Artificial Intelligence in Medical Education

for

Viksit Arogya Bharat

Curriculum Design

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Module 1

Introduction to AI for Clinicians: What It Is, What It Is Not

Objective:
Clarify what AI truly is in healthcare and set realistic expectations for clinicians.

Key components

- AI ≠ automation ≠ intelligence
- Prediction ≠ decision
- Pattern recognition ≠ causation
- AI assists clinicians, does not replace them
- Human judgment remains central

Take-home:
AI is a tool, not a clinician.

Module 2

From Biostatistics to AI: A Gentle Bridge for Beginners

Objective:
Help clinicians connect familiar biostatistics concepts to modern AI thinking.

Key components

- Regression → ML → Deep Learning
- Association ≠ prediction ≠ causation
- Bias–variance trade-off
- Simpler models often safer
- More data ≠ better model

Take-home:
AI extends statistics—it does not erase it.

Module 3

Types of Clinical Data & Asking the Right Questions

- **Duration:** 40 minutes

Objective:
Train clinicians to frame correct questions before using data or AI.

Key components

- Structured vs unstructured data
- Labels ≠ outcomes
- Clinical question → data question
- Garbage in → confident garbage out
- Context matters more than volume

Take-home:
Bad questions create bad AI.

Module 4

Unstructured & Missing Data: What Clinicians Must Know

- **Duration:** 45 minutes

Objective:
Highlight how documentation and missing data silently bias AI.

Key components

- Text, images, signals ≠ clean data
- Missing ≠ random
- Documentation habits shape AI behavior
- Completeness ≠ correctness
- Privacy starts at data capture

Take-home:
How you document today shapes tomorrow's AI.

Module 5

Electronic Phenotyping & Prompt Thinking for Clinicians

- **Duration:** 45 minutes

Objective:
Enable clinicians to convert clinical reasoning into computable logic.

Key components

- Phenotype ≠ diagnosis code
- Time, severity, progression matter
- Prompt = structured clinical thinking
- Ambiguity breaks models
- Good inputs beat complex models

Take-home:
Clear thinking creates usable AI.

Module 6

Why Machine Learning in Healthcare (and When Not to Use It)

- **Duration:** 35 minutes

Objective:
Help clinicians decide when ML is useful—and when it is harmful.

Key components

- ML fits patterns, not judgment
- Stable rules > ML for stable problems
- Rare events are ML traps
- Cost & maintenance matter
- Not everything needs AI

Take-home:
Just because we can use AI doesn't mean we should.

Module 7

Core Machine Learning Concepts Without Math Fear

- **Duration:** 45 minutes

Objective:
Introduce ML fundamentals using clinical intuition.

Key components

- Classification vs prediction
- Supervised vs unsupervised learning
- Overfitting = memorizing
- Underfitting = oversimplifying
- No universal “best model”

Take-home:
Models learn patterns—not understanding.

Module 8

How Machines Learn: Intuition for Clinicians

- **Duration:** 40 minutes

Objective:
Explain how AI learns, adapts, and fails in real settings.

Key components

- Loss function = what the model values
- Training ≠ deployment
- Drift is inevitable
- Silent failure is dangerous
- Continuous oversight is mandatory

Take-home:
A working model today can fail tomorrow.

Module 9

Deep Learning in Medicine: Images, Text, and Signals

- **Duration:** 45 minutes

Objective:
Demystify deep learning applications clinicians commonly encounter.

Key components

- CNNs see patterns, not disease
- NLP reads text, not intent
- Transformers predict next tokens
- Deep ≠ explainable
- Validation > excitement

Take-home:
Deep learning is powerful—and fragile.

Module 10

Model Evaluation: When Is an AI Actually Useful?

- **Duration:** 45 minutes

Objective:
Teach clinicians to judge AI beyond accuracy claims.

Key components

- Accuracy ≠ safety
- ROC ≠ clinical usefulness
- Calibration matters
- Subgroup performance matters
- Validation population matters

Take-home:
A good metric does not guarantee good care.

Module 11

Beyond Metrics: Clinical Utility & Outcome–Action Pairing

- **Duration:** 40 minutes

Objective:
Align AI predictions with real clinical actions.

Key components

- Outcome ≠ action
- Prediction without action is useless
- Lead time defines value
- Alert fatigue is real harm
- Net benefit > novelty

Take-home:
Prediction without action is noise.

Module 12

Retrospective Data, Shelf Life & Generalizability

- **Duration:** 35 minutes

Objective:
Help clinicians judge whether old data is still valid.

Key components

- Past care ≠ present care
- Protocols evolve
- Populations differ
- Bigger datasets can mislead
- External validation is essential

Take-home:
Old data ages faster than we think.

Module 13

Interpretability: Black Box vs Explainable AI

- **Duration:** 40 minutes

Objective:
Guide clinicians on when explainability is essential.

Key components

- Explainable ≠ truthful
- Black box ≠ unsafe by default
- Risk level determines need
- Trust requires understanding limits
- Patients deserve explanations

Take-home:
Trust is built, not assumed.

Module 14

Bias in Healthcare AI: Real-World Clinical Examples

- **Duration:** 45 minutes

Objective:
Expose clinicians to how bias enters and amplifies harm.

Key components

- Historical bias
- Representation bias
- Measurement bias
- Deployment bias
- Automation bias

Take-home:
AI often magnifies existing inequities.

Module 15

Algorithmic Fairness: What Clinicians Should Understand

- **Duration:** 40 minutes

Objective:
Introduce fairness concepts relevant to clinical care.

Key components

- Equality ≠ equity
- Calibration vs parity
- Trade-offs are unavoidable
- One metric cannot ensure fairness
- Clinical judgment remains central

Take-home:
Fairness is a clinical decision, not a formula.

Module 16

Ethics of AI in Healthcare: Beyond Checklists

- **Duration:** 45 minutes

Objective:
Strengthen ethical reasoning beyond compliance.

Key components

- Consent is not paperwork
- Transparency builds trust
- Accuracy ≠ ethical
- Human dignity matters
- Clinicians remain accountable

Take-home:
Ethics does not end at deployment.

Module 17

Wearables, Robotics & SaMD: How AI Is Entering Clinical Practice (Indian Context)

- **Duration:** 45 minutes

Objective:
Enable clinicians to critically adopt AI-enabled devices in India.

Key components

- Wearables: signal vs noise
- Robotics: assistance ≠ autonomy
- SaMD: software can harm
- Indian infrastructure realities
- Validation before adoption

Take-home:
Not every smart device is clinically smart.

Module 18

AI for Smarter Journal Reading, Evidence Synthesis & Clinical Learning

- **Duration:** 35–40 minutes

Objective:
Use AI to improve—not replace—critical reading.

Key components

- Information overload problem
- AI for triage, not truth
- Methods matter more than conclusions
- Cross-study comparison
- Hallucination awareness

Take-home:
AI should sharpen thinking, not dull it.

Module 19

Cybersecurity, Data Privacy & Trust in Clinical AI Systems

- **Duration:** 45 minutes

Objective:
Equip clinicians to recognize cyber and privacy risks in AI systems.

Key components

- Healthcare data is uniquely vulnerable
- Ransomware, API misuse, insider threats
- Model inversion & data leakage
- Training data poisoning
- Prompt leakage (LLMs)
- De-identification ≠ anonymity
- Consent vs secondary use
- Audit trails & access control
- DPDP Act (conceptual)
- Public vs private hospital risks
- Startups & cloud responsibility gaps
- Clinician cyber hygiene

Take-home:
An accurate AI that leaks data is a failed clinical tool.

Module 20

Building & Governing Clinical AI Teams

- **Duration:** 40 minutes

Objective:
Prepare clinicians to lead sustainable AI programs.

Key components

- Multidisciplinary ≠ chaotic
- Clear ownership matters
- Governance before scale
- Monitoring after deployment
- Sustainability over pilots

Take-home:
AI success is organizational, not technical.

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1. Conclusion

This program is not just about teaching technology—it's about democratizing innovation, ensuring that the next generation of Indian physicians are not passive consumers of foreign-built algorithms, but active co-creators of solutions rooted in India's unique epidemiological, cultural, and resource contexts.

By training 50,000 doctors {Training the trainers (15000), training the trainees (35000)}, we create:

- **A network** of informed stakeholders who can govern AI responsibly
- **A pipeline** of clinician-innovators who can build India-specific solutions
- **A standard** that positions India as a global leader in ethical, equitable AI deployment

The time is now. The cohort is ready. The infrastructure is buildable. The impact is transformational.

Let's build the future of healthcare—together.