New Challenges in Regulating Artificial Intelligence in Radiological Imaging

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Overview of Regulation of Radiological AI/ML

- Mission & Vision
- Key Regulatory Concepts
- Brief History
- New Challenges
CDRH’s Mission

✓ Protect and promote public health

✓ Safe, effective, and high-quality devices

✓ Science-based information

✓ Facilitate innovation
Our Vision for Radiological AI/ML

Patients in the U.S. have access to high-quality, safe, and effective devices first in the world.

The U.S. is the world’s leader in regulatory science and technology development.

Transparency and real-world evidence foster confidence in device performance.

Policies that are consistent, transparent, and effective for public health.
Key Regulatory Concepts

• For new technologies, discussion of the
  – Benefits and risks, and
  – Potential risk mitigation through general/special controls
helps determine the appropriate regulatory pathway and performance testing
General and Special Controls

- General controls apply to all medical devices, unless exempted by regulation
  - Examples: registration and listing, and good manufacturing practices

- Alone are unlikely to provide a reasonable assurance of safety and effectiveness for radiological AI/ML devices
General and Special Controls

• Special controls
  – When general controls alone are **not** sufficient
  – Experience and knowledge can be used establish device-specific risk mitigations
  – Examples:
    • Performance testing: “A thorough, quantitative evaluation of the diagnostic utility and quality of images/data acquired, or optimized, using the device”
    • Labeling: “A statement on upholding the As Low As Reasonably Achievable (ALARA) principle with a discussion on the associated device controls/options”
# Premarket Submission Pathways

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<th>Pathway</th>
<th>Summary</th>
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<tr>
<td><strong>De Novo</strong></td>
<td>Establishes the 510(k) pathway for a new device type if general/special controls are sufficient for risk mitigation</td>
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<td><strong>510(k)</strong></td>
<td>Evaluation of substantially equivalence of a device to a legally marketed predicate; FDA reviews intended use, technological characteristics, performance testing, and if special controls need to be addressed</td>
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<td><strong>Premarket Approval (PMA)</strong></td>
<td>High-risk devices that already require a PMA; or general/special controls are not adequate for risk mitigation</td>
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*A De Novo can also result in a 510(k) Exempt determination and/or a determination that general controls alone are sufficient for risk mitigation*
510(k) & Special Controls

- Special controls provide consistency and transparency on the expectations for the validation of safety, effectiveness, and risk mitigations in future 510(k)s.
Regulation of Radiological AI/ML

• How does experience and knowledge of
  – Benefits and risks
  – Risk mitigation through special controls, and
  – Validation / performance testing
facilitate our mission and vision for radiological AI/ML?
Regulation of Radiological AI/ML

1998 - 2017

• Premarket Approvals for Computer Aided Detection (CADe)
  – 1998 – First PMA approval for mammography CADe
  – 1998 to 2017 – Additional approvals for specific dental, chest radiograph, mammography, and ultrasound indications

• **Experience** from regulating CADe and other uses of AI/ML for image processing tasks (e.g., segmentation) and 510(k)s for CT colon/chest CADe

• **Knowledge** from public meetings, research, guidance development, and public feedback
• Relied on experience and scientific knowledge to define **special controls** for risk mitigation
• Established the 510(k) regulatory pathway for more radiological AI/ML device types through De Novos and reclassification
Regulation of Radiological AI/ML

- De Novos
  - 2017: Computer aided diagnosis (CADx) (DEN170022, QuantX)
  - 2018: Computer aided triage (CADt) (DEN170073, ContaCT)
  - 2018: Combined detection and diagnosis (CADe/x) (DEN180005, OsteoDetect)
  - Feb 2020: Radiological acquisition and/or optimization guidance systems (DEN190040, Caption Guidance)

- Reclassification
  - Jan 2020: Reclassification of CADe from PMA to 510(k)
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<th>Intended Use</th>
<th>Description</th>
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<td><strong>Computer Aided Detection</strong></td>
<td>• CADx: concurrent/sequential use to aid the identification of potential disease; 510(k) under 21 CFR 892.2050 or 892.2070</td>
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<tr>
<td><strong>Computer Aided Diagnosis</strong></td>
<td>• CADx: concurrent/sequential use to aid the classification of lesions suspicious of cancer; 510(k) under 21 CFR 892.2060</td>
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<tr>
<td><strong>Computer Aided Detection &amp; Diagnosis</strong></td>
<td>• CADe/x: combined systems that both detect and provide a classification of potential disease; 510(k) under 21 CFR 892.2090</td>
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<tr>
<td><strong>Computer Aided Triage &amp; Notification</strong></td>
<td>• CADt: notification of potentially time sensitive findings – not CADe/x; 510(k) under 21 CFR 892.2080</td>
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<tr>
<td><strong>Radiological Acquisition &amp; Optimization Guidance</strong></td>
<td>• Aid the acquisition/optimization of images/diagnostic signals; 510(k) under 21 CFR 892.2100</td>
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Regulation of Radiological AI/ML

- Special controls provide consistency and transparency on the expectations for the validation of safety, effectiveness, and risk mitigation in future 510(k)s.
• Continue to refine policies for current technologies...
• Promote best practices...
  – Study designs that match the intended use/indications
  – Not tuning on the “validation” dataset
  – Pre-specified algorithm change and testing protocols
• Seek greater insight on post-market performance
• Engage with CDRH Digital Health efforts
Regulation of Radiological AI/ML

• Many challenges – but this workshop is more specific!
• Proactively discuss
  – Benefit and risks
  – Potential risk mitigation through special controls, and
  – Validation / performance testing

for autonomous AI/ML systems and AI/ML-guided image acquisition systems
New Challenges

• Day 1: Autonomous AI/ML systems that automate some portion of the radiological imaging workflow

• Day 2: AI/ML-guided image acquisition systems that guide a non-expert user to acquire diagnostic quality images

• Both challenge the standard of care by introducing new questions of safety and effectiveness into an established radiological imaging workflow

• What risk mitigations and performance testing are appropriate?
Example – Autonomous AI/ML

• **Device:** AI intended to identify a patient’s condition as stable from images, without a radiologist’s review to confirm

• **Benefits include:** Potential reduction in radiologists’ workload allowing them to focus on more critical cases

• **Risks include:** Potential for false negatives and missing secondary findings the algorithm was not trained to identify

• **Challenging questions:**
  – What are approaches to establish an acceptable device performance?
  – What other risks are introduced for the radiological imaging workflow, patients, and healthcare providers?
  – What additional experience or knowledge do we need to develop sufficient risk mitigations?
  – Should real-world performance monitoring and QC be expected as AI becomes more autonomous?
Example – AI Guided Imaging

• **Device**: AI guided ultrasound intended to enable use by untrained operators in emergency settings

• **Benefits include**: Faster acquisition of diagnostic information that can be transmitted to a remote reading room

• **Risks include**: Failures may delay patient care or result in an incorrect diagnosis; lack of operator knowledge of ALARA

• **Challenging questions**:  
  – What trade-off in image quality is acceptable?  
  – What risks could be mitigated with just-in-time operator training?  
  – What are potential mechanisms to assess real-world performance?  
  – Can special controls be adapted to mitigate the risks in different scenarios?  
  – What level of transparency will give users confidence in the AI?  
  – What are the patient perspectives?
Summary

• We’re seeking feedback on the
  – Benefit-risks
  – Risk mitigations, and
  – Validation / performance testing

for autonomous AI/ML systems and AI/ML-guided image acquisition systems to best inform policies that support our public health mission and vision.