Hospital Pharmacy Forecasting & Replenishment — Open‑Source Architecture (v1)

## What this system delivers

* Today’s recommended orders for each SKU.
* Simple dashboards for trends (demand, stockouts/bounce, service level, forecast accuracy).
* Daily health report showing if data looked OK or if an anomaly was detected. (role-based)

## Simple technology stack (open‑source; free to start)

* Storage (data lake): MinIO (S3‑compatible object storage)
* Scheduler: Linux cron (or Apache Airflow if preferred)
* Ingest: Airbyte or a small Python fetch script
* EDA & Data Quality: ydata‑profiling (HTML) + Great Expectations (automated checks)
* Processing & Scale: Pandas/Dask; Databricks (Spark + Delta Lake) for very large datasets
* Forecasting & Model Tracking: Prophet / statsmodels / scikit‑learn + MLflow
* Policy/Logic: Python job for reorder point / (s,S) / min‑max
* Serving: FastAPI (APIs), PostgreSQL (fast reads), Next.js (pharmacist UI), Superset (dashboards)

## Daily flow (plain English)

* Collect yesterday’s data and store it in MinIO.
* Run EDA and automated checks (missing values, spikes, gaps, wrong columns).
* Gate: If FAIL → quarantine + alert; If PASS → continue.
* Prepare features (day/week rollups, moving averages, holidays).
* Forecast: retrain weekly or when drift is detected; otherwise reuse last good model.
* Recommend orders using forecasts + on‑hand + lead time + service level.
* Publish results to PostgreSQL and refresh dashboards.

## Diagram

[Daily cron]  
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 Ingest -> MinIO (raw files)  
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 EDA report + Data Quality checks  
 | pass | fail  
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 Features -> Forecast -> Policy Quarantine + Alert  
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 Results -> PostgreSQL (serve) & Delta Lake/Parquet (analytics)  
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 FastAPI (APIs) -> Next.js UI (pharmacists) & Superset (dashboards)

## Config (no code changes)

* Horizon (14/28/56 days) and granularity (day/week)
* Service level (e.g., 95%) and policy (min‑max, (s,S), reorder‑point)
* Retraining day (e.g., Sunday) and drift threshold

## APIs

* GET /data?sku=123&from=YYYY‑MM‑DD&to=YYYY‑MM‑DD
* GET /forecasts?sku=123&horizon=28d&freq=day
* GET /recommendations?date=YYYY‑MM‑DD&service\_level=0.95
* GET /runs/latest

## Security basics

* Role‑based access to the web app (SSO if available)
* HTTPS for all endpoints; encrypt data at rest (MinIO/Delta/Postgres)