TAILORING FDA’S REGULATORY FRAMEWORK TO ENCOURAGE RESPONSIBLE INNOVATION IN AI/ML

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Overview

- The promise and resulting challenges and opportunities
- Tailoring our regulatory approach for emerging technology
- A pathway towards practical regulation that promotes responsible innovation
The Promise of AI/ML in Healthcare

AI can address unmet clinical demand

20% Estimated Unmet Demand Addressable via AI

Clinician Supply

Clinician Demand

Source: Accenture analysis. Graph is not to scale and is illustrative.

Top 10 AI Applications

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>VALUE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robot-Assisted Surgery*</td>
<td>$40B</td>
</tr>
<tr>
<td>Virtual Nursing Assistants</td>
<td>$20B</td>
</tr>
<tr>
<td>Administrative Workflow Assistance</td>
<td>$18B</td>
</tr>
<tr>
<td>Fraud Detection</td>
<td>$17B</td>
</tr>
<tr>
<td>Dosage Error Reduction</td>
<td>$16B</td>
</tr>
<tr>
<td>Connected Machines</td>
<td>$14B</td>
</tr>
<tr>
<td>Clinical Trial Participant Identifier</td>
<td>$13B</td>
</tr>
<tr>
<td>Preliminary Diagnosis</td>
<td>$5B</td>
</tr>
<tr>
<td>Automated Image Diagnosis</td>
<td>$3B</td>
</tr>
<tr>
<td>Cybersecurity</td>
<td>$2B</td>
</tr>
</tbody>
</table>

TOTAL = $150B

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Opportunities and Challenges

Data Responsibility

Learning Bias + Ethics

Access to Evidence and Experience

Augmenting health care
Responsible Innovation

- Improve healthcare delivery
- Avoid unintended consequences
AI/ML for Medical Purpose – A Subset of SaMD

Artificial Intelligence (AI)
Programming computers to perform tasks to mimic human capabilities—such as understanding language, recognizing objects and sounds, learning, and problem solving—by using logic, decision trees, machine learning, or deep learning

Machine Learning (ML)
Subset of AI that gives “Computers the ability to learn without being explicitly programmed” -Arthur Samuel, 1959

Supervised Learning (labeled data)
Unsupervised Learning
Deep Learning
Subset of ML: enable computer to teach itself by exposing it to vast amount of data
Reinforcement Learning
A Rapidly Evolving Situation ...

The Need for a Tailored Approach

Current Device World

Product Development Timeline
• Months to years +
• Less frequent modifications

Postmarket Data
• Limited availability and access to real world data (522, PAS, MDRs, MedSun)

FDA Premarket Program Volume:
• Stable (~3,500 510(k) submissions / 2200 pre-submissions)

Evolving Digital Health Device World

Weeks to months + (incremental, iterative) and potentially frequent modifications

Potential for high availability and access to rich real world data (benefits and risks)

Potential for exponential increase in volume of submissions
Open Questions

Evaluation of safety and effectiveness:

- **Current hardware devices**: Human modifies, we understand
- **Fixed Algorithm SaMD**: Human/technology modifies, can be explained
- **Deep Learning SaMD**: Technology modifies, cannot be explained

Open Questions:
- Continuous learning while assuring safety and effectiveness?
- Availability for large and robust datasets with representable clinical variability
- Continuous algorithm updates
- Interpretability and explain-ability of the “basis of the recommendation”
Objectives for a Tailored Regulatory Framework

- Reasonable Assurance of Safety and Effectiveness (RASE)
- Improved time for patients to access high-quality software medical devices first in the world
- Improved submission experience (Clarity, Predictability, Efficiency of review process)
- Least burdensome
Five Excellence Principles Proposed

- **Patient Safety**: Demonstration of a commitment to providing a *safe patient experience*, and to emphasizing patient safety as a critical factor in all decision-making processes.

- **Product Quality**: Demonstration of a commitment to the development, testing, and maintenance necessary to deliver SaMD products at the *highest level of quality*.

- **Clinical Responsibility**: Demonstration of a commitment to responsibly *conduct clinical evaluation and to ensure that patient-centric issues* including labeling and human factors are appropriately addressed.

- **Cybersecurity Responsibility**: Demonstration of a *commitment to protect cybersecurity*, and to proactively address cybersecurity issues through active engagement with stakeholders and peers.

- **Proactive Culture**: Demonstration of a commitment to a *proactive approach* to surveillance, assessment of user needs, and continuous learning.
Move from **episodic** oversight to **continuous** oversight that enables **trust** in the organization and a pragmatic check-in with **real-world** organization and product performance data.
Development Lifecycle for the Software Precertification Pilot Program

A Pilot:
To help inform the development of a future regulatory model

2017
EXPLORE

2018
CONCEPT

2019+
FEASIBILITY TESTING
(Iterative Prototyping)

TBD
Evaluate Results for
Path Forward
Discussion Paper

A **TPLC** approach for modifications to AI/ML

*Software as a Medical Device (SaMD)*
FDA’s Proposed TPLC Approach

Good Machine Learning Practices

- Data selection and management
- Model training and tuning
- Model validation
  - Performance evaluation
  - Clinical evaluation
- Data for re-training

Legend
- AI Model Development
- AI Production Model
- AI Device Modifications
- Proposed TPLC Approach

New (Live) Data → Deployed Model → Model monitoring

- Log and track
- Evaluate performance

SPECTRUM OF ML/AI-BASED ALGORITHMS

- Lock Algorithm, Discrete Updates
- Updates less frequent
  - and performed by human
- Updates more frequent
  - and performed by computer
- Continuously Adaptive Algorithm

Culture of Quality and Organizational Excellence

- Performance evaluation
- Clinical evaluation

Review of SaMD Pre-Specifications and Algorithm Change Protocol

Premarket Assurance of Safety and Effectiveness

Real-World Performance Monitoring

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Review of SaMD Pre-Specifications and Algorithm Change Protocol

Premarket Assurance of Safety and Effectiveness

Real-World Performance Monitoring
Proposed Goals for an AI/ML Framework

1. Allow for frequent iterations in alignment with the way AI/ML works naturally.
2. Ensure that the performance of products improves over time while avoiding their degradation.
3. Advance the standard of care / create an environment with a better standard of care.
Collaborate to Build Practical Oversight