INTERNATIONAL HUMAN EMBRYOLOGY RESEARCH ACADEMY

AndroNet
An Initiative of IHERA

AndroDigest

The Science of Fatherhood

Rewriting the Narrative of Fatherhood Through Science and Awareness

Featured in this Issue

- AI in Semen Analysis — Standardisation and Evidence
- AI for Sperm DNA Fragmentation (DFI) Assessment
- AI in Sperm Selection for ICSI
- AI in Predicting TESE Outcomes in NOA
- Impact of AI on Andrology Outcomes
- Current Recommendations & Global Guidelines
- Myths vs Facts: AI in the Andrology Lab

Published by **AndroNet** – An Initiative of IHERA

Volume 1 | Issue 2 | 2026

FOUNDERS

Dr. Ved Prakash

Dr.Sanjay Shukla

Dr. Charudutt Joshi

CONVENERS

Mr. Hetal Shukla

Dr. P Durai

Dr. Deven Patel

COORDINATORS

Siddhartth Morwadia

Jayesh Shinde

Priyal Shah

Dr. Arth Ladwa

EDITORS

Neha Goswami

Mr. Jayesh Shinde

Bageshree Jhala

About AndroDigest

AndroDigest is a curated newsletter dedicated exclusively to male reproductive health, published under AndroNet — an initiative of iHERA. Each issue translates current research into practical knowledge for andrologists, laboratory scientists, and reproductive medicine professionals.

This second issue focuses on Artificial Intelligence in the andrology laboratory. The scope is deliberate: sperm science only. We examine where AI is generating real, evidence-supported advances in andrology — in semen analysis, DNA fragmentation testing, sperm selection, and surgical retrieval prediction — and where significant questions remain unanswered.

AI in the Andrology Laboratory — The Science of What It Does

Artificial intelligence in the andrology laboratory is not a single technology — it is a family of computational approaches applied to different problems. Understanding which tool is being applied, and to what problem, is essential for critically evaluating any AI claim in this space.

Machine Learning (ML)	Algorithms that improve at a task as they are exposed to more labelled data. Applied in andrology to predict outcomes (TESE success, DFI elevation) from clinical variables.
Deep Learning / CNNs	Layered neural networks designed for image recognition. The engine behind AI-based sperm morphology classification, motility analysis, and AI-aided DFI halo evaluation.
AI-Enhanced CASA	Computer-Assisted Sperm Analysis with AI layers for improved cell-debris discrimination, motility sub-classification, and morphology scoring beyond classical threshold-based CASA.

The term "AI-powered" does not in itself confer clinical validity. Each application must be evaluated on the quality of its training data, the outcome it was trained to predict, and the population on which it was validated.

Semen Analysis: Where the Evidence is Strongest

Semen analysis is the examination of a semen sample to assess sperm count, motility, morphology, and overall semen characteristics to evaluate male reproductive health and fertility

Sperm Concentration and Motility: Modern AI-enhanced CASA systems have demonstrated improvements in cell-debris discrimination and motility sub-categorization — the two most operator-sensitive parameters in conventional analysis. The Mojo system (Microptic) has been trained on over 100 million sperm images using convolutional neural networks at nanometer tolerance, improving discrimination in difficult samples[1]. Automated progressive vs non-progressive vs immotile sub-classification, a parameter particularly vulnerable to inter-observer variability, shows consistent improvement in reproducibility[2].

Sperm Morphology: Kruger strict-criteria morphology remains the most subjective parameter in the standard semen analysis. Inter-observer disagreement rates of up to 50% for borderline samples are documented in the literature[3]. Deep learning classifiers trained on large annotated datasets demonstrate morphology classification accuracy approaching that of experienced andrologists. SVM and DNN models applied to holographic microscopy report accuracy above 90% for clearly normal vs clearly abnormal sperm[4]. Performance for borderline morphology drops substantially for both AI and human assessors.

Critical Limitation: No AI morphology system has yet been validated against WHO 6th edition criteria across multiple independent laboratories in a prospective design. Image capture conditions — staining protocol, magnification, lighting — directly determine model performance. A model trained on Papanicolaou-stained samples in one laboratory is not automatically transferable to a Diff-Quik protocol elsewhere.

AI in Sperm DNA Fragmentation Assessment

Sperm DNA fragmentation is the presence of single- or double-strand breaks in sperm DNA, reflecting compromised genetic quality and potentially affecting fertilization, embryo development, and pregnancy outcomes.

Sperm DNA fragmentation testing is a domain where AI offers a specific and clinically meaningful advantage: reducing intra-operator variability in assay interpretation. This is not the same as replacing the assay or the andrologist — it is improving the consistency of a step that has always been prone to human subjectivity.

AI-Aided SCD Halo Evaluation: A 2023 publication in Andrology described an AI-aided halo evaluation system for the sperm chromatin dispersion (SCD) test. The system compared DFI classification against TUNEL and SCSA across the same sample set. AI-aided SCD demonstrated comparable sensitivity and specificity to established DFI assays, with significantly reduced intra-operator variability in halo size interpretation — the step that most commonly drives disagreement between operators[5]. This positions

AI-enhanced SCD as a potentially accessible, cost-effective entry point for laboratories without access to TUNEL or SCSA platforms.

Predictive ML for DFI Elevation: Machine learning algorithms trained on clinical metadata — age, abstinence duration, smoking status, BMI, scrotal temperature history, hematological markers — have been applied to predict the likelihood of elevated DFI before the assay is performed. Published models report modest but statistically significant predictive accuracy in training cohorts. These are not yet clinically validated tools, but they represent an early-stage pipeline for triaging which patients require DFI testing as a priority within structured workup.

AI in Sperm Selection for ICSI — Current Evidence

Intracytoplasmic Sperm Injection (ICSI) *is an assisted reproductive technique in which* ***a single sperm is directly injected into the cytoplasm of an egg (oocyte)*** *to achieve fertilization.*

Sperm selection for ICSI is under active AI investigation. The clinical question is specific: does AI-guided morphological selection improve fertilization rates or live birth beyond what a trained andrologist achieves with conventional selection? Current evidence has not yet answered this definitively.

Deep Learning Morphology Classifiers: CNN-based systems have been applied to score individual sperm morphology under brightfield and Nomarski DIC optics. A 2023 systematic review in Fertility and Sterility found that AI-based systems provide more reproducible morphology scores than manual assessment, with reduced inter-session variability[6]. The review noted that most published studies use proprietary training datasets with limited external validity and report surrogate endpoints — morphology score agreement — rather than clinical outcomes such as fertilization rate or live birth.

What AI Morphology Selection Cannot Assess: Image-based AI sperm selection works at the level of morphological inference only. The following parameters — all clinically relevant to ICSI outcomes — are invisible to any current image-based AI system:

AI selects the best-looking sperm. The Functional competence — the biology that ultimately determines fertilization and downstream outcomes — is beyond what any current image-based system can infer.

Parameters not assessed by AI	What it reflects
Sperm DNA Fragmentation (DFI)	Reactive Oxygen Species (ROS) burden
Centrosomal integrity	Mitochondrial membrane potential
Hyaluronan binding capacity (HBA)	Sperm-borne epigenetic contributions

AI in Predicting TESE Outcomes in NOA

Testicular Sperm Extraction (TESE) *is a surgical procedure in which* ***sperm is directly retrieved from testicular tissue*** *for use in assisted reproductive techniques like ICSI.*

Non-Obstructive Azoospermia (NOA) *is a condition where* ***there is no sperm in the semen due to impaired or absent sperm production in the testes****, rather than a blockage.*

In non-obstructive azoospermia (NOA), surgical sperm retrieval is resource-intensive, invasive, and clinically uncertain. The ability to predict retrieval success before surgery has significant value for both patient counselling and resource allocation. This is one of the most clinically promising applications of AI in male reproductive medicine.

Machine learning models trained on preoperative variables — FSH, LH, total testosterone, testicular volume, Y-chromosome microdeletion status, and histopathological pattern (Sertoli-cell only vs maturation arrest vs hypo spermatogenesis) — have been applied to predict the probability of successful sperm retrieval at micro-TESE. Published predictive models report AUC values of 0.75–0.85 in training cohorts, which is clinically meaningful[7]. However, external validation data remain limited, and prospective RCT evidence for clinical decision-making based on these models does not yet exist.

A model with AUC 0.82 still means 18% of cases are misclassified. In the context of the irreversible decision to proceed or defer surgery, that residual uncertainty requires transparent communication with the patient and cannot be resolved by the algorithm alone.

How AI Has Affected Andrology Outcomes — What the Data Show

Reproducibility: The Most Consistent Gain: The most consistent and well-documented benefit of AI across andrology applications is improved reproducibility — reduced intra-operator and inter-operator variability in test interpretation. This applies to:

- Sperm concentration and motility sub-classification (AI-CASA vs manual)
- Sperm morphology scoring (CNN classifiers vs experienced andrologists)
- DFI halo interpretation in SCD assays (AI-aided vs manual)

Reproducibility is not a trivial outcome: variability in andrology reporting is a documented source of clinical mismanagement, including unnecessary escalation to ART, delayed treatment of correctable conditions, and patient anxiety from inconsistent results across laboratories.

Throughput and Speed: AI-enhanced CASA systems analyze thousands of sperm per sample in seconds, with consistent application of the same classification criteria across every cell. For high-volume laboratories, this translates into meaningful efficiency gains without the concentration-dependent errors that affect manual counting. This is one area where commercial claims of AI vendors are largely supported by published data.

Clinical Outcome Data: Where the Evidence Is Thinner : Improvements in fertilization rate, clinical pregnancy, or live birth attributable specifically to AI sperm selection tools have not been demonstrated in prospective randomized controlled trials. Published evidence linking AI application in andrology to improved ART outcomes is predominantly retrospective, uses surrogate endpoints, and is subject to substantial publication bias.

A 2025 analysis in Reproductive BioMedicine Online noted that rigorous validation, defined key performance indicators, and post-deployment monitoring are prerequisites for safe and effective integration of AI in reproductive medicine[8]. The field has, in places, "over-promised and under-delivered on clinical impact" — a statement that applies specifically to outcome data rather than to process and quality metrics.

Current Recommendations & Guidelines — Global Landscape

No single regulatory or professional body has yet issued comprehensive guidelines specifically governing AI in andrology. Andrology laboratories operate at the intersection of three overlapping frameworks: society guidelines on male infertility evaluation, broader AI-in-medicine regulatory frameworks, and emerging consensus statements from reproductive medicine societies. The summary below reflects positions of major bodies as of 2026.

Body / Region	Document & Year	Position on AI in Andrology
WHO ***Global***	WHO Laboratory Manual for the Examination and Processing of Human Semen, 6th edition (2021)	Manual semen analysis remains the reference standard. CASA (incl. AI-enhanced) permitted as supplementary; SDF testing classified as "extended" non-routine examination [9]
AUA / ASRM ***United States***	AUA/ASRM Male Infertility Guideline (2024 Amendment) — Brannigan et al., J Urol	Does not endorse SDF testing as routine first-line evaluation. Suggests SDF testing for RPL. AI tools not specifically addressed; standard semen analysis remains foundational [10]
EAU ***Europe***	EAU Guidelines on Male Sexual & Reproductive Health: 2025 Update on Male Infertility — Minhas et al.	Strongly recommends SDF testing for RPL (natural or ART) and unexplained infertility. Broader endorsement of SDF than AUA/ASRM. Recognizes emerging role of AI-aided assays as adjunctive QC [11]
ESHRE ***Europe***	ESHRE Guidelines on RPL (2023) and ART Centre Certification (2022, ongoing)	SDF acknowledged as biomarker but not routine. ART Centre certification framework requires defined laboratory KPIs and competency verification — the structural foundation against which any AI integration must be assessed [12]
AI Fertility Society ***International***	Croatia Consensus on AI in ART (2024)	Mandates that all AI tools in reproductive lab practice remain operator-supervised. Defines minimum validation standards: external validation, transparent training data reporting, declared performance metrics

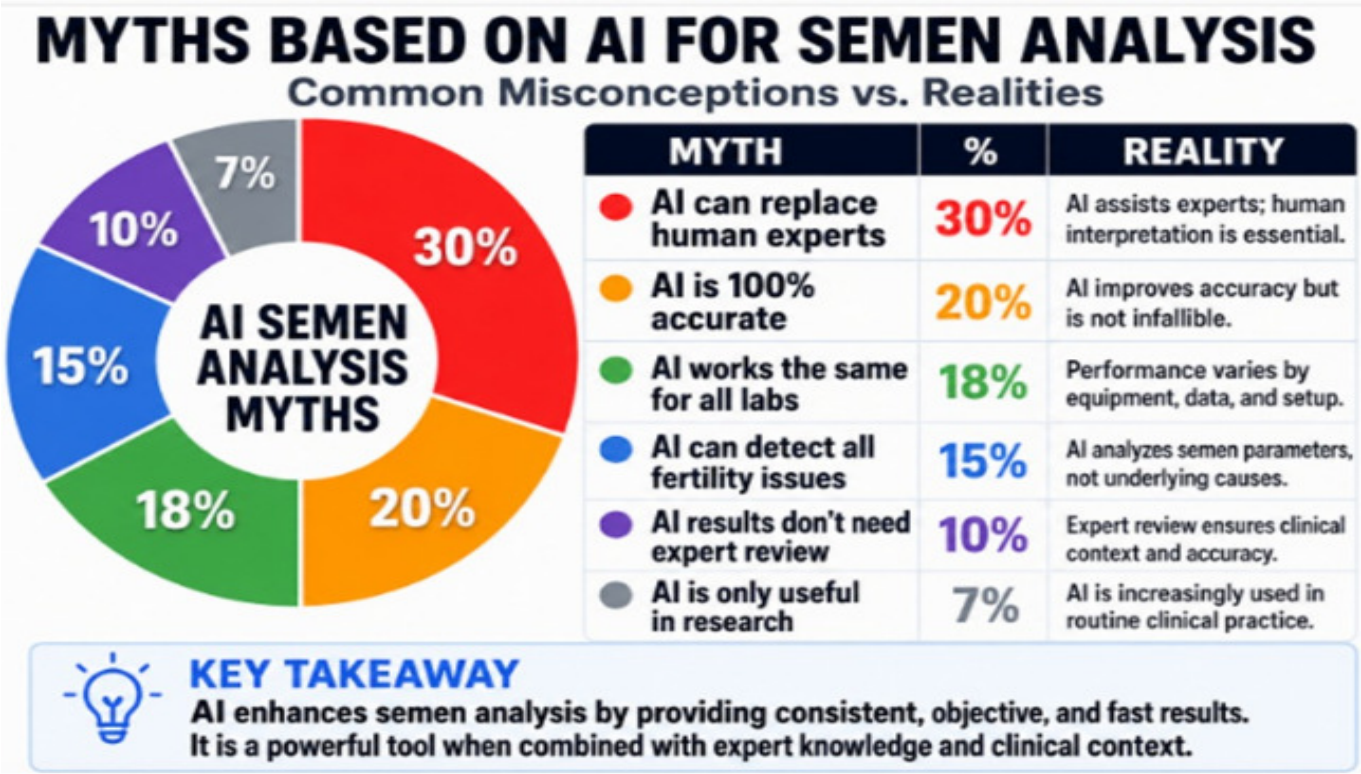
Regulatory Frameworks for AI Medical Devices: Beyond clinical guidelines, AI tools used in andrology laboratories are simultaneously subject to medical device regulation in the jurisdictions where they are deployed. The regulatory map is fragmented and evolving.

European Union	EU AI Act (Regulation 2024/1689) entered into force August 2024. AI systems used as medical device software (including AI tools for diagnosis or treatment decisions) are classified as high-risk. High-risk AI obligations — quality management, transparency, mandatory human oversight, post-market monitoring — apply progressively, with full applicability for medical device AI by August 2026. Operates alongside MDR/IVDR conformity assessment requirements [13].
United States	FDA regulates AI/ML-based medical devices through 510(k), De Novo, and PMA pathways. The December 2024 FDA Predetermined Change Control Plan (PCCP) guidance specifically addresses adaptive AI/ML algorithms and lifecycle management. As of mid-2024, over 950 AI/ML-enabled medical devices have been

	authorized, predominantly in radiology. AI in andrology specifically remains a small subset, with no FDA-cleared AI-only sperm analysis or selection tool to date [14].
India	CDSCO Draft Guidance on Medical Device Software (October 2025) brings AI-based laboratory software under the Medical Device Rules 2017 framework, with risk-based classification (Class A–D) aligned to IMDRF standards. ICMR Ethical Guidelines for AI in Biomedical Research and Healthcare (2023) emphasize patient safety, privacy, and transparency. The ART (Regulation) Act 2021 governs ART laboratory practice broadly but does not yet contain AI-specific provisions [15].

Common thread across all jurisdictions: human oversight is mandatory. Every regulatory framework reviewed — EU AI Act, FDA, CDSCO, ICMR — requires that AI outputs in clinical settings be supervised, interpreted, and acted upon by qualified medical professionals.

Myths vs Facts — AI in the Andrology Laboratory



Myth 1: "AI semen analysis is equivalent to WHO 6th edition manual semen analysis."

Fact: AI-enhanced CASA outputs and WHO-manual analysis are not interchangeable. WHO 6th edition parameters were developed and validated on human-assessed datasets with specific pre-analytic and analytic conditions. AI systems trained on proprietary image datasets may generate outputs that do not map directly to WHO reference ranges. For regulatory and clinical purposes, a WHO-compliant manual analysis remains the recognized standard; AI outputs serve as supplementary or QC data**.**

Myth 2: "AI can replace the trained andrologist in the laboratory."

Fact: No clinical or regulatory framework supports this. AI functions as a decision-support and quality-assurance layer. The Croatia Consensus on AI in ART (2024) states that all AI tools in reproductive laboratory practice must remain operator-supervised. The EU AI Act (Regulation 2024/1689) classifies relevant ART AI tools as high-risk, mandating human oversight; equivalent human-oversight provisions apply under FDA AI/ML guidance and India's CDSCO 2025 draft**.**

Myth 3: "AI-aided DFI testing (e.g. AI-SCD) replaces validated DFI assays such as TUNEL or SCSA."

Fact: AI-aided SCD has demonstrated comparable classification performance to TUNEL and SCSA in published data (Kuroda et al., Andrology 2023). However, this is not equivalence by regulatory or guideline standards. Each DFI assay measures a different aspect of chromatin integrity with different thresholds and clinical correlations. AI-SCD reduces intra-operator variability in halo interpretation; it does not replicate the biochemical specificity of TUNEL or the flow cytometric precision of SCSA**.**

Myth 4: "AI can predict male infertility from a single semen analysis."

Fact: AI models trained on semen parameters can stratify populations by fertility risk, but no model predicts infertility from a single semen analysis in an individual patient. Biological and technical variability in semen parameters is substantial; WHO 6th edition guidance explicitly recommends repeating abnormal results before management decisions are finalized. AI-generated risk scores are population-level probability estimates, not individual diagnoses.

Myth 5: "AI morphology tools assess the same features as IMSI."

Fact: IMSI uses approximately 6,000× magnification to identify specific ultrastructural vacuolar defects in the sperm head — features invisible at standard ICSI magnification (400×). AI morphology classifiers trained on standard brightfield or DIC images at conventional magnification do not capture IMSI-level ultrastructural data. The two approaches operate at fundamentally different resolution scales and are not substitutable.

Myth 6: "AI eliminates inter-laboratory variability in andrology reporting."

Fact: AI reduces intra-operator variability within a given platform and protocol. It does not eliminate inter-laboratory variability, which arises from differences in sample preparation, staining protocols, imaging equipment, and the AI model itself. Laboratories using different AI-CASA platforms, or the same

platform with different image capture settings, will not produce equivalent outputs. External quality assurance programs remain essential

Myth 7: "Once an AI andrology tool is validated, no further internal QC is required."

Fact: AI model performance is sensitive to changes in imaging hardware, sample preparation protocols, staining reagents, and patient population characteristics. A model validated at deployment will not necessarily perform equivalently after protocol updates or equipment changes. Ongoing internal quality assurance — comparing AI outputs against known-standard samples and periodic re-evaluation against manual WHO analysis — is a regulatory and scientific requirement, not a one-time step.

Research Spotlight

01 | AI in Andrology: From Semen Analysis to Image Diagnostics

World Journal of Men's Health, 2024 | Ghayda RA, Cannarella R, Calogero AE et al. [16]

Comprehensive Global Andrology Forum review mapping AI applications across the andrology laboratory workflow. Identifies reproducibility as the most consistently demonstrated benefit, while noting prospective clinical outcome data remain sparse. Provides a SWOT analysis framework and proposes minimum validation standards for clinical-grade AI tools.

02 | Novel Sperm Chromatin Dispersion Test with AI-Aided Halo Evaluation

Andrology, 2023 | Kuroda S, Karna KK, Kaiyal RS, Cannarella R, Lundy SD, Vij SC, Agarwal A. [5]

AI-aided halo evaluation system for SCD test, compared against TUNEL and SCSA. Demonstrated comparable sensitivity and specificity to both established assays, with statistically significant reduction in intra-operator variability. Directly relevant for laboratories where TUNEL/SCSA are unavailable and SCD is the primary DFI platform.

03 | Improving Outcomes of ART Using AI for Sperm Selection

Fertility and Sterility, 2023 (Systematic Review) [6]

Evaluation of AI-based sperm selection systems for ICSI — CNN-based morphology classifiers and integrated image-analysis platforms. Found consistent evidence of more reproducible morphology classification than manual assessment. Explicitly noted that the evidence base for improved ART outcomes (fertilisation, blastocyst, live birth) is dominated by retrospective designs with surrogate endpoints. Called for prospective RCTs with live birth as primary endpoint.

AndroDigest • Expert Micro Opinions

Three landmark publications on AI in andrology — selected for citation impact and direct clinical relevance.

Publication & Authors	Conclusion	Clinical Takeaway
Ghayda RA, Cannarella R, Calogero AE et al. World J Men's Health. 2024;42(1):39–61 [16] Global Andrology Forum	"AI-based tools are poised to become valuable assets in diagnosing and treating male infertility. Automated predictions may offer consistency and efficiency. Better integration of AI will lead to pioneering evidence-based breakthroughs and the reshaping of andrology and reproductive medicine."	AI offers consistency and efficiency — but reshaping the field requires evidence-based integration, not adoption alone.
Calogero AE, Crafa A, Cannarella R, Saleh R, Shah R, Agarwal A. Asian J Androl. 2024;26(6):600–604 [17] University of Catania / Cleveland Clinic	"AI uses machine learning algorithms to predict therapeutic success or assist clinical decision-making. The strengths and limitations of this approach must be clearly understood. The clinician remains central — AI enhances, not replaces, clinical judgment in andrology."	Understand AI's strengths and limits before deployment. Clinical judgment is irreplaceable.
Panneerselvam MK, Moharana AK, Baskaran S et al. Medicina. 2024;60(2):279 [18] Tulane University — Systematic Review	"The examination and selection of sperm by andrologists may benefit greatly from using AI algorithms. When bigger and more reliable datasets become accessible for training, these algorithms may improve over time. The accuracy of semen analysis remains quite poor — and this is precisely the gap AI is positioned to address."	AI addresses a real accuracy gap. Performance improves as training datasets grow — making dataset quality a key criterion when evaluating any platform.

Awareness Tools • Patient Education

What is AI actually doing in the andrology lab?

AI in the andrology laboratory is a computer system trained to recognize patterns — in sperm images, test results, or clinical data — and generate a score or classification based on what it has learned from previous cases. It is not a doctor. It does not examine your individual biology. It compares your data against the dataset it was trained on and tells you where you fall in that pattern.

The principle: AI is a tool, not a decision-maker

Every AI system in reproductive medicine is designed to assist a qualified professional, not to replace them. Regulators in India (ICMR, CDSCO), Europe (EU AI Act), and the United States (FDA) all require that AI outputs be reviewed, interpreted, and acted upon by a qualified medical professional. If a result is presented to you purely as "the AI says so," ask who reviewed it and how.

Why your andrologist's role is irreplaceable

AI can count sperm, assess movement, and classify shape. What it cannot do is integrate your personal history — your illness last month, your work environment, your abstinence period, your medication — with the number on the screen. It cannot recognize that a technically "normal" result contradicts four previous tests showing a problem. Your andrologist holds that context. The AI provides a data point; your doctor provides the interpretation.

Why you should ask: "What was this AI trained on?"

Different AI platforms have been trained on different datasets — different patient populations, different ethnicities, different laboratories, different imaging conditions. An AI system trained exclusively on data from European fertility centers has not necessarily learned the patterns relevant to an Indian patient population. An AI trained on clean semen samples may perform differently on a high-debris sample from your laboratory. There is no single universal AI for andrology. Each system's performance depends entirely on the data it learned from and the conditions it was tested in.

Why "still image" AI has important limits

Many AI sperm analysis tools assess sperm from a photograph — a single frozen moment in time. A sperm that looks perfect in a still image may carry fragmented DNA, poor mitochondrial function, or reduced capacity to fertilize. What AI sees in a still image is shape and structure. What matters biologically is function — and function cannot be photographed. This is not a limitation of AI technology alone; it is a fundamental boundary of image-based inference.

Three questions every patient can ask their clinic:

1. Has your AI tool been validated in a patient population similar to mine?
2. Who reviews the AI output before it informs my clinical decision?
3. If the AI result disagrees with a previous test, what is the process for resolving that conflict?

Understanding AI in Andrology: The Fun Way!

AI in the Andrology Lab — Test Your Practical Thinking

Five scenario-based MCQs from real andrology laboratory situations. One best answer each. Brief science explanation provided after each question.

MCQ 1

A 34-year-old male presents with 5 semen analysis reports over 14 months. Reports 1–4 from two independent laboratories are concordantly conclusive for OAT. Report 5, from a third laboratory using an AI-enhanced CASA platform, returns parameters within WHO 6th edition normal range. The AI flags the sample as "normal." The patient requests clinical reassurance. What is your interpretation?

A) Accept the AI-CASA result — it is the most recent and uses the most advanced technology.
B) Reject the AI-CASA result entirely — AI platforms cannot be used for clinical reporting.
C) Weight the four concordant OAT reports significantly; investigate the AI-CASA result critically for pre-analytic, platform, and validation confounders before offering any reassurance.
D) Request a sixth analysis at the same AI-CASA laboratory to confirm the result.

Correct answer: C

The science: Four concordant OAT results from two independent laboratories constitute a robust pattern. One discordant result demands investigation, not override. Confounders to explore: abstinence duration, delivery time and temperature, whether the AI-CASA platform has been validated against WHO manual analysis in that specific laboratory. WHO 6th edition is explicit: abnormal results should be repeated — this applies equally to isolated normal results contradicting an established pattern.

MCQ 2

An AI-CASA system reports progressive motility (PR) of 34% (above WHO lower reference of 32%) in a 38-year-old male with unexplained infertility. The senior andrologist, assessing the same sample independently, records PR at 26% (below reference). The AI-CASA platform has not been internally validated against WHO manual analysis in your laboratory. Which interpretation should guide clinical management?

A) Use the AI-CASA result — it analyses more cells and is more statistically robust.
B) Average both results and use 30% as the clinical figure.
C) Use the manual result as the primary clinical finding; flag the discrepancy for QC investigation, and initiate internal platform validation before using AI-CASA outputs clinically.
D) Use the manual result only because this patient has unexplained infertility — in other contexts AI takes precedence.

Correct answer: C

The science: Volume of measurement does not substitute for calibration against a known standard. AI-CASA outputs not validated against WHO manual analysis in a specific laboratory cannot be assumed equivalent. The senior andrologist's manual result under your SOP is the reference. The discrepancy is a QC finding requiring formal platform evaluation. Averaging two methodologically non-equivalent outputs has no guideline basis.

MCQ 3

A 40-year-old male with recurrent pregnancy loss (3 first-trimester losses; female factor excluded) undergoes AI-aided SCD-based DFI testing. Result: 18% — below the platform-validated threshold of >27%. Pre-analytic data: abstinence 7 days; sample delivered 95 minutes after collection at ~14°C. The clinical team proposes to close the DFI investigation. What is your response?

A) Accept the result and close the investigation — 18% is below threshold on a validated AI-aided platform.

B) Repeat the DFI under strictly controlled pre-analytic conditions before any clinical conclusion is drawn.

C) Upgrade to TUNEL or SCSA immediately — AI-aided SCD is not a validated assay.

D) Accept the result but start empirical antioxidant therapy regardless given the RPL history.

Correct answer: B

The science: Three simultaneous pre-analytic red flags: abstinence at the upper boundary (ROS accumulation); delivery at 95 minutes exceeding the 60-minute maximum (ongoing DNA damage ex vivo); cold transport (~14°C). The AI-aided halo system standardized interpretation — it does not correct pre-analytic failures upstream. Kuroda et al. (Andrology, 2023) [5] confirmed AI-aided SCD performs comparably to TUNEL/SCSA only under standardized pre-analytic conditions. Repeat under controlled conditions before any management decision.

MCQ 4

A 32-year-old male with confirmed NOA is counselled for micro-TESE. FSH 31 IU/L; bilateral testis volume 5 mL; maturation arrest on prior biopsy. An ML-based retrieval prediction model — trained on a European cohort of 620 patients, unvalidated in South Asian populations — returns a retrieval probability of 31%. What is the most appropriate use of this result?

A) Inform the patient the surgery has a 31% chance of success and offer it on that basis.

B) Decline surgery — probability is below 50%, making success unlikely.

C) Disregard the model entirely — it is not validated in South Asian populations.

D) Present 31% as one data point in a shared decision-making conversation, disclosing training population and validation limitations, integrating with the full clinical picture.

Correct answer: D

The science: ML micro-TESE models are population-level tools. A European-trained model probability may not be valid for a South Asian patient. The correct use is as one input into a shared decision-making conversation, not as a decision rule. Declining surgery on a sub-50% model probability alone is not consistent with AUA/ASRM NOA management guidance. [7]

MCQ 5

An AI-CASA system reports concentration 19 million/mL and total motility 48% from a 36-year-old male. The senior andrologist reviewing the raw microscopy field simultaneously notes a high density of immature germ cells, round cells, and debris. The AI platform has been validated only on clean, high-quality samples. What is the most appropriate next step?

A) Report AI-CASA as definitive — it analyses more cells and is less susceptible to observer fatigue.

B) Report AI-CASA with a caveat that manual verification is recommended.

C) Perform a manual WHO 6th edition analysis and treat the AI-CASA output as unreliable in this sample context, pending validation on high-debris samples.

D) Centrifuge and re-run through AI-CASA to reduce debris interference before reporting.

Correct answer: C

The science: AI-CASA cell-discrimination performance depends on training sample characteristics. A model validated on clean samples has not learned to handle high-debris or high-round-cell specimens — it may misclassify non-sperm cells. The andrologist's visual field assessment is itself a QC signal. WHO manual analysis under your laboratory SOP is the reference standard. The discrepancy should be documented and trigger formal review of the platform's validated scope.

Disclaimer: This newsletter summarises published evidence and current society positions for educational and discussion purposes within the AndroNet community. It does not constitute clinical guidance or a substitute for the full text of cited guidelines and primary literature.

AI BASED SPERM

A Poem of Precision and Potential

Millions begin the silent race,
In a microscopic time and space.
A tiny cell with dreams so small,
Yet carries life that conquers all.

Then comes AI with watchful eyes,
A blend of science, art and wise.
It sees beyond what humans see,
In every curve, in every key.

It counts, it tracks, it measures true,
Motility, shape, and strength too.
Detects the flaws that hide within,
Where DNA whispers, deep and thin.

No more the guess, no more the doubt,
Data speaks and removes the cloud.
Precision leads, the right cell found,
For new beginnings can be crowned.

In labs of hope, where futures start,
AI supports with brain and heart.
Not here to replace, but to guide,
To walk with humans, side by side.

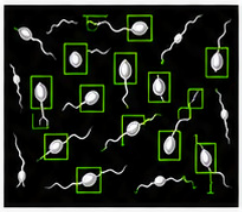
From pixels captured, life is read,
From knowledge born, to dreams ahead.
AI and science, hand in hand,
Build a tomorrow, safe and grand.

HOW AI ANALYZES SPERM – STEP BY STEP

1. SAMPLE COLLECTION
2. MICROSCOPIC IMAGING
3. IMAGE ACQUISITION
4. AI IMAGE PROCESSING
5. PARAMETER EXTRACTION
   - Count
   - Motility
   - Morphology
   - Viability
   - DNA Integrity
6. RESULT & REPORT

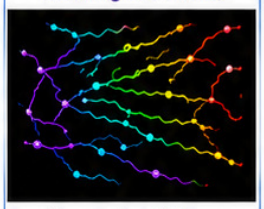
AI IN ACTION

1. SPERM DETECTION & COUNTING



Total Count:
98 Million/ml

2. MOTILITY ANALYSIS (Tracking Movement)

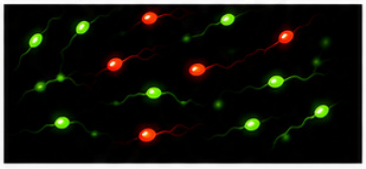


Progressive: 65%
Non-progressive: 20%
Immotile: 15%

3. MORPHOLOGY ANALYSIS (Shape Assessment)

Normal: 82%
Abnormal: 18%

4. DNA FRAGMENTATION (DFI) (Fluorescence Analysis)



DFI: 12% (Low)
(Green: Intact DNA Red: Fragmented DNA)

5. BEST SPERM SELECTION (AI Ranking)

AI selects sperm with best overall quality for assisted reproduction (ICSI)

KEY BENEFITS OF AI IN SEMEN ANALYSIS

- High Precision & Accuracy
- Time Saving & Efficient
- Reduces Human Error & Bias
- Standardized Results
- Better DNA Integrity Assessment
- Improved Clinical Outcomes

FROM SAMPLE TO HOPE

Where microscopes once told a tale,
AI now reveals the finer detail.
In every cell, a future lies,
With hope, with trust, and open skies.

For science is not just machines,
It is compassion, truth, and dreams.
AI based sperm analysis today,
Creates a better life tomorrow.

AI BASED SEMEN CROSSWORD PUZZLE

1. AI-assisted device commonly used for semen analysis. (4 letter word)
2. AI-based diagnostics may reduce human-related _____ (6 letter word)
3. AI can rapidly process large amounts of _____ (4 letter word)
4. Human-independent semen analysis reduces observer _____ (4 letter word)
5. AI improves workflow and laboratory _____ (10 letter word)
6. AI equipment require high initial _____ (10 letter word)
7. Fertility laboratories invest heavily in AI-driven _____(10 letter word)
8. AI identifies damaged sperm DNA more _____ (9 letter word)
9. AI should support, not replace, human _____ (9 letter word)
10. Human supervision remains essential for clinical _____ (9 letter word)

Z	E	C	V	B	N	M	A	S	D	F	G	H	J	K	L	Q	W	E	I
Q	F	W	E	R	T	Y	U	I	O	P	T	A	S	D	F	G	H	J	N
Z	F	X	C	V	B	N	M	Q	W	E	E	R	T	Y	U	I	O	P	V
M	I	N	B	V	C	C	X	Z	A	S	C	D	F	G	H	J	K	L	E
D	C	G	H	J	K	A	L	P	O	I	H	U	Y	T	R	E	W	Q	S
Q	I	R	G	W	L	Q	S	J	H	V	N	V	G	H	F	D	F	R	T
A	E	T	H	R	K	W	R	A	G	F	O	I	D	F	G	T	S	S	M
S	N	Y	Y	T	J	E	E	W	A	T	L	S	E	R	T	A	Y	U	E
E	C	Y	T	Y	H	R	I	V	F	G	O	C	B	V	I	C	X	N	N
R	Y	G	R	G	G	T	R	G	T	H	G	O	S	B	D	F	B	M	T
F	E	H	E	F	G	Y	D	S	V	B	Y	S	Q	W	E	R	T	Y	H
P	R	E	C	I	S	E	L	Y	A	N	R	I	Y	D	S	D	D	F	G
C	R	B	S	D	F	U	S	E	M	E	N	T	T	C	G	F	E	Q	W
D	T	D	W	E	X	P	E	R	T	I	S	E	B	T	R	R	C	R	E
S	Y	S	Q	S	A	I	S	P	E	R	M	E	R	T	Y	H	I	T	Y
A	U	R	A	X	S	O	D	G	N	B	V	X	C	V	G	B	S	G	H
W	J	O	D	C	D	P	W	E	Q	A	D	E	H	T	E	R	I	J	K
E	H	R	F	F	F	L	V	B	S	N	R	A	F	D	S	F	O	U	T
R	G	R	F	R	G	K	R	O	S	S	E	H	T	G	D	C	N	E	W
T	F	E	R	E	H	J	E	D	C	F	D	G	D	A	M	D	S	F	W

References

References cited inline in superscript brackets are listed below in order of first appearance. Full citations are provided with DOI where available; readers are encouraged to consult original sources for clinical decision-making.

1. Mojo AISA / Microptic CASA system specifications.AI-based sperm analysis using deep learning on >100 million sperm images .Microptic SL technical documentation, 2023.
2. You JB, McCallum C, Wang Y, et al. Machine learning for sperm selection. Nat Rev Urol. 2021;18:387–403. doi:10.1038/s41585-021-00465-1
3. Eustache F, Auger J. Inter-individual variability in the morphological assessment of human sperm. Hum Reprod. 2003;18(5):1018–1022. doi:10.1093/humrep/deg197
4. Mirsky SK, Barnea I, Levi M, et al. Automated analysis of individual sperm cells using stain-free interferometric phase microscopy and machine learning. Cytometry A. 2017;91(9):893–900.
5. Kuroda S, Karna KK, Kaiyal RS, Cannarella R, Lundy SD, Vij SC, Agarwal A. Novel sperm chromatin dispersion test with AI-aided halo evaluation: a comparison study with existing modalities. Andrology. 2023;11(8):1581–1592. doi:10.1111/andr.13436
6. Lin TC, Yeh PJ. Improving outcomes of assisted reproductive technologies using artificial intelligence for sperm selection. FertilSteril. 2023;120(4):723–734.
7. Zeadna A, Khateeb N, Rokach L, et al. Prediction of sperm extraction in non-obstructive azoospermia patients: a machine-learning perspective. Hum Reprod. 2020;35(7):1505–1514. doi:10.1093/humrep/deaa109
8. Cohen J, Hickman C, Shoukir Y, et al. Artificial intelligence in IVF: developing standards for clinical implementation. Reprod Biomed Online. 2025;50(2):103638.
9. World Health Organization. WHO Laboratory Manual for the Examination and Processing of Human Semen, 6th edition. Geneva: WHO Press; 2021. ISBN: 978-92-4-003078-7.
10. Brannigan RE, Hermanson L, Kaczmarek J, Kim SK, Kirkby E, Tanrikut C. Updates to male infertility: AUA/ASRM Guideline (2024). J Urol. 2024;212(6):789–799. doi:10.1097/JU.0000000000004180
11. Minhas S, Boeri L, Capogrosso P, et al; EAU Working Group on Male Sexual and Reproductive Health. EAU Guidelines on Male Sexual and Reproductive Health: 2025 Update on Male Infertility. Eur Urol. 2025;87(5):601–621.
12. Gianaroli L, Veiga A, Gordts S, et al. ESHRE certification of ART centres for good laboratory and clinical practice. Hum Reprod Open. 2022;2022(4):hoac040.
13. Regulation (EU) 2024/1689 (Artificial Intelligence Act). Official Journal of the European Union, L series, 12 July 2024.
14. U.S. FDA. Marketing Submission Recommendations for a Predetermined Change Control Plan for AI-Enabled Device Software Functions. December 2024.
15. CDSCO, Ministry of Health and Family Welfare, India. Draft Guidance on Medical Device Software under MDR 2017. October 2025. ICMR Ethical Guidelines for Application of AI in Biomedical Research and Healthcare. New Delhi: ICMR; 2023.
16. Ghayda RA, Cannarella R, Calogero AE, et al. Artificial intelligence in andrology: from semen analysis to image diagnostics. World J Mens Health. 2024;42(1):39–61.
17. Esteves SC, Zini A, Coward RM, et al; EAU Guidelines Panel. A clinical consultation guide on the indications for performing sperm DNA fragmentation testing.EurUrol Focus. 2021;7(6):1300–1306.
18. PannerSelvam MK et al. AI and ML in semen analysis: systematic review. Medicina. 2024;60(2):279.