

DIGITAL IDENTITY SYSTEMS AND PUBLIC FINANCIAL MANAGEMENT: THE ROLE OF BIOMETRIC AUTHENTICATION IN REDUCING PAYROLL BILLS IN BORNO STATE PUBLIC SERVICE

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Abstract

This study assesses Digital Identity Systems and Public Financial Management: The Role of Biometric Authentication in Reducing Payroll Bills in Borno State Public Service. A cross-sectional field survey employing a convergence triangulation mixed-method design was adopted to generate both quantitative and qualitative evidence. Quantitative data were collected from 426 public servants through a structured questionnaire, while qualitative insights were obtained from key informant interviews involving government officials, members of the biometric committee, and labour union representatives. Data were analysed using multi linear regression for the quantitative component and thematic analysis for the qualitative data. The findings indicate that biometric authentication significantly enhances payroll integrity by identifying discrepancies, correcting inaccurate records, and preventing payroll inflation through tamper-resistant verification mechanisms. The system also contributed to substantial reductions in payroll costs by eliminating ghost workers and unauthorised salary claims, while simultaneously improving transparency and administrative efficiency within the public service. Qualitative evidence further revealed that automation, financial accuracy, and system security are major drivers of fiscal accountability within the biometric payroll framework. However, the findings also highlighted persistent challenges, including delays in complaint resolution, human errors, and certain institutional bottlenecks affecting system operations. The study concludes that biometric authentication represents a critical digital governance reform capable of improving payroll efficiency, reducing recurrent expenditure, and strengthening accountability in public financial management. It therefore recommends enhanced capacity building for personnel, the introduction of automated validation protocols, and continuous system audits to ensure the sustainability and effectiveness of biometric payroll systems.

Keywords: Biometric Authentication; Borno State; Digital Identity Systems; Payroll Bill Reduction; Payroll Integrity; Public Financial Management; Public Sector Reform.

Introduction

Payroll efficiency is the institutional ability to perform mandated functions accurately, promptly, and accountably while minimising waste and administrative bottlenecks. It is regarded as an element of effective governance as it ensures optimal use of scarce public resources. In Borno State, the government implemented a biometric system to improve payroll accuracy and strengthen cost

control in the public service. The initiative was designed to create a reliable employee database, sanitize the payroll system, eliminate irregularities, and ensure that salary payments correspond strictly to verified active staff. However, findings from the biometric audit revealed significant structural weaknesses in the wage administration of the state public service.

The exercise uncovered inflated salary structures and duplicate payments affecting more than 3,000 employees, while payroll cleansing subsequently reduced monthly salary expenditures by over ₦300 million (Biometric High Power Committee Report, 2022). Such unsustainable payroll practices diverted resources that could have been invested in infrastructure development, employee welfare, and improved public service delivery, while also distorting budget planning and weakening fiscal discipline. Although the biometric exercise achieved some success in sanitizing the payroll system, persistent inconsistencies and potential human errors have raised concerns about the reliability of the system, thereby underscoring the need for systematic evaluation. The absence of empirical assessment limits the government's ability to determine whether the biometric initiative has fully achieved its objectives of improving payroll accuracy and reducing financial leakages. Consequently, the failure to evaluate its outcomes constrains policymakers' capacity to identify systemic gaps, strengthen existing mechanisms, and replicate successful reforms across other sectors of the public service in Borno State.

Although, studies on payroll management have contributed to thoughtful of payroll efficiency and the role of technology literature though research gaps remain as notable limitations. The studies by Adegbite and Zahraddeen (2021) on the effectiveness of the Integrated Personnel Payroll Information System (IPPIS) on ghost workers in Nigeria, and Tefurukwa (2021) assess management of ghost employees within the payroll system in Tanzania. The studies relied on secondary data which may not adequately capture the operational realities of the civil service. The absence of primary data limits the validity and depth of findings.

Similarly, Tammel (2017) examined shared services as a mechanism for cost reduction in the public sector, the study did not provide a specific empirical assessment of how biometric solutions compare with traditional administrative methods in addressing payroll efficiency challenges. Methodological limitations are also evident in the works of Allen and Sofiri (2017) on ghost employee fraud, bloated wage bills, and employment decline in the primary and secondary education sector in Bayelsa State, as well as Bwaki (2020), which examined the causes of recurring ghost workers on payroll systems. The studies relied on non-probability sampling techniques specifically purposive sampling. These approaches may not produce representative samples, thereby limit the diversity of perspectives and introduce potential selection bias. Additionally, the studies is found with a noticeable imbalance in

methodological approaches as qualitative studies lack rigorous quantitative support. This methodological imbalance constrains the development of an understanding of how biometric systems can effectively address payroll inefficiencies and reduce payroll-related fraud in the public service. Therefore, the gaps highlighted in previous studies, particularly those relating to methodological weaknesses and contextual limitations, have resulted in inconsistent findings on the effectiveness of digital identity systems in public financial management. The current study enriches theoretical debates by demonstrating how digital identity systems function improve financial integrity, administrative efficiency, and accountability which expands the understanding of public financial management. Thus, it is important to acknowledge that there could be instances where the impact is minimal. In light of the discourse mentioned above, the hypothesis put forward in this study is:

H₁: *Biometric authentication has significantly impacted on reduction in payroll bills.*

Literature Review and Theoretical Framework

Biometric

The concept reviewed indicates that scholars present complementary yet slightly divergent perspectives on biometric authentication within administrative and payroll management contexts. El-Rufai (2011), *Arora et al. (2015)*, and Omolehinwa and Naiyeju (2015) conceptualise biometric authentication primarily as a computerised identity verification mechanism designed to enhance the efficiency, credibility, and accuracy of personnel record management and monthly payroll administration. This standpoint implicitly links biometric authentication with accountability, fraud prevention, and transparency in public sector financial management. However, while these authors emphasise operational efficiency and trust enhancement, their conceptualisation tends to focus narrowly on technological functionality, with limited engagement on broader governance implications such as fiscal sustainability, cost-reduction outcomes, and institutional behavioural changes resulting from biometric adoption.

On the other hand, authors such as Ross and Jain (2015), Kohlakala and Coetzer (2021), *Jaiswal et al. (2011)*, Margaret (2018), *Prabhakar et al. (2006)*, *Mir et al. (2011)*, Emersic and Peer (2015), *Guenmouni, et al. (2018)*, *Emami et al. (2016)*, *Paulino et al. (2011)*, Kaur (2017), Simon, and Mark (2001), *Maio et al., (2004)*, *Prakash et al. (2009)*, and *Jenkins, et al. (2016)* approach the concept of biometric authentication from a perspective that focuses on recognising and identifying individuals by considering their physiological or behavioural attributes, including facial features, palm prints, DNA, body movement, fingerprints, hand structure, handwriting, iris patterns, retinal patterns, vein patterns, signatures, and gait. Therefore, within the context of this study, Biometric authentication

aligns with the viewpoints of El-Rufai (2011), *Arora et al. (2015)*, and Omolehinwa and Naiyeju (2015), which extend beyond simple identification and recognition of individuals. It promotes stability by enhancing personnel record accuracy, reducing payroll bills, preventing payroll fraud, and ensuring accurate salary payments to employees.

Payroll Bills

In the evolving discourse on organisational finance and human resource management, the concept of payroll bills holds a central position, particularly within public-sector administration and accountability frameworks. The MBA Skool Team (2023) conceptualises payroll as the aggregate of employee compensation, including salaries, bonuses, and deductions, emphasising its importance for organisational ethics, financial stability, employee morale, and institutional credibility. This perspective is reinforced by Patriot Software (2022), which expands the concept to include the administrative architecture supporting payroll operations, such as employee record management, payslip generation, and statutory reporting compliance. This broader view highlights payroll as an integrated management system rather than a standalone transactional activity.

Similarly, Aliyu (2020) provides a detailed structural breakdown of payroll components, including base pay, overtime, allowances, bonuses, and statutory deductions, illustrating the complexity and regulatory sensitivity embedded within payroll bills. Such structural detail underscores the need for precision and effective coordination between human resource and financial management functions. Furthermore, Dauda (2023) conceptualises payroll taxes as mandatory financial obligations shared between employers and employees, thereby linking payroll administration to broader public welfare financing systems. This dual-liability dimension situates payroll management within national socioeconomic policy frameworks and reinforces its macroeconomic relevance. Moses (2021) advances this argument by emphasising the diversity of payroll deductions, including health insurance, retirement contributions, and legal garnishments, which require transparent documentation and systematic controls to prevent discrepancies and legal infractions. Mohammed (2019) complements these perspectives by framing payroll as both a register of entitled employees and a historical repository of compensation transactions, positioning payroll records as essential tools for auditing, policy evaluation, and strategic financial planning.

Therefore, this study aligns with the viewpoints of Moses (2021), MBA Skool Team (2023), and Mohammed (2019) and defines payroll as an integrated administrative and financial management system that documents, processes, and regulates employee compensation including salaries, benefits, bonuses, and statutory deductions while maintaining verifiable records that support organisational accountability, legal compliance, and strategic financial decision-making.

Public Service

The study provides diverse perspectives on the conceptualisation of public services. It presents insights from researchers and scholars, shedding light on the nature and function of public services in government operations. Nwanolue and Iwuoha (2012), Adamolekun (2002), *Anazodo, et al. (2012)*, Ipinlaiye (2001), Ajaegbu (2010), Iyayi (2010), and Yang and Zhang (2012) perceive public services as comprising employees engaged by government institutions in a non-political capacity, with the primary objective of faithfully executing their decisions. Conversely, Salisu (2001), *Sharma et al. (2012)*, Adedire (2014), and Ezeani (2006) regard the public service as an administrative system accountable for implementing and upholding government laws and programs. Thus, this study aligns with the viewpoints of Nwanolue and Iwuoha (2012), Adamolekun (2002), *Anazodo et al. (2012)*, Ipinlaiye (2001), Ajaegbu (2010), Iyayi (2010), and Yang and Zhang (2012), who consider public service as the institutional mechanism of governance whose legitimacy and effectiveness are anchored on operational efficiency, achieved through administrative systems that optimize the use of resources to maximize output while minimizing waste. Such efficiency manifests in practical outcomes including accurate personnel records, reduction in payroll costs, prevention of fraud, and improved accuracy in salary payments, thereby ensuring transparency, accountability, and trust in governance.

Biometric Authentication and Reduction in Payroll Bill

Studies on payroll management and technological reforms in the public service encompassing Tammel (2017), Allen and Sofiri (2017), Adegbite and Zahraddeen (2021), Bwaki (2020), *Haruna et al. (2015)*, Tefurukwa (2021), Adesubomi (2018), *Fernandez et al. (2016)*, Jones (2016), Bhuiyan and Amagoh (2011), Agbaje and Aladetanye (2021), *Osisioma et al. (2016)*, Farajimakin and Anichebe (2017) and Ahmed (2021) provides important contribution in administrative inefficiencies and reform initiatives; however, the literature reveals contextual and methodological deficiencies that render findings inconsistent in assessing the role of biometric authentication in reducing payroll bills within public financial management. Contextually, the studies adopt a broad public sector without embedding biometric authentication within specific fiscal environments where payroll expenditure constitutes a dominant share of recurrent spending, thereby weakening contextual sensitivity and limiting institutional transferability. As Tammel (2017) evaluates shared service reforms at a general administrative level but does not empirically isolate the comparative performance of biometric verification relative to traditional payroll control mechanisms.

Similarly, Adegbite and Zahraddeen (2021) Agbaje and Aladetanye (2021), *Osisioma et al. (2016)*, Farajimakin and Anichebe (2017) and Tefurukwa (2021) depend largely on secondary datasets,

which are often unable to capture real-time operational dynamics, implementation bottlenecks, and behavioural responses of payroll administrators and employees to biometric reforms. Methodologically, several studies rely on descriptive statistics or basic regression analyses (Allen & Sofiri, 2017; *Haruna et al., 2015*), limiting their capacity to establish explanatory or causal linkages between biometric adoption and measurable payroll bill reduction. The frequent use of non-probability and purposive sampling (Allen & Sofiri, 2017; Bwaki, 2020) further raises concerns regarding representativeness, external validity, and selection bias. Consequently, the studies reviewed reveal an imbalance between qualitative and quantitative evidence, resulting in inconclusive findings on the extent to which biometric authentication reduces payroll bills. This gap underscores the need for the present study. The study adopts a pragmatic approach integrating quantitative and qualitative data.

Theoretical Framework

Public Financial Management Theory, developed by Richard A. Musgrave in 1959, provides a useful framework for assessing the role of biometric authentication in reducing payroll bills in the Borno state public service. The theory emphasizes that governments must manage public resources efficiently through sound financial controls, accountability, transparency, and prudent expenditure management (Constantino & Gruber, 2005). Within this framework, biometric authentication reflects the modern financial control mechanism that strengthens payroll management systems. By integrating biometric verification into payroll administration, Borno state governments can reduce errors associated with third-party deductions, improve the accuracy and reliability of payroll data, correct faulty payroll entries, and ensure tamper-proof payroll processes. These mechanisms help eliminate unauthorized salary payments and reducing unnecessary payroll expenditure.

Methodology

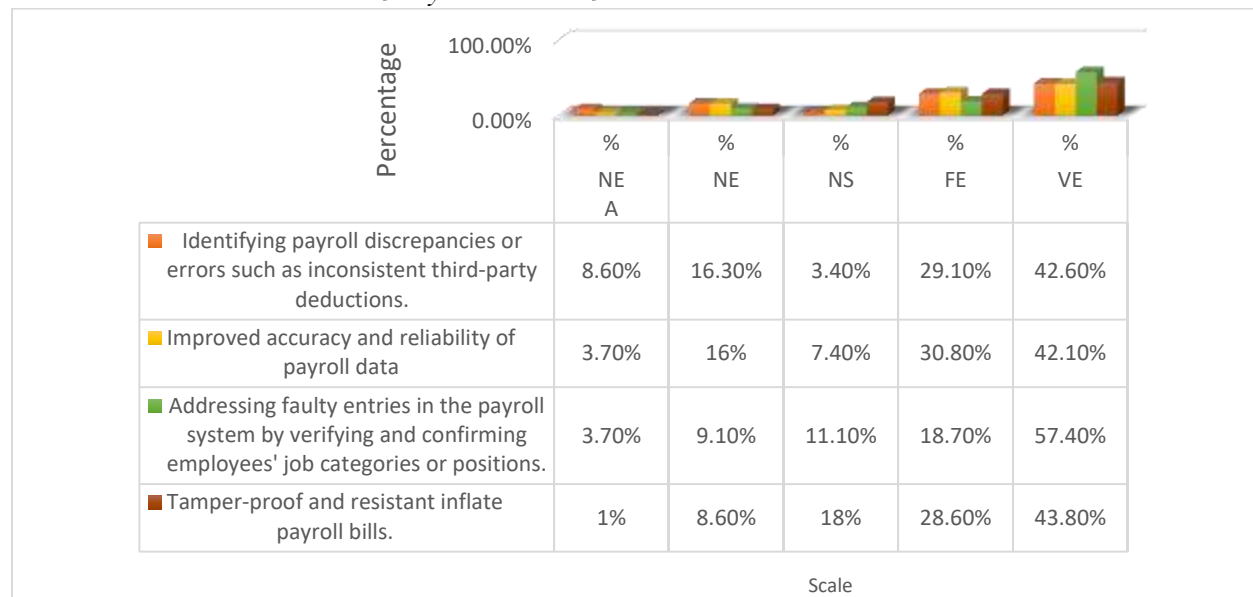
The study adopted a pragmatic approach that combines quantitative and qualitative techniques to examine how biometric authentication contributes to payroll bill reduction in the Borno State public service. Quantitative data were collected from public service employees through a structured questionnaire using a 5-point Likert scale. The instrument measured the influence of biometric authentication on payroll bill reduction. It specifically assessed how biometric systems reduce errors related to third-party deductions, improve the accuracy and reliability of payroll data, correct faulty payroll entries, and ensure tamper-proof payroll processes. For the qualitative aspect, key informant interviews with semi-structured questions were conducted with members of the Biometric High-Powered Committee (Permanent Secretaries from the Office of the Head of Service and the Ministry

of Finance, officials from the Public Service Commission, biometric desk officers, and leaders of labour unions). The sample size for the survey was initially determined as 387 respondents using the Yamane (1967) formula. To address possible non-response and invalid questionnaires, 10 percent (39 respondents) was added following Sudman (1976), resulting in a final sample size of 426 respondents. Interview data were transcribed using Otter.ai software and analysed with a Python script to generate preliminary thematic codes and categories. Thereafter, thematic analysis was conducted to interpret the narratives and provide deeper insights into how biometric authentication contributes to reducing payroll expenditure in the Borno State public service.

Results and Discussions

Figure 4.1

Biometric Authentication and Payroll Bill Reduction.



Source: *Field Survey, 2026*

The figure indicates that a strong majority of respondents perceive biometric authentication as highly effective in improving payroll management and reducing payroll bills. Specifically, 71.7% agree that biometric authentication helps identify payroll discrepancies, particularly errors related to third-party deductions, thereby supporting cost reduction. Similarly, 72.9% respondent believe it significantly improves the accuracy and reliability of payroll data, highlighting its role in minimizing payroll errors.

Additionally, 76.1% consider biometric authentication very effective in addressing faulty payroll entries by verifying employees' job categories and positions, leading to more accurate records. Furthermore, 72.4% view the system as effective in ensuring tamper-proof payroll processes and preventing inflated payroll bills caused by manipulation or fraud. Therefore, the findings demonstrate that biometric authentication positively enhances payroll accuracy, reliability, and security by detecting discrepancies, correcting faulty entries, and preventing fraudulent activities, ultimately contributing to reduced payroll costs and improved payroll management efficiency.

Thematic Analysis Results

The research question aims to assess how Biometric Authentication influences the reduction of payroll expenses.

Theme 1: Automation and Efficiency in Payroll Management

"Automated grading systems play a pivotal role in optimising our payroll processes. it streamlines the promotion and upgrade procedures. By automating transitions for workers approaching retirement to the pension system, we simplify the process and enhance the accuracy of our payroll records. Additionally, the streamlined data processing facilitated by these systems is instrumental in identifying and managing duplicate entries."

Theme 2: Financial Accuracy and Cost Reduction

"Borno state government implemented Biometric technology in our payroll management to ensures directing of dues and charges, contributing to the overall accuracy of our financial dealings. This enhances our financial records in preventing multiple payments essential for cost savings."

Theme 3: Security and System Integrity

"Integrating Biometric data enhances our system integrity by preventing unauthorised access only authorised personnel through Biometric verification, can access the payroll data. The system actively detects and manages cases involving deceased individuals and staff who have withdrawn their services to ensure payroll records remain accurate, secure, and aligned with the current status of our employees."

Theme 4: Challenges in Addressing Complaints

"The complaint resolution process is complicated, leading to delays in addressing concerns. Biometric data errors are not promptly resolved, and staff complaints often go unaddressed. Timely resolution of staff concerns is hindered by delays and human errors in updates, resulting in inaccuracies. The complex nature of the process contributes to delays in handling Biometric data errors, a lack of prompt attention to staff concerns, and issues in timely resolution."

The participants' responses demonstrate that biometric authentication has a significant positive impact on payroll bill reduction through automation, financial accuracy, and enhanced system security. Participants (1, 2, 3, 5, 6, and 8) highlight that the integration of automated grading within biometric systems improves payroll management by streamlining promotion, upgrading, and retirement processes. The automation of employee transitions into the pension system reduces administrative delays and human interference, thereby improving payroll accuracy. Additionally, biometric-enabled data processing strengthens the detection of duplicate which enhances payroll reliability and minimises discrepancies that often inflate payroll costs.

Participants (2, 4, 5, and 8) further emphasise the financial efficiency gained from biometric adoption in Borno State as it enhances deductions and prevents multiple payments. This indicates that biometric authentication not only payroll bill reduction but also strengthens financial accountability. Similarly, Participants (1, 3, 5, and 7) focus on the security dimension, noting that biometric verification prevents unauthorised access as it identified deceased and disengaged employees. This improves personnel database integrity and ensures that payroll payments are limited to legitimate staff, thereby significantly reducing payroll inflation. Automation mechanisms also reduce human error and improve transparency in payroll administration. However, participants (1, 2, and 3) identify institutional constraints such as bureaucratic complaint resolution processes, human errors during data capture, and inadequate monitoring of biometric databases. These challenges may weaken system credibility and delay the correction of payroll inaccuracies, thereby limiting the full impact of biometric authentication on payroll reduction.

The findings imply that biometric authentication has impacted on payroll bill reduction by improving accuracy, preventing fraud, eliminating ghost workers, and automating administrative processes. The integration of automated grading systems further enhances efficiency by ensuring timely personnel updates, which prevents unnecessary salary payments. Therefore, it can be inferred that biometric authentication is a critical tool for strengthening payroll management and reducing payroll expenditure.

Table 4.2: *Report on Biometric Authentication and payroll bills reduction.*

Model	Unstandardised		Standardised t		Sig.
	Coefficients		Coefficients		
	B	Std. Error	Beta		
(Constant)	.306	.137		2.233	.026
Identifying payroll inconsistent third-party deductions.	.547	.033	.616	.523	.000
Addressing faulty entries in the payroll system using job categories.	.197	.035	.190	.646	.000
tamper-proof against inflation of payroll bills.	.174	.045	.147	.392	.000

a. Dependent Variable: accuracy and reliability of Biometric Authentication on the payroll bills.

The multi linear regression analysis indicate that the implementation of biometric authentication significantly improves payroll data accuracy and integrity, thereby contributing to payroll bill reduction. Specifically, biometric authentication enhances the identification of payroll discrepancies, including inconsistent third-party deductions $t = 0.523$, $p < 0.001$, demonstrating a strong positive effect on payroll reliability. It also effectively addresses faulty payroll entries by verifying employees and confirming their job categories $t = 0.646$, $p < 0.001$, suggesting its ability to detect and prevent fraudulent or erroneous records. Furthermore, the tamper-proof nature of biometric systems $t = 0.392$, $p < 0.001$ shows a positive, though relatively modest, impact on strengthening payroll security and preventing payroll inflation.

Therefore, discrepancy identification, faulty entry correction, and system tamper-resistance are statistically significant, as reflected by the consistently low p-values. The findings therefore support the hypothesis that biometric authentication plays a crucial role in enhancing payroll accuracy, reliability, and security, ultimately leading to a significant reduction in payroll bills through the detection and correction of errors and inconsistencies in payroll management systems.

Discussion of Result

The descriptive statistics show that the biometric system contributes to payroll bill reduction by improving automation, financial accuracy, and system security. The integration of an automated grading system streamlines promotions, upgrades, and retirement transitions of employees into the pension system. The biometric system also detects duplicate records, strengthens deduction processes, prevents unauthorized access, and identifies deceased or disengaged employees. These

functions improve payroll reliability and reduce discrepancies that often inflate wage bills. These results are consistent with the thematic analysis findings. The qualitative evidence indicates that the biometric system through the use of Bank Verification Numbers (BVN), supports the automation of grading processes, reduces multiple deductions, prevents multiple salary payments and facilitates promotions, upgrades, and retirement transitions. The multiple linear regression results further show that discrepancy identification, correction of faulty payroll entries, and system tamper-resistance are statistically significant predictors of payroll bill reduction, as indicated by consistently low p-values. The findings therefore support the hypothesis that biometric authentication improves payroll accuracy, reliability, and security. This ultimately leads to a significant reduction in payroll bills through the detection and correction of errors and inconsistencies in payroll management systems. However, bureaucratic delays in complaint resolution, human errors during data capture, and inadequate monitoring of biometric databases constraints and weaken the system credibility. This weakness limits the full potential of biometric authentication in achieving effective payroll bill reduction. The findings align with the study of Agbaje and Aladetanye (2021), *Osisioma et al. (2016)*, and Farajimakin and Anichebe (2017), which highlight the effectiveness of biometric-driven payroll reforms such as the Integrated Personnel and Payroll Information System (IPPIS) in improving payroll accuracy, reducing administrative costs, and promoting policy-driven accountability. Similarly, Bakari (2021) reported substantial reductions in payroll padding following ICT deployment, supporting the argument that digital authentication systems enhance financial discipline. Nonetheless, contrasting perspectives exist. Tammel (2017) argues that technological reforms may also serve political or managerial objectives, including workforce downsizing, rather than purely financial optimisation.

Conclusion and Recommendations

The study highlights that Biometric authentication improves accuracy and reliability of payroll bills by rectifying discrepancies through automated grading systems for personnel transitions, ensures accurate direction of dues, enhances financial administration accuracy, and prevents fraudulent activities. Concurrently, its tamper-proof nature and automation of retirement transitions improve payroll efficiency, enhances security in payroll management processes within the Borno State Public service. However, procedural bottlenecks in complaint resolution and human errors in data capture limit system effectiveness. Therefore, the deployment of automated error-checking features and multi-level verification protocols within the biometric system will ensure that updates undergo rigorous scrutiny before final approval, thereby minimizing inaccuracies. Establishing a dedicated grievance redress mechanism will also provide staff with a structured channel to resolve concerns

promptly, enhancing trust in the system. These measures will be supported by periodic system audits in safeguarding personnel data integrity.

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