



PharmaTrust

PHARMATRUST SRI LANKA

BLOCKCHAIN & AI-POWERED MEDICINE

AUTHENTICITY VERIFICATION SYSTEM WITH IOT COLD CHAIN

MONITORING

User Manual

Year 2025

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1. Introduction

1.1. Overview

PharmaTrust Sri Lanka is a platform that leverages blockchain and AI technologies to ensure the authenticity of pharmaceuticals and the integrity of the cold chain throughout Sri Lanka's healthcare system.

The platform integrates **IoT sensors** to monitor temperature and humidity in real time, providing continuous oversight of sensitive pharmaceutical products. By utilizing **blockchain**, PharmaTrust guarantees the immutability of records, ensuring that every transaction or change is securely logged and verifiable. In addition, **AI** is employed to detect anomalies, offering proactive alerts to prevent potential issues before they arise.

PharmaTrust is designed to meet the needs of pharmaceutical suppliers, distributors, and healthcare providers by delivering transparency, security, and efficiency, safeguarding the quality of medicines from manufacturer to patient.

1.2. Target Audience

PharmaTrust Sri Lanka is designed to serve a variety of users, each with specific roles and responsibilities in the pharmaceutical and healthcare ecosystem. The platform offers tailored dashboards and features to meet the unique needs of each group:

1. **Admin Dashboard**

The Admin Dashboard is meant for system administrators who oversee the entire platform. This user will have access to all system settings, data management tools, and reporting functionalities, ensuring smooth operations and oversight of all users and activities within the platform.

2. **Manufacturer Dashboard**

Intended for pharmaceutical manufacturers, this dashboard provides tools for tracking production, monitoring the supply chain, and ensuring the authenticity and proper storage conditions of medicines. Manufacturers can also access real-time data about product distribution and receive alerts for any discrepancies in the cold chain.

3. **Supplier Dashboard**

The Supplier Dashboard caters to wholesalers and distributors, allowing them to track the movement of products, and verify the authenticity of shipments. Suppliers can also monitor cold chain conditions and ensure that deliveries meet regulatory standards.

4. **Pharmacist Dashboard**

Designed for pharmacists, this dashboard helps verify the authenticity of pharmaceuticals

received, and track product conditions. Pharmacists can also access real-time data to ensure the quality and safety of the medicines they dispense to patients.

5. **Mobile App for General Users/Patients**

The mobile app is designed for general users and patients who wish to verify the authenticity of the medicines they receive. Users can scan QR codes on packaging to access detailed product information, including its origin, storage conditions, and shipment history, ensuring transparency and trust in the medications they use.

Each dashboard and app is designed to meet the specific needs of its user, providing interfaces and functionality to ensure that every stakeholder in the pharmaceutical supply chain can track, verify, and ensure the safety and integrity of medicines.

1.3. Prerequisites

To use PharmaTrust Sri Lanka, the following basic requirements must be met:

- **Admin, Manufacturer, Supplier, and Pharmacist Dashboards**
The dashboards are accessible exclusively through a web browser. Ensure that you have an internet connection and a modern web browser (e.g., Google Chrome, Mozilla Firefox, or Microsoft Edge) for optimal performance.
- **Mobile App for General Users/Patients**
The PharmaTrust mobile app is designed for Android devices running **Android 11** or higher. Ensure your device meets this requirement and that the app is downloaded from the official Google Play Store.

2. Functions and Core Features - Web Dashboard

2.1. Common Features

These are features that users of all roles in the web dashboard have access to

2.1.1. Scan QR Code

Allows administrators to scan previously generated QR codes to verify their validity and authenticity. The interface provides:

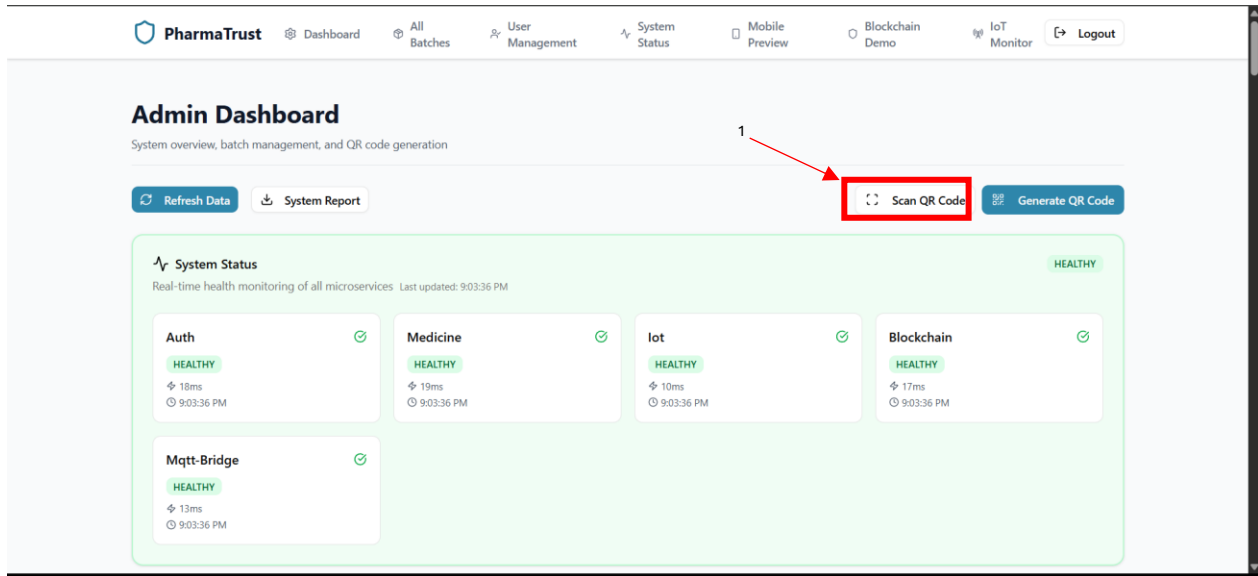


Figure 1. Shows the Scan QR code Function within the dashboard.

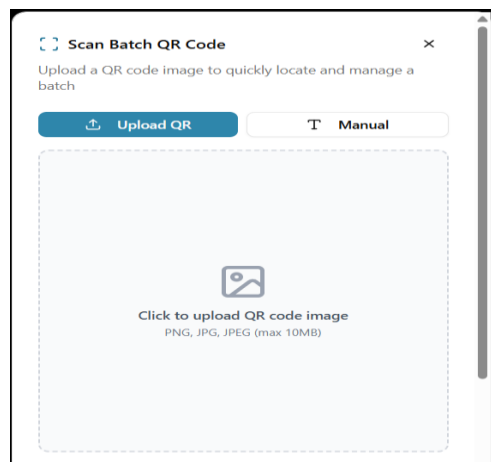


Figure 2. Shows the interface for uploading the QR code.

- QR code upload functionality (drag-and-drop or file selection)
- Manual input option for batch verification
- Real-time verification status display

To scan a QR code:

1. Click "Scan QR Code" button on the Admin Dashboard
2. Upload the QR code image or use device camera
3. System verifies the code against the blockchain
4. Results display batch information if valid, or error message if invalid/tampered

2.1.2. ML control Panel & ML Status Overview

ML Control Panel

Select a medicine batch to view its current status and ML insights in the sections below. Refer to figure 3 and 4.

ML Status Overview

Displays ML model performance and anomaly detection metrics:

- **Total batches** – Number of batches being monitored
- **Readings processed** – Total sensor readings analyzed
- **Adaptive models** – Number of active ML models
- **Avg confidence** – Average prediction confidence across all batches

Medicine models – Shows configured tolerance profiles for different medicines

Focused batch insight – Displays detailed metrics for the selected batch, including total readings, anomaly rate, and average temperature/humidity readings

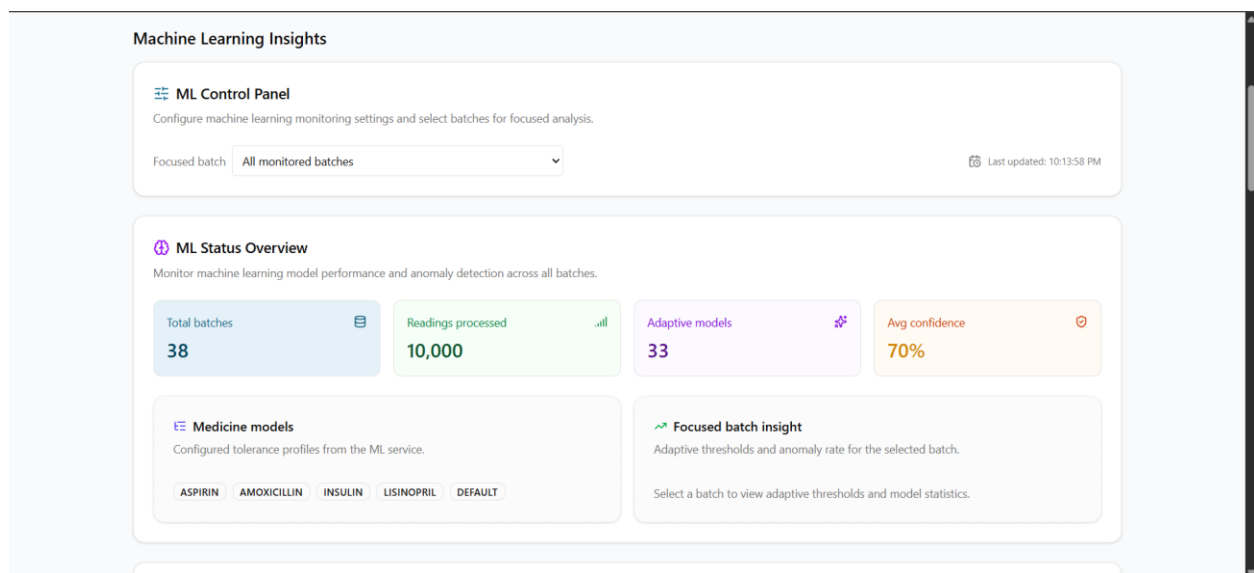


Figure 3. Shows the ML Control Panel without having selected a medicine batch

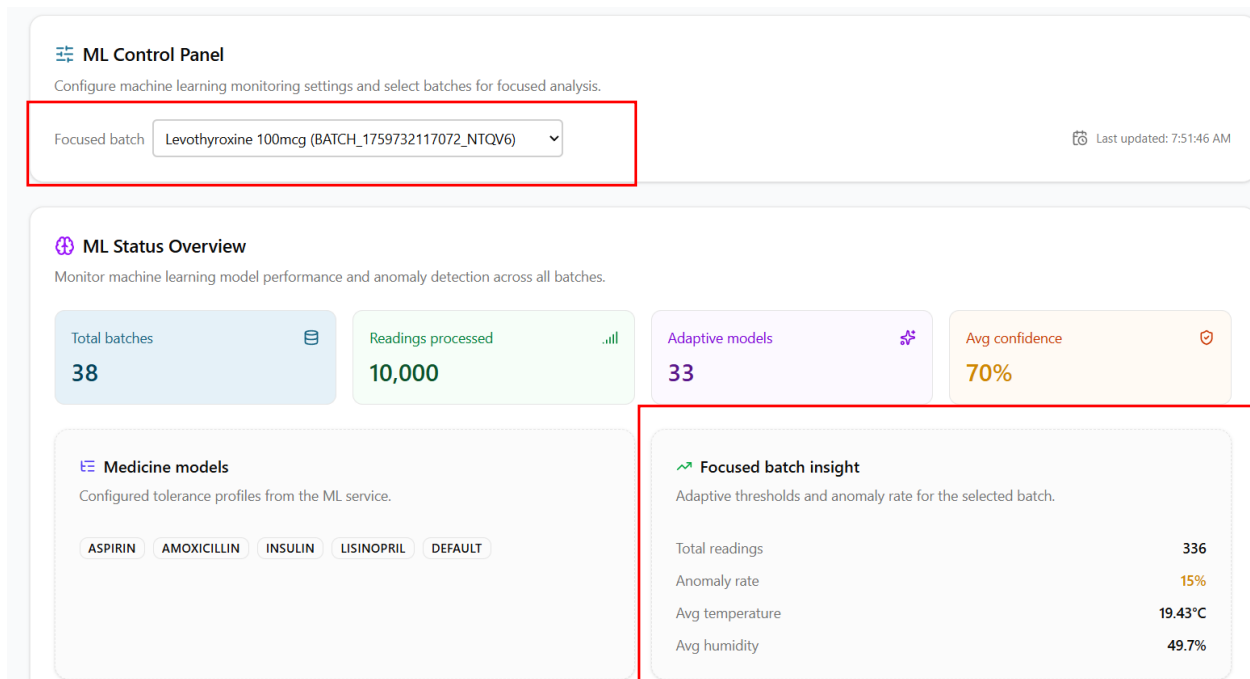


Figure 4. Shows the changes in the ML Control Panel after selecting a medicine batch.

2.1.3 ML Event Log

The ML event Log shows recent anomalies within the medicine batches and classifies them based on their severity.

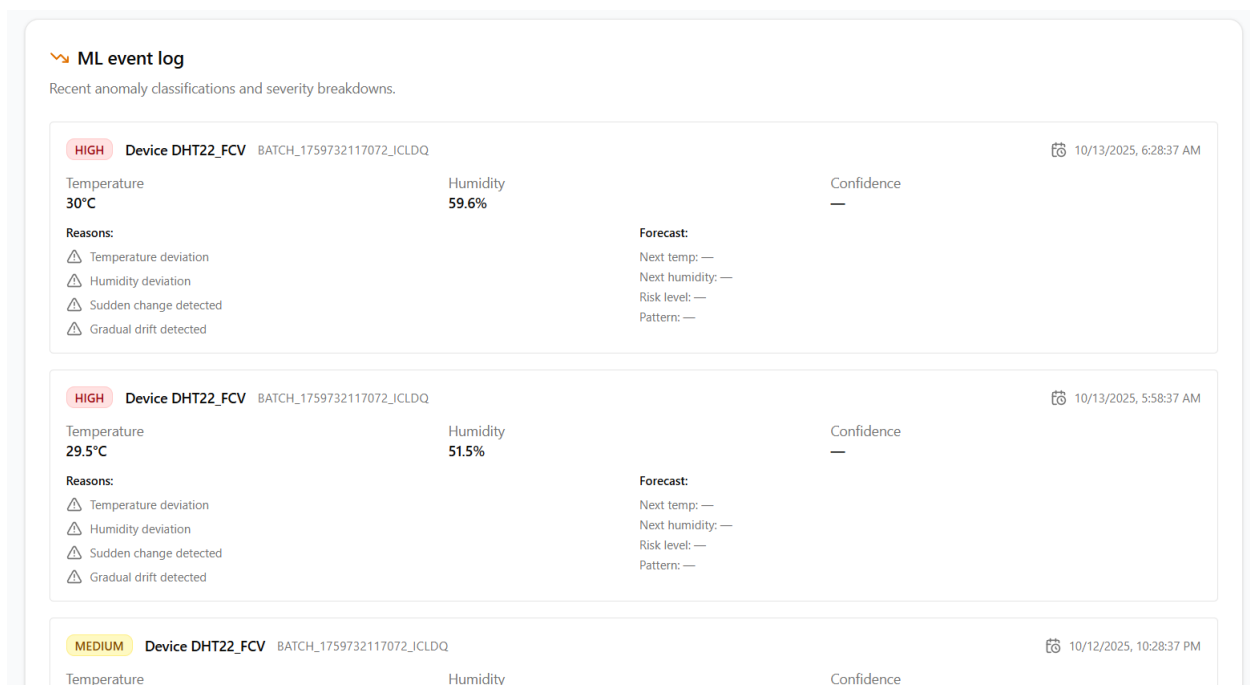


Figure 5. Shows the ML event log section.

2.1.4. System Overview Dashboard

Provides administrators with a real-time snapshot of platform metrics and batch distribution across the pharmaceutical supply chain (Refer to figure 6).

Key Metrics:

- **Total Batches** – Total number of medicine batches currently in the system, with change indicator showing batches added in the last 24 hours
- **Manufacturers** – Number of active manufacturer entities registered on the platform
- **Good Quality** – Number and percentage of batches meeting quality standards based on ML analysis and sensor data
- **Quality Issues** – Number of batches flagged as requiring attention due to detected temperature/humidity anomalies or quality concerns
- **Blockchain Verified** – Number and percentage of batches that have been verified and recorded on the blockchain for tamper-proof authentication
- **System Health** – Overall health status of all five platform services (Auth, Medicine, IoT, Blockchain, MQTT Bridge). Displays "HEALTHY" when all services are operational

Supply Chain Stage Distribution

Visualizes the current distribution of medicine batches across four supply chain stages:

- **Manufacturer** – Batches at the production/manufacturing stage
- **Supplier** – Batches in supplier warehouses or distribution centers
- **Pharmacist** – Batches at pharmacy locations
- **Customer** – Batches that have reached end customers

This view helps administrators quickly identify bottlenecks or unusual distribution patterns in the supply chain.

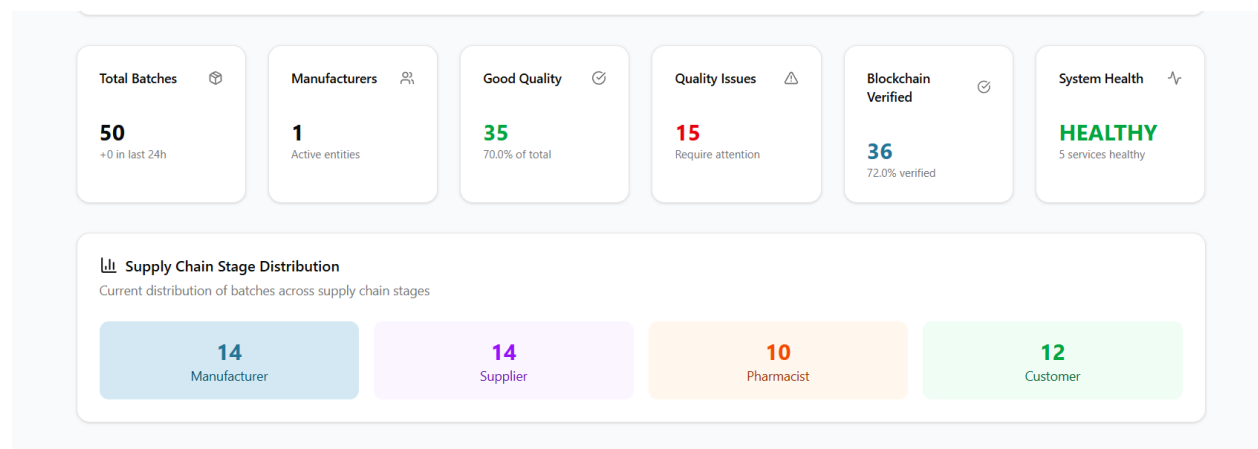


Figure 6. Shows the System overview and supply chain distribution.

2.1.5. Batch Management

Allows users to search, filter, and manage all medicine batches in the system (Refer to figure 7) .

Search and Filter Options:

- **Search bar** – Search batches by batch ID, medicine name, or manufacturer
- **Stage filter** – Filter batches by supply chain stage (All Stages, Manufacturer, Supplier, Pharmacist, Customer)
- **Quality filter** – Filter batches by quality status (All Quality, Good, Compromised)

Batch List View:

Each batch entry displays:

- **Medicine name and dosage** – e.g., "Panadol 100mg"
- **Batch ID** – Unique identifier for the batch
- **Manufacturer** – The entity that created the batch
- **Creation date** – When the batch was created
- **Quality status** – Visual indicator showing "GOOD" (green) or "COMPROMISED" (red) based on ML analysis
- **Current stage** – Badge showing the batch's current location in the supply chain
- **Supply Chain Progress** – Visual timeline showing the batch's journey through Manufacturer → Supplier → Pharmacist → Customer stages

Actions:

- **Transfer** – Move the batch to the next stage in the supply chain
- **View Details** – Access comprehensive information about the batch, including sensor data, quality metrics, and full transaction history

Summary Statistics:

The bottom panel shows aggregate counts across all batches:

- **Good Quality** – Number of batches meeting quality standards
- **Compromised** – Number of batches with quality issues
- **Blockchain Verified** – Number of batches verified on blockchain
- **Manufacturers** – Number of unique manufacturers

2.1.5.1 Batch Details View

Provides complete information about a selected medicine batch, including its current status, specifications, environmental monitoring data, and full supply chain history.

Overview Section:

Displays three key status indicators:

- **Quality Status** – Shows "GOOD" or "COMPROMISED" based on ML analysis of sensor data
- **Current Stage** – Indicates where the batch currently is in the supply chain (Manufacturer, Supplier, Pharmacist, or Customer)
- **Blockchain Status** – Shows "PENDING" (awaiting blockchain verification) or "VERIFIED" (recorded on blockchain)

Batch Information:

Contains essential batch details:

- **Medicine Name** – Product name and dosage
- **Medicine Type** – Classification of the medicine
- **Quantity** – Number of units in the batch
- **Expiry Date** – When the batch expires
- **Manufacturer** – Company that produced the batch
- **Manufacturer ID** – Unique identifier for the manufacturer
- **Created Date** – When the batch was created
- **Last Updated** – Most recent update timestamp
- **Description** – Additional information about the medicine

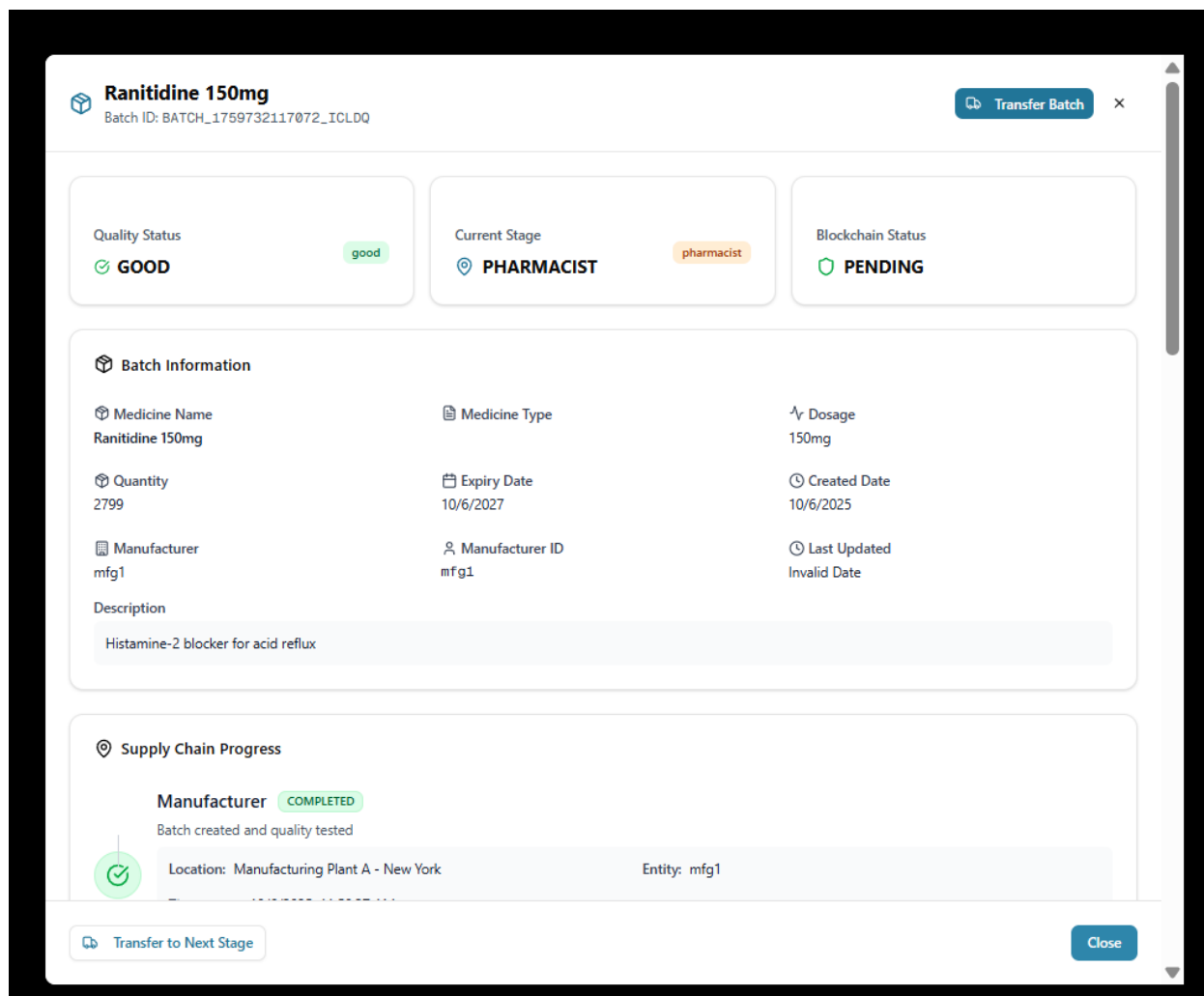


Figure 8. Shows the detail overview section within the view details feature

Supply Chain Progress:

Visual timeline showing the batch's journey through each supply chain stage. Each completed stage displays:

- Stage name (e.g., "Manufacturer", "Supplier")
- Status badge ("COMPLETED" for finished stages, "CURRENT" for active stage, "PENDING" for upcoming stages)
- Brief description of activities at that stage
- Location where the batch was handled
- Entity that handled the batch
- Timestamp of the transaction

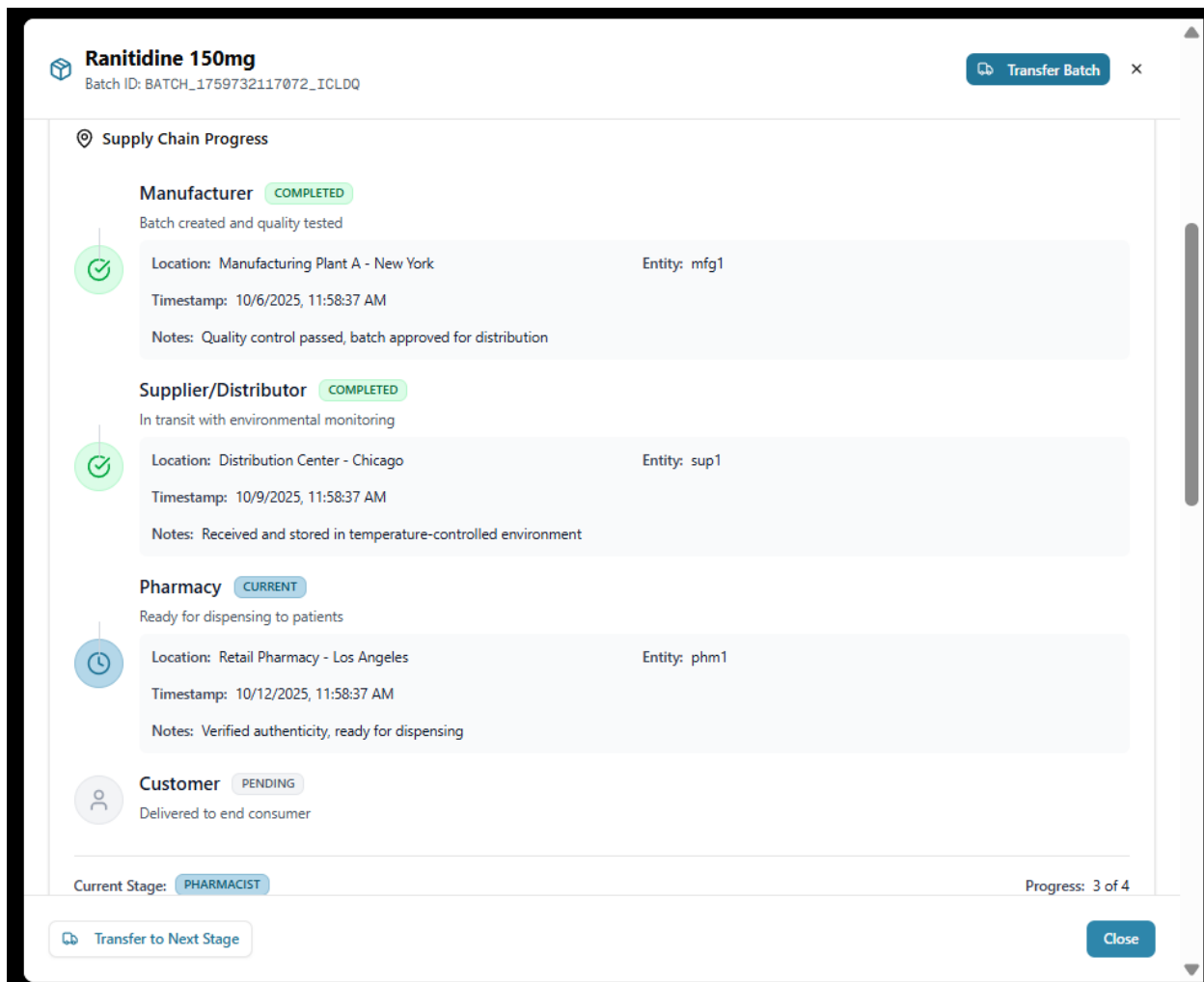


Figure 9. Shows the supply chain progress section in the view details feature

Supply Chain History:

Detailed chronological log of all transfers and events:

For each stage, displays:

- **Handled by** – Entity responsible at that stage
- **Location** – Physical location and facility name
- **Timestamp** – Exact date and time of the transfer
- **Notes** – Additional context about what happened (e.g., "Quality control passed, batch approved for distribution")

This provides complete traceability from manufacturing to final customer delivery.

Actions:

- **Transfer Batch** – Move the batch to the next stage in the supply chain
- **Close** – Return to the Batch Management list view

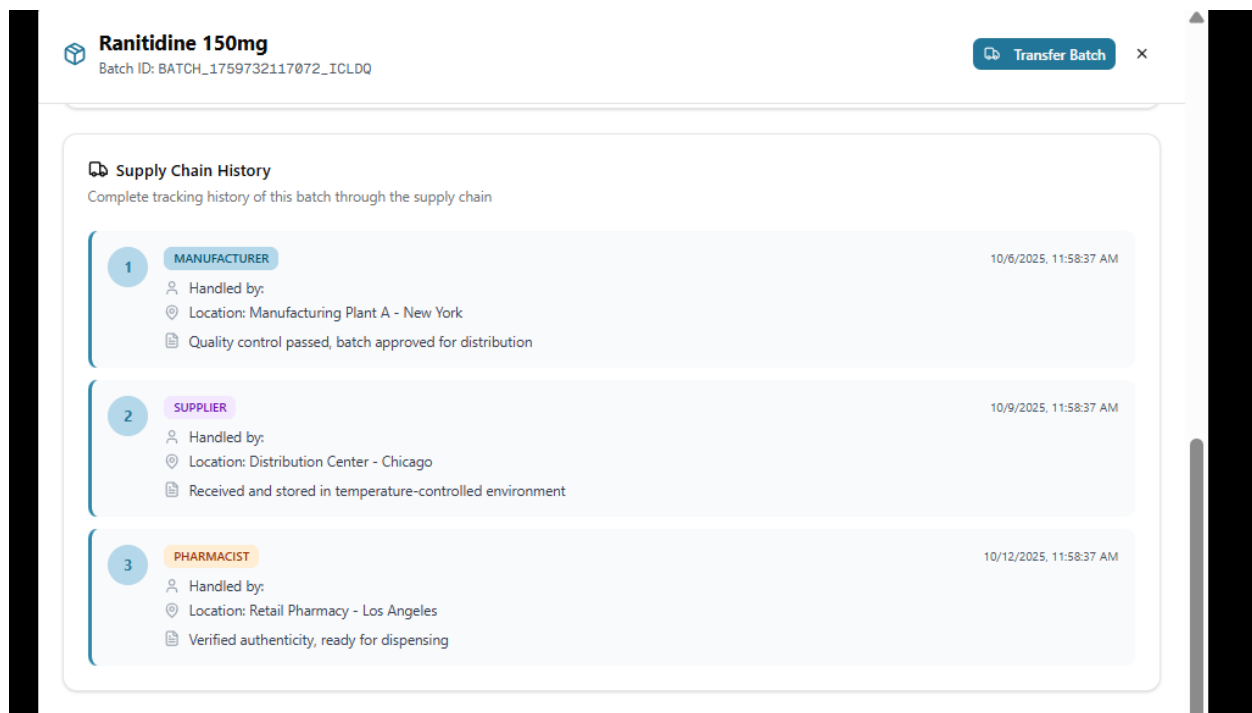


Figure 10. Shows the supply chain history section in the view details feature

Environmental Monitoring:

Displays real-time IoT sensor data for the batch:

Summary Cards:

- **Avg Temperature** – Average temperature recorded across all readings
- **Avg Humidity** – Average humidity level
- **Anomalies Detected** – Number of readings that exceeded acceptable tolerance thresholds

Recent Readings Table: Shows the most recent sensor readings with:

- Temperature and humidity values
- Device ID that captured the reading
- Timestamp of each reading

This data helps identify environmental conditions that may compromise medicine quality.

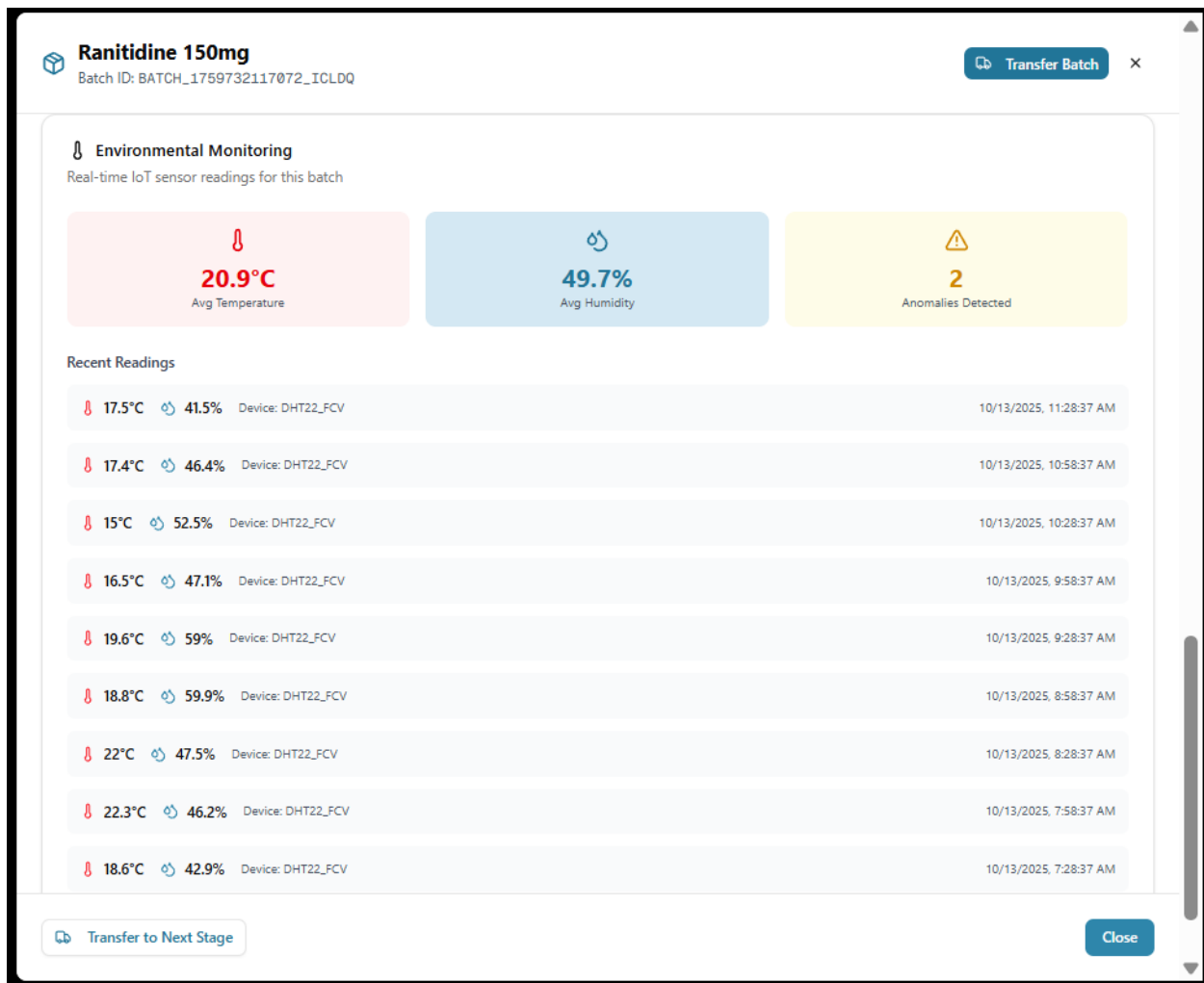


Figure 11. Shows the environmental monitoring section in the view details feature

2.2. Admin Dashboard

The Admin Dashboard provides system administrators with full oversight and control of PharmaTrust. It offers key features and functionalities for managing the platform.

2.1.1. Generate QR Code

Enables administrators to generate QR codes for medicine batches created by manufacturers and scan existing QR codes to verify pharmaceutical product authenticity.

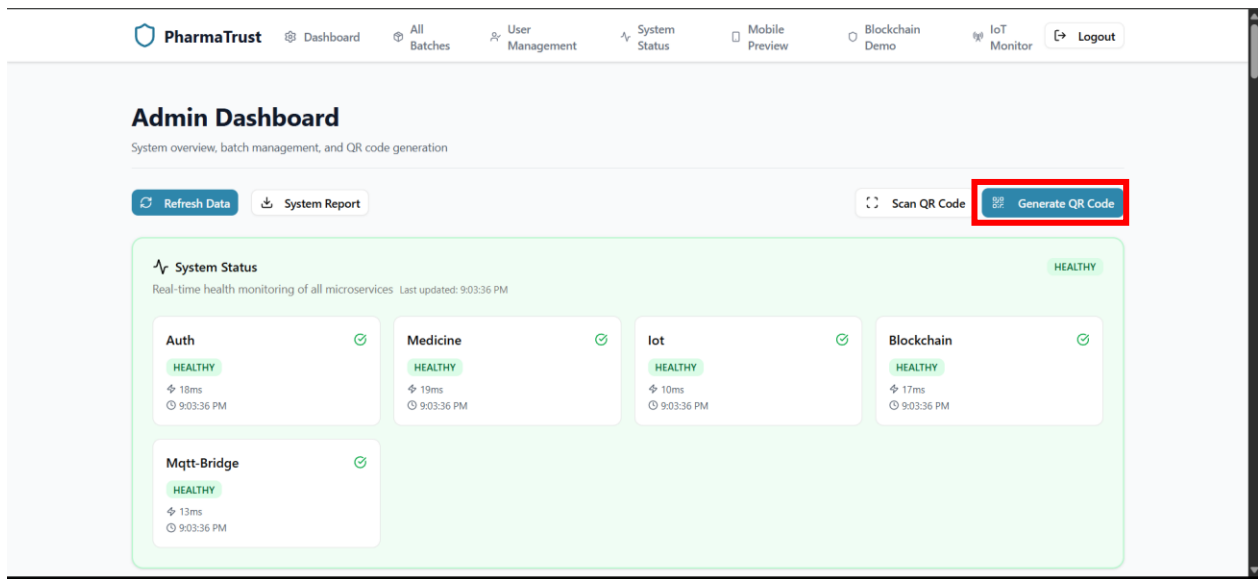


Figure 12. Shows the Scan QR code and Generate QR code Function within the dashboard.

2.1.1.1. Generate QR Code

Allows administrators to generate QR codes for medicine batches created by manufacturer dashboard users. The interface includes:

- **Select Batch** dropdown displaying available batches with batch IDs
- Batch status indicators showing quality status (e.g., "UNREGISTERED" for blockchain-pending batches)
- **Generate QR Code** button to create the code

To generate a QR code:

1. Click "Generate QR Code" button on the Admin Dashboard
2. Select the desired batch from the dropdown menu
3. Click "Generate QR Code"
4. System creates a unique QR code linked to the batch
5. QR code displays on screen and can be downloaded for printing/distribution

Generated QR codes contain encrypted batch information and blockchain references for tamper-proof verification throughout the supply chain.

Select a batch from this section

The screenshot shows a web application titled "QR Code Generator" with the subtitle "Generate QR codes for medicine batch verification". On the left, a panel titled "Select Batch" contains a search bar and a list of three medicine batches: "Panadol 100mg" (BATCH_1760179280043), "Panadol 100mg" (BATCH_1759760353845), and "Ranitidine 150mg" (BATCH_1759732117072_ICLDQ). Each batch has a green "GOOD" status indicator. A red box highlights this list, and an arrow points to it from the text "Select a batch from this section". On the right, a larger panel titled "Select a Batch" contains a QR code icon and the text "Choose a medicine batch from the list to generate its QR code." A "Close" button is at the bottom left of the interface.

Figure 13. Shows the interface before selecting a QR code.

The screenshot shows the same "QR Code Generator" interface, but now a batch has been selected. In the "Select Batch" panel, the search bar contains "BATCH_1759732117072_ICLDQ". The list shows three batches: "Levothyroxine 100mcg" (BATCH_1759732117072_NTQV6) with a red "COMPROMISED" status, "Gabapentin 300mg" (BATCH_1759732117072_UA6DW) with a green "GOOD" status, and "Metformin 850mg" (BATCH_1759732117072_201MR) with a green "GOOD" status. The "Gabapentin 300mg" batch is highlighted with a blue border. On the right, a new panel titled "Generated QR Code" shows the selected batch ID "BATCH_1759732117072_UA6DW" and the text "QR code for Gabapentin 300mg". Below this text is a large blue QR code. A "Close" button is at the bottom left of the interface.

Figure 14. Shows the interface after a batch has been selected and a QR code generated.

2.1.2. System Health Overview

The System Overview feature provides administrative staff with real-time insight into the operational status of all PharmaTrust services.

Services monitored:

1. **Auth Service** – Authentication service for users
2. **Medicine** – Database storing medicine information created and managed by the platform
3. **IoT** – Monitors temperature sensor connections to PharmaTrust
4. **Blockchain** – Monitors Ethereum network connection to PharmaTrust
5. **MQTT Bridge** – Sends IoT sensor updates to ML algorithms and receives processed results back to the platform

Status Display:

The System Status interface shows:

- **Service name and status** – Each service displays "HEALTHY" (green) when operational or error status when issues are detected
- **Uptime metrics** – Shows how long each service has been running
- **Last updated timestamp** – Indicates when status was last checked

Visual Indicators:

- **Green background** – All services operating normally (Figure 15)
- **Yellow background** – One or more services experiencing issues (Figure 16)
- **Performance warnings** – Detailed error messages for services requiring attention

When a service is unhealthy, administrators receive:

- Specific error descriptions
- Affected service identification
- Recommended actions for resolution

This real-time monitoring enables administrators to quickly identify and address system issues before they impact users.

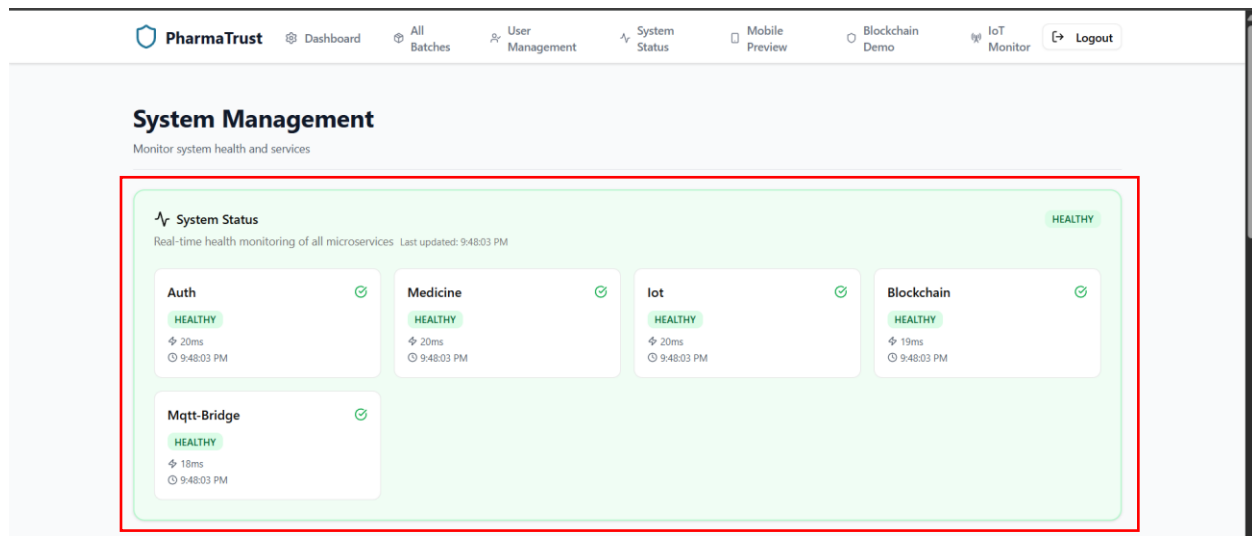


Figure 15. Shows the System Status feature with all services healthy.

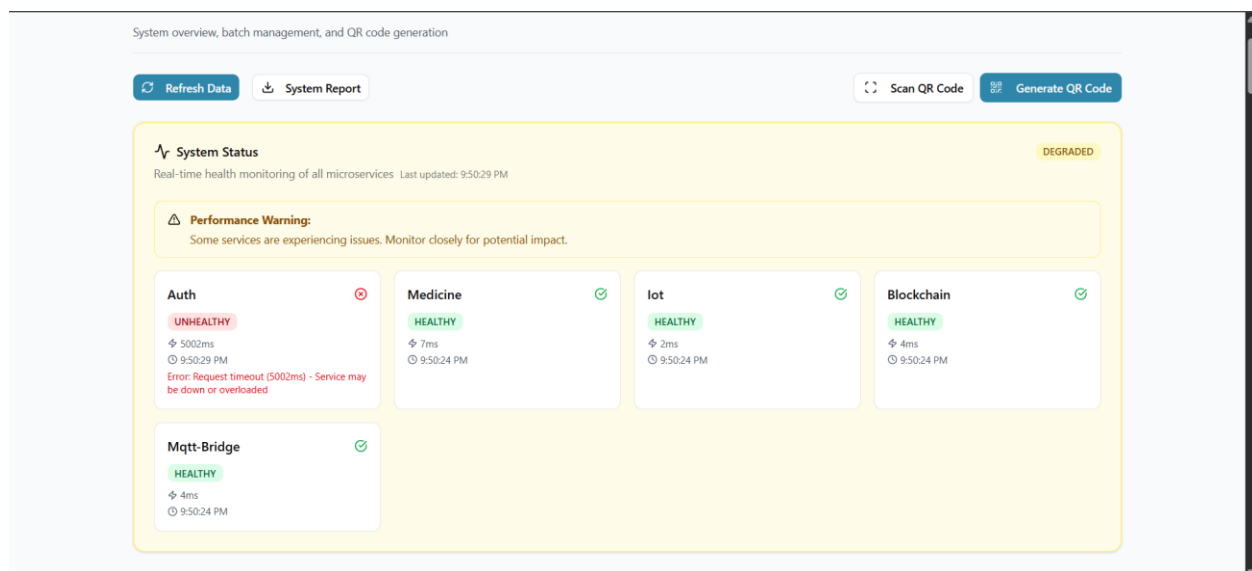


Figure 16. Shows the System Status feature when a certain is unhealthy.

2.1.3. User Management

Allows administrators to manage system users and their roles across the PharmaTrust platform.

User List View:

Displays all registered users with the following information:

- **User ID** – Unique identifier for each user
- **Role badge** – Visual indicator showing user type (MANUFACTURER, SUPPLIER, PHARMACIST, or ADMIN)
- **Entity name** – Organization or company name associated with the user

User Actions:

Each user entry provides three action buttons:

- **Edit** (pencil icon) – Modify user details such as username, password, role, or entity name
- **Reset password** (key icon) – Generate a new password for the user
- **Delete** (trash icon) – Remove user from the system (note: admin users cannot be deleted)

User Statistics:

The bottom panel displays aggregate counts:

- **Total Users** – Total number of users in the system
- **Admins** – Number of administrative users
- **Manufacturers** – Number of manufacturer accounts
- **Supply Chain** – Combined count of suppliers and pharmacists

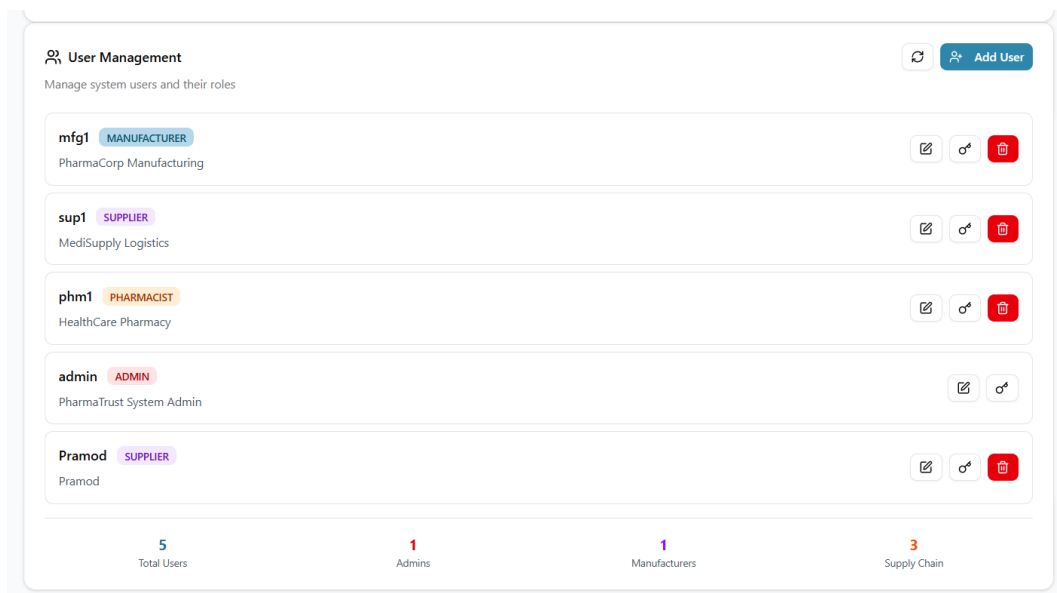


Figure 17. Shows the user management feature

Add New User:

Click the "Add User" button to create a new user account. The creation form requires:

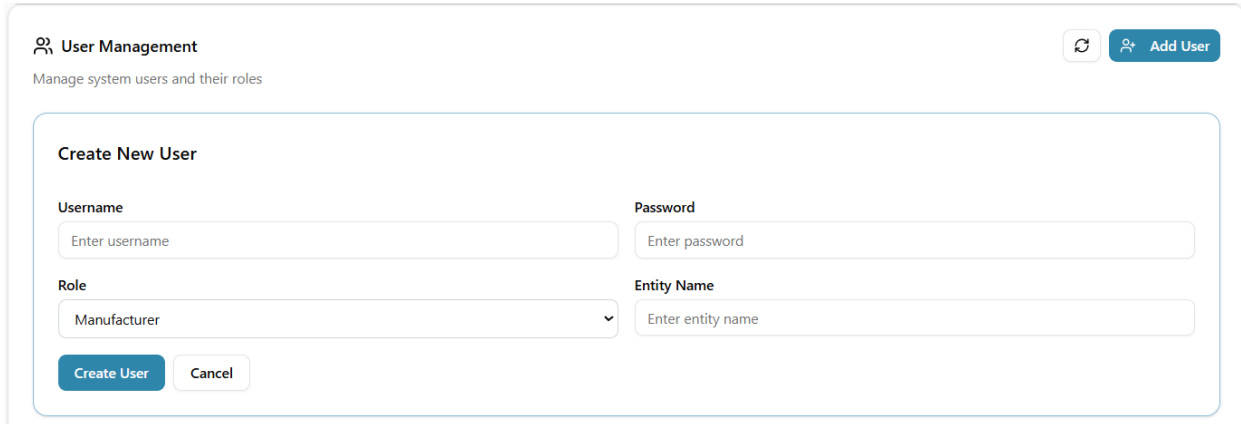
The screenshot shows a web interface for 'User Management'. At the top, there's a header with a gear icon, the text 'User Management', and a subtitle 'Manage system users and their roles'. To the right of the header is a refresh icon and a blue 'Add User' button. Below the header is a 'Create New User' form. The form has four input fields: 'Username' (text input), 'Password' (text input), 'Role' (dropdown menu with 'Manufacturer' selected), and 'Entity Name' (text input). At the bottom of the form are two buttons: 'Create User' (blue) and 'Cancel' (white).

Figure 18. Shows the Add user function under the user management section.

Required Fields:

- **Username** – Unique login identifier for the user
- **Password** – Secure password for account access
- **Role** – Select from dropdown: Manufacturer, Supplier, Pharmacist, or Admin
- **Entity Name** – Organization or company name the user represents

Actions:

- **Create User** – Save the new user account
- **Cancel** – Discard changes and return to user list

User Roles:

The platform supports four user roles, each with specific permissions:

- **MANUFACTURER** – Can create batches, and transfer batches to suppliers
- **SUPPLIER** – Can receive batches from manufacturers and transfer to pharmacists
- **PHARMACIST** – Can receive batches from suppliers and dispense to customers
- **ADMIN** – Full system access including user management, system monitoring, and all batch operations

This role-based access control ensures users only have access to functions relevant to their position in the supply chain.

2.2. Manufacturer Dashboard

The Manufacturer Dashboard allows manufacturers to create and monitor medicine batches throughout the supply chain.

2.2.1. Dashboard Overview:

Displays key metrics for manufacturer operations (Figure 18)

- **Total Batches** – Total number of batches manufactured
- **Quality Status** – Number of batches with good quality (meeting ML-monitored temperature/humidity standards)
- **Compromised** – Number of batches with detected quality issues requiring attention
- **In Transit** – Number of batches currently moving through the supply chain

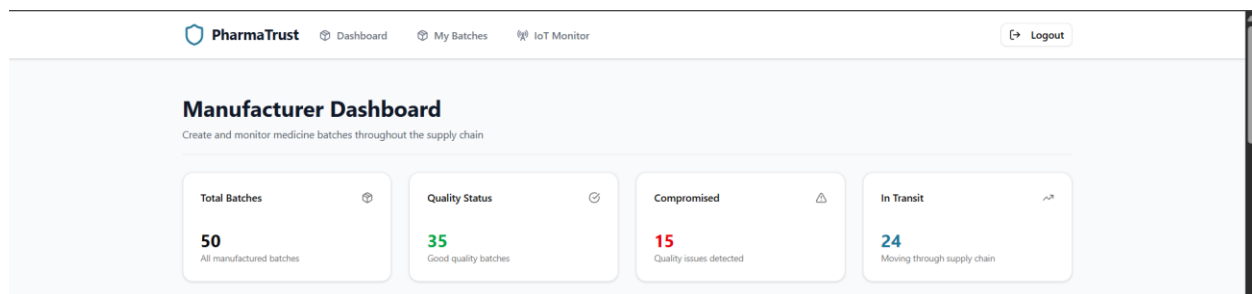


Figure 18. Shows the manufacturer dashboard overview section.

2.2.2. My Batches

Shows all medicine batches created by the manufacturer with search and filter capabilities.

Search and Filter:

- **Search bar** – Search batches by batch ID, medicine name, or manufacturer
- **Filters button** – Filter batches by quality status, supply chain stage, or other criteria

Batch List View:

Each batch entry displays:

- **Medicine name and dosage** – e.g., "Panadol 100mg"
- **Batch ID** – Unique identifier for tracking
- **Medicine type icon** – Visual indicator (e.g., Painkiller)
- **Creation date** – When the batch was manufactured
- **Quantity** – Number of units in the batch (e.g., "Qty: 10 tablets")
- **Quality status** – "GOOD" (green) or "COMPROMISED" (red) based on ML monitoring
- **Current stage badge** – Shows current location in supply chain (MANUFACTURER, SUPPLIER, PHARMACIST, CUSTOMER)

- **Supply chain progress bar** – Visual timeline showing batch movement through all four stages
- **View button** – Access detailed batch information

Actions:

- **Scan QR Code** – Verify authenticity of existing batch QR codes
- **Create New Batch** – Generate a new medicine batch and register it in the system

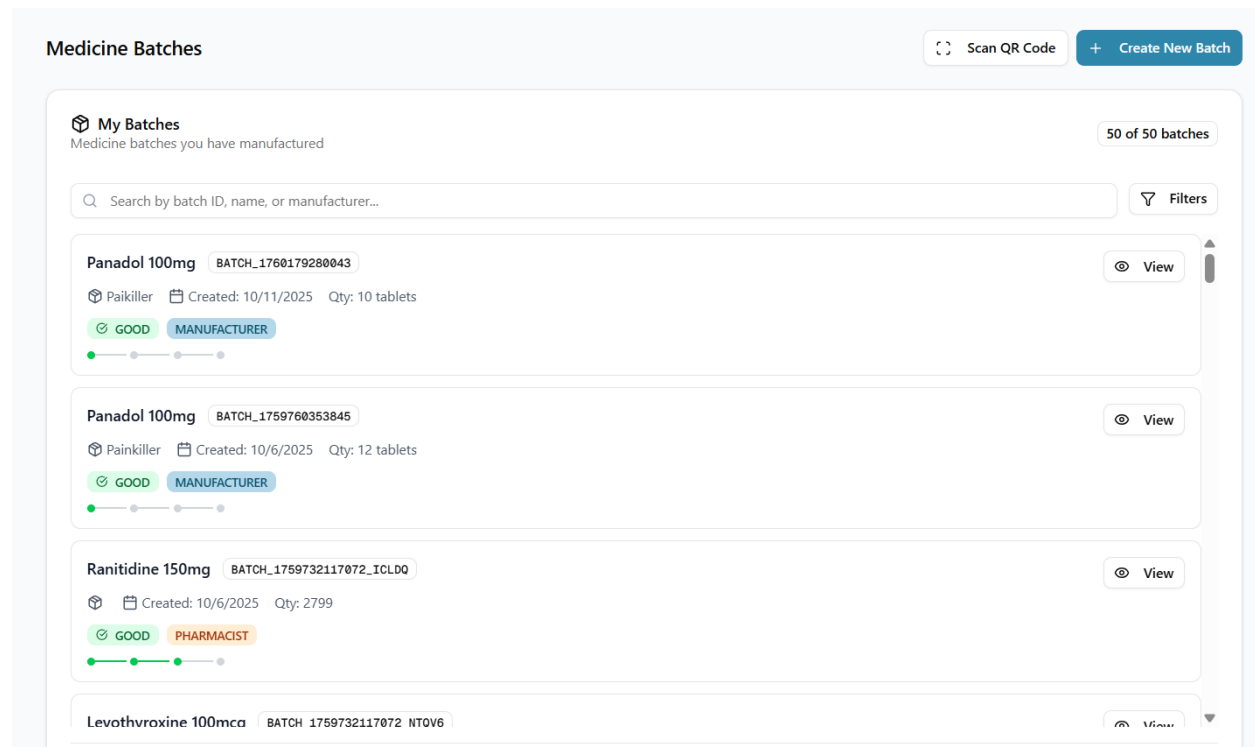


Figure 19. Shows my batches section.

2.2.3. Create New Batch

Allows manufacturers to create a new medicine batch and register it in the PharmaTrust system for supply chain tracking.

Batch Creation Form:

To create a new batch, click "Create New Batch" (Figure 19) and complete the following fields:

Required Fields:

- **Medicine Name*** – Name and strength of the medicine (e.g., "Aspirin 500mg")
- **Medicine Type*** – Classification or category (e.g., "Painkiller", "Antibiotic")
- **Quantity*** – Number of units being manufactured (e.g., "1000")
- **Unit*** – Select unit type from dropdown (options include: Tablets, Capsules, Vials, Bottles, etc.)
- **Expiry Date*** – Date when the batch expires (format: mm/dd/yyyy)

Optional Fields:

- **Dosage** – Specific dosage information (e.g., "500mg", "10ml")
- **Description** – Additional details about the medicine or batch

Blockchain Verification:

- **Record on blockchain for authenticity verification** – Checkbox option (enabled by default)
 - When checked, the batch will be recorded on the Ethereum blockchain for tamper-proof verification
 - Provides immutable proof of batch authenticity throughout the supply chain
 - Enables QR code verification by all stakeholders

Automatic Features:

- **Batch ID** – A unique batch identifier is automatically generated upon creation (e.g., "BATCH_1760179280043")
- **Manufacturer** – Automatically populated with the logged-in manufacturer's entity name
- **Blockchain recording** – Confirmation message indicates the batch will be recorded on blockchain for immutable verification


Actions:

- **Create Batch** – Save the new batch and register it in the system
- **Cancel** – Discard changes and close the form

Post-Creation:

Once created, the batch:

1. Appears in the "My Batches" list with "MANUFACTURER" stage
2. Receives a unique QR code (generated via Admin Dashboard)
3. Is recorded on the blockchain for verification (if option was selected)
4. Begins IoT environmental monitoring if sensors are attached
5. Can be transferred to the next supply chain stage (Supplier)

 **Create New Batch**

×

Create a new medicine batch for supply chain tracking

Medicine Name *

e.g., Aspirin 500mg

Medicine Type *

e.g., Painkiller, Antibiotic

Dosage (Optional)

e.g., 500mg, 10ml

Quantity *

e.g., 1000

Unit *

Tablets

Expiry Date *

mm/dd/yyyy

Description (Optional)

Additional details about the medicine

☒ **Record on blockchain for authenticity verification**

Manufacturer: PharmaCorp Manufacturing

A unique batch ID will be automatically generated upon creation.

✓ This batch will be recorded on the blockchain for immutable verification.

Cancel Create Batch

Figure 20. Shows the batch creation form

2.3. Supplier Dashboard

The Supplier Dashboard allows suppliers to monitor and manage medicine batches received from manufacturers and track them through distribution.

2.3.1. Dashboard Overview

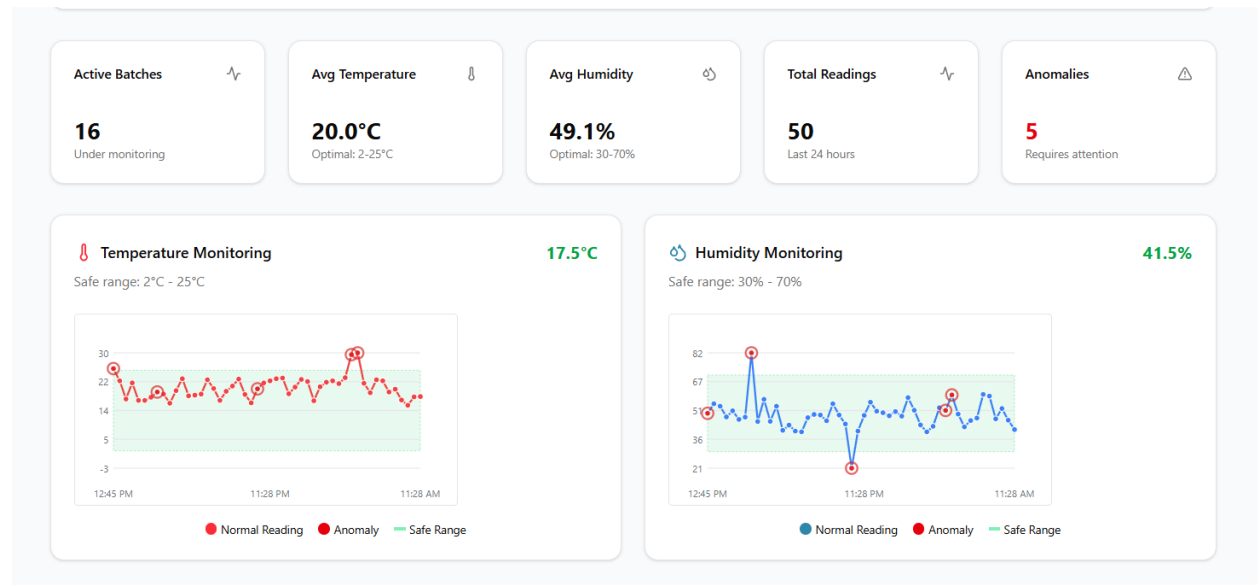


Figure 21. Shows the dashboard Overview.

Displays key metrics for supplier operations:

- **Active Batches** – Number of batches currently under monitoring (in supplier custody)
- **Avg Temperature** – Average temperature across all batches with optimal range indicator (e.g., "Optimal: 2-25°C")
- **Avg Humidity** – Average humidity across all batches with optimal range indicator (e.g., "Optimal: 30-70%")
- **Total Readings** – Number of IoT sensor readings captured in the last 24 hours
- **Anomalies** – Number of anomalies requiring attention (displayed in red when present)

Environmental Monitoring Charts:

Temperature Monitoring:

- Real-time line chart showing temperature trends over time
- **Safe range** – Green shaded area indicating optimal temperature zone (2°C - 25°C)
- **Current temperature** – Displayed in top right (e.g., "17.5°C")
- **Anomaly markers** – Red circles with alert icons indicate readings outside safe range
- **Normal readings** – Standard red dots for readings within safe range

Humidity Monitoring:

- Real-time line chart showing humidity trends over time

- **Safe range** – Green shaded area indicating optimal humidity zone (30% - 70%)
- **Current humidity** – Displayed in top right (e.g., "41.5%")
- **Anomaly markers** – Red circles with alert icons indicate readings outside safe range
- **Normal readings** – Blue dots for readings within safe range

2.3.2. Device Status

Shows the current status of all IoT monitoring devices:

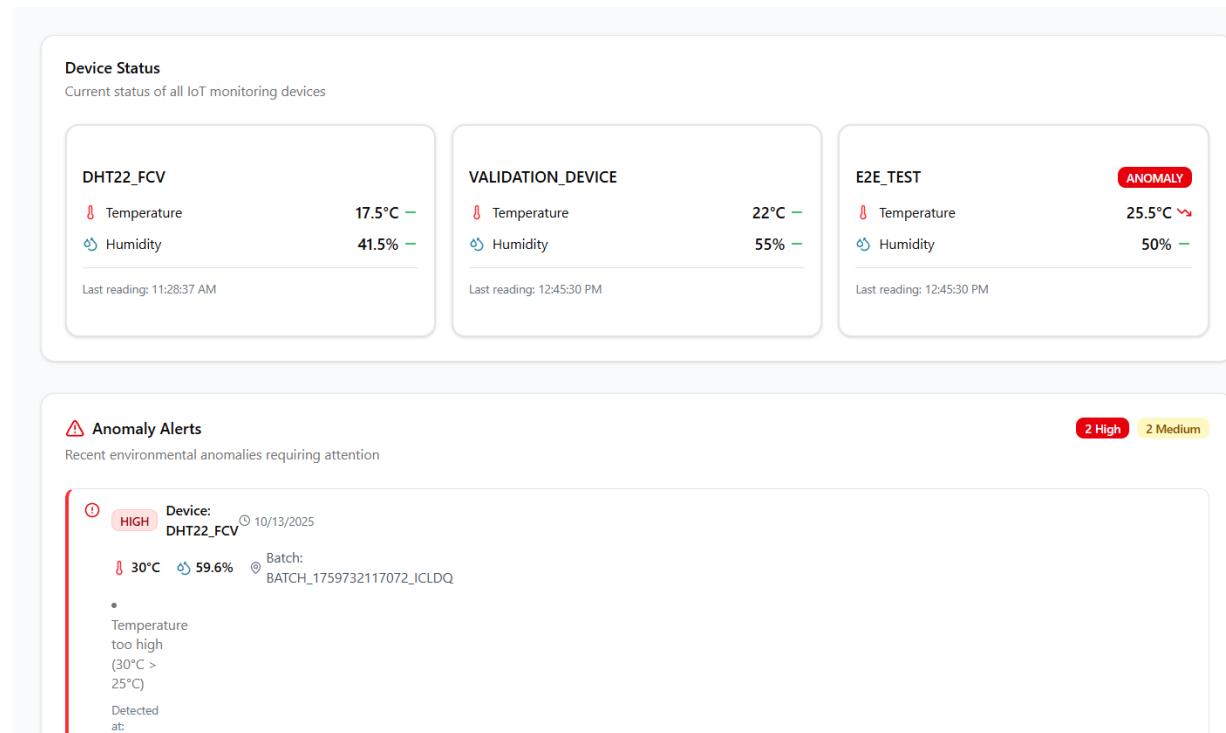


Figure 22. Shows the device status section.

Each device card displays:

- **Device ID** – Unique identifier (e.g., "DHT22_FCV", "VALIDATION_DEVICE")
- **Current temperature** – Latest temperature reading with trend indicator (↑ rising, ↓ falling, — stable)
- **Current humidity** – Latest humidity reading with trend indicator
- **Last reading timestamp** – When the device last transmitted data
- **Anomaly badge** – Red "ANOMALY" label appears when device detects out-of-range readings

Anomaly Alerts:

Displays recent environmental anomalies requiring attention:

Alert Summary:

- Severity badges showing count of "High" (red) and "Medium" (yellow) priority alerts

Alert Details:

Each alert shows:

- **Severity level** – HIGH, MEDIUM, or LOW with color coding
- **Device ID** – Which IoT device detected the anomaly
- **Date/Time** – When the anomaly was detected
- **Temperature and humidity readings** – Exact values at time of detection
- **Batch ID** – Which batch was affected
- **Description** – Specific issue (e.g., "Temperature too high (30°C > 25°C)")
- **Detection timestamp** – Precise time anomaly was identified

2.3.3. Last 24 Hours Overview:

Summary statistics for all batches over the past 24 hours:

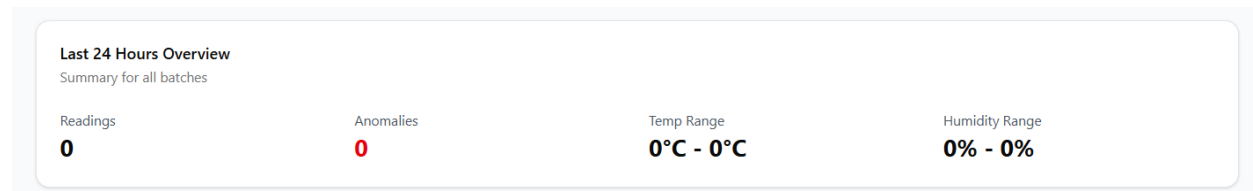


Figure 23. Shows the 24h overview section.

- **Readings** – Total number of sensor readings captured
- **Anomalies** – Total anomalies detected
- **Temp Range** – Minimum and maximum temperatures recorded
- **Humidity Range** – Minimum and maximum humidity levels recorded

Common Features:

The Supplier Dashboard includes the following common features detailed in section 2.1:

- **2.1.1. Scan QR Code** – Scan QR codes to verify batch authenticity upon receipt
- **2.1.2. ML Control Panel & ML Status Overview** – View machine learning monitoring data and batch insights
- **2.1.3. ML Event Log** – Access logs of ML-detected anomalies and events for supplier batches
- **2.1.5. Batch Management** – Search, filter, and manage batches in supplier custody
 - **2.1.5.1. Batch Details View** – View comprehensive batch information including status, environmental monitoring, and supply chain history

Supplier Capabilities:

- **Receive batches** – Accept batches transferred from manufacturers
- **Environmental monitoring** – Real-time IoT tracking of temperature and humidity conditions
- **Anomaly detection** – Automated ML alerts for out-of-range environmental conditions
- **Blockchain verification** – Verify batch authenticity via blockchain records
- **Transfer batches** – Move batches to the next supply chain stage (Pharmacist)
- **Multi-device monitoring** – Track multiple IoT sensors across different storage locations

2.4 Pharmacist Dashboard

The Pharmacist Dashboard allows pharmacists to verify medicine authenticity and quality before dispensing to customers.

2.4.1. Dashboard Overview

Displays key metrics for pharmacy operations:

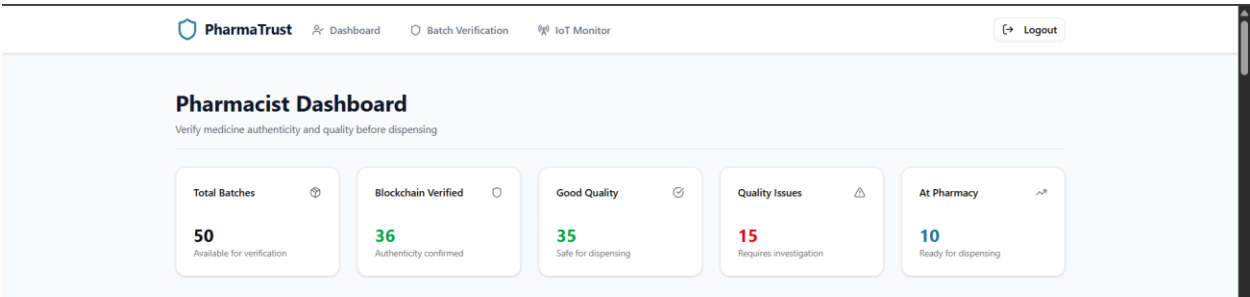


Figure 24. Shows the overview of the supply chain from the pharmacist dashboard.

- **Total Batches** – Total number of batches available for verification
- **Blockchain Verified** – Number of batches with confirmed blockchain authenticity
- **Good Quality** – Number of batches safe for dispensing (meeting quality standards)
- **Quality Issues** – Number of batches requiring investigation before dispensing (displayed in red)
- **At Pharmacy** – Number of batches currently ready for dispensing to customers

2.4.2. Batch Verification

Allows pharmacists to search and verify medicine batches before dispensing.

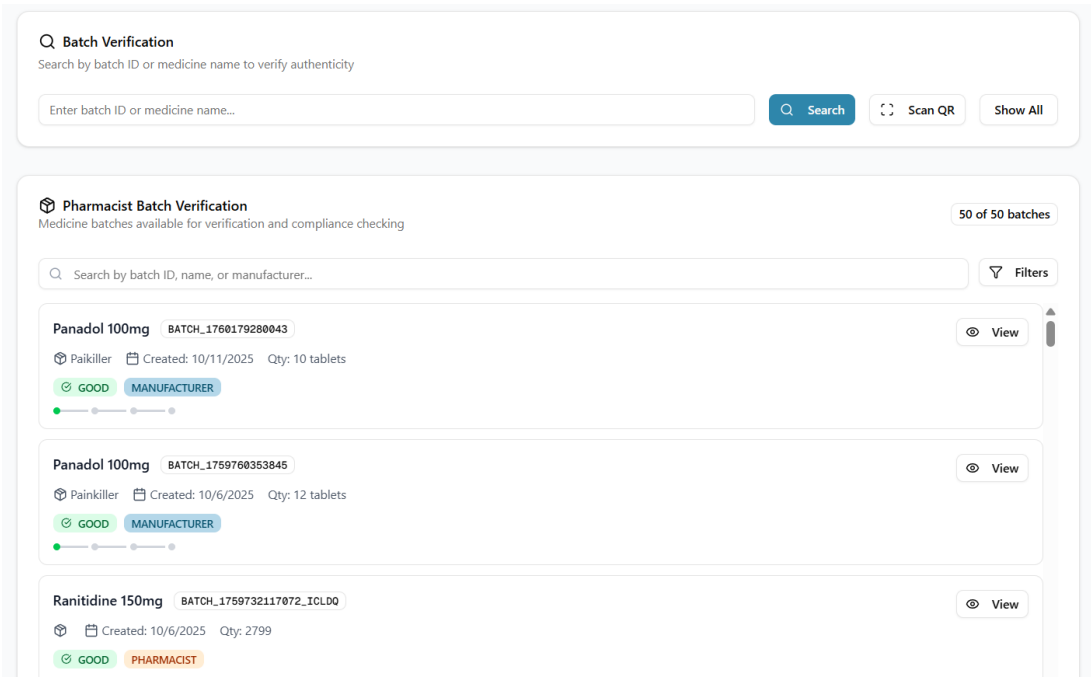


Figure 25. Shows the batch verification section.

Search Options:

Three methods to verify batches:

- **Manual search** – Enter batch ID or medicine name in search bar, then click "Search"
- **Scan QR** – Scan the batch QR code using device camera for instant verification
- **Show All** – Display all available batches for verification

Pharmacist Batch Verification List:

Shows all medicine batches available for verification and compliance checking.

Search and Filter:

- **Search bar** – Search by batch ID, medicine name, or manufacturer
- **Filters button** – Filter batches by quality status, stage, blockchain status, or other criteria

Batch List View:

Each batch entry displays:

- **Medicine name and dosage** – e.g., "Panadol 100mg", "Ranitidine 150mg"
- **Batch ID** – Unique identifier for tracking
- **Medicine type icon** – Visual indicator (e.g., Painkiller)
- **Creation date** – When the batch was originally manufactured
- **Quantity** – Number of units in the batch (e.g., "Qty: 10 tablets")
- **Quality status** – "GOOD" (green) for safe batches
- **Current stage badge** – Shows where the batch is in supply chain (MANUFACTURER, PHARMACIST, etc.)
- **Supply chain progress bar** – Visual timeline showing batch movement through stages
- **View button** – Access detailed batch information (see section 2.1.5.1 Batch Details View)

2.4.2. Compliance Reporting

Provides comprehensive compliance status for all batches, helping pharmacists make informed dispensing decisions.

☒ Compliance Reporting

RefreshDownload Report

BATCH	STAGE	BLOCKCHAIN	QUALITY	ANOMALIES	SUPPLY CHAIN	COMPLIANCE STATUS	SCORE	RECOMMENDATION	LAST CHECKED
Panadol 100mg BATCH_1760179280043	MANUFACTURER	NOT RECORDED	GOOD	0	1 stages	MONITOR	65	Monitor environmental trends and confirm blockchain records.	10/15/2025, 10:16:33 AM
Panadol 100mg BATCH_1759760353845	MANUFACTURER	NOT RECORDED	GOOD	0	1 stages	MONITOR	65	Monitor environmental trends and confirm blockchain records.	10/15/2025, 10:16:33 AM
Ranitidine 150mg BATCH_1759732117072_ICL DQ	PHARMACIST	NOT RECORDED	GOOD	3	3 stages	NON COMPLIANT	55	Requires investigation before dispensing. Generate formal report.	10/15/2025, 10:16:33 AM
Levothyroxine 100mcg BATCH_1759732117072_NTQ V6	MANUFACTURER	VERIFIED SOURCE: MOCK	COMPROMISED	5	1 stages	NON COMPLIANT	50	Requires investigation before dispensing. Generate formal report.	10/15/2025, 10:16:33 AM
Gabapentin 300mg BATCH_1759732117072_UA6 DW	PHARMACIST	FAILED SOURCE: MOCK	GOOD	0	3 stages	NON COMPLIANT	55	Requires investigation before dispensing. Generate formal report.	10/15/2025, 10:16:33 AM
Metformin 850mg BATCH_1759732117072_201 MR	PHARMACIST	FAILED SOURCE: MOCK	GOOD	3	3 stages	NON COMPLIANT	40	Requires investigation before dispensing. Generate formal report.	10/15/2025, 10:16:33 AM
Ranitidine 150mg BATCH_1759732117072_8KL ML	MANUFACTURER	FAILED SOURCE: MOCK	COMPROMISED	6	1 stages	NON COMPLIANT	10	Requires investigation before dispensing. Generate formal report.	10/15/2025, 10:16:33 AM
Albuterol 90mcg BATCH_1759732117072_H10 GP	CUSTOMER	FAILED SOURCE: MOCK	GOOD	0	4 stages	NON COMPLIANT	55	Requires investigation before dispensing. Generate formal report.	10/15/2025, 10:16:33 AM
Clopidogrel 75mg BATCH_1759732117072_2R5 4W	CUSTOMER	FAILED SOURCE: MOCK	GOOD	3	4 stages	NON COMPLIANT	40	Requires investigation before dispensing. Generate formal report.	10/15/2025, 10:16:33 AM

Figure 26. Shows the compliance reporting section.

Report Actions:

- **Refresh** – Update the report with latest data
- **Download Report** – Export compliance data for record-keeping

Compliance Table Columns:

- **BATCH** – Medicine name and batch ID
- **STAGE** – Current supply chain stage (MANUFACTURER, PHARMACIST, CUSTOMER)
- **BLOCKCHAIN** – Blockchain verification status:
 - "VERIFIED" (green) – Successfully recorded on blockchain
 - "NOT RECORDED" (yellow) – Pending blockchain registration
 - "FAILED" (red) – Blockchain verification failed
- **QUALITY** – Quality assessment from ML monitoring:
 - "GOOD" (green) – Safe for dispensing
 - "COMPROMISED" (red) – Quality issues detected

- **ANOMALIES** – Number of environmental anomalies detected (0 = none, higher numbers indicate concerns)
- **SUPPLY CHAIN** – Number of stages batch has completed (e.g., "1 stages", "3 stages")
- **COMPLIANCE STATUS** – Overall compliance assessment:
 - "MONITOR" (yellow) – Continue monitoring, acceptable for dispensing
 - "NON-COMPLIANT" (red) – Requires investigation before dispensing
- **SCORE** – Compliance scores out of 100 (higher is better)
- **RECOMMENDATION** – Specific guidance for pharmacist action (e.g., "Monitor environmental trends and confirm blockchain records", "Requires investigation before dispensing. Generate formal report.")
- **LAST CHECKED** – Timestamp of most recent compliance check

Compliance Score Interpretation:

- **65-100** – Generally compliant, monitor as indicated
- **50-64** – Borderline compliance, requires additional attention
- **Below 50** – Non-compliant, investigation required before dispensing

Compliance Status Categories:

- **MONITOR** – Batch is acceptable but requires ongoing environmental monitoring
- **NON-COMPLIANT** – Batch has issues (failed blockchain verification, quality compromise, or multiple anomalies) and requires investigation

Common Features:

The Pharmacist Dashboard includes the following common features detailed in section 2.1:

- **2.1.1. Scan & Generate QR Code** – Scan QR codes to verify batch authenticity before dispensing
- **2.1.2. ML Control Panel & ML Status Overview** – View machine learning monitoring data and batch insights
- **2.1.3. ML Event Log** – Access logs of ML-detected anomalies and events
- **2.1.5. Batch Management** – Search, filter, and manage batches available at pharmacy
 - **2.1.5.1. Batch Details View** – View comprehensive batch information including status, environmental monitoring, and supply chain history

Pharmacist Capabilities:

- **Batch verification** – Verify authenticity using batch ID, medicine name, or QR code scanning
- **Blockchain authentication** – Confirm batches are properly recorded on blockchain
- **Quality assessment** – Review ML-detected quality issues before dispensing
- **Compliance checking** – Access comprehensive compliance reports with scoring and recommendations
- **Supply chain validation** – Verify batch has moved through proper supply chain stages
- **Anomaly review** – Check environmental anomaly history
- **Dispense to customers** – Transfer verified batches to customer stage

3. Functions and Core Features – Mobile Application

The PharmaTrust mobile application allows the general public to verify medicine authenticity by scanning QR codes on medicine packaging. This ensures consumers can confirm they are receiving genuine, quality-verified pharmaceutical products.

3.1. Home

The Home screen provides quick access to medicine verification and displays scan history with authentication results.

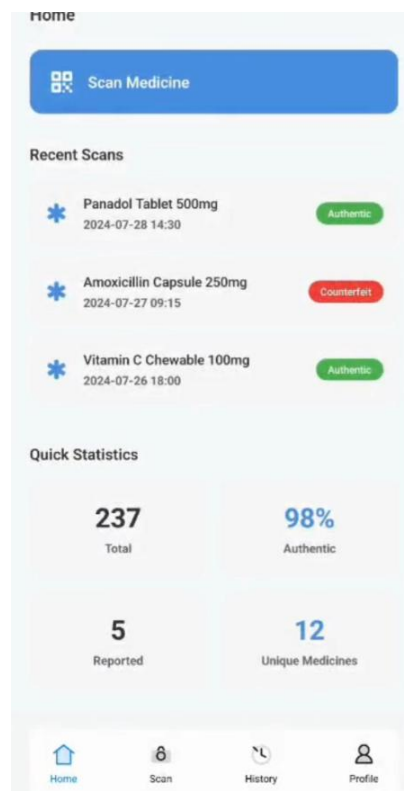


Figure 27. Shows the home page in the mobile application.

3.1.1. Scan Medicine:

Large, blue button at the top of the screen that allows users to:

- Open the camera to scan a medicine QR code
- Instantly verify the authenticity of pharmaceutical products
- Access detailed information about scanned medicines

3.1.2. Recent Scans:

Displays the most recent medicine verification scans with the following information for each entry:

- **Medicine icon** – Visual indicator (blue medical cross symbol)
- **Medicine name and dosage** – e.g., "Panadol Tablet 500mg", "Amoxicillin Capsule 250mg"
- **Scan timestamp** – Date and time of scan (format: YYYY-MM-DD HH:MM)
- **Authentication badge** – Result indicator:
 - "Authentic" (green) – Medicine is verified as genuine and recorded on blockchain
 - "Counterfeit" (red) – Medicine failed authentication, potentially fake or tampered

3.1.3. Quick Statistics:

Summary dashboard showing user's scanning activity and overall platform statistics:

- **Total** – Total number of medicines scanned by the user (e.g., "237")
- **Authentic** – Percentage of scanned medicines verified as authentic (e.g., "98%")
- **Reported** – Number of counterfeit medicines reported by the user (e.g., "5")
- **Unique Medicines** – Number of different medicine types scanned by the user (e.g., "12")

3.1.4. Bottom Navigation:

Four tabs for navigating the application:

- **Home** – Current screen (highlighted in blue)
- **Scan** – Direct access to QR code scanner
- **History** – Complete scan history
- **Profile** – User account settings

3.2. Scan

The Scan feature allows users to verify medicine authenticity by scanning QR codes on pharmaceutical packaging using their device camera.

3.2.1. QR Code Scanner:

- **Camera viewfinder** – Black screen with white corner brackets indicating scan area
- **Flashlight toggle** – Light bulb icon in top-right corner to enable/disable flash for low-light scanning
- **Automatic detection** – Scanner automatically recognizes and processes QR codes when positioned within the frame
- **Manual Entry option** – Blue button with plus icon below scanner for entering batch information manually if QR code is damaged or unavailable

How to Scan:

1. Tap "Scan" in the bottom navigation or "Scan Medicine" button on home screen
2. Point device camera at the QR code on medicine packaging
3. Align QR code within the corner brackets
4. Wait for automatic detection (success notification appears at top: "QR Code scanned successfully!")
5. View verification results

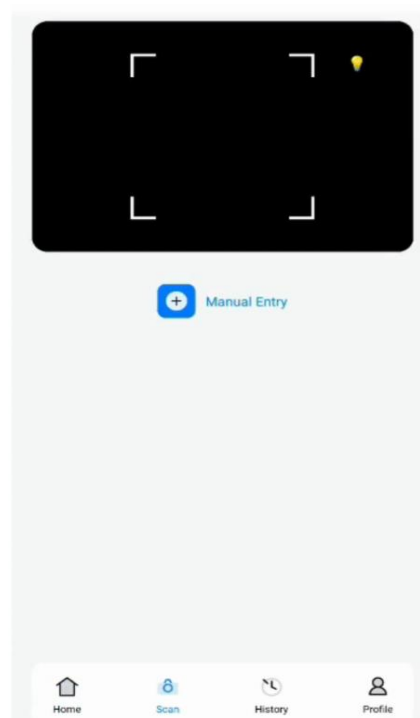


Figure 28. Shows the scan function.

3.2.2. Verification Results:

After scanning, one of two outcomes will be displayed:

3.2.2.1. Outcome 1: Medicine Verified (Authentic)

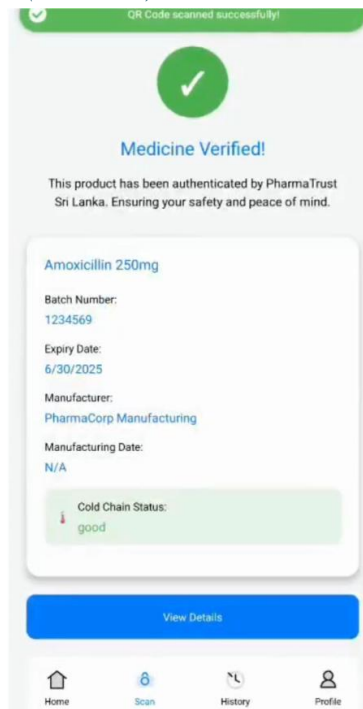


Figure 29. Shows the outcome when medicine is authentic.

Success screen with:

- **Green checkmark icon** – Large circular icon indicating successful verification
- **"Medicine Verified!" heading** – Confirmation message
- **Authentication message** – "This product has been authenticated by PharmaTrust Sri Lanka. Ensuring your safety and peace of mind."

Medicine Information Card:

Displays key batch details:

- **Medicine name and dosage** – e.g., "Amoxicillin 250mg"
- **Batch Number** – Unique batch identifier (e.g., "1234569")
- **Expiry Date** – When the medicine expires (e.g., "6/30/2025")
- **Manufacturer** – Company that produced the medicine (e.g., "PharmaCorp Manufacturing")
- **Manufacturing Date** – When batch was created (displays "N/A" if not available)
- **Cold Chain Status** – Environmental monitoring result:
 - "good" (green background) – Temperature/humidity maintained within safe range
 - Other indicators may show if quality concerns exist

Action Button:

- **View Details** – Large blue button to access comprehensive medicine information

Medicine Details View:

Accessible by tapping "View Details" button, shows complete batch information:

Basic Information:

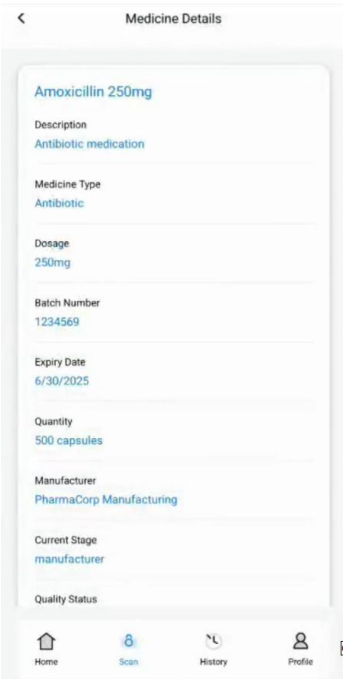


Figure 30. medicine Details.

Temperature History Chart:

Visual graph showing environmental monitoring data:

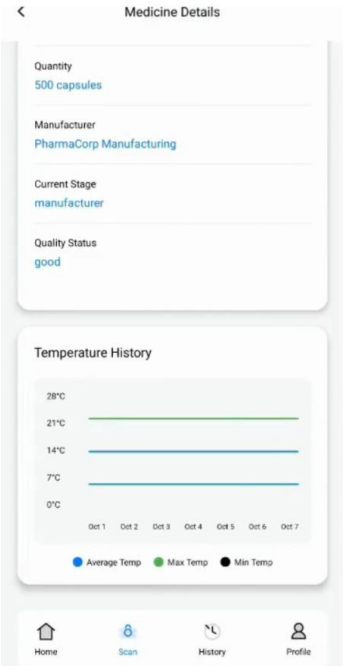


Figure 31. Temperature history under medicine details.

3.2.1.2. Outcome 2: Counterfeit Detected

Warning screen with:

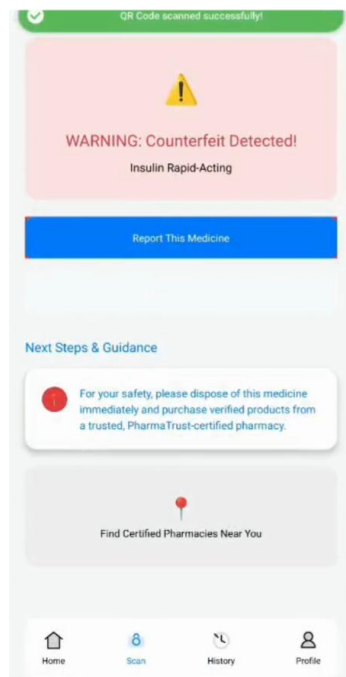


Figure 32. Shows the outcome when medicine is counterfeit.

- **Yellow warning icon** – Triangle with exclamation mark
- **"WARNING: Counterfeit Detected!" heading** – Alert message in red
- **Medicine name** – Product identified (e.g., "Insulin Rapid-Acting")
- **Report button** – Large blue "Report This Medicine" button to flag counterfeit

Next Steps & Guidance:

Safety information panel with:

- **Red alert icon** – Warning symbol
- **Safety message** – "For your safety, please dispose of this medicine immediately and purchase verified products from a trusted, PharmaTrust-certified pharmacy."
- **Find pharmacies button** – Red location pin icon with "Find Certified Pharmacies Near You" to locate legitimate sources

Reporting Counterfeits:

When users tap "Report This Medicine":

1. Counterfeit is flagged in the system
2. Report is logged for investigation
3. User's "Reported" count in Quick Statistics increases
4. Authorities may be notified depending on severity

3.3. History

The History screen displays a complete record of all medicine scans performed by the user, allowing them to review past verifications and track authentication results.

Search and Filter:

- **Search bar** – Search medicines by name or dosage (placeholder: "Search medicines...")
- **Filter button** – Orange filter icon to sort or filter results by:
 - Authentication status (Authentic/Counterfeit)
 - Date range
 - Medicine type
- **Export button** – Brown export icon to download scan history for personal records

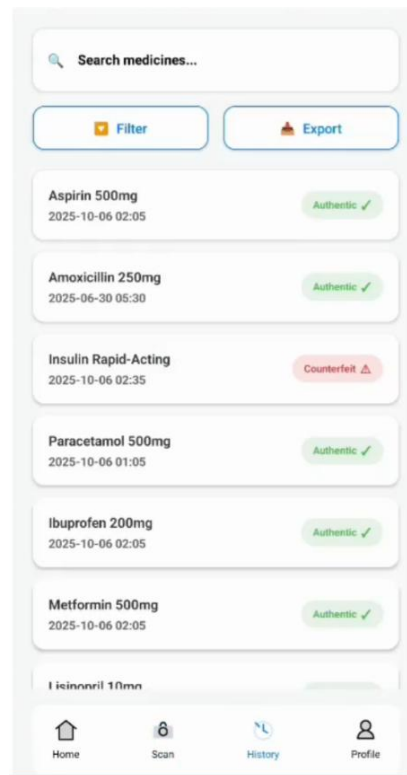


Figure 32. Shows the history section.

Scan History List:

Displays all scanned medicines in reverse chronological order (most recent first). Each entry shows:

- **Medicine name and dosage** – e.g., "Aspirin 500mg", "Amoxicillin 250mg"
- **Scan timestamp** – Date and time of verification (format: YYYY-MM-DD HH:MM)

- **Authentication badge** – Result indicator:
 - "Authentic ✓" (green) – Successfully verified as genuine
 - "Counterfeit ⚠" (red) – Failed verification, potential counterfeit

Interaction:

- Tap any entry to view detailed information about that specific scan
- Scroll to browse complete scan history
- Use search to quickly find specific medicines
- Filter to view only authentic or counterfeit results
- Export history for documentation or sharing with healthcare providers

Key Features:

- **Complete scan record** – Access to all past verifications
- **Quick search** – Find specific medicines instantly
- **Filter options** – View scans by authentication status or date
- **Export capability** – Download history for personal records
- **Persistent storage** – History maintained across app sessions
- **Visual indicators** – Easy-to-identify authentic vs. counterfeit badges

3.4. Profile

The Profile screen displays user information, verification statistics, and access to app settings and support.

User Information:

- **Profile photo** – Circular avatar (can be customized)
- **Username** – Display name
- **Email address** – Registered email

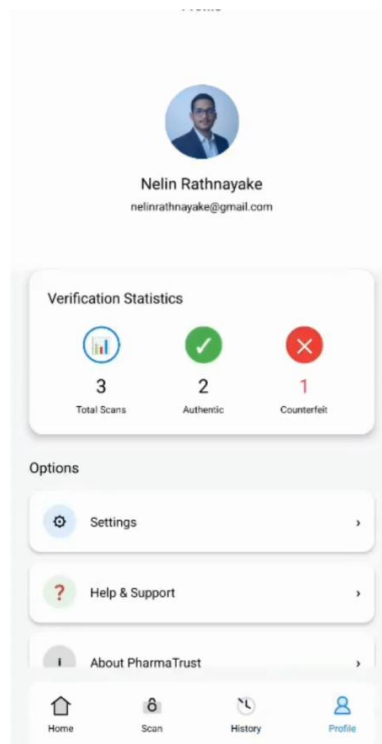


Figure 33. Shows the user profile.

Verification Statistics:

Dashboard showing user's scanning activity with three key metrics:

- **Total Scans** – Number of medicines verified (icon: bar chart)
 - Example: "3"
- **Authentic** – Number of verified genuine medicines (icon: green checkmark)
 - Example: "2"
- **Counterfeit** – Number of detected counterfeit medicines (icon: red X)
 - Example: "1"

These statistics help users track their verification activity and awareness of counterfeit medicines encountered.

Options Menu:

Three main menu items for app configuration and information:

1. Settings (gear icon) Access app configuration options including:

- Notifications
- Language preferences
- Auto-scan settings
- Privacy controls
- Scan history management

2. Help & Support (question mark icon) Access assistance resources:

- User guides and tutorials
- Frequently asked questions (FAQs)
- Contact support
- Report issues
- Feedback submission

3. About PharmaTrust (information icon) Learn about the platform:

- App version information
- Terms of service
- Privacy policy
- About the organization
- Mission and vision

3.4.1. Settings

Detailed configuration options for customizing the app experience:

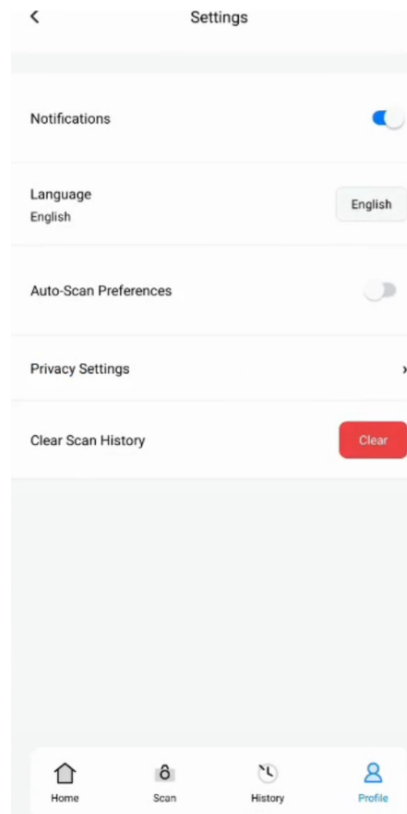


Figure 34. Shows the settings under user profile.

Notifications:

- **Toggle switch** – Enable/disable push notifications
- Alerts for:
 - Scan result confirmations
 - Counterfeit warnings
 - Security updates
 - App updates

Language:

- **Current selection** – Displays current language (e.g., "English")
- **Language selector** – Tap to change app language
- Supports multiple languages for international users

Auto-Scan Preferences:

- **Toggle switch** – Enable/disable automatic QR code detection
- When enabled: Camera automatically scans QR codes when detected
- When disabled: Manual trigger required to capture QR code

Privacy Settings:

- **Arrow indicator** – Tap to access detailed privacy controls:
 - Data collection preferences
 - Sharing permissions
 - Location access
 - Camera permissions
 - Storage permissions

Clear Scan History:

- **Red "Clear" button** – Delete all scan history
- Warning: This action cannot be undone
- Removes all past scan records from device
- Verification statistics will be reset

Navigation:

- **Back arrow** – Return to Profile screen
- All settings save automatically

Key Profile Features:

- **Personalization** – Custom profile photo and display name
- **Activity tracking** – Visual statistics of verification history
- **Customizable notifications** – Control alert preferences
- **Multi-language support** – Use app in preferred language
- **Privacy controls** – Manage data and permissions
- **History management** – Option to clear scan records

Privacy & Security:

- User data stored securely on device
- Optional cloud sync for multi-device access
- Scan history can be exported or cleared
- Email used only for account identification
- No personal data shared without consent