METADOC

ALIGN INTELLIGENCE

One photo. A clearer view of alignment.

A practical, evidence-informed framework for accessible musculoskeletal wellness insights.

The product thesis

MetaDoc combines a guided standing photograph, three-dimensional body reconstruction, transparent alignment scoring, reported pain and function, and user-authorized health context to help people understand patterns and take the next appropriate wellness step.

INTENDED USE

MetaDoc is designed for general wellness education, self-awareness and progress tracking. It is not intended to diagnose, screen for, monitor or treat a disease or medical condition, predict injury, or replace professional evaluation.



01 / EXECUTIVE SUMMARY

Executive summary

What MetaDoc is, what it is not, and why the distinction matters.

MetaDoc turns one guided standing photograph into an understandable alignment baseline. The platform fits a three-dimensional body representation, derives regional and subregional measures, applies a versioned scoring framework, and adds the user's reported pain and function as visible context. The result is an Align Score, a body map, an explanation and an educational action plan.

The system addresses a practical gap between subjective visual observation and laboratory motion capture. Smartphone imaging can expand access, but the literature also shows that camera position, task, joint, plane and population materially affect accuracy. MetaDoc therefore treats every output as a wellness insight with explicit limitations, not a diagnosis or proof of causation. [3-9]

1	3-5 sec	5	2,240
standing photo	processing target	top-level regions	clinician-assigned calibration grades

What MetaDoc provides

Alignment measurements and scores; left-right comparisons; reported pain and function; progress views; educational exercises; optional authorized-record context.

What MetaDoc does not claim

Diagnosis, disease screening, injury prediction, return-to-play clearance, treatment authorization, or clinical equivalence to radiography or laboratory motion capture.

Core principle

The scan is most useful as a repeatable baseline and conversation starter. It becomes more meaningful when the measurement method stays stable, the original inputs remain visible, and changes are interpreted alongside symptoms, function and context.

02 / WHY AN ACCESSIBLE BASELINE MATTERS

Why an accessible baseline matters

Musculoskeletal burden is high, while everyday measurement remains fragmented.

Musculoskeletal conditions affect people across the lifespan and are a leading contributor to disability worldwide. Access to rehabilitation and objective measurement remains uneven, and conventional visual posture assessment can vary substantially by observer and method. [1-3]

Approach	Primary value	Primary limitation
Laboratory motion capture	High-detail kinematics under controlled conditions	Cost, space, expertise and limited everyday access
Clinical observation	Fast, contextual and inexpensive	Observer variability; limited reproducibility
2D photogrammetry	Accessible angles and ratios from standard images	Sensitive to camera setup and landmark visibility
Markerless 3D systems	Scalable multi-joint measurement without markers	Accuracy varies by joint, plane, task and population
MetaDoc approach	One guided photo plus 3D reconstruction and transparent context	Must remain versioned, limited and prospectively validated

Peer-reviewed work supports the feasibility of smartphone posture and markerless motion measurement, while consistently cautioning that performance is not uniform. Studies of mobile posture tools report useful validity and reliability in selected settings, but evidence is strongest for specific measures and controlled protocols. [4-8]

That is the opportunity: make measurement easier without pretending it is effortless or universally equivalent to a reference laboratory. MetaDoc's design emphasizes guided capture, method versioning, visibility of reported context and conservative claims.

Design objective

Create a baseline that is simple enough for everyday use, structured enough for repeat measurement, and transparent enough that users and partners understand what the number can - and cannot - mean.

03 / SYSTEM OVERVIEW

System overview

A single-photo workflow from capture to user-facing insight.

Stage	System behavior
1 CAPTURE	The phone guides framing for one relaxed, front-facing standing photograph.
2 RECONSTRUCT	A server-side model estimates landmarks and fits a three-dimensional body representation.
3 MEASURE	Fixed anatomical relationships generate angles, asymmetries and normalized ratios.
4 SCORE	Versioned tolerances translate available measurements into subregion, region and whole-body scores.
5 CONTEXTUALIZE	Reported pain and functional limitations remain visible and may influence the composite wellness score.
6 EXPLAIN	The app presents the body map, AI-assisted summary, educational action plan and optional record context.

Frontal plane

Most directly observed in a front-facing image. Examples include side-to-side tilt, level and asymmetry.

Sagittal plane

Depends on depth inferred by the fitted 3D model. It should be treated with lower confidence than directly observed geometry.

Transverse plane

Rotation is inferred and is typically the most technically difficult plane for single-camera reconstruction.

Capture quality

Framing, camera orientation, clothing, occlusion, body build and model fit can change measurement quality.

The photograph is the capture source; the 3D fit is an estimate, not a direct depth sensor. The system should preserve a confidence and provenance trail for every served result, and low-confidence or unavailable measurements should be withheld rather than imputed as normal.

04 / MEASUREMENT HIERARCHY

Measurement hierarchy

One system of regions, subregions and left-right findings.

Top-level region	Illustrative subregions	Interpretive caution
Head / Neck	Head orientation, upper neck, lower neck	Head rotation and depth require particular caution
Spine	Upper back (including middle thoracic), lower back	Thoracic bend and rotation are model-derived
Arms	Shoulder, elbow, wrist; hand when validated	Shoulder rotation is more difficult than frontal alignment
Legs	Hip, knee, upper shin	Body shape and frontal alignment can interact
Ankle / Foot	Lower shin, ankle/talocrural, heel, arch and toe when validated	Distal geometry and foot pitch can affect readings

Every applicable result is calculated separately for the left and right sides. A regional score may summarize multiple inputs, but the underlying components remain available. Measurements are not duplicated across a regional score and its subregions.

The displayed catalogue is intentionally narrower than the theoretical anatomy map. A body part is served only when the measurement route, scoring definition and acceptance evidence are sufficient for the current release. Unavailable regions should display Score unavailable rather than a partial score that could be mistaken for a complete assessment.

Versioning rule

Only scans created under the same measurement and scoring definitions should be compared in one trend series. A material method change starts a new comparable cohort rather than silently rewriting history.

05 / ALIGN SCORE FRAMEWORK

Align Score framework

A transparent 0-100 wellness scale with visible component context.

MetaDoc translates available regional measurements into a common 0-100 scale. Higher scores represent closer agreement with the current reference definition. The same display bands are used at the subregion, region and whole-body levels only after each underlying measurement is independently normalized.



Layer	Meaning
Measurement layer	Angles, asymmetries and ratios derived from the fitted body model
Alignment layer	Subregion and regional scores produced from available, accepted measurements
Reported context	Pain location, side, intensity, frequency and functional limitations
Composite Align Score	A wellness summary that may include reported context under the approved versioned rule

Pain is not a posture measurement. It remains visibly separate in the results experience even when it influences the composite Align Score. The app should list every reported painful body part and functional limitation instead of collapsing them into a single pain number. A lower score is not an injury-risk percentage and does not establish causation.

The band edges are clinician-set product conventions, not diagnostic thresholds. Measurement tolerances and severe caps remain provisional until prospective agreement, repeatability and responsiveness studies support them.

Interpretation guardrail

A score supports prioritization and education. It does not determine pathology, injury risk, treatment necessity or return-to-play readiness.

06 / RESULTS EXPERIENCE

Results experience

The interface keeps measurement, symptoms, function and next steps understandable.

A good result page answers four questions:

- What did the scan measure?

Show the whole-body score, regional scores and body map.

- What did the user report?

List pain by body part and side, plus functional limitations.

- What does the system infer?

Provide a concise explanation with limitations and source labels.

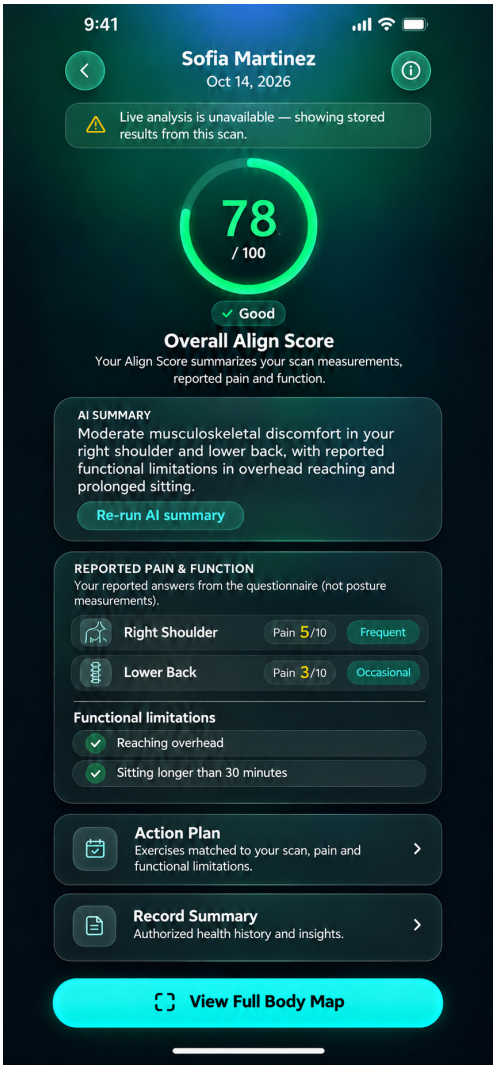
- What can the user do next?

Offer an educational action plan and optional record context.

Recommended content order

AI Summary
Reported Pain & Function
Action Plan
Record Summary
Full Body Map

The action plan follows the scan and reported context. The record summary remains complementary and optional; it does not change the raw camera-derived measurements.



Illustrative interface. Exact text and available body parts depend on the current scoring release.

07 / AUTHORIZED RECORDS AS COMPLEMENTARY CONTEXT

Authorized records as complementary context

The scan stands alone; records add history rather than changing geometry.

A MetaDoc scan can be completed without medical records. When an adult user separately authorizes record retrieval, structured health history can add context such as prior diagnoses, procedures, imaging, medications, laboratory results and care history. The record layer should never silently alter the raw alignment measurements.

Principle	Product behavior
User authorization	The user initiates retrieval and controls access.
Source preservation	Every extracted fact retains the source document and date.
Provenance	System-generated, user-reported and record-derived statements are labeled distinctly.
Separation of layers	Scan measurements, reported symptoms and record facts remain individually inspectable.
Partner boundary	Partners may see approved scan scores and basic demographics, not the user's medical records.
Interoperability direction	FHIR R4 resources and provenance patterns provide a standards-based model for future exchange. [19]

AI-assisted summarization can make long records easier to review, but published research shows that omissions and unsupported statements remain possible. MetaDoc should preserve traceability, make source review easy, and avoid presenting generated text as a new diagnosis. [20]

One complete health story - without blending the evidence

The value comes from bringing scan measurements, reported experience and authorized history into one view while preserving where every statement came from.

08 / EXTERNAL EVIDENCE LANDSCAPE

External evidence landscape

What the literature supports - and where it remains incomplete.

Evidence area	Supported direction	Important boundary
Smartphone photogrammetry	Useful validity and reliability for selected posture measures under standardized capture.	Performance varies across spinal region, plane and method. [3-5]
Markerless pose estimation	Can localize joints and estimate kinematics without physical markers.	Accuracy depends on task, camera geometry, joint, plane and population. [6-8]
Monocular 3D reconstruction	Modern models can recover plausible three-dimensional body pose from a single image.	Depth, axial rotation and body shape are inferred and may be ambiguous. [9]
Digital MSK programs	Digital exercise and education can improve pain and function in selected populations.	Program outcomes do not validate a posture score or prove causal mechanisms. [21-23]
Pain and alignment	Symptoms can guide priority and action-plan relevance.	Posture-pain associations are often cross-sectional and do not prove cause. [14-15]

The external literature supports feasibility, not interchangeability. A phone-based system should be validated for its own intended use, capture protocol, population, regions and outputs. Evidence from gait, exercise or multiple-camera systems cannot automatically be transferred to a single static photograph.

MetaDoc therefore separates technical verification (does the software produce the intended output?), analytical validation (does the measurement agree with known or reference truth?), and clinical or wellness validation (is the output useful and interpretable for the intended population?). This follows the fit-for-purpose V3 framework. [10]

Evidence standard

Every public performance statement should name the sample, reference, metric, capture protocol and whether the result came from synthetic or real images.

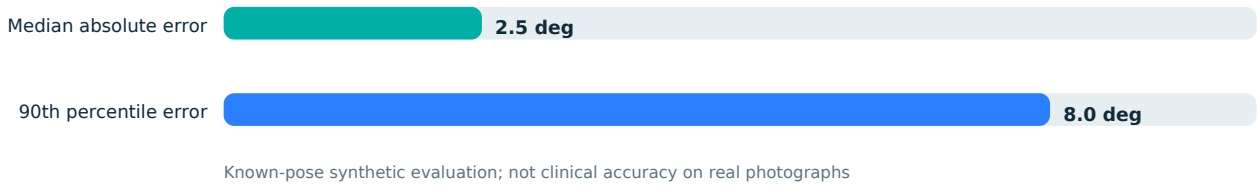
09 / METADOC EVIDENCE FOUNDATION

MetaDoc evidence foundation

A calibrated development program supported by clinical grading and known-pose technical evaluation.

MetaDoc's current evidence foundation includes a clinician-assigned calibration workbook and a known-pose synthetic evaluation. Together, these resources support scoring development, technical verification and the next phase of prospective validation.

Evidence source	Current fact	Correct interpretation
Clinical calibration set	2,240 joint-side grades across 56 individuals, assigned by one clinician.	Used to inform calibration and scoring logic. Not an independent holdout set or inter-rater study.
Known-pose synthetic set	116 synthetic images; 900 angle readings with exact posed-body truth.	Median absolute error about 2.5 degrees; 90th percentile about 8 degrees. Synthetic truth only.
Versioned scoring controls	Measurement and scoring definitions are recorded and comparable cohorts are separated.	Supports reproducibility; does not establish clinical validity.
Feature withholding	Unavailable or insufficiently supported measurements may be hidden.	Prevents a missing measurement from appearing as good alignment.



Known-pose synthetic evaluation; not clinical accuracy on real photographs

The known-pose result is useful for engineering because the angle truth is exact. It should not be presented as clinical accuracy on real users. Real-world agreement, repeatability, device variation, body-build effects and responsiveness still require prospective study.

Current evidence position

MetaDoc has a credible measurement architecture, calibration evidence and known-pose technical testing. It does not yet claim independent clinical validation, injury prediction or diagnostic performance.

10 / SAFETY AND LIMITATIONS

Safety and limitations

The limitations are part of the product, not fine print.

Limitation	User-facing meaning
Single image	A static photograph does not measure strength, endurance, balance, tissue health or complete functional capacity.
Inferred depth	Sagittal and transverse readings depend on the fitted 3D model and are generally less direct than frontal geometry.
Capture conditions	Camera height, tilt, framing, lighting, clothing, background and occlusion can change result quality.
Body model	Body build and fit assumptions may influence measurements; body templates are estimates, not personalized anatomy.
Symptoms	Pain and alignment can coexist without a causal relationship; no-pain and high-pain presentations both require context.
Trend comparison	Scores should be trended only under compatible measurement and scoring versions.
Unavailable features	A missing or low-confidence measurement is withheld; it must never default to a perfect score.
Escalation	Urgent symptoms or health concerns require appropriate professional or emergency evaluation outside the app.

The app should never imply that a normal-looking scan excludes a health problem. It should also avoid labeling an alignment pattern as pathology. Educational suggestions can be based on scan findings and reported limitations, but treatment decisions remain outside the wellness product.

Safe language

Use “alignment pattern,” “wellness insight,” “reported limitation,” “progress view” and “consider professional evaluation.” Avoid “diagnosis,” “disease screening,” “injury risk,” “medical grade,” “abnormality” and “treatment required.”

11 / PRIVACY, CONSENT AND DATA GOVERNANCE

Privacy, consent and data governance

Separate transient capture, longitudinal results and authorized records.

Data layer	Governance requirement
Capture image	Used to perform the scan. Launch controls should verify deletion from active image storage after processing and define lifecycle handling for versions and backups.
Derived scan data	Landmarks, measurements, scores, confidence, method versions and a privacy-safe body representation may be retained to reproduce results.
Reported answers	Pain and function are bound to the exact scan that used them; a skipped answer remains “Not answered.”
Medical records	Retrieved only through a separate adult user-authorized flow and kept unavailable to partners.
Sharing	Users choose the partner connection and may stop future sharing. Previously exported data cannot always be recalled automatically.
Deletion and restriction	The interface should state what MetaDoc can delete directly, what is retained for legal or security reasons, and what requires partner action.

Privacy claims must match the deployed environment. “No face retained” should mean more than deleting a visible crop: the product must account for raw images, image versions, backups, landmarks, 3D representations and any data that could enable re-identification. Consumer-health, biometric and breach-notification obligations may apply even when HIPAA does not. [17, 20]

MetaDoc's governance goal is data minimization with traceability: collect what is needed, preserve the provenance of each result, restrict access by purpose, and make retention and deletion understandable to the user.

Launch control

Before making public retention claims, verify photo deletion, object-version lifecycle, backup behavior, derived-data retention and every partner or processor agreement.

12 / APPLICATIONS

Applications

A wellness platform can support several settings without turning every use into a medical claim.

Setting	Potential value	Evidence / governance position
Consumer wellness	Create a baseline, understand patterns, follow an educational action plan and track compatible repeat scans.	Strongest fit
Fitness and performance	Use alignment information as one input to coaching, mobility and recovery conversations.	Practical, non-diagnostic
Wellness and MSK partners	Scan users, review approved scores and support engagement without accessing medical records.	Requires consent and role controls
Remote coaching	Provide a common visual and numeric baseline before a virtual conversation.	Capture quality remains critical
Research and product improvement	Study measurement behavior, usability and repeatability using governed, consented data.	Needs prespecified protocols
Employers and populations	Use only aggregate, voluntary wellness insights with strict privacy boundaries.	Emerging; avoid employment decisions

Digital musculoskeletal programs can improve pain and function, but the value usually comes from the full intervention - education, exercise, coaching and adherence - rather than from a single posture metric. [21-23] MetaDoc's action plan should therefore be evaluated as an experience, while the Align Score is validated as a measurement system.

Marketplace direction

The scan can help route a user toward relevant wellness resources, products or professionals. Recommendations should remain transparent, optional and separate from diagnosis or medical referral claims.

13 / PTSA LINEAGE AND PRODUCT TRANSLATION

PTSA lineage and product translation

A clinical concept informed the architecture; it did not validate the camera system.

MetaDoc's regional reasoning is informed by the Postural Torsion Syndrome Algorithm (PTSA), developed by Armia Abdo and Vikas Sharma. The 2019 publication described a five-level manual hypomobility framework applied across paired articulations. [16]

Element	Accurate interpretation
PTSA contribution	Ordered severity, regional rollup and a whole-body view of interdependent findings.
What changed	MetaDoc uses standing image geometry and model-derived landmarks rather than hands-on passive hypomobility grading.
What did not transfer	PTSA does not supply the current camera thresholds, 0-100 bands or evidence that a standing photograph replaces manual assessment.
Current score bands	The 85/73/56 boundaries are clinician-set product conventions and remain subject to prospective validation.
Scientific role	PTSA is a conceptual lineage and calibration influence, not validation of the present scan.

The distinction is important. A concept can guide what to measure and how to organize results, while the implemented technology still requires its own analytical and prospective validation. MetaDoc should cite PTSA transparently, state the pilot nature of the publication, and avoid claiming bilateral camera validity from the original work.

Scientific position

PTSA informed the question. Computer vision changed the measurement. The current system must earn its own evidence.

14 / VALIDATION ROADMAP

Validation roadmap

A staged program from content validity to real-world monitoring.

Stage	Question	Primary evidence
1 Content validity	Confirm that regions, labels, interpretations and action-plan logic are relevant and understandable.	Clinical review plus user testing
2 Technical verification	Test framing, failure handling, versioning, missing data and deterministic behavior.	Automated test suites and known-pose cases
3 Analytical agreement	Compare joint and regional measures with appropriate reference measurements.	Bland-Altman bias/limits; a-priori error targets [12]
4 Repeatability	Repeat scans with repositioning across operators, devices and days.	ICC with CI, SEM and MDC95 [11]
5 Construct validity	Test prespecified relationships with function and symptom measures.	Hypothesis testing; keep PROMs distinct [13]
6 Responsiveness	Determine whether meaningful changes exceed measurement noise.	Longitudinal study; change thresholds
7 Generalizability	Evaluate performance by body build, skin tone, clothing, device, age and environment.	Subgroup performance and failure rates
8 Post-release monitoring	Track capture quality, drift, failures and version-specific behavior.	Governed monitoring and change control [18]

Training, calibration and test participants must be separated at the person level. Repeat images from one person cannot be treated as independent evidence. Every validation report should identify the model, scoring version, body regions, capture protocol, exclusions and confidence intervals.

Release principle

If a region does not meet the accepted analytical and repeatability thresholds, withhold the score. Do not substitute a partial score, infer normal alignment from missing data, or place an incomparable scan into trends.

15 / GOVERNANCE, INTENDED USE AND CONCLUSION

Governance, intended use and conclusion

Accessible does not mean ungoverned.

Intended-use statement

MetaDoc is a low-risk general wellness platform that helps users visualize alignment patterns, record pain and functional limitations, follow educational exercises and review changes across compatible scans. It is not intended for diagnosis, disease screening, disease monitoring, injury prediction, treatment decisions or emergency assessment.

Governance rule	Operating standard
Evidence before claims	Public statements must be supported by a named dataset, protocol, metric and approved report.
Versioned change control	Model and scoring changes require review, testing and a new comparable trend cohort when meaning changes.
Human-readable limitations	Users see what was measured, what was inferred, what was reported and what was unavailable.
Separation of wellness and care	No clinician signature or medical-care framing appears in the consumer wellness output.
Source-aware AI	Summaries preserve provenance and never fabricate new diagnoses or unsupported causal claims.
Privacy by design	Retention, sharing and deletion controls are verified against actual deployed behavior.

Conclusion. MetaDoc's promise is not that one photograph replaces a clinical examination. Its promise is that a well-designed, well-governed photograph can become a practical wellness baseline - easier to access than laboratory measurement, more structured than unaided observation, and more useful when paired with transparent symptoms, function and next steps.

The strongest path forward is disciplined: make the experience simple, keep the evidence visible, validate the measurements prospectively, withhold what is not ready, and expand claims only as the data earns them.

ONE SCAN	ONE APP	ONE COMPLETE HEALTH STORY

16 / REFERENCES

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17 / REFERENCES CONTINUED

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Document status

Public-facing evidence white paper integrating MetaDoc's current product architecture, supporting research, technical evaluation and prospective validation roadmap.

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The future of MSK wellness
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