building modules is labor-intensive, but will provide basis for “supervised learning” for Machine Learning algorithms.
Why Do We Need ACR Assist CDS for Reporting?
CDS for Reporting – Why Do We Need It?

Can you memorize and apply this flowchart?

Figure 4

Incidental pancreatic cyst in patient 80 years old at presentation

- Cyst ≤2.5 cm
  - Reimage q3y x 2
  - Interval growth
  - Cyst is still ≤2.5 cm
    - Reimage q1y
    - STOP if stable or if no longer surgical candidate
  - Cyst is >2.5 cm
    - Reimage q3y x 2
    - Interval growth

- Cyst >2.5 cm
  - SCA
  - Low Risk by Imaging
  - High Risk by Imaging
    - Reimage q3y x 2
    - Interval growth
    - STOP if stable
    - EUS/PNA
      + Surgical consultation

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**LEGEND**

1. The decision to pursue imaging follow-up and/or EUS/PNA should be anchored to a patient’s overall health and preferences; such work-up is only advised if the patient is a surgical candidate.
2. Growth defined as 20% increase in longest axis diameter, as depicted on either axial or coronal image. No growth = stable.
3. The decision to discontinue imaging follow-up is dependent on a patient’s surgical candidacy and preferences, and the duration of the cyst’s stability.
4. For SCA ≤4 cm, surgical consultation for consideration of resection is advised.
5. Low-risk features: no mural nodule, no wall thickening, normal caliber MPD, no peripheral Ca++. If surgery is contemplated for low-risk cysts, EUS/PNA is strongly advised prior to the procedure.
6. High-risk features: mural nodules, wall thickening, MPD ≥7 mm maximal diameter, peripheral Ca++. All patients with “high risk stigmata” (pancreas, enhancing mural nodule, MPD ≥10 mm) at time of cyst detection should undergo immediate clinical evaluation for surgery if they are surgical candidates.

*Appearance of any mural nodule, wall thickening, dilation of MPD ≥7 mm, or extrahepatic biliary obstruction/jaundice should prompt consideration of immediate EUS/PNA and surgical evaluation regardless of size or amount of growth.*
This is one of 5 flowcharts for a single scenario
CDS for Reporting – Why Do We Need It?

- How to use Incidental Findings white papers?
  - Memorize them?
  - Post all of the flowcharts you need on a bulletin board or in a binder?
  - Refer to the flowcharts online?
- How well can you do with these methods?
CDS for Reporting – Why Do We Need It?

- JACR – Before/after pancreatic IF white paper:
  - 2.4 fold difference in recommendations across rads
  - Adhered to guidance in 47.4% cases

Abdominal CT incidental pulmonary nodule

- No CT when indicated
- Follow-up CT too late
- Follow-up CT too early
- CT when not indicated
- Concordant

Real-time access to guidelines improves compliance from 45% to 95%

Courtesy Keith Dreyer, DO, PhD
Tarik Alkasab, MD

M T Lu, MD, Boston, MA; D A Rosman, MD; C C Wu, MD; T K Alkasab, MD, PhD; J O Shepard, MD; G W Boland, MD; et al. Impact of a Point-of-Care Electronic Clinical Decision Support (CDS) Tool on Adherence to Departmental Guidelines for Follow-up of Incidental Pulmonary Nodules on Abdominal CT. RSNA 2013
Why do we accept <50% agreement with published recommendations?

- No time, easier, don’t accept validity, etc.

Referring physicians, administrators, regulators, patients and families will not continue to tolerate this level of performance. Should they?

We can’t claim to be providing patient-focused care unless we are providing the most helpful, consistent guidance.
Introduction to Computer Assisted Reporting – Decision Support (CAR/DS)
ACR Assist – Report Information Quality

What would a system that assists the radiologist to improve report IQ look like?

- Detect findings (AI-ML)
- Interpretation/classification of disease
- Recommend actions
- Communicate all the above
- Follow-up recommendations

Courtesy Keith Dreyer, DO, PhD
How Does CAR/DS work?
Some now using highly structured reporting
- Can be complex, time-consuming, limiting
- Assures completeness and organization

CAR/DS uses similar structure, but also:
- Provides consistent text for findings
- AND generates the Impression
- AND generates the Recommendations
Developing CAR/DS Modules

- Start with source information (e.g. white paper, X-RADS system, etc.)
- Create decision tree
- Develop XML
- Check accuracy (will discuss verification later)
- How will this get to your workstation? (Later)
Content Sources for CAR/DS

Managing Incidental Findings on Abdominal and Pelvic CT and MRI, Part 1: White Paper of the ACR Incidental Findings Committee II on Adnexal Findings

Maitrey D. Patel, MD, M. Susan M. Ascher, MD, Raj Mohan Pasupuleti, MD, Alainpady K. Shanbhogue, MD, Evan S. Singelman, MD, Marjorie W. Stein, MD, and Lincoln L. Berland, MD

These findings have been placed into these categories of urgency under the assumption that they are known or suspected to be new findings or are known to have significantly worsened since a prior study. A stable finding that was previously known and appropriately communicated may not require additional non-routine communication despite the severity of the disease process.

**Category 1 - Communicate within Minutes**
- Suspected non-accidental trauma
- Malpositioned line or tube of immediate clinical concern (e.g. ET tube or enteral tube kinked)
- Allergic reaction or other adverse event resulting in a code
- Foreign body with potential immediate and/or severe consequences
- Any finding that the interpreting radiologist determines requires immediate physician notification

**Category 2 - Communicate within Hours**
- Clinically significant mass, tumor, or infection
- Finding suggestive of malignancy
- Intravascular lesions of suboptimal location, moderate-risk (e.g., intimal central lumen in segmental or aneurysm, right atrium, etc.)
- Retained surgical instruments, sponges, devices
- Misplace or migrated surgical or other implanted devices (e.g., pacemaker, catheters, etc.)
- Adverse event from diagnostic imaging or interventional procedure
- Significant congenital anomaly

**Category 3 - Communicate within Days**
- Probable malignancy, any location, no acute danger to patient
- Significant non-malignant diagnosis, any location, no acute danger to patient
- Incidental finding on imaging study requiring further work-up or longer term follow-up

**X-RADS (e.g. LI-RADS, PI-RADS, TI-RADS, etc.)**

**ACR actionable findings white paper**

Others: organ injury classification, cancer staging, etc.
In the right adrenal gland (series 2, image 12), a 12 mm lesion does not have specifically benign imaging features.

Impression

Indeterminate 12 mm right adrenal nodule does not have the typical characteristics of a benign adenoma, although most such lesions will ultimately prove to be benign.

Recommendations

- Adrenal mass protocol CT in 6 months.
Cases to Assist Recognition of Findings

- Large comet-tail artifacts
- Macrocalcifications
- Peripheral (rim) calcifications
- Punctate echogenic foci
Scans were continued into the pelvis to evaluate the entire GI tract.

COMPARISON: 9/15/2012

FINDINGS:
LOWER THORAX: Lung bases are clear.

HEPATOBILIARY: No focal hepatic lesions. No biliary ductal dilatation.
SPLEEN: No splenomegaly.
PANCREAS: No focal masses or ductal dilatation.

ADRENALS:
In the right adrenal gland (series 2, image 12), a 12 mm lesion is unchanged in size for at least six months.
KIDNEYS/URETERS: No hydronephrosis, stones, or solid mass lesions.
PELVIC ORGANS/BLADDER: Unremarkable.

PERITONEUM / RETROPERITONEUM: No free air or fluid.
LYMPH NODES: No lymphadenopathy.
VESSELS: Unremarkable.

GI TRACT: No distention or wall thickening.

BONES AND SOFT TISSUES: Unremarkable.

IMPRESSION:
Stable 12 mm right adrenal nodule. Radiologic findings are most consistent with a benign adrenal adenoma.

RECOMMENDATION:
First CAR/DS, then CAR with AI-ML will eventually be how we apply most complex medical information

- Improves accuracy, consistency, confidence, efficiency
- Should decrease overutilization and decrease costs
New ACR Assist Tool to Facilitate Developing Modules

MARVAL (Module Authoring, Reviewing and VALidation)
Verification-Validation

- Validation to assure that algorithm provides correct results

- MARVAL will
  - Help others to develop new modules
  - Simplify the manual validation process
  - Allow multiple reviewers to collaborate
### Observation in high risk patient (Required)

**Dataelement Type:** Choice

**Choices:**
- Treated observation
- Definitely benign
- Probably benign
- Neither definite nor probable benign
- Probable malignancy, not specific for HCC
- Tumor in vein

### Arterial phase enhancement (Required)

**Dataelement Type:** Choice

**Choices:**
- Hypo-enhancement
- Iso-enhancement
- Hyper-enhancement

### Diameter (mm) (Required)

### Washout (Required)
**MARVAL – Path View Tab**

- **Tumor in vein**

- **Neither definite nor probable benign**
  - **Arterial phase enhancement**
    - **Hyper-enhancement**
    - **Diameter**
      - **< 10**
        - **Washout/Capsule/Threshold growth**
          - **None**
            - [LR-3] Observation that does not meet unequivocal criteria for other LI-RADS categories.
          - **One**
            - [LR-4] Observation with imaging features suggestive but not diagnostic of HCC.
          - **Two or More**
            - [LR-4] Observation with imaging features suggestive but not diagnostic of HCC.
      - **10-19**
        - **Washout/Capsule/Threshold growth**
          - **None**
            - [LR-3] Observation that does not meet unequivocal criteria for other LI-RADS categories.
          - **One**
            - [LR-4/LR-6] Refers to a cell in the LI-RADS table where observations may be considered LR-4, LR-5us, or LR-5g.
          - **Two or More**
            - [LR-5] Observation with imaging features diagnostic of HCC.
      - **>= 20**
        - **Washout/Capsule/Threshold growth**
          - **None**
            - [LR-4] Observation with imaging features suggestive but not diagnostic of HCC.
Choose an endpoint from below:

**LR-5**

**REPORT TEXT**

LR-5: Observation with imaging features diagnostic of HCC.

**Path 1**
- Arterial phase enhancement: Hyper-enhancement
- Diameter: 10-19
- Washout/Capsule/Threshold growth: Two or More

**Path 2**
- Arterial phase enhancement: Hyper-enhancement
- Diameter: >20
- Washout/Capsule/Threshold growth: One

**Path 3**
- Arterial phase enhancement: Hyper-enhancement
- Diameter: >20
- Washout/Capsule/Threshold growth: Two or More
What Can You Do?

- New era, taking knowledge directly to the point of reporting within workflow

- ACR needs help from SCBT-MR, other societies and individuals to:
  - Develop modules
  - Validate that pathways are correct
What are Candidates for Modules?

- Any knowledge where elements of data must be organized
  - White papers
  - X-RADS (e.g. LI-RADS, PI-RADS, TI-RADS)
  - Cancer staging systems
  - Calculators
Caveats

- These modules are to assist reporting, not *rules* to comply with

- Using CAR/DS modules is not the panacea for *not* having to know the subject matter. If you *want* AI to replace you sooner rather than later, than that is the way to do it.
CAR/DS-type system already in some products and will be developed for more VR systems, PACS, EHRs, etc. using ACR Assist tools and content.

The model for dissemination is not finalized, but ACR will produce modules that it will license to any vendor who wants to commercialize it.

ACR will provide some form of validation to assure its proper use.