COVER NOTE

By Dr. Mathew Abraham (Team leader)

Title: Hospital Waste Management AI Agent System Aligned with SDG 12

Introduction

Biomedical waste in hospitals, if mismanaged, can lead to significant public health hazards and environmental contamination. Common issues include improper segregation, manual errors, and a lack of real-time validation—resulting in infections, regulatory penalties, and increased operational costs. This project presents an AI-driven agentic system built using **Relay App**, which automates the validation, routing, and logging of biomedical waste, ensuring compliance with **SDG 12 – Responsible Consumption and Production**.

Problem Statement

Hospitals generate large volumes of biomedical waste across departments (OPD, IPD, OT, ICU, etc.), necessitating strict compliance with biomedical waste segregation protocols. Human errors often lead to:

- Misclassification of waste.
- Environmental harm due to improper disposal.
- Inadequate feedback loops to correct missteps.
- Manual log maintenance and follow-up delays.

There is a need for **an intelligent, automated system** to ensure correct waste segregation, immediate error reporting, and appropriate disposal action—all in real-time.

Objective

- Automate real-time validation of **waste category** against **waste description**.
- Route biomedical waste correctly based on validation and disposal method.
- Log and report segregation errors to responsible departments.

- Communicate and assign internal or external disposal actions automatically.
- Contribute toward achieving SDG 12 goals by promoting safer waste practices.

Why This Problem Matters?

Biomedical waste mismanagement is a **systemic risk** in hospitals:

- **Public Health Impact**: Spread of infection among patients and staff.
- **Environmental Harm**: Soil and water pollution from toxic waste.
- **Regulatory Non-compliance**: Penalties under Biomedical Waste Management Rules.
- **Operational Inefficiencies**: Increased cost and risk without accountability.

By leveraging AI, hospitals can ensure **sustainable waste handling** while improving compliance, reducing human error, and enabling **data-driven decision-making**.

Solution Overview: AI Agentic Workflow

Built on the **Relay App**, the project consists of 4 AI Agents interacting via Google Forms, Excel sheets, emails, and internal prompts.

Input Capture via Google Form

- Email (Responder)
- Date and Time of Collection
- Department Name
- Waste Category (Yellow, Red, White, Blue, Black)
- Waste Description
- Weight (Kg)
- Disposal Method (Internal / External)

System Architecture & Agentic Workflow

Agent 1: Hospital Waste Routing & Validation Agent

- **Trigger**: New form response.

- **Prompting GPT-5**: Validates whether the waste category aligns with the waste description.
- **Decision Logic**:
    - Mismatch → "Error"
    - Match + Internal → "Internal"
    - Match + External → "External"
- **Flow Control**: Routes response to 3 pathways:
    - Segregation Error
    - Internal Disposal
    - External Vendor Pickup

Agent 2: Segregation Error Logging & Reporting

- **Trigger**: Output = "Error"
- **Action**:
    - Appends error data to an Excel log.
    - Sends auto-email to form responder requesting correction and awareness.
- **Data Used**: Email, Date, Time, Department, Waste Category, Description, Weight.

Agent 3: Internal Disposal Agent

- **Trigger**: Output = "Internal"
- **Action**:
    - Summarizes data via GPT-5 into actionable steps.
    - Sends email report to **Internal Disposal Authority**.
- **Goal**: Ensure timely and proper internal waste handling.

Agent 4: External Disposal Agent

- **Trigger**: Output = "External"
- **Routing**:
    - **Incineration Team** → If category is Yellow.
    - **Recycling Team** → For other categories (Red, White, Blue, Black).
- **Actions**:
    - Sends email to **Incineration Team** (for Collection Area 1).
    - Sends email to **Recycling Team** (for Collection Area 2).
    - Waits for response to confirm collection.
- **Goal**: Minimize delays and ensure categorized disposal externally.

Alignment with SDG 12: Responsible Consumption and Production

SDG Target	Contribution
12.4: Environmentally sound management of waste	Ensures proper segregation and disposal of biomedical waste
12.5: Waste reduction through reuse/recycling	Promotes accurate routing to reduce contamination and enable recycling
12.8: Awareness for sustainable development	Sends feedback to staff to avoid repeat errors and improve training

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Technology Stack

- **Relay App**: Workflow automation and agent management
- **Google Forms**: Data collection
- **GPT-5**: Validation and summarization
- **Excel Workbook**: Error logging
- **Email System**: Notification and escalation
- **Custom HTTP Requests**: Inter-agent communication

Outcomes and Impact

- **100% Real-Time Validation**: No need to check waste manually post-disposal.
- **Reduced Error Rates**: Through immediate feedback and tracking.
- **Improved Compliance**: Enables audit logs and proper documentation.
- **Operational Efficiency**: Faster decision-making, reduced delays.
- **Environmental Safety**: Fewer misdisposals, better recycling and incineration routing.

Future Enhancements

- Integration with **QR Code Scanning** for bins.
- Live dashboard for waste trends and error hotspots.
- AI model training on hospital-specific disposal rules.
- Voice-based form input for field workers.

Conclusion

The AI Agent system significantly reduces manual burden, ensures compliance, and promotes sustainable biomedical waste management aligned with **SDG 12**. It demonstrates the power of low-code platforms like Relay combined with AI to deliver intelligent, real-time, and impactful solutions in the healthcare domain.

Call to Action: Encourage widespread adoption of such AI agentic systems in hospitals to achieve sustainable operations, reduce environmental harm, and enhance institutional accountability.