BLOCKCHAIN-ENABLED SECURE DATA COMMUNICATION FRAMEWORK FOR WEARABLE SWEAT LITHIUM MONITORING IN BIPOLAR DISORDER MANAGEMENT

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Abstract

Bipolar disorder is a chronic psychiatric illness characterised by recurrent episodes of depression and mania. Lithium remains the gold-standard mood stabiliser; however, its narrow therapeutic index necessitates regular monitoring. Maintenance serum lithium concentrations are typically targeted at 0.6–0.8 mmol L^{-1} and may be increased to 1.0 mmol L^{-1} when clinical response is inadequate. Concentrations below 0.6 mmol L^{-1} may compromise efficacy, whereas levels above 1.5 mmol L^{-1} are commonly associated with toxicity. Sweat lithium monitoring offers a non-invasive alternative to blood testing, but the data are sensitive and need secure, immutable communication. DHIS2 is used for clinical monitoring in Sri Lanka and many other countries, yet it cannot manage high-frequency wearable streams alone. This research proposes Hyperledger Fabric as consent-and-audit middleware before a minimum consented payload is sent to DHIS2 via its REST API. A Python model generates a sweat-lithium stream with additive noise and diurnal variation and labels each sample as sub-therapeutic, therapeutic, or toxic using those serum cut-offs. Signed readings are submitted to a two-organisation Fabric test network. Chaincode commits a record only when patient consent is true, assigns clinical status on-chain, and exposes patient and toxic-reading queries, so new wearable writes do not depend on the DHIS2 administrator. The wearable is not a Fabric peer; an ESP32-class gateway submits invokes, avoiding on-device endorsement and consensus cost. Toxic levels are intended to notify emergency services and relevant persons. If DHIS2 fails, the ledger remains the source record; after recovery, the gateway re-queries composite-key indexes (GetPatientReadings, GetToxicReadings) and replays only consented records missing a chain transaction id to the Tracker API. Targets are a commit latency below 2 s and at least 10 accepted events per minute. The study will evaluate security, performance, scalability, patient agency, and practicality in low-resource settings.

Keywords: Hyperledger Fabric, DHIS2, Sweat Lithium, Patient Consent, Bipolar Disorder