From Submission-Ready to AI-Ready: Balancing Compliance, Automation, and Intelligence

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March 5, 2026

Agenda

Why This Conversation Now – The Quiet Shift in Clinical Data
AI adoption is advancing faster than standards evolution

Submission-Ready vs AI-Ready
Where compliance ends and machine readiness begins

Where Standards Already Enable Automation
What works well across CDASH, SDTM, and ADaM

Where Friction Creeps In
Early design choices that limit downstream intelligence

The Role of Human Judgement
Why AI augmentation still needs expert oversight

What Might Need to Evolve
Preparing standards for intelligent automation, without disruption

Looking Ahead
What “AI-Ready” could mean in practice

The Quiet Shift in Clinical Data

- **AI is no longer experimental. It is embedded in production workflows.**
  - Reviewing QC outputs
  - Flagging data anomalies
  - Drafting outputs
  - Assisting analysis

…And it is relying on the standards we built, supporting regulated workflows, not just innovation labs.

- **Why is this shift happening?**
  - Rapidly expanding trial data volumes
  - Compressed development timelines
  - Increasing cross-study complexity
  - Demand for faster, reusable insight across studies

Designed for Compliance. Now Expected to Support Intelligence.

Our Standards Were Designed To:

- Enable regulatory submission
- Ensure human traceability
- Provide structural consistency (SDTM/ADaM)
- Enable regulatory confidence

They Are Now Being Asked To:

- Enable intelligent automation (rule-based SDTM checks, metadata-driven mapping)
- Support explainable decision-making (e.g. traceable derivations for ADaM analysis flags so both regulators and AI can trace how endpoints are calculated).
- Minimize semantic ambiguity
- Scale interpretation across datasets
- Ensure interoperability across clinical systems (EDC, CTMS, external data vendors, EHR bridging), enabled by metadata governance (MDR).
- Leverage standardized medical ontologies (e.g. SNOMED, LOINC)
- Provide rich, contextual metadata for machine learning

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Quick Pulse Check

1. **In your organization, AI is currently:**

a) Experimental
b) Supporting limited workflows
c) Embedded in multiple processes
d) Being formally evaluated for scale

2. **Do you believe our current standards are fully AI-ready?**

a) Yes
b) No
c) Not sure

3. **Who should adapt more to enable AI at scale?**

a) Standards should evolve
b) AI tools should adapt to existing standards
c) Both a) and b) equally
d) Not sure

https://www.menti.com/alin7qqdk1f3

Submission-Ready vs. AI-Ready: What's the Real Difference?

Submission-ready data is:

- Structurally consistent
- Traceable end-to-end
- Controlled by defined terminology
- Reviewable by regulators
- Defensible in an audit

→ **Proves compliance**

AI-ready data requires:

- Explicit meaning (not implied)
- Minimal ambiguity
- Rich, structured metadata context
- Reduced dependence on human interpretation. Logic needs to be machine-interpretable
- Relationships across variables are computable, not just readable

→ **Enables machines to understand the data**

Where Standards Already Enable Automation

For years, we have automated:

- SDTM validation rules
- Metadata consistency checks
- Template-driven ADaM derivations
- Cross-study QC comparisons

→ **These are standards-driven automation, not new AI innovations.**

This automation is possible because standards provide:

- Predictable domain structures
- Consistent variable naming
- Controlled Terminology
- Defined traceability across datasets
- Repeatable derivation logic

→ **Predictability is what makes automation scalable.**

CDISC 360i extends this foundation:

- Unified Study Definitions Model (USDM) – a machine-readable digital representation of the study protocol
- Biomedical Concepts (BCs) – standardized semantic building blocks. Reusable, standardized definitions of clinical concepts (e.g. systolic blood pressure, tumor response) that link study design to CDASH/SDTM
- Digital Schedule of Activities – structured study design (computable study timelines)
- Open Rules Engine – continuous conformance checking

→ **Automation is moving upstream, from validation to design.**

Where Friction Creeps In

The bottleneck isn't the mapping — It's the data.

- **Core Challenges**
  - Inconsistent, messy source data limits automation
  - Poor interoperability across EDC, SDTM, and downstream tools
  - Privacy and ethical concerns

- **Regulatory Reality**
  - FDA flags risks around bias, data quality, transparency, and model drift:
    - *Considerations for the Use of Artificial Intelligence To Support Regulatory Decision-Making for Drug and Biological Products*
  - Current AI models lack explainability and reproducibility
  - Lifecycle maintenance required as data evolves

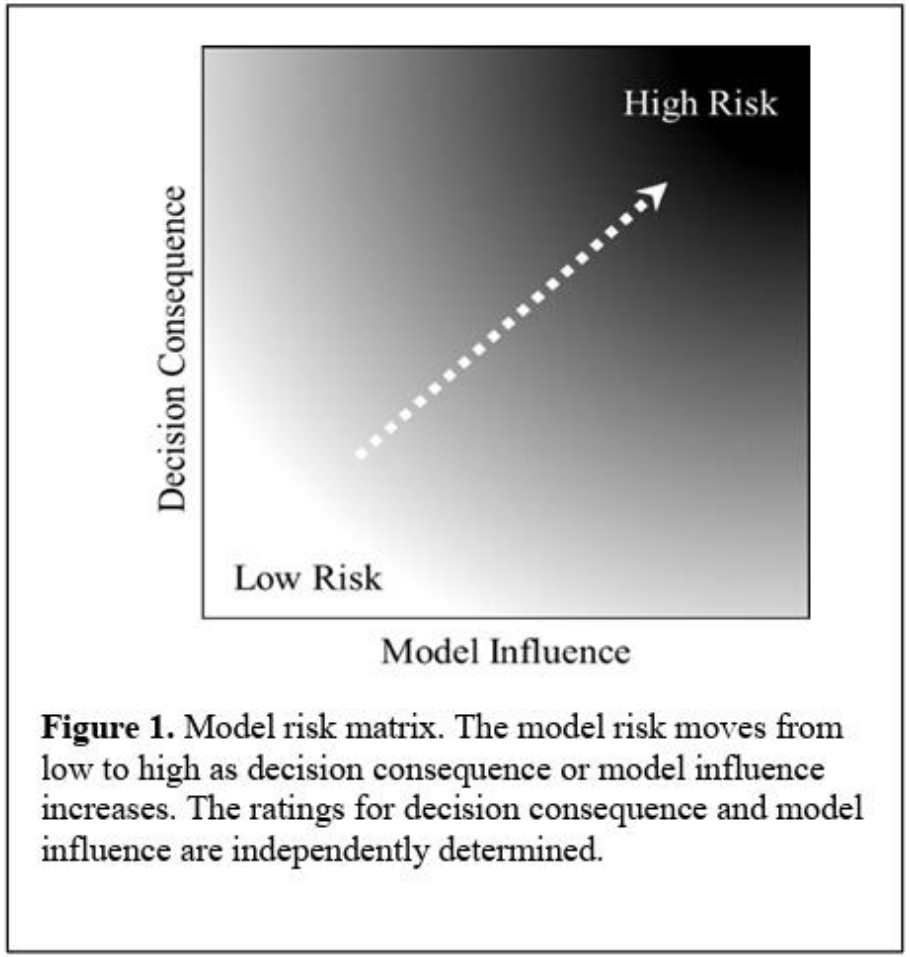

Figure 1. Model risk matrix. The model risk moves from low to high as decision consequence or model influence increases. The ratings for decision consequence and model influence are independently determined.

FDA: Considerations for the Use of Artificial Intelligence To Support Regulatory Decision-Making for Drug and Biological Products

https://www.fda.gov/regulatory-information/search-fda-guidance-documents/considerations-use-artificial-intelligence-support-regulatory-decision-making-drug-and-biological

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The Role of Human Judgement

Why Humans Still Matter

- Human interaction in clinical trials
- Sponsors—not AI—remain accountable to regulators
- Ensure raw inputs are correct and biases don't creep in
- Human validation guards against over-confidence in automated outputs

What Only Humans Can Do

- Reproduce results without AI
- Interpret protocol nuances AI may miss
- Navigate gray areas where standards need experience, not algorithms

Building Responsible AI

- Select credible models and monitor for bias
- Maintain transparent audit trails
- Balance AI efficiency with ethical, environmental considerations

What Might Need to Evolve

- **Raising the Data & Standards Bar**
  - Data collection needs consistent, downstream-aware standardization
  - EDC ↔ dataset tool interoperability must improve like CDISC 360i
  - Programming guidance and Real-World Data must become more unified and predictable
  - Clear expectations for documenting AI-generated data and models for regulators

- **Regulatory Confidence in AI**
  - Agencies may require validation metrics, audit trails, and new documentation standards for AI models

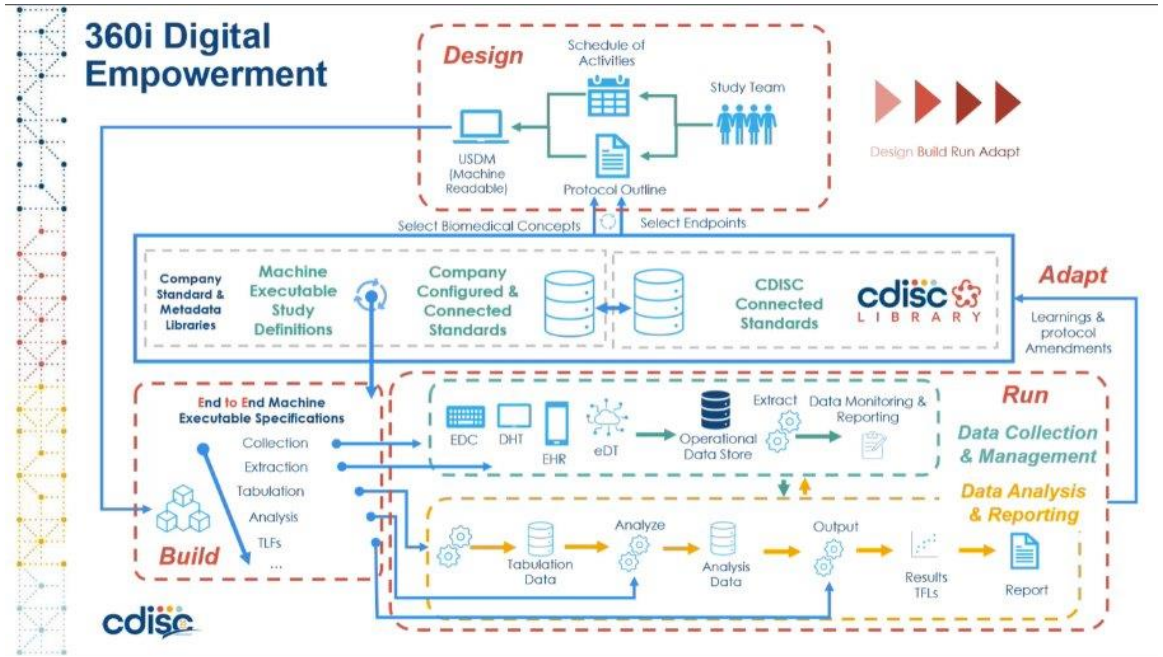
- **Ethical & Environmental Responsibility**
  - AI's reliance on massive data centers is not sustainable—innovations like green data centers, efficient energy use, and smarter siting are essential

Looking Ahead

- **What's Possible**
  - AI can streamline clinical trial workflows and shorten time to approval
  - Hybrid models blend AI speed with human oversight for trustworthy outputs
  - Real-world evidence becomes easier to integrate through flexible automation

- **What's Still Hard**
  - Upfront investment, design, and adoption barriers
  - Sponsors must validate AI-driven decisions with regulatory-level rigor

- **What "AI-Ready" Looks Like**
  - Human-in-the-loop validation
  - Transparent, explainable models
  - Prospective trials evaluating AI decision tools



https://www.cdisc.org/events/webinar/360i-program-kickoff-enabling-standards-driven-automation-study-design-through

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Tell us your experiences with AI:

1. What is your most common use of AI on daily/weekly basis? At work or outside of?

2. What components of CDISC 360i have you actively worked with?

    a) Digital Protocol Design (USDM & Biomedical Concepts)
    b) Automated Study Build (Collection/CDASH)
    c) Automated Data Transformation (SDTM)
    d) Conformance and Validation (CDISC Open Rules Engine)
    e) None – familiar but not hands-on
    f) Not familiar with CDISC 360i*

    *(https://www.lexjansen.com/phuse-us/2025/ds/PAP_DS01.pdf)

3. Have you tried working with DM to conform to CDASH to allow for better use of SDTM standards?

4. Who has worked with Real World Evidence and how do you see it benefit from AI usage?

Thank You!

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