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2026

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WHITE PAPER

The Physical Operating System for Sovereign Healthcare

Introducing ZoyeMed 3.0: The World's First Autonomous Edge AI Clinical Terminal

Version: **1.0 (Pre-Release / WHX Edition)** Date: **January 2026** Author: **Zoya Technologies (Zoyel)**

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1. Executive Summary

The global healthcare model is facing an existential trilemma: costs are skyrocketing, access is fragmented, and patient data privacy is compromised by cloud-dependent AI.

ZoyeMed 3.0 represents a paradigm shift from "Digital Health" (Apps/Telemedicine) to "**Physical AI Infrastructure**". It is a highly **autonomous**, human-in-the-loop, **5sqm** clinical terminal capable of delivering a complete medical episode—from triage to diagnostics (as applicable from a panel of **120+ tests**) to prescription—in **under 30 minutes**. Final prescriptions and clinical decisions remain under licensed clinician authority, with ZoyeMed providing structured decision support.

Unlike systems powered solely by generic **Large Language Models (LLMs)** that hallucinate on static data, **ZoyeMed** is powered by a **Longitudinal Multimodal Model (LMM)** operating on a **Hybrid Edge-Cloud Architecture.**

- **Edge Processing:** Handles immediate, privacy-sensitive decision-making on-site.
- **Cloud Intelligence:** Analyzing anonymized (PHI-cleaned) data to provide longitudinal insights on the time dimension.

This ensures **Data Sovereignty, zero latency**, and clinical decision-making that views patient health as a **dynamic**, evolving movie rather than a **static** snapshot. This architecture is designed to support **strong data sovereignty**, local processing, and privacy-first clinical decision-making

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2. The Core Philosophy: Edge AI & Data Sovereignty

2.1. The Privacy Imperative (Sovereign AI)

Most "AI Health" solutions stream **sensitive Patient Health Information (PHI)** to centralized clouds, creating latency and security risks. ZoyeMed 3.0 is built on a **"Privacy-First, Edge-Native"** architecture.

- **Local Processing:** All computation occurs first on the machine using the proprietary **"Amygdala"** engine. No raw patient data leaves the terminal unless authorized.
- **Encryption:** The system utilizes AES-256 encryption for data at rest and TLS 1.3 for data in transit.

2.2. Seamless Connectivity & Resilience

Healthcare cannot stop when the internet goes down.

- **Internet Bonding & Load Balancing:** The system aggregates multiple connections (Fiber, Wi-Fi 7, 5G, Ethernet) for unshakeable uptime.
- **Offline Capability:** The Edge AI ensures maximal diagnostic and clinical function even in total disconnectivity, syncing only essential metadata when the connection is restored.

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3. The Artificial Intelligence Engine: Zoyel LMM

3.1. "The Movie vs. The Snapshot" (LMM vs. LLM)

Standard LLMs view a patient's query as a static **"Snapshot"** in time, lacking context of the past or the trajectory of the future

Zoyel AI is a Longitudinal Multimodal Model (LMM):

- **Time-Based Decisions:** It treats health as an evolving **dynamic** movie. It analyzes the *trajectory* of vitals over time *(e.g., "Creatinine is rising 15% faster than last month")* rather than just the current value.
- **Multimodal Input:** It ingests text, voice, medical images (X-Ray, CT, MRI, Dermoscopy), digital stethoscopy sounds, and bio-signals simultaneously to form a holistic clinical picture.

3.2. Closed-Loop Intelligence

The system learns from Outcome Feedback. Unlike static expert systems, ZoyeMed tracks patient recovery. If a specific treatment path yields faster recovery, the weighting for that pathway increases, creating a self-optimizing "Collective Medical Intelligence". It incorporates a closed-loop intelligence framework, where outcomes are monitored and reviewed through controlled, audited processes. Insights derived from aggregated, de-identified outcomes inform future model updates and clinical pathway optimization, ensuring continuous improvement while maintaining regulatory compliance and clinical oversight

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4. Technical Specifications & Hardware Architecture

ZoyeMed 3.0 is not a kiosk; it is a supercomputer disguised as a clinic.

4.1. Compute Power (The Brain)

- **Primary AI Core:** AMD Strix Halo (128GB RAM) – Dedicated to heavy neural network inference and LMM processing locally.
- **Operations Core:** Intel Twin Lake (16GB) – Dedicated to peripheral management, UI flow, and sensors to ensure zero lag in user experience.

4.2. Integrated Peripherals

- **Telepresence Audio-Visual Suite:** A 12-camera multi-spectral array including 4K PTZ for AI analysis, Infrared & RGB sensors, and dual 12-bit depth cameras with negatoscope for medical image scanning. Audio is handled by DSP microphones with a dedicated sound board.
- **Connectivity:** Native Wi-Fi 7, Bluetooth 5.4, Gigabit Ethernet.
- **Input/Output:** Built-in high-speed prescription printing, OCR document scanning, and biometric authentication.
- **Power:** Integrated UPS and power management for conditioned, safe operation in unstable grids.

4.3. The Physical Footprint

- **Size:** Ultra-compact 5sqm footprint.
- **Efficiency:** Designed for "Plug & Play" deployment in malls, lobbies, or shipping containers.

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5. Clinical Capabilities: The 120+ Test Ecosystem

ZoyeMed 3.0 integrates a comprehensive suite of **Point of Care** CE-compliant analytical components.

A. Vitals & Physical Examination (Automated)

- **Basic Vitals:** Height, Weight, BMI, Temperature, SpO2, Heart Rate.
- **Advanced Vitals:** Digital ECG (12 Lead), Fetal Doppler, Digital Stethoscopy, Thermal Camera.
- **Specialized Exams:** Dermatoscope, Oto/Rhinoscope, 4K Focusable PTZ Camera.
- **Spirometry:** FVC, SVC, MVV, and Pre/Post Bronchial Dilation tests.

B. Biochemistry Profile (Dry Chemistry)

- **Liver Function:** ALT, AST, TBIL, DBIL, TP, ALB, Globulin, GGT, ALP.
- **Renal Function:** Urea, Creatinine (CRE), Uric Acid (UA), CO2.
- **Lipid Profile:** TG, CHOL, HDL-C, LDL-C.
- **Electrolytes:** K+, Na+, Cl-, Ca, P, Mg.
- **Cardiac Enzymes:** CK, CK-MB, LDH, a-HBDH.
- **Diabetes:** Glucose, HbA1c, Glycated Serum Protein (GSP).

C. Immunofluorescence (Hormones & Markers)

- **Cardiac:** cTnI, Myoglobin, NT-proBNP, D-Dimer.
- **Inflammation:** Hs-CRP, CRP, Procalcitonin (PCT), IL-6, SAA.
- **Thyroid:** T3, T4, TSH, Free T3, Free T4.
- **Fertility/Hormones:** Beta-HCG, LH, FSH, Progesterone, Testosterone, Estradiol, Prolactin, AMH.
- **Tumor Markers:** tPSA (Prostate).
- **Vitamins:** Ferritin, Vitamin D, Total IgE

D. Hematology (Cell Counter)

- **Differentials:** 3-Part & 5-Part Differentials (WBC, RBC, HGB, HCT, PLT, RDW, Ratios & Fractions etc.).

E. Rapid Diagnostics (AI Vision Analyzed)

- **Infectious Diseases:** Malaria, Dengue, Typhoid, Chikungunya, Leishmania.
- **Viral Screening:** HIV, Hep-B, Hep-C.
- The list is not exhaustive - all commercially available Rapid Diagnostic Kits, approved by appropriate regulatory bodies, can be integrated and the model trained for analysis in a short time.

F. Urinalysis

- **10-Parameter Strip:** Glucose, Protein, pH, Ketones, Blood, Bilirubin, Urobilinogen, Nitrite, Leukocytes, Specific Gravity.

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6. Regulatory Compliance & Security Architecture

6.1. Safety & Certification

- **System Certification:** CE (Electrical) and NYCE (Mexico) certified.
- **Component Compliance:** All internal analyzers are sourced from manufacturers holding CE-MDR certifications.
- **In-Process:** CE-MDR (System Level), CDSCO (India), COFEPRIS (Mexico), and INVIMA (Colombia).
- **Guardrailing:** The AI is strictly guardrailed against hallucinations by linking to real-time, verified medical databases and adherence to clinical protocols.
- **Configurable :** System behavior, clinical workflows, and AI outputs are configurable to align with country-specific regulatory, licensure, and scope-of-practice requirements.

6.2. Interoperability (The Universal Language)

ZoyeMed is designed to integrate, not isolate.

- **HL7 & FHIR:** Seamless bidirectional synchronization with Hospital Information Systems (HIS).
- **DICOM:** Standardized imaging formats.
- **LOINC, ICD-11 & SNOMED-CT:** Standardized nomenclature for universal result interpretation.

6.3. Security Architecture (The Fortress Principle)

Security is a foundational design principle, not an afterthought.

- **Application Sandboxing:** Each clinical module runs in isolated containers, preventing lateral movement in case of a breach.
- **Encryption:** AES-256 for data at rest; TLS 1.3 for data in transit.
- **Data Anonymization:** PHI is stripped before any data leaves the terminal for cloud analytics.
- **Access Control:** Strict Role-Based Access Control (RBAC) and Multi-Factor Authentication (MFA) for all clinicians and administrators.
- **Immutable Logging:** Every action is logged, stamped, and centrally archived for audit trails.
- **Biometric Verification:** Facial recognition ensures patient identity integrity

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7. The Operational Ecosystem: Zoyel.one

Hardware is useless without the business logic to run it. Zoyel.one is the built-in ERP suite.

- **Multi-Lingual Support:** English, Spanish, French, German, Arabic, Hindi, Chinese, and Japanese
- **Three Operational Modes (Multi-Flow):**
  - **Nurse Managed:** Assisted by on-site staff, supported by remote clinicians.
  - **Doctor Run:** Functions as a high-tech clinical terminal for physicians.
  - **Autonomous:** Self-service health screening or remote tele-doctor connection
- **Collaborative Care:** Supports multi-doctor review for complex case management.
- **Business Intelligence (BI):** extensive & configurable including:
  - **Granular Analytics:** Consultation times, inputs, outputs, Real-time P&L per machine/test (94 ready made templates + more configurable).
  - **Geospatial Intelligence (GIS):** Population health heatmaps mapped against revenue centers.

8. Deployment Philosophy

ZoyeMed is designed for enterprise-scale deployments, typically involving fleets of clinics rolled out over multi-year horizons. Commercial viability is driven by scale rather than isolated installations, with each deployment customized for local regulations, language, pharmacopoeia, and healthcare workflows.

The system is showcased globally at WHX Dubai as a reference platform, while deployments are evaluated selectively based on strategic alignment and scale.

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9. Conclusion: The Strategic Value

- **For Governments:** A scalable, sovereign layer of primary care that reduces the burden on national hospitals.
- **For Real Estate:** A premium "Health Amenity" that increases asset value ($/sqft).
- **For Insurers:** A drastic reduction in claims cost through preventative, accessible care (30-minute episodes).

***ZoyeMed 3.0** is not just a device,*
*it is the **infrastructure** of the **future**.*

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