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Automated Forensic Auditing and Fraud Control in Nigeria (A Case Study of Federal Medical Center Bida)

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ABSTRACT

This study investigates the development and implementation of an automated forensic auditing system designed to strengthen fraud detection, financial transparency, and accountability within healthcare financial operations, using Federal Medical Centre Bida as a case study. The research is motivated by persistent weaknesses in conventional auditing approaches, particularly the reliance on manual processes and system designs that enable unlogged or manipulated transactions. The study adopts a systematic approach that combines system analysis, software design, and implementation of a pay point management framework capable of real-time transaction logging, audit trail generation, and anomaly monitoring. Core technologies including a centralized database, middleware communication, and monitoring tools were integrated to ensure continuous forensic readiness and reduce opportunities for revenue leakages and unauthorized overrides. Findings from the implementation demonstrate that automated forensic auditing significantly improves data integrity, enhances visibility over financial flows, and supports timely detection of suspicious transactions. The study concludes that automated forensic auditing presents a viable pathway for improving fraud prevention and forensic investigation in public healthcare institutions and recommends further integration of artificial intelligence, blockchain, and advanced analytics in future models.

Keywords: Forensic Auditing, Automation, Fraud Control, Healthcare Finance, Real-Time Monitoring, Audit Trail

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1. BACKGROUND TO THE STUDY

Fraud is generally understood as a misleading conduct carried out with the intention of obtaining an unlawful advantage or causing harm to another party's rights. It encompasses various forms, including bankruptcy fraud, credit card fraud, securities fraud, and wire fraud, all of which individuals and organizations are vulnerable to in today's world (Elumilade *et al.,* 2021). Fraudulent activities may be orchestrated by a large organization, smaller groups, or even a single individual. According to Bello *et al.,* (2024), fraud is "an intentionally deceptive action designed to provide the perpetrator with an unlawful gain or to deny a right to a victim."

Fraud may be classified as either a civil wrong or a criminal act. In the case of civil fraud, litigation may be initiated by a government agency, an individual, or an entity harmed by the fraudulent act to halt the misconduct, seek compensation, or pursue both remedies simultaneously. On the other hand, criminal fraud involves prosecution by the state, as the act violates public laws and threatens societal order (Martinez *et al.,* 2024). As Dissanayake *et al.,* (2020) observe, machine learning not only facilitates the detection of fraud but also enables systems to continuously learn from new data, thereby adapting to emerging threats. Traditional audit techniques, however, remain insufficient for modern healthcare fraud detection. They lack the ability to provide continuous assurance and are unlikely to uncover the most significant risks, such as frauds committed by managers who override internal controls or manipulate ledger and journal entries. Auditors employ transaction testing and substantive testing to evaluate the likelihood of material misstatements in financial statements. Transaction tests determine whether erroneous or falsified data have been processed, while substantive tests assess account balances such as receivables, payables, inventories, liabilities, and depreciation to ensure accuracy in reporting (Celestin and Vanitha, 2019). A forensic audit refers to the examination and evaluation of a firm's or an individual's financial records for the purpose of obtaining evidence that may be used in a court of law or other legal proceedings. It involves a detailed review and inquiry into facts concerning suspected fraud, with the goal of collating information that can support litigation processes (Adejumo and Ogburie, 2025). Forensic auditing engagements often aim to determine where funds have been misappropriated, the methods used in such movements, and the individuals responsible for the transactions.

At the Federal Medical Center (FMC) Bida, the existing eHealth software system is primarily designed for managing medical and financial records but lacks integrated forensic auditing functionalities capable of automatically detecting, preventing, or flagging fraudulent activities perpetrated by some point-of-payment officials. This deficiency creates loopholes for financial manipulation, fund misappropriation, and weakened accountability structures. The absence of forensic auditing tools within the eHealth system raises significant concerns regarding transparency and institutional trust, as deficiencies in IT controls are closely linked to financial reporting errors, while continuous auditing and forensic IT integration are essential for promptly identifying and addressing such weaknesses (Oguntibeju *et al.,* 2024). Consequently, without the incorporation of forensic auditing practices and advanced fraud detection mechanisms such as machine learning and continuous transaction monitoring, FMC Bida remains highly susceptible to financial irregularities, revenue leakages, and potential reputational damage.

2. LITERATURE REVIEW

Fraud is a deliberate deception intended to cause individuals or organizations to give up their properties or legitimate rights. It involves dishonestly depriving someone of something they are entitled to, but for the fraudulent act (Adebisi *et al.,* 2022). The American Institute of Certified Public Accountants (AICPA) defines fraud as a broad legal concept that distinguishes it from error based on the intentionality of the act. It typically involves theft and manipulation of records, often followed by attempts to conceal the theft. Fraud includes converting stolen assets into personal property. Among the three categories of fraud internal fraud, external fraud, and corruption—internal fraud is most pertinent to this study as it focuses on how managers (such as top management and heads of government agencies) embezzle funds designated for specific projects and conceal corruption within their organizations or ministries (Ajetunmobi *et al.,* 2016).

Forensic accounting is a rapidly growing field within accounting. The term "forensic" means "suitable for use in a court of law." Forensic accounting is an investigative approach used to determine whether individuals and organizations have engaged in illegal financial activities. According to Eko (2022) it involves using expert knowledge and specialized skills to uncover facts related to financial transactions. Chigozie-Okwum, Michael and Ugboaja (2017) describes forensic accounting as a combination of accounting, auditing, and investigative expertise, making it suitable for legal assessment and providing high assurance through scientific methods. Ghasemisharif, Kanich and Polakis (2022) adds that it employs accounting principles and techniques, offering investigations that are admissible in court and forming the basis for discussions, arguments, and eventual rulings. Ugwu (2021) research assert that fraud control in Nigeria has been a very difficult issue in Nigerian public sector and seems to have been institutionalized in the country owing to many years and increasing cases of fraudulent activities by public office holders.

The recent wave of the use of forensic accounting/auditing in Nigeria have attracted wide acceptance as possible panacea to the menace of fraud in Nigerian public sector. To this end, the study critically reviewed the application of forensic accounting in fraud detection, investigation and litigation support services. The study adopted descriptive research design with extensive and intensive literature review. It was concluded that the emergence/ introduction of forensic accounting contributes significantly in fraud control however, it seems not to be a complete panacea for fraud issues in Nigeria. The study recommends amongst others that fraud detection should be enshrined as part of auditors work by the policy makers so that non detection of fraud would attract sanctions to the auditor concerned. Also, training and retraining of forensic accountants on court process to avoid loss of good cases to avoidable court technicalities.

Nassif, Talib, Nasir, and Dakalbab (2021) conducted a systematic review on the application of machine learning for anomaly detection. Their study, published in *IEEE Access*, provided a comprehensive survey of anomaly detection techniques across various domains. The authors analyzed both supervised and unsupervised approaches, emphasizing their respective strengths and limitations. Their review highlighted that while supervised methods often deliver high accuracy when labeled datasets are available, unsupervised methods are more adaptable in real-world environments where labels are scarce. Importantly, they noted that the effectiveness of anomaly detection models depends significantly on the quality and diversity of the datasets, as well as the capacity of models to handle high-dimensional and dynamic data. A research gap identified in their work is the need for greater explainability and scalability in machine learning models, as these are essential for practical deployment in sensitive domains such as healthcare and finance.

Building upon the foundation laid by Nassif *et al.,* (2021), Lekkala (2023) explored the importance of machine learning models specifically in healthcare fraud detection. In the study published in *Voice of the Publisher*, the author underscored healthcare fraud as a persistent challenge that not only contributes to massive financial losses but also compromises the quality of patient care. The research emphasized the role of machine learning models in enhancing fraud detection by leveraging diverse healthcare datasets, including billing records, claims data, and patient demographics. The study examined traditional algorithms such as Random Forest alongside advanced deep learning models like Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs). The findings revealed that machine learning models achieve higher precision and recall compared to traditional rule-based auditing methods.

Additionally, the models demonstrated robustness and adaptability to evolving fraud schemes, confirming their potential to improve fairness, trustworthiness, and accuracy in fraud detection systems (Lekkala, 2023). While both studies affirm the promise of machine learning for anomaly and fraud detection, they also expose research gaps. Nassif *et al.,* (2021) pointed to the lack of explainability and scalability in machine learning models, whereas Lekkala (2023) noted the challenge of integrating fairness and trustworthiness into healthcare fraud detection. These gaps highlight the ongoing need for interdisciplinary approaches that not only improve model performance but also address ethical and practical considerations in real-world applications.

Wahyuandari (2025), in *The Journal of Academic Science*, explored the role of forensic auditing in detecting and preventing financial fraud within organizations. The study highlighted forensic auditing as a critical mechanism for bridging the gap between conventional auditing practices and legal investigations. Using a qualitative approach, the author illustrated how forensic auditing goes beyond routine checks to uncover deeper fraudulent schemes through investigative techniques. The study concluded that forensic auditing enhances accountability and financial transparency in organizations. Nonetheless, Wahyuandari identified a challenge in implementing forensic auditing universally, particularly due to resource limitations and lack of specialized training in some organizations.

Emmanuel, Enyi, and Olajide (2018), writing in the *Journal of African Interdisciplinary Studies*, investigated the relationship between forensic accounting techniques and the integrity of financial statements. The authors adopted an investigative approach to assess how forensic accounting tools—such as digital tracing, document review, and fraud pattern recognition—contribute to reducing manipulation in financial reporting. Their findings established a strong correlation between the use of forensic techniques and the reliability of financial statements. The study recommended the institutionalization of forensic accounting practices in corporate governance frameworks. However, the authors noted that forensic accounting is still underutilized in many developing countries due to lack of awareness and institutional support, which creates a research gap for further exploration.

Similarly, Akinninyi, Akpan, and Umoren (2025) focused on forensic accounting and financial integrity within the Nigerian public sector. Published in the *Journal of Accounting and Financial Management*, their study employed empirical analysis to evaluate the effectiveness of forensic accounting in curbing financial mismanagement in government institutions. The results revealed that forensic accounting plays a pivotal role in reducing corruption, detecting embezzlement, and improving public sector accountability. The authors argued that forensic accounting strengthens financial integrity by exposing loopholes in financial management systems. However, they highlighted persistent challenges, including resistance to transparency, inadequate regulatory frameworks, and insufficient institutional willpower to implement forensic auditing practices effectively.

Uniamikogbo *et al.,* (2019) This study examined the impact of forensic audits on fraud detection and prevention in the Nigerian banking sector. A census was taken of the 16 Deposit Money Banks (DMBs) listed on the Nigerian Stock Exchange (NSE) as of December 31, 2016. Data were collected from secondary sources, specifically the Nigerian Deposit Insurance Corporation's (NDIC) annual reports for 2013 and 2016. The study covered a period of five years, spanning 2012-2016. Data generated were analyzed using charts, graphs, tables, and regression analysis. The findings revealed that forensic audits had a significant negative impact on the number of fraud cases, the number of staff involved in bank fraud, and the actual amount of bank losses due to fraud in the Nigerian

banking sector. However, forensic auditing had an insignificant impact on the expected losses generated through fraudulent activities in Nigerian banks. The study recommended that banks in Nigeria should intensify the application of forensic auditing in the fight against fraud and forgeries. Additionally, forensic auditing should focus on detecting the number of fraud cases as well as staff involvement in fraud within the Nigerian banking sector. Staff welfare and remuneration should be prioritized since staff are strategic in the prevention of fraud in any organization, including Nigerian banks.

3. METHODOLOGY

3.1 Research Design

The design of the study is the basis plan which guides the data collection phrase of the research project. In designing, the researcher made use of survey research. Survey research is a quantitative research method used to collect data from a sample of people through self-report measures, such as questionnaire, interviews, or online polls, to understand their attitudes, behaviors, opinions, or characteristics. Due to time constraints, and the type of research to be carried out, the researcher limits the research design to questionnaire and observations from the primary data.

3.1 Method of Data Analysis

The sample size will be derived using a statistical software package known as MATLAB.
MATLAB is a high-level programming language and environment specifically designed for numerical computation, data analysis and visualization.

```
% Population size
N = 30;
% Sample size (change as required)
n = 10;
% Represent population (IDs 1 to 30)
population = 1:N;
% Simple Random Sampling without replacement
sample = population(randperm(N, n));
disp('Selected sample (Simple Random Sampling):');
disp(sample);
```

(equaton 1)

4. SYSTEM ANALYSIS AND DESIGN

4.1 Current System Framework

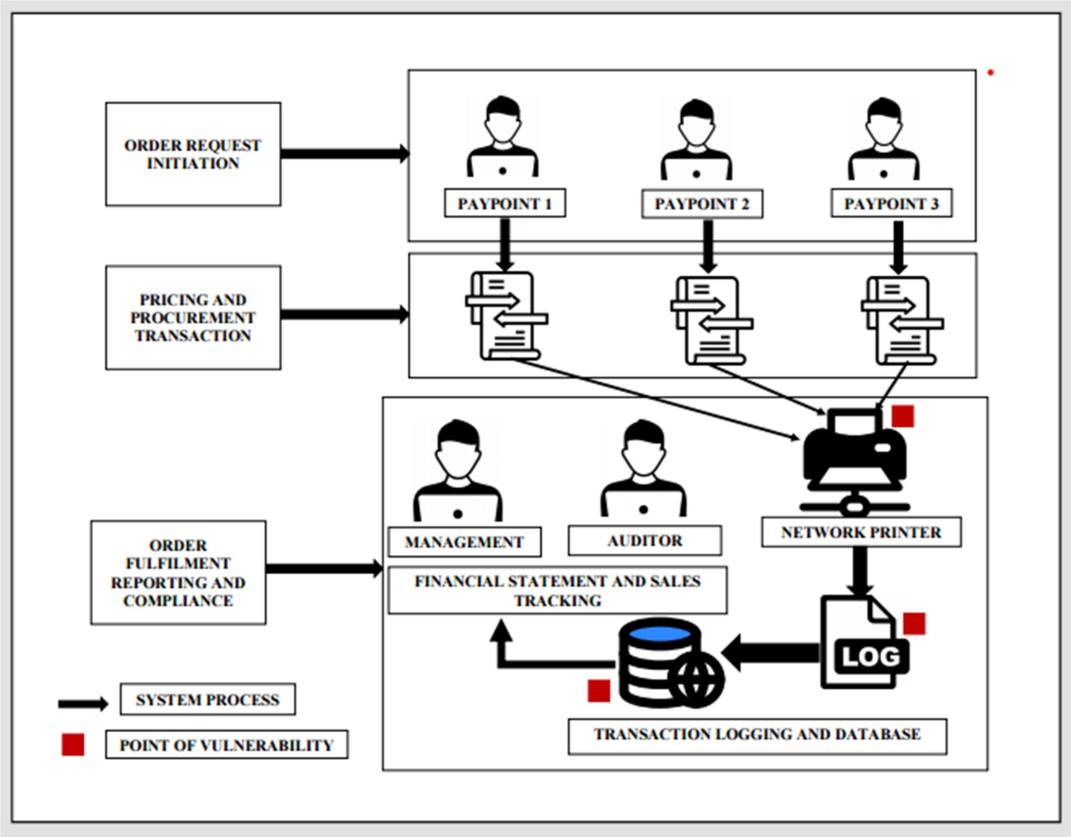

Fig 1. Framework for the Existing System

The current payment processing system at Federal Medical Centre Bida is a Windows-based executable application (exe) used for managing payments related to patient purchases and services. This system, while functional, has critical vulnerabilities that impact reliability and accuracy, particularly from a forensic auditing perspective. The central issue lies in how the system logs transaction data. At present, transaction records are only logged into the database after they have been printed through a networked printer. This dependency on the printing process creates a significant point of vulnerability: if the printer fails or is disabled, transactions will not be recorded in the database, resulting in unlogged payments. This gap not only affects the completeness of financial records but also introduces substantial risks for forensic auditing, as unrecorded transactions can lead to discrepancies in financial statements, missed revenue, and potential undetected fraud.

4.2 Structured Pseudocode

```
BEGIN
   Initialize System_Resources
   Receive Order_Request
   IF Validate(Order_Request) = FALSE THEN
      Terminate_Process
   ELSE
      Assign Paypoint
      Execute Pricing_and_Procurement
      Generate Transaction_Details
      Print Receipt
      Log Transaction
      Store Transaction in Database
      Update Financial_Records
      Enable Management_Review
      Enable Auditor_Access
      Perform Compliance_Check
      IF Anomaly_Detected = TRUE THEN
         Flag Transaction
      END IF
      Complete Order
   END IF
END
```

(equation 2)

The current system framework involves multiple steps, each with limitations from a forensic auditing standpoint. The payment process begins with an "Order Request Initiation," where patient or service requests are logged for payment processing. Following this, a "Pricing and Procurement Transaction" stage confirms the cost of services, and payment is managed through multiple pay points staffed by individual users. Each of these pay points—independent workstations in the network—sends payment details to the central network printer. However, due to the system's design, these transactions are only committed to the database once the details are printed. Management and auditors rely on the database to review and verify financial transactions, but if printing is disrupted, such transactions are effectively "invisible" to the system, leading to potential data gaps. For forensic auditing, this flaw is highly problematic, as it prevents auditors from accessing a complete and accurate record of transactions. This not only limits their ability to detect anomalies or investigate discrepancies but also opens up the potential for financial malpractice, where payments could be missed or altered without leaving an official record.

4.3 System Flowcharts

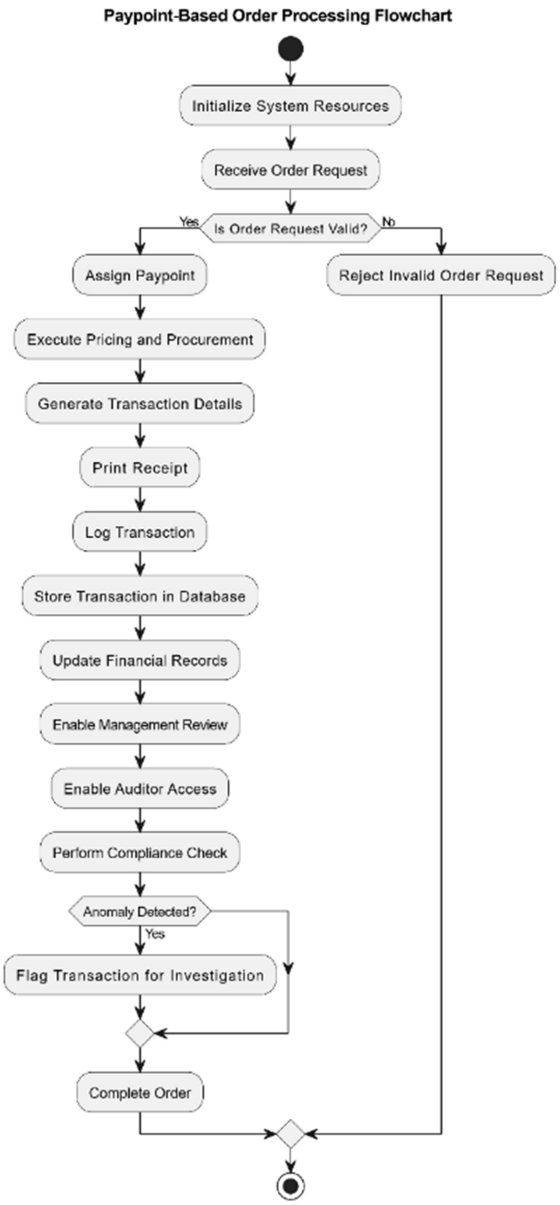

Fig 2 Current System Flowchart

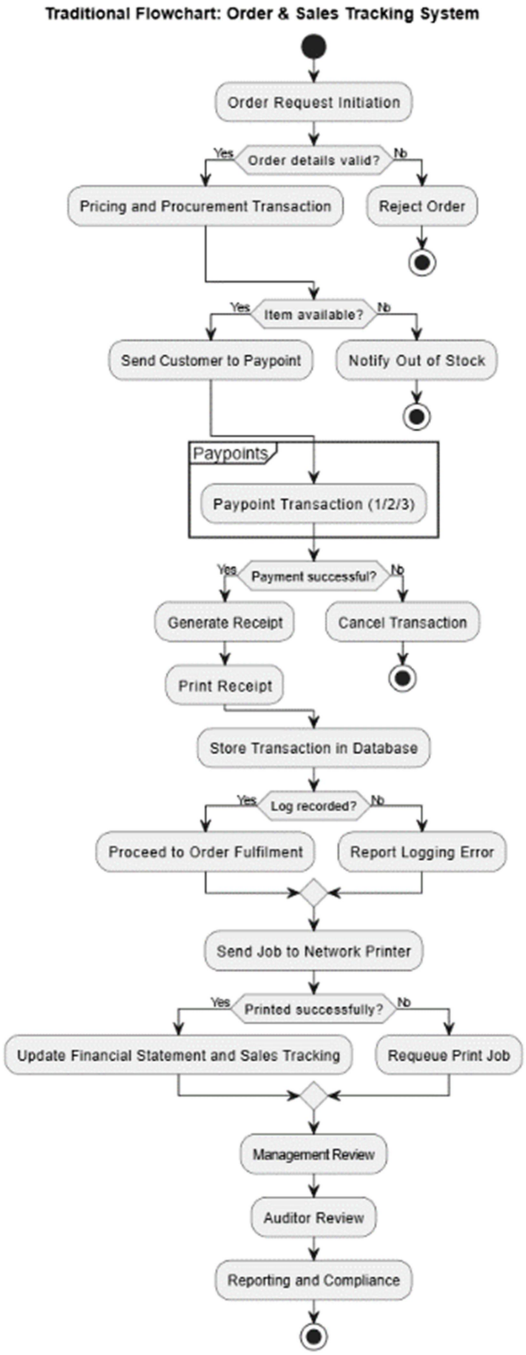

Fig 3. Proposed System Flowchart

The flowchart of the current system illustrates the order processing system, beginning with the initialization of system resources and the reception of an order request. It first verifies whether the order request is valid, rejecting invalid requests or proceeding to assign a paypoint for valid ones.

Once a paypoint is assigned, the system executes pricing and procurement procedures, generates transaction details, prints a receipt, logs the transaction, and stores it in the database. Following this, financial records are updated, management and auditors are granted access, and a compliance check is performed. If any anomalies are detected, the transaction is flagged for investigation before proceeding. The process culminates with the completion of the order, ensuring that all necessary validations, record-keeping, and oversight mechanisms are observed to maintain accuracy, accountability, and compliance.

4.4 Proposed System Framework

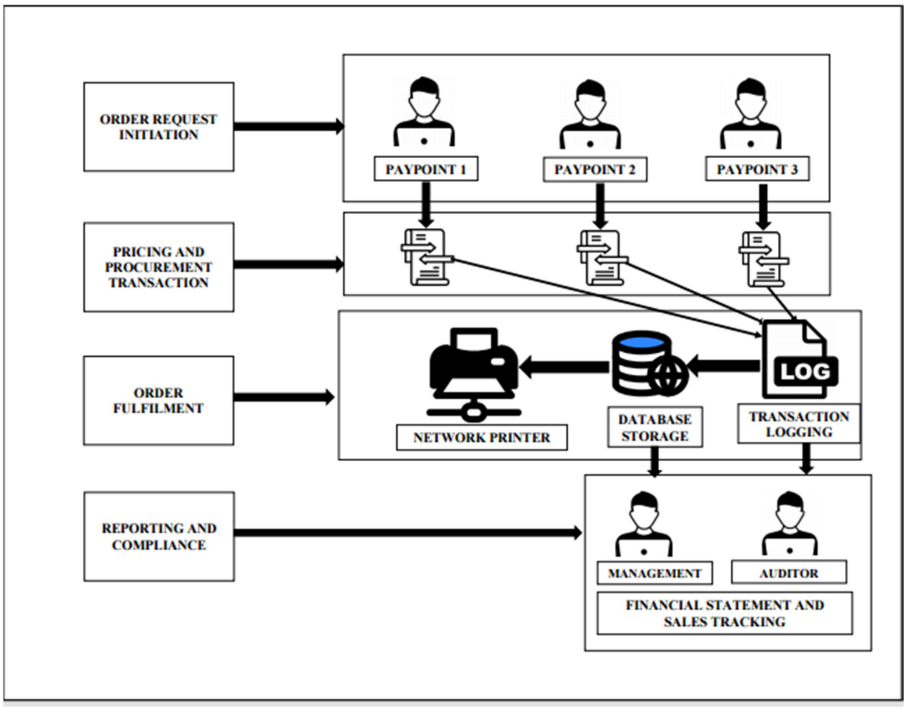

Fig. 4 The Framework for Proposed New System

To address these vulnerabilities, a new system framework has been proposed. This proposed framework eliminates the printer dependency by ensuring that transactions are logged to the database immediately after processing at each pay point, regardless of whether printing occurs. The system still begins with an "Order Request Initiation" phase, followed by the "Pricing and Procurement Transaction" step. However, the new system allows each pay point to log transactions directly to a centralized database as soon as payment is processed. By removing the requirement for printing as a trigger for database logging, the new design greatly reduces the risk of unrecorded transactions and ensures that financial data remains consistent and complete. The network printer is maintained as an optional feature for producing hard copies of transaction details if needed, but it no longer serves as a mandatory step for transaction recording. This adjustment ensures that the system can capture every transaction in real-time, regardless of network printer availability.

From a forensic auditing perspective, this proposed framework offers significant benefits. With direct logging, auditors and management gain immediate access to real-time transaction data, providing a continuous and accurate financial record. This setup allows for prompt detection of any inconsistencies, greatly reducing the opportunity for undetected fraud or data manipulation. Furthermore, forensic auditors can access complete transaction histories without needing to rely on physical receipts, which are susceptible to loss or tampering. The system's enhanced transparency and reliability support thorough forensic investigation and make compliance auditing more efficient and accurate.

5. RESULT AND DISCUSSION

The system development for the Automated Forensic Auditing and Fraud Control system at Federal Medical Centre Bida involves a layered framework with key components for payment processing, transaction monitoring, and data storage. The development consists of a front-end user interface for payment processing, middleware for seamless communication, and a secure, scalable database for real-time transaction logging. The system employs a centralized database accessed by all paypoints, which ensures that transactions are recorded as soon as they are processed. Network printers are retained as optional features rather than mandatory components for transaction logging. Additionally, monitoring tools are incorporated to alert administrators to logging failures or data inconsistencies.

The Admin Login Page serves as a secure entry point for the administrator, requiring valid login credentials to access the backend dashboard. This page ensures that unauthorized users are blocked through session management protocols. Upon successful login, the administrator gains access to control various system operations. From the dashboard, the administrator can navigate to various sections, including product management, ward assignment, paypoint registration, and revenue analytics. User-friendly menus and search functionalities streamline tasks, enabling the admin to quickly access detailed records or perform bulk operations. Notifications and alerts inform the administrator of important events, such as new paypoint registrations or unusual transaction patterns.

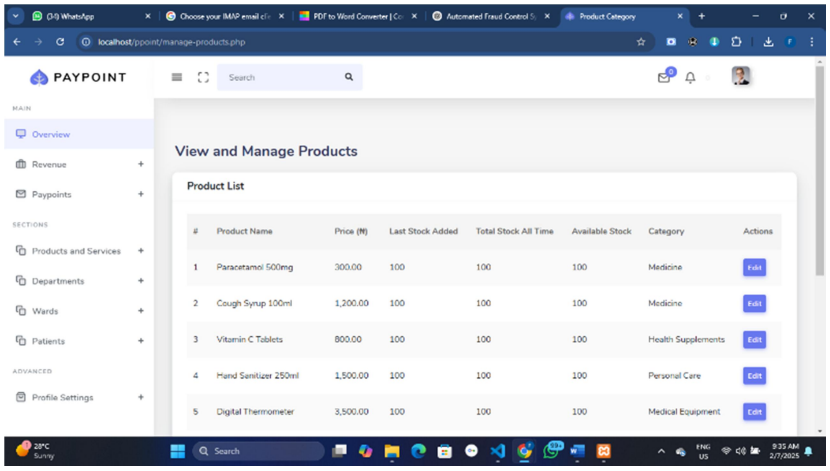

Fig 5. Product Management

The Managing Products Page allows the administrator to maintain the product catalog available for transactions across different paypoints. Here, products can be created, updated, or deleted. Key details such as product name, category, price, and description are input and managed. Search and filtering functions may assist in handling large product inventories efficiently. On the Managing Wards Page, the administrator can oversee and manage wards, which represent subdivisions or operational units linked to specific paypoints. The admin can add new wards, modify existing ones, or deactivate entries. This structure helps in better categorization and management of payment operations. The Managing Paypoints Page focuses on the registration and administration of paypoints where payments are collected for different commodities. The administrator can create new paypoints, assign specific products, and allocate wards as needed. Each paypoint is given a unique login and dashboard to manage its operations independently, with the admin overseeing their status and activity logs.

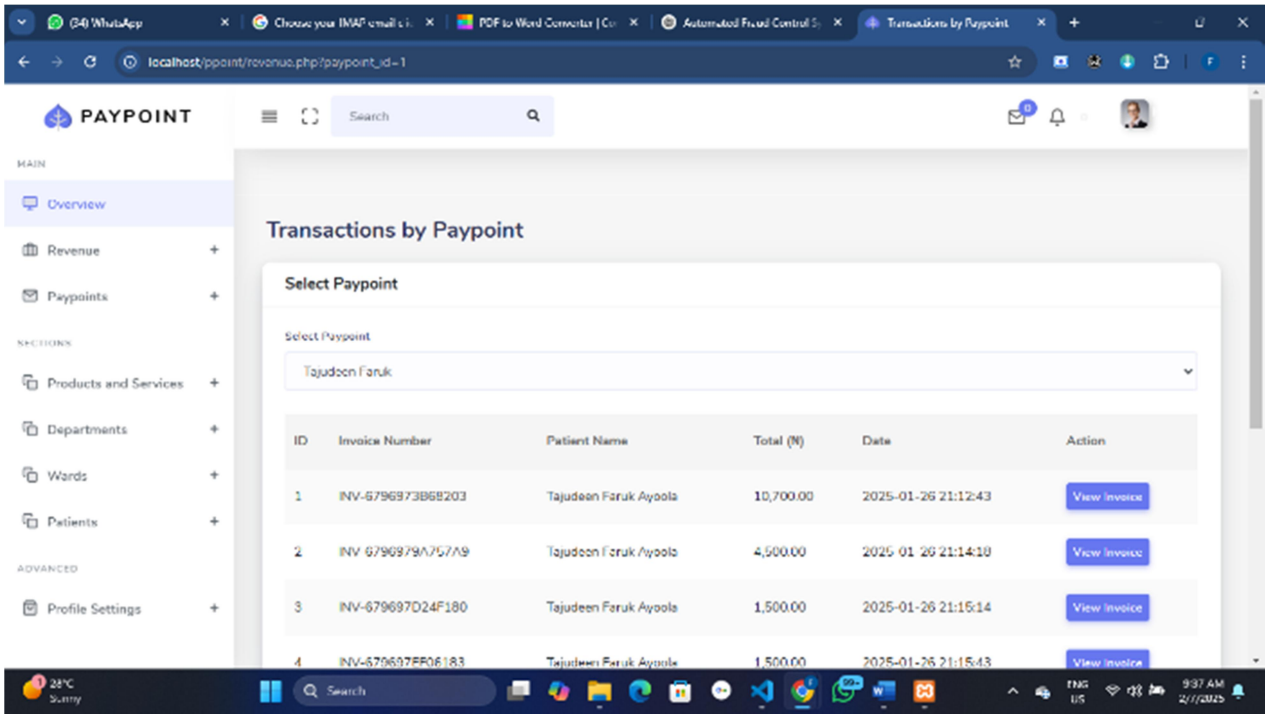

Fig 6. Revenue by Paypoints

The Revenue by Paypoints Page provides an analytical view of the system's financial performance. It displays real-time or periodic revenue reports from individual paypoints which is logged immediately a transaction is initiated, allowing the administrator to track earnings and identify trends. Filtering options help compare revenue figures over time or across specific paypoints, supporting effective auditing and strategic decision-making.

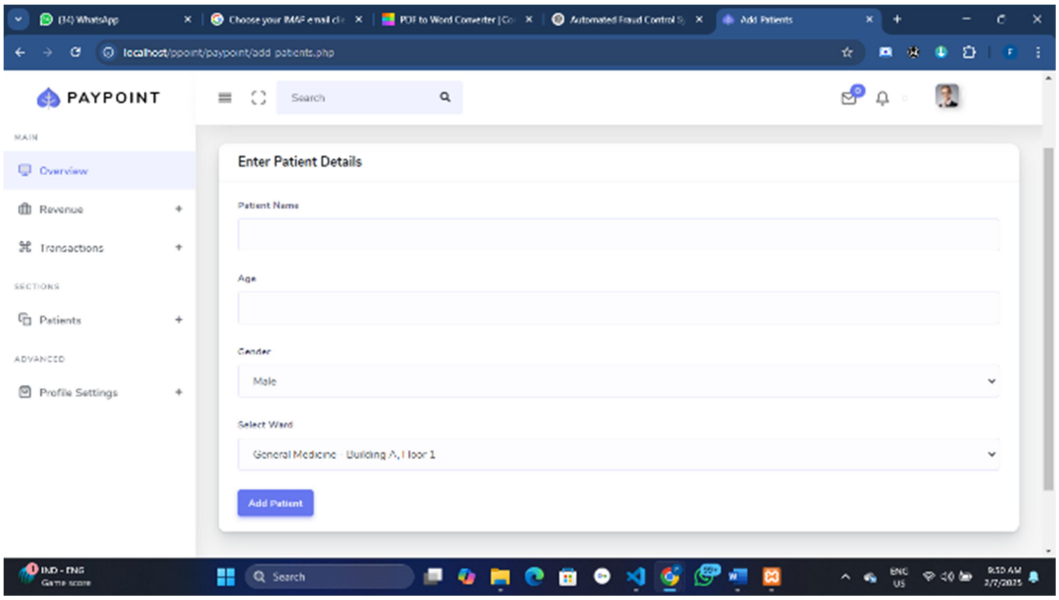

Fig 7. Patients Management

Paypoints play a crucial role in managing patient information within the system. When adding a new patient, the paypoint operator accesses the "Add Patient" section through their dashboard. Here, they input essential patient details such as name, age, ward. The system validates the information to ensure data accuracy and completeness. Once successfully submitted, the new patient record is stored in the database and becomes accessible for future transactions and administrative purposes.

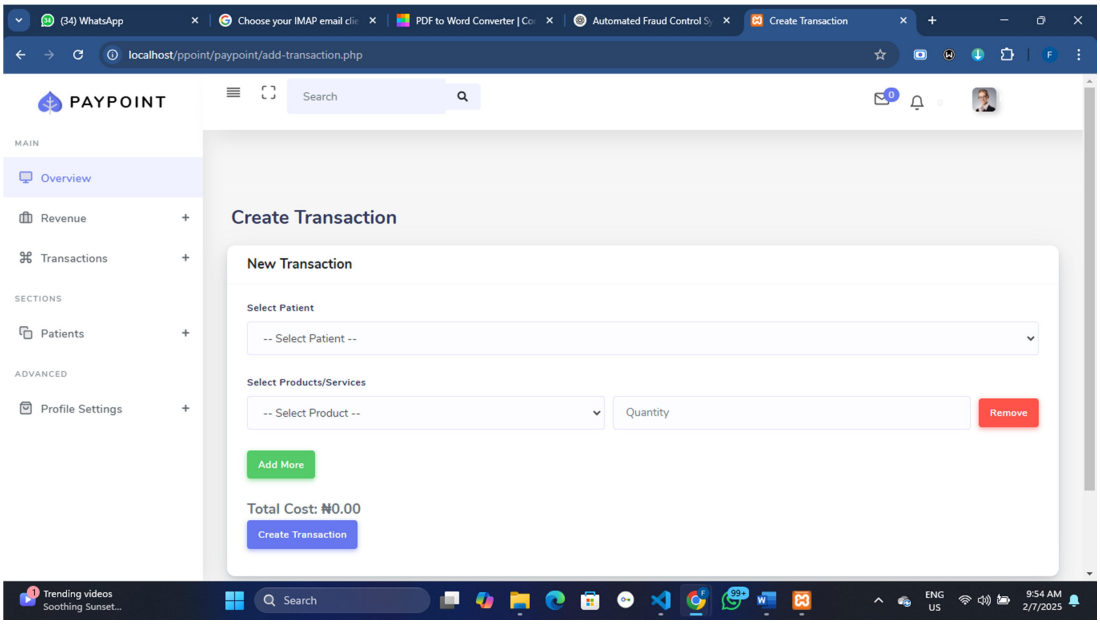

Fig 8. Create Transaction

Creating a transaction is a core function of the paypoint's operation. When a patient requires services or products, the paypoint operator initiates the transaction process through the "Create Transaction" module. The system prompts the operator to select the patient's record and specify the services rendered or products provided.

The total amount payable is calculated automatically, including any applicable taxes or discounts. Payment methods are then selected, and once the transaction is confirmed, the system generates a unique transaction ID and updates the revenue records accordingly after then a receipt is printed for the patient.

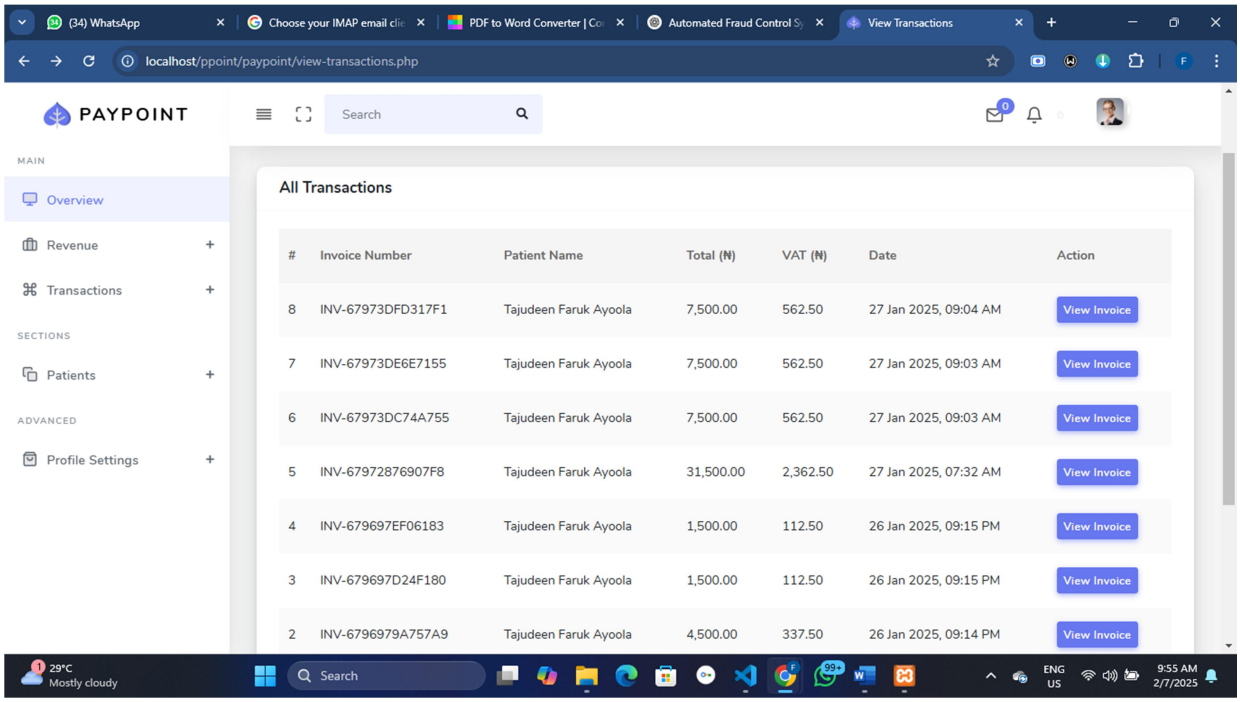

Fig 9. View Revenue

The "View Revenue" feature allows paypoints to track their financial performance over time. By accessing this module, paypoint operators can view detailed summaries and breakdowns of revenue generated from completed transactions. The data can be filtered by specific time periods, transaction types, or patient categories, providing valuable insights into operational efficiency and cash flow.

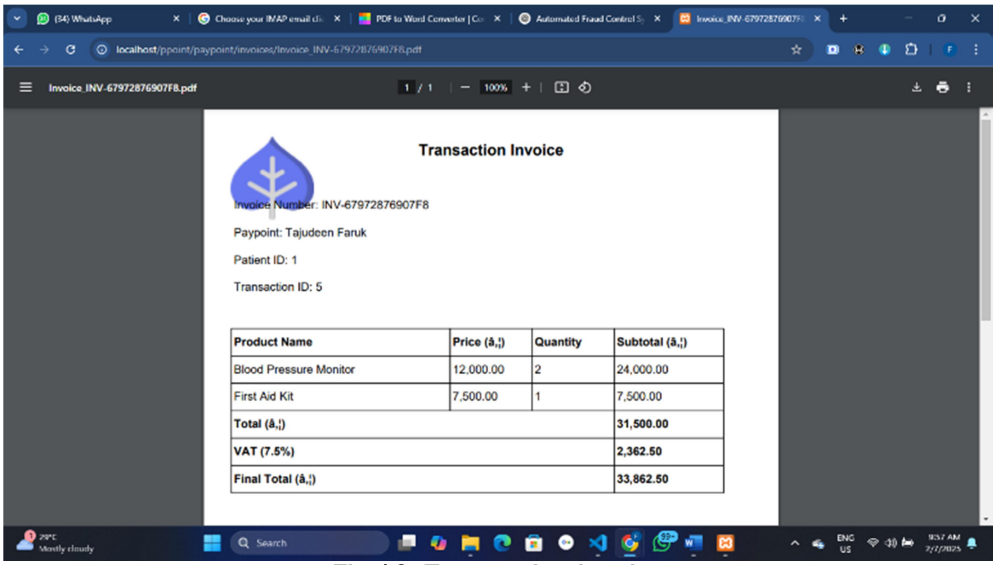

Fig 10. Transaction Invoice

The transaction invoice serves as a formal and detailed record of transactions conducted at a paypoint. When a transaction is successfully created, the system automatically generates an invoice containing essential details. This includes the unique transaction ID, date, and time of the transaction, patient information, and a detailed list of services rendered or products sold along with their prices. The invoice also displays the total amount payable, applicable taxes, discounts (if any), and the payment method used.

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