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Performance Metrics and Challenges of Edge AI Deployment in Healthcare Environments

1. How do interoperability and cybersecurity issues affect edge deployment metrics in healthcare?

Interoperability problems arise when medical devices and software products of different vendors are not able to communicate with each other smoothly. This affects edge deployment as:

Data may not be appropriately shared across systems.

There will be a lag in diagnosis and treatment.

There needs to be more manual intervention to integrate and clean data.

These issues directly injure metrics like latency (slow data transmission) and accuracy (lost or misread data).

Security issues impact edge system trust and safety:

Hacked devices can transmit or manipulate sensitive patient data.

Edge systems must comply with strict regulations (e.g., HIPAA, GDPR).

Security features (access control, encryption) can introduce latency or system complexity.

By and large, these issues injure uptime, reliability, compliance, and user trust in edge deployments.

2. What performance metrics are most critical to quantify the impact of edge computing on healthcare (most notably latency and accuracy)?

The key performance indicators (KPIs) are:

Latency: It quantifies the time between data capture and action (i.e., generation of an alert). Minimum latency is critical in emergency situations like cardiac emergencies.

Accuracy: It quantifies the accuracy of edge AI diagnoses or predictions. High accuracy enables safe clinical decision-making.

Throughput: It measures the volume of data processed in real-time. Important in high-patient-load environments.

Uptime: Measures system availability. Critical in 24/7 monitor devices.

Reliability: Consistency in system performance over time and in changing conditions.

Compliance: Verifies compliance with data protection law. Essential for legal and ethical operations.

Cost-effectiveness: Verifies if edge computing saves costs compared to cloud-only solutions (e.g., less bandwidth consumption, fewer delays).

3. What are standards for measuring the reliability of edge AI in patient diagnosis?

Standard benchmarks are:

Precision, Recall, F1 Score: Ensure how well AI correctly diagnoses conditions with no false positives or false negatives.

False Positive/Negative Rates: Measure safety of diagnostic decisions—critical in avoiding misdiagnoses.

Stress Testing: Tests the system with extreme loads of data.

Robustness Testing: Tests the system's reaction to noisy, changing, or missing data.

Explainability: Allows clinicians to understand and confirm AI recommendations.

Compliance Audits: Ensures legal and regulatory compliance in the processing of patient information.

4. Importance of Key Metrics

Measure Significance

Latency Enables real-time responses in life-critical processes.

Throughput Allows scalable performance in high-traffic healthcare settings.

Accuracy of Diagnostics Ancillary though essential guaranteeing accurate patient diagnosis and treatment.

Uptime Ensures system availability and continuous monitoring.

Reliability Creates trust in repeated execution under changing conditions.

Compliance Maintains patient confidentiality and reduces legal risks.

Cost-effectiveness Determines practical value and suitability for healthcare providers.