Optimizing Patient Care through Clinical Decision Support: Call to Action by the National Academy of Medicine

November 5, 2017
AMIA Annual Fall Symposium

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Blackford Middleton, MD, MPH, MSc, Apervita, Inc.
Jonathan Teich, MD, PhD, Harvard University
Scott Weingarten, MD, MPH, Cedars-Sinai Health System
Disclosure

• In the past year, KK has been a consultant or sponsored research on clinical decision support for ONC*, McKesson InterQual, and Hitachi
• BM is an employee of Apervita
• SW is Chairman of the Board of Stanson Health
• The other panelists have no disclosures

*via ESAC, A+ Government Solutions, Hausam Consulting
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<td>SVP &amp; Chief Clinical Transformation Officer, Cedars-Sinai</td>
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Overview of NAM/ONC Effort to Optimize CDS

James E. Tcheng, MD
Professor of Medicine
Professor of Community and Family Medicine (Informatics)
Duke University School of Medicine
Chair, NAM Planning Committee
Project Background

• **Partnership:** National Academy of Medicine (NAM) & Office of the National Coordinator for Health IT (ONC)

• **Aim:** To reflect on the current CDS environment, then identify potential approaches & recommend practical strategies for improving CDS practices and adoption

• **Leadership:** External Planning Committee

• **Deliverable:** Special NAM Publication (Nov 2017)
Planning Committee Members

- James Tcheng, Duke University (Chair)
- Suzanne Bakken, Columbia University
- David Bates, Brigham and Women’s Hospital
- Hugh Bonner III, Saint Francis Hospital
- Tejal Gandhi, National Patient Safety Foundation
- Meredith Josephs, Privia Health
- Edwin A. Lomotan, AHRQ
- Erin Mackay, National Partnership for Women & Families
- Jonathan Teich, Harvard University
- Scott Weingarten, Cedars-Sinai Health System
Small work groups

• **Approach:**
  – CDS Planning Committee initiated 4 topic-specific work groups
  – Each group identified priorities for action and developed brief action plans

• **Leadership:** The work groups are guided by:
  – CDS authoring: Kensaku Kawamoto (University of Utah)
  – Platform integration / technical implementation: Scott Weingarten (Cedars-Sinai Health System)
  – Operations: Jonathan Teich (Harvard University)
  – Spread/distribution: Blackford Middleton (Apervita Inc.)
Strategies for CDS Content

Kensaku Kawamoto, MD, PhD, MHS

Associate Chief Medical Information Officer, Univ. of Utah
Co-Chair, HL7 Clinical Decision Support Work Group

Lead, NAM CDS Content Work Group
Current State

Vision for 25 years+: widespread sharing of effective CDS content

Reality: sharing of effective CDS still limited

Key Questions:

• Why aren’t we there yet?
• What prior work can we leverage?
• How can we finally reach our goal?
Need: Strong Business Case for CDS

Barrier: Fee-for-service = no incentive to improve quality via CDS

Past and Present Efforts:

• Limited incentives for quality; dwarfed by fee-for-service
• Potential game changer: CMS Merit-Based Incentive Payment System (MIPS), Alternative Payment Models (APMs), Physician Focused Payment Models (PFPMs)

Action Priority: Develop business case for CDS content

• Demonstrate CDS ROI via federally sponsored projects/challenges
• Institute strong financial incentives for improving quality
Need: Efficient, Standards-Based CDS Content Sharing

Barrier: Sharing CDS content more expensive than re-inventing wheel

Past and Present Efforts (Highlights):

• ONC-sponsored Health eDecisions (HeD) initiative: standards for knowledge artifacts and CDS services

• ONC and CMS-sponsored Clinical Quality Framework (CQF) initiative: harmonization of HeD standards with quality measurement and FHIR

• CDS Hooks, SMART on FHIR, OpenCDS, EHR support for CDS services
Need: Efficient, Standards-Based CDS Content Sharing

Action Priorities:

• Develop, validate, and adopt standards and tools for CDS sharing (including important building blocks such as value sets and mapping tools)

• Seed the marketplace with useful CDS content
Example: SMART on FHIR Bilirubin CDS App Leveraging CDS Hooks

Consider Exchange Transfusion
Rationale: Patient's latest bilirubin level of 17.1 mg/dL at 46.57 hrs is above treatment threshold for exchange transfusion (16.98) given gestational age >= 35 wks and < 38 wks with risk factors for exchange transfusion.

Billing Measurements
<table>
<thead>
<tr>
<th>Age (Hrs)</th>
<th>Result</th>
<th>Date/Time</th>
<th>Test Type</th>
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<td>8.1</td>
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<td>23.38</td>
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<td>09/27/16 03:32</td>
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<td>46.57</td>
<td>17.1</td>
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<td>Total</td>
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</table>

Albumin Measurements
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<th>Age (Hrs)</th>
<th>Result</th>
<th>Date/Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>43.85</td>
<td>2.9</td>
<td>09/28/16 00:00</td>
</tr>
</tbody>
</table>
CDC Zika Guidelines Encapsulated in OpenCDS via FHIR Clinical Reasoning
Example Zika Virus Exposure Assessment

Patient is pregnant, non-symptomatic, and a resident of, or frequent traveler to, an area with active Zika transmission. Recommend testing for Zika virus IgM once during 1st and 2nd trimesters.
Maximum morphine equivalent daily dose (MEDD) is **545 mg/day** (PRN meds assumed to be taken at maximum allowed frequency). Taper to < 50.

### Active Opioid Rx

<table>
<thead>
<tr>
<th>Drug</th>
<th>Max MEDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxycodone Hydrochloride 5 MG Oral Tablet</td>
<td>45 mg</td>
</tr>
<tr>
<td>Sig: 5 mg Oral every 4 hours as needed</td>
<td></td>
</tr>
<tr>
<td>Daily dose: Oxycodone Oral Tablet 6 id * 5 mg = 30 mg. Morphine equivalence: 1.5x.</td>
<td></td>
</tr>
<tr>
<td>72 HR Fentanyl 0.1 MG/HR Transdermal System</td>
<td>240 mg</td>
</tr>
<tr>
<td>Sig: Apply 1 patch to the skin every 72 hours.</td>
<td></td>
</tr>
<tr>
<td>Prescriber: Michael Flynn, MD. Rx date: 2017-09-19.</td>
<td></td>
</tr>
<tr>
<td>Dispense: 30 patches. Refills: 0. Expected supply duration: through 2017-12-17.</td>
<td></td>
</tr>
<tr>
<td>Daily dose: Fentanyl patch: 1 * 0.1 mg/hr ~ 0.1 mg/hr. Morphine equivalence: 2400x.</td>
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</tr>
<tr>
<td>Buprenorphine 2 MG Sublingual Tablet</td>
<td>120 mg</td>
</tr>
<tr>
<td>Sig: Place 2 mg under the tongue 2 times a day.</td>
<td></td>
</tr>
<tr>
<td>Prescriber: HISTORICAL, MEDS.</td>
<td></td>
</tr>
<tr>
<td>Daily dose: Buprenorphine Sublingual Tablet 2 id * 2 mg = 4 mg. Morphine equivalence: 30x.</td>
<td></td>
</tr>
<tr>
<td>Methadone Hydrochloride 10 MG Oral Tablet</td>
<td>80 mg</td>
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<tr>
<td>Sig: Take 0.5 tablets by mouth every 6 hours as needed for pain for up to 180 days.</td>
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<td>Prescriber: Michael Flynn, MD. Rx date: 2017-09-19.</td>
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<td>Dispense: 360 tablets. Refills: 0. Expected supply duration: through 2017-12-30.</td>
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<td>Daily dose: Methadone Oral Tablet 4 id * 5 mg = 20 mg. Morphine equivalence: 4x.</td>
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<tr>
<td>Oxycodone Hydrochloride 5 MG Oral Capsule</td>
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<tr>
<td>Sig: Take 2 capsules by mouth every 6 hours as needed.</td>
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<tr>
<td>Prescriber: Michael Flynn, MD. Rx date: 2017-09-19.</td>
<td></td>
</tr>
<tr>
<td>Daily dose: Oxycodone Oral Capsule 4 id * 10 mg = 40 mg. Morphine equivalence: 1.5x.</td>
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</tbody>
</table>

**Total** 545 mg

### CDC Opioid recommendation #5

**MMX conversion table**

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Need: Discovery and Dissemination of CDS Best Practices

Barrier: Insufficient guidance on creation of effective CDS. Much of current CDS viewed as nuisance ("alert fatigue")

Past and Present Efforts:
• Compilation of CDS best practices (e.g., 10 Commandments, 5 Rights)
• Best practices from clinical trial evidence
• AHRQ Patient-Centered Outcomes Research CDS Learning Network
Need: Discovery and Dissemination of CDS Best Practices

**Action Priority:** Accelerate discovery & dissemination of best practices

- Make national investments in CDS research (e.g., for multi-site RCTs)
- Establish robust, interoperable CDS marketplace within context of business incentives to improve care quality
Upcoming Sessions on Standards-Based CDS Implementation

Monday 10:30-12:00
• S32: SMART on FHIR Apps from the University of Utah Interoperable Apps and Services (IAPPS) Initiative

Tuesday 8:30-10:00
• S64: Enabling-Knowledge Driven Care at Scale through CDS Hooks and the FHIR Clinical Reasoning Module

February 15-16
• Healthcare Services Platform Consortium (HSPC) Implementers Forum
Strategies for CDS Implementation

Scott Weingarten MD
Senior Vice President
Chief Clinical Transformation Officer
Cedars-Sinai Health System
Stanson Chairman of Board
• EHR native rules engines
  - Different approaches, workflow
  - Mapping
  - Impacts implementation costs
  - Challenging to scale
• CDS in the Cloud (Web API)
  - Easier to scale
  - Reduces EHR vendor work
  - Across multiple EHRs
  - Reduces content vendor work
  - Reduces implementation costs
  - Requires standards
  - Sustainable, scalable
CDS Implementation

Content Management
Develop, Update, Maintain

Cloud CDS
EMR

Manage CDS
Retire poor performing CDS

EMR Embedded Rules Engine

Deploy CDS

* Active integration discussions
Strategies for CDS Implementation

BEFORE Ordering
Education
Remove low performing CDS
Optimize order sets, preference lists
  19% reduction cardiac monitoring orders*
  67% reduction Vitamin D orders**

DURING Ordering
CDS

AFTER Ordering
Peer-comparison feedback
  20% to 4% antibiotics for URIs***

*Epic UGM 2017
**JAMIA 2017;24:776-8
***JAMA 2016;315:562-70
Vitamin D intervention, Kaiser Permanente

“Making it harder to do the wrong thing”

Education

Removing items from preference list

“Hard stop” alerts

Results

Screening declined 3-fold, from 74 tests/1,000 to 24 tests/1,000 (p<0.001), 67% decrease

Appropriate care increased 56% to 70%

Inappropriate care decreased 44% to 30%

Followed rates decreased 10% to 4%, best practice internalized

JAMIA 2017;24:776-80
### Before Ordering

#### INITIATE CARDIAC MONITORING

**NURSING TREATMENTS AND TASKS [41469]**

<table>
<thead>
<tr>
<th>order source</th>
<th>totals</th>
<th>patients</th>
<th>encounters</th>
<th>alerts</th>
<th>alert to order</th>
<th>patient to order</th>
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<tbody>
<tr>
<td>ANE IP POST-PROCEDURE / POST OP (FOR PACU ONLY) order set [1464]</td>
<td>1,680</td>
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<td>CSHS IP ORD DEP MD MEDICAL IP3 preference list [157248]</td>
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<td>CSHS IP ORD FAC NURSING IP3 - IP preference list [158994]</td>
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<td>ICU IP MEDICAL ADMISSION order set [1400]</td>
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<td>CSHS IP ORD DEP ED NURSING preference list [2436]</td>
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<td>0</td>
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Don't order continuous telemetry monitoring outside of the ICU without using a protocol that governs continuation.
Telemetric monitoring is of limited utility or measurable benefit in low risk cardiac chest pain patients with normal electrocardiogram. Published...
Before Ordering

Total Time on Cardiac Monitoring

- **Q1**: 245,582
- **Q2**: 263,236
- **Q3**: 293,461
- **Q4**: 210,726

Discharge Month:
- Jul'16: 77,519
- Aug'16: 84,663
- Sep'16: 83,400
- Oct'16: 86,818
- Nov'16: 85,527
- Dec'16: 90,891
- Jan'17: 105,780
- Feb'17: 93,454
- Mar'17: 94,228
- Apr'17: 80,470
- May'17: 73,620
- Jun'17: 56,636
- Jul'17: 51,192

Source: Clarity
During Ordering
## During Ordering

<table>
<thead>
<tr>
<th>Today</th>
<th>Tomorrow</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Data Icon] uses <strong>structured EMR</strong> data</td>
<td>![Data Icon] structured + <strong>unstructured</strong> data (via NLP/ML)</td>
</tr>
<tr>
<td>![Guidance Icon] uses <strong>rules-based</strong> approach</td>
<td>![Guidance Icon] uses rules-based + <strong>AI-based</strong> (ML) approach</td>
</tr>
<tr>
<td>![Delivery Icon] <strong>episodic</strong>: delivered in response to specific provider actions</td>
<td>![Delivery Icon] <strong>episodic + surveillance</strong>: delivered whenever and wherever clinical circumstances change</td>
</tr>
</tbody>
</table>
During Ordering

• Measuring impact
  o Followed rate
    ▪ Decline over time with educational effect
  o Educational effect
    ▪ Workflow
      o PAP smears, colonoscopy
  ▪ Peer-comparison feedback
Randomized controlled trial
Low value care

- **Antibiotics for URIs**
- 248 providers
- 14,753 patient visits
- **Control** (24.1% to 13.1%)
- **Suggested alternative** (22.1% to 6.1%, NS)
- **Peer-comparison feedback** (19.9% to 3.7%, p<0.001)
- **Accountable justification** (23.2% to 5.2%, p<0.001)

1 year later

- **Drift**
- **Peer-comparison feedback still has some impact**
Priorities for Action

• Evidence for implementation science
  ○ Pilots
    ▪ Implementation in real-world environments
    ▪ Across different workflows
    ▪ Using different implementation models
    ▪ Evaluate usability and impact over time

• Implementation standards
  ○ Cloud
    ○ National standards with federal and industry partners
    ○ Examples include SMART on FHIR, CDS Hooks
    ○ Sharing of best practices

• Consider incentives for CDS use
Strategies for CDS Operations

Jonathan Teich, MD, PhD

Depts. of Medicine and Emergency Medicine
Brigham & Women's Hospital / Harvard Univ.

Lead, NAM CDS Operations Work Group
CDS Core Components

Figure 7-1: Intervention Core Components and Their Sequence in Intervention Execution

- Trigger
- Logic: intervention needed?
  - Yes: EHR Data
  - No: Exit (if needed)
- Notification
- Acknowledgement
- Presentation
- Action Items
CDS Core Components

Figure 7-1: Intervention Core Components and Their Sequence in Intervention Execution

- Be precise
- Make it easy to comply OR except
- Show relevant data and knowledge
- State reason for intervention
CDS-related EHR operation

Trigger points
- Register
- ADT
- Observation
- Order start
- Med select
- Test result
- Time

Data
- Meds
- Conditions
- Test Results
- Vitals
- Events

Actions
- Add Order
- Del/Chg Order
- Display info
- Post assertion
- Exception
- [Log]
Full operational lifecycle

Model

Measure

Implement
Operational problems & priorities

1. Usability design:
   - Problems: nonspecific (over-alert); too late; interruptive; crowded; difficult to take action
   - Collect, codify examples of good practices, educate with dos and don’ts – varied CDS types, varied settings
   - Publish usability evaluations of EHR and CDS systems

2. Standard CDS operation:
   - Problem: inconsistent CDS and EHR-interface components
   - Define CDS core elements allowing standard CDS build
   - Specify and require two-way APIs: standard triggers, data and actions in certified EHRs
Operational problems & priorities

3. Reusable CDS:
   - Problem: cannot leverage good work elsewhere
   - Specify CDS Repository standard with logic, core elements, index, performance data

4. Implementation & communication:
   - Problem: stakeholders not involved early; inconsistent governance; “computer making policy”; patients not involved where appropriate
   - Include stakeholders in above planning groups
   - Routine collaboration of proponents, users, vendors
   - Include patient preferences and PSDH in CDS
   - Collect, educate & facilitate best practices
Operational problems & priorities

5. Measurement:
   – Problem: lack of logging & analysis tools in EHRs; lack of broad forum for evaluation and feedback; failure to measure true process and outcome objectives.
   – Establish logging standard & requirement, measures, test suites – with all stakeholders including vendors.

6. Drivers:
   Problem: payment and regulatory requirements prioritize documentation, do not provide drive for CDS.
   • Produce ideas for reasonable payment incentives and requirements for CDS.
Priority areas

1. Usability design
2. Standard CDS operation
3. Reusable CDS
4. Implementation and communication
5. Measurement
6. Drivers
Strategies for CDS Dissemination

Blackford Middleton, MD, MPH, MS
Chief Informatics & Innovation Officer, Apervita, Inc.
Lead, NAM CDS Dissemination Work Group
Toward a Shareable Knowledge Ecosystem

Clinical Decision Support Consortium
Middleton B, PI: 2008-13, AHRQ—funded: HHSA290200810010

• Major accomplishments:
  – Knowledge artifacts published: 11 clinical rules, 50+ classification rules and 375 immunization schedule rules -- 87 rules total published on KM Portal
  – 8 clinical sites implemented using 5 different EHRs
  – More than 240 users utilize CDS services
  – Established legal framework for collaboration
  – Since 2010 more than 1.7M CCD transactions were processed
  – 31 entities (companies and academics) in a pre-competitive environment
  – Contributed to ONC-sponsored Health-e-Decisions efforts: KAS 1 and KAS 2

Advancing Clinical Decision Support
Bell PI and Middleton Co-PI: Rand-Harvard, 2010-11 ONC—funded: HHSP23320095649WC

• Take away findings:
  – Limited expertise in translating evidence or experience into knowledge artifacts
  – Need standards-based approach to knowledge sharing
    • Standard knowledge artifact specifications
    • Standard approaches to CDS web services
  – Need credible library of knowledge artifacts to meet users’ CDS implementation needs
    • And maintenance model
CDS “Unified Approach”

Clinical guidelines
Local protocols
Experience

CDSC “L2”
GEM Import

CDSC “L3”
Duodecim Import
GRades Import

CDSC “L4”
OpenCDS
CDS cloud service

CDS Performance Data

$25B

Clinical Knowledge

Structured Knowledge

Encoded & Machine-Interpretable Knowledge

Decision Support Service

HeD KAS 1

HeD KAS 2

EHRs

Kawamoto K, Middleton B, Reider J, Rosendale D, Schiffman R.

From Guidelines to Clinical Decision Support: a Unified Approach to Translating and Implementing Knowledge

AMIA Panel Presentation, Chicago, IL 2012

“CDSC” = CDS Consortium
EHR - API Ecosystem

K.D. Mandl, J.C. Mandel, I.S. Kohane,
CDS Marketplace Current State

CDS Resource Sharing and Use
Discern Health Recommendations to Office Clinical Quality and Safety, ONC, 2015
CDS Market Preferred State

Supply

Generation

Translation

Standards and automation to support efficient translation

Feedback contributes to a continuously learning system

Exchange

Competition increases benefits and lowers cost

Multiple options for users to buy

Demand

Integration

Awareness of benefits, lower cost, and trust stimulate demand

Use

Standards and automation make customization and maintenance less costly

Feedback
Marketplace Guiding Principles, 1/2

1. Anchor CDS Distribution in Basic Principles
   – ‘5 rights’, actionable/reportable, workflow integration, web services, interoperable

2. Articulate CDS value statements for different purposes and stakeholders
   – Value proposition from individual practitioner to macro scale

3. Leverage the developments in financing and measurement to accelerate CDS adoption.
   – Incentivize adoption through payment reform; measure and assess performance
Marketplace Guiding Principles, 2/2

4. Reorient health care financing to decision-making
   – Reward documentation of decisions (not just observations)

5. Industry should work closely with federal partners, patients and families, and representatives from professional societies to advance awareness, understanding, and application of CDS strategies
   – Improve multi-stakeholder awareness of CDS benefits
   – Address legal barriers to CDS use, knowledge sharing

6. Industry, in collaboration with multiple partners, should take a lead in industry regulation and certification efforts
   – Assess/define appropriate regulatory framework for CDS
Priorities

• Assess, define, demonstrate the value proposition for CDS from individual care encounter to the national scale. Publicize widely.

• Assess, define, demonstrate best practices for CDS implementation at scale: appropriate standards, workflows (insertion points), APIs and architecture

• Assess, define, demonstrate best practices for CDS knowledge interoperability to support wide dissemination (knowledge exchange)
Cross-Cutting Recommendations

James Tcheng, MD
Professor of Medicine and Community and Family Medicine (Informatics)
Duke University School of Medicine
Chair, NAM Planning Committee
Developing Priorities for Action

• Over the course of the project, a comprehensive set of key Priorities for Action was identified. Participants prioritized the following actions for optimizing strategies for CDS adoption and use, and offered actionable collaborative steps that could be initiated over the next 5 years.

• The intent is to forward the discussion in a way that complements and enhances clinical practice.

• Of note, these actions are cross-cutting, and will require commitment by multiple stakeholders.
Priorities for Action

• Develop, test, establish, validate, and apply standards
  – Establish CDS technical standards
  – Provide federal funding for CDS standards management
  – Create a CDS technical information resource

• Encourage adoption, use & assessment at the delivery system level
  – Disseminate best practices
  – Create a national CDS repository network
  – Measure CDS usage
  – Develop tools to assess CDS efficacy
  – Publish performance evaluations
  – Leverage meaningful financing and measurement incentives
  – Market CDS to stakeholders

• Establish a national CDS infrastructure
  – Create a CDS legal framework
  – Develop a multi-stakeholder CDS learning community to inform usability
  – Establish a federal investment program in CDS research
Priorities for Action

1. Establish Clinical Decision Support (CDS) technical standards.
   - Develop coordinated activities to stand up standard intervention templates, methods, artifacts, and intervention repositories.
   - Develop a standard set of each of the core CDS operational elements such as EHR trigger points, action items, and supporting data [leveraging existing work such as the 2012 NQF Expert Panel report and existing HL7 standards] to increase predictability of the EHR environment.
   - Establish repeatable conventions [e.g., FHIR resources, APIs] to pass data and context/situational info from the EHR to the CDS and to accept recommendations from the CDS back to the EHR.
   - Stand up an entity of appropriate stakeholders to resolve governance issues and drive EHR vendor acceptance for support of CDS standards.
Priorities for Action

Priorities for Action: An Industry Response

• Establish CDS technical standards
• Create a national CDS repository network
• Market CDS to stakeholders
• Measure CDS usage
Priorities for Action

Priorities for Action: Clinicians & Health Delivery Systems

- Develop tools to assess CDS efficacy
- Measure CDS usage
- Leverage meaningful financing and measurement incentives to accelerate CDS adoption
Priorities for Action

Priorities for Action: Partnering with Professional Societies

• Establish Clinical Decision Support (CDS) technical standards
• Create a CDS information resource
• Disseminate best practices
• Market CDS to stakeholders
• Publish performance evaluations
Discussion and Q&A

• How can you or your organization contribute to the Priorities for Action?
• What can ONC, NAM, and others do to accelerate progress?
• What barriers do you see, and how do you think we should overcome them?
### Thank You!

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