World Journal of Public Health
2026, Vol. 11, No. 3, pp. 249–263
https://doi.org/10.11648/j.wjph.20261103.13

Research Article

Effects of Manual and Digital Registration Systems on Data Quality, Waiting Time, and Healthcare Worker Satisfaction in Tertiary Hospitals in Kogi State, Nigeria

Olutunde Samuel Michael[1], Omokanye Akingbola Sunday[2], Olatunde Raimi[1, 3, *], Owolabi Ruth Onajite[4], Anthony Ike Wegbom[1]

[1]Department of Public Health Sciences, Rivers State University, Port Harcourt, Nigeria
[2]Institute of Public Health, Obafemi Awolowo University, Ile-Ife, Nigeria
[3]Public Health Research Unit, Bloomfield International Learning and Evaluation Network, Oyo, Nigeria
[4]Information Resources Management Department, Babcock University, Ilishan-Remo, Nigeria

Abstract

Patient registration systems play an important role in ensuring accurate health information management and efficient service delivery within healthcare facilities. In many Nigerian tertiary hospitals, manual and digital registration systems continue to operate simultaneously, yet evidence comparing their influence on data quality, patient waiting time, and healthcare worker satisfaction remains limited. This study assessed the effects of manual and digital registration systems on data quality, waiting time, and healthcare worker satisfaction in tertiary hospitals in Kogi State, Nigeria. The facility-based cross-sectional study was conducted among 452 healthcare workers selected through stratified random sampling from two tertiary hospitals in Kogi State. Data were collected using a structured questionnaire and analyzed using descriptive statistics, independent samples t-tests, and multiple linear regression. Statistical significance was set at $p < 0.05$. Most respondents were aged 25–29 years (30.31%), female (67.70%), Christian (57.08%), and married (76.99%). Respondents using digital registration systems reported higher data quality scores (2.96 ± 0.36) than those using manual registration systems (2.72 ± 0.37; $p < 0.001$). Similarly, digital registration systems recorded better waiting-time performance (2.17 ± 0.26) compared with manual registration systems (2.07 ± 0.23; $p = 0.001$). Healthcare worker satisfaction was significantly lower among users of manual-only registration systems ($\beta = -0.527$, 95% CI: -0.678 to -0.376; $p < 0.001$), whereas satisfaction among digital-only users did not differ significantly from that of hybrid-system users ($\beta = 0.027$, 95% CI: -0.142 to 0.197; $p = 0.750$). The study concludes that digital registration systems offer advantages in data quality, waiting time, and healthcare worker satisfaction compared with manual registration systems. Strengthening digital health infrastructure, providing continuous staff training, and ensuring adequate technical support may enhance the effectiveness of registration systems and improve health information management in tertiary healthcare facilities.

Keywords

Data Quality, Digital Health, Healthcare Worker Satisfaction, Patient Registration Systems, Tertiary Hospitals, Waiting Time

*Correspondence: Olatunde Raimi (rolatunde1@yahoo.com)

Received: 11 June 2026; **Accepted:** 23 June 2026; **Published:** 22 July 2026

1. Introduction

Healthcare systems worldwide are increasingly adopting digital technologies to improve the management of patient information and enhance the quality of healthcare delivery [1-3]. Among these technologies, digital patient registration systems have become an important component of health information management because they facilitate the collection, storage, retrieval, and sharing of patient data across different levels of care [4, 5]. Effective registration systems serve as the entry point into the healthcare system and provide the foundation for accurate documentation, continuity of care, and informed clinical decision-making [6].

Traditionally, patient registration in many healthcare facilities has relied on manual paper-based processes involving handwritten records and physical filing systems [7, 8]. Although manual registration systems remain widely used because of their simplicity and relatively low infrastructure requirements, they are often associated with challenges such as incomplete documentation, transcription errors, misplaced records, and difficulties in retrieving patient information when needed [9, 10]. These limitations can affect the quality of healthcare data and reduce the efficiency of healthcare delivery.

Furthermore, accurate and complete patient information supports appropriate clinical decisions, effective communication among healthcare providers, and reliable monitoring of health outcomes [11-13]. Conversely, poor-quality data can contribute to medical errors, duplication of services, delays in treatment, and inefficient use of healthcare resources [14]. Digital registration systems have been promoted as a means of improving data quality through standardized data entry procedures, automated validation processes, and improved record management capabilities [15, 16].

Beyond data quality, registration systems can influence the timeliness of healthcare services. Patient waiting time remains an important indicator of healthcare system performance and is closely linked to patient experiences and perceptions of service quality [17]. Delays during registration may create bottlenecks that affect patient movement through healthcare facilities and prolong access to clinical services [18]. Evidence from previous studies suggests that digital registration systems can reduce administrative delays and improve access to patient information, thereby contributing to shorter waiting times and more efficient service delivery processes [19, 20]. However, improvements in registration procedures do not necessarily translate into better service flow across healthcare facilities, as other organisational and operational factors may also influence patient movement and service coordination [21].

In addition, healthcare workers play a central role in the successful implementation and utilization of registration systems as their experiences and level of satisfaction can influence system acceptance, compliance with documentation procedures, and overall effectiveness of health information management practices [11, 22]. Registration systems that are perceived as user-friendly, reliable, and supportive of routine work processes are more likely to be accepted and used effectively by healthcare professionals [23]. However, systems that increase workload or disrupt established workflows may generate dissatisfaction and reduce the expected benefits of digital transformation initiatives [24].

In Nigeria, efforts to strengthen digital health systems have increased in recent years, leading to the gradual introduction of electronic registration and health information systems in many healthcare institutions [25, 26]. Despite these developments, many tertiary hospitals continue to operate a combination of manual and digital registration systems, creating variations in data management practices and service delivery experiences across facilities [27]. Existing studies in Nigeria have largely focused on the adoption of digital registration systems and the challenges associated with digital health implementation [24, 28, 29]. However, there remains limited empirical evidence comparing how different registration system types influence data quality, patient waiting time, and healthcare worker satisfaction within tertiary healthcare settings.

Addressing this knowledge gap is important for informing health information management policies and guiding investments in digital health infrastructure. Therefore, this study examines effects of manual and digital registration systems on data quality, waiting time, and healthcare worker satisfaction in tertiary hospitals in Kogi State, Nigeria.

2. Materials and Methods

2.1. Study Setting

This facility-based cross-sectional study was conducted in two tertiary healthcare institutions in Kogi State, North-Central Nigeria: Federal Teaching Hospital Lokoja (FTHL) and Prince Abubakar Audu University Teaching Hospital (PAAUTH), Anyigba. Both hospitals serve as referral centres for Kogi State and neighbouring states and provide specialised clinical care, teaching, and research services.

Kogi State is located in North-Central Nigeria and occupies a strategic position connecting the northern and southern regions of the country. Healthcare services within the state are delivered through the primary, secondary, and tertiary levels of care. The selected hospitals operate within a mixed health information environment where both manual and digital registration systems are used for patient documentation and record management.

2.2. Study Population

The study population comprised healthcare workers directly involved in patient registration, documentation, and

health information management activities within the selected hospitals. These included health information management personnel, nurses, physicians, pharmacists, laboratory scientists, and administrative staff who routinely interact with patient registration systems. The estimated workforce across both institutions was approximately 2,500 personnel.

Eligible participants were healthcare workers involved in registration-related activities who had worked in their respective facilities for at least six months prior to the study. Staff members who were on leave during data collection, had less than six months of work experience, or were not involved in patient registration or documentation processes were excluded.

2.3. Sample Size Determination

The sample size was determined using the single population proportion formula:

$$n = \frac{Z^2P(1-P)}{d^2} \quad (1)$$

where *n* represents the minimum sample size, *Z* is the standard normal deviate at 95% confidence level (1.96), *P* is the estimated proportion of healthcare workers engaged in registration-related activities (50%), and *d* is the margin of error (5%).

Substituting the values:

$$n = \frac{(1.96^2 \times 0.50 \times 0.50)}{(0.05^2)} = 384.16 \quad (2)$$

To account for a 15% non-response rate, the sample size was adjusted upward, resulting in a sample size of 452 participants.

2.4. Sampling Technique

A multistage sampling approach was adopted. First, participants were stratified according to hospital and professional unit, including clinical departments, nursing services, and health information management units. Proportional allocation was then applied to determine the number of respondents selected from each stratum. Finally, eligible participants were selected using simple random sampling to ensure equal chances of participation.

2.5. Data Collection Instrument and Procedure

Data were collected using a structured questionnaire developed from previous studies on health information systems, digital registration systems, and healthcare service delivery. The instrument was informed by the Technology Acceptance Model (TAM), which emphasizes the influence of perceived usefulness and ease of use on technology adoption.

The questionnaire consisted of sections covering socio-demographic characteristics, registration system type, data quality, waiting time, service flow, and healthcare worker satisfaction. Content validity was assessed through expert review by specialists in Health Information Management and Public Health. A pilot study was conducted among healthcare workers in a tertiary hospital outside the study area, and the instrument demonstrated good internal consistency, with a Cronbach's alpha coefficient of 0.87.

Questionnaires were self-administered with support from trained research assistants. Completed questionnaires were reviewed for completeness and consistency before data entry and analysis.

2.6. Data Analysis

Data were coded and analysed using the Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarise respondents' characteristics and key study variables.

Specifically, data quality indicators were analysed using both descriptive and bivariate statistical techniques. Descriptive statistics were used to summarise levels of data accuracy and completeness across registration system types. Where data quality indicators were measured as composite continuous scores, an independent samples *t*-test was used to compare mean scores between manual and digital registration systems. The chi-square statistic is expressed as:

To estimate the effect of registration system type on these outcomes, multiple linear regression analysis was performed.

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \ldots + \beta_kX_k + \varepsilon \quad (3)$$

where Y represents healthcare workers' satisfaction score, X_1 to Xk represent the explanatory variables, β_0 is the intercept, β_1 to β_k are the regression coefficients, and ε is the error term. Adjusted β coefficients, 95% confidence intervals, and p-values were reported, with statistical significance set at $p < 0.05$.

2.7. Ethical Considerations

Ethical approval was obtained from the Rivers State University Health Research Ethics Committee (Approval No. RSU/FMBS/REC/25/263), as the study was conducted as part of an academic research programme under Rivers State University. Administrative approval was subsequently obtained from the management of the participating hospitals before commencement of data collection. Participation was voluntary, and written informed consent was obtained from all respondents. Confidentiality and anonymity were maintained throughout the study, and no personally identifiable information was collected.

3. Results

Table 1 below presents the socio-demographic and professional characteristics of respondents included in the study. The age distribution shows that respondents aged 25–29 years

accounted for the highest proportion (30.31%), while those aged below 25 years (23.23%). The sex distribution indicates that females constituted the majority of respondents (67.70%), while males accounted for 32.30%. The findings further revealed that more than half of the respondents were Christians (57.08%). Most respondents were married (76.99%).

Furthermore, educational and professional qualifications reveal that a large proportion of respondents possessed a bachelor's degree (57.08%), while 22.12% had obtained a master's degree. Similarly, most of the respondents earned above ₦131,000 (72.35%). Additionally, nurses and midwives formed the largest professional group (44.25%), followed by health information and records officers (23.23%) and medical doctors (13.27%). Most respondents were permanently employed (72.35%), while others were on temporary (24.34%) or contract appointments (3.32%).

The distribution further shows that respondents with 20 years and above professional experience accounted for 23.01%, while those with less than five years of experience accounted for 20.80%.

Table 1. *Socio-Demographic and Professional Characteristics of Respondents.*

Variables	Frequency (n=452)	Percentage (%)
Age (years)		
Less than 25	105	23.23
25–29	137	30.31
30–34	133	29.42
35–39	52	11.50
40–44	13	2.88
45–49	6	1.33
50 and above	6	1.33
Sex		
Female	306	67.70
Male	146	32.30
Religion		
Christianity	258	57.08
Islam	194	42.92
Marital Status		
Married	348	76.99
Unmarried	104	23.01
Highest Professional Qualification		
Diploma	90	19.91
Bachelor'Degree (B.Sc/B.NSc/B.Mid/MBBS/B.Pharm/BMLS)	258	57.08
Master'sDegree (M.Sc/M.NSc/MPH/MHA/MBA)	100	22.12
Doctorate Degree (PhD)	4	0.88
Monthly Income (₦)		
Below ₦70,000	73	16.15
₦71,000 ₦100,000	10	2.21
₦101,000 ₦130,000	42	9.29
Above ₦131,000	327	72.35
Professional Cadre		
Medical Doctor	60	13.27

Variables	Frequency (n=452)	Percentage (%)
Nurse/Midwife	200	44.25
Health Information/Records Officer	105	23.23
Others	87	19.25
Current Employment Status		
Permanent	327	72.35
Contract	15	3.32
Temporary	110	24.34
Years of Professional Experience		
Less than 5 years	94	20.80
5–9 years	74	16.37
10–14 years	86	19.03
15–19 years	94	20.80
20 years and above	104	23.01
Years Using Hospital Registration System		
Less than 1 year	82	18.14
1–3 years	86	19.03
4–6 years	63	13.94
More than 6 years	221	48.89
Hospital Affiliation		
Federal Teaching Hospital, Lokoja	379	83.85
Prince Abubakar Audu University Teaching Hospital, Anyigba	73	16.15
Years of Experience in Current Hospital		
Less than 5 years	130	28.76
5–9 years	81	17.92
10–14 years	62	13.72
15 years and above	179	39.60
Primary Unit/Department		
Accident and Emergency	30	6.64
Clinics	51	11.28
Medical Records	193	42.70
Nursing Station/Ward	75	16.59
Outpatient Department (OPD)	103	22.79

Figure 1 below presents the distribution of respondents by type of registration system used and their years of experience with manual and digital registration systems. The figures show that the hybrid registration system, which combines both manual and digital processes, was the most commonly used, accounting for 40.27% of respondents. Manual paper-based systems were used by 37.61% of respondents, while fully digital or electronic systems were used by 22.12%.

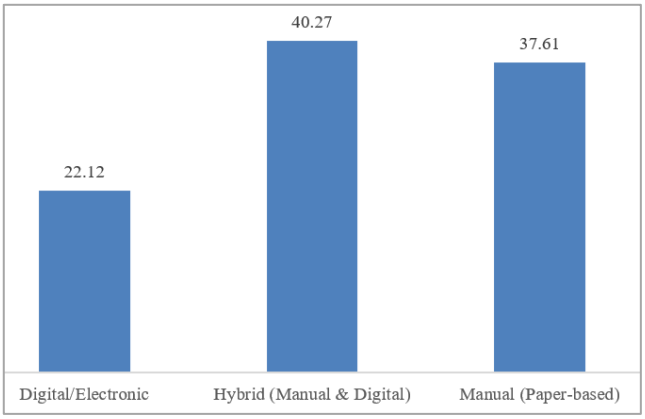

Figure 1. *Type of Registration System Used.*

Table 2 presents data accuracy and completeness of registration systems. The findings show that a large proportion of respondents affirmed that patient demographic information is accurately captured during registration, with 18.14% strongly agreeing and 69.69% agreeing, while only 10.18% disagreed or strongly disagreed. Most respondents also indicated that clinical and administrative data fields are usually completed during patient registration, as 73.01% either strongly agreed or agreed, although 20.13% expressed disagreement.

Similarly, a considerable proportion of respondents (45.80%) agreed or strongly agreed that missing patient information is common, 48.45% disagreed or strongly disagreed. Also, most respondents indicated that duplicate patient records are uncommon, as 71.68% either strongly agreed or agreed, compared with 28.31% who disagreed or strongly disagreed.

The findings further show that, most respondents agreed that digital registration reduces data entry errors, with 82.31% expressing agreement, while only 16.15% disagreed or strongly disagreed. A large proportion of respondents also agreed that manual records are more prone to loss or damage, as 89.83% either strongly agreed or agreed. Similarly, 93.58% of respondents indicated that corrections of registration errors are easier using digital systems.

Most respondents reported that patient registration records are well preserved and protected from loss, with 86.29% expressing agreement. In addition, 88.27% of respondents indicated that errors identified during patient registration can be corrected easily, while only 11.72% expressed disagreement. However, responses on the rarity of errors in patient registration data showed some variation, as 67.26% agreed that errors are uncommon, while 29.20% disagreed. Furthermore, a majority of respondents (90.49%) indicated that patient information remains consistent across repeated visits. Similarly, 74.34% agreed that missing or incomplete patient information is rare, although 24.34% disagreed. Most respondents affirmed the superiority of digital systems over manual systems, as 80.31% agreed that digital registration systems produce more accurate patient records, while 77.88% agreed that digital systems produce more complete patient records than manual systems.

Table 2. *Data Accuracy and Completeness of Registration Systems.*

Data Accuracy & Completeness Items	Strongly Agree n (%)	Agree n (%)	Undecided n (%)	Disagree n (%)	Strongly Disagree n (%)
Patient demographic information is accurately captured during registration	82 (18.14)	315 (69.69)	9 (1.99)	30 (6.64)	16 (3.54)
Clinical and administrative data fields are usually completed during patient registration	40 (8.85)	290 (64.16)	31 (6.86)	83 (18.36)	8 (1.77)
Missing patient information is common during registration	9 (1.99)	198 (43.81)	26 (5.75)	129 (28.54)	90 (19.91)
Duplicate patient records are uncommon in the registration system used	59 (13.05)	265 (58.63)	–	116 (25.66)	12 (2.65)
Digital registration reduces data entry errors	85 (18.81)	287 (63.50)	7 (1.55)	20 (4.42)	53 (11.73)
Manual records are more prone to loss or damage	79 (17.48)	327 (72.35)	13 (2.88)	–	33 (7.30)
Corrections of registration errors are easier using digital systems	66 (14.60)	357 (78.98)	–	–	29 (6.42)
Patient registration records are well preserved and protected from loss	71 (15.71)	319 (70.58)	9 (1.99)	21 (4.65)	32 (7.08)
Errors identified during patient registration can be corrected easily	92 (20.35)	307 (67.92)	–	26 (5.75)	27 (5.97)
Errors in patient registration data are uncommon in the system used	29 (6.42)	275 (60.84)	16 (3.54)	120 (26.55)	12 (2.65)
Patient information remains consistent across repeated visits	73 (16.15)	336 (74.34)	–	34 (7.52)	9 (1.99)
Missing or incomplete patient information is rare	63 (13.94)	273 (60.40)	6 (1.33)	73 (16.15)	37 (8.19)

Data Accuracy & Completeness Items	Strongly Agree n (%)	Agree n (%)	Undecided n (%)	Disagree n (%)	Strongly Disagree n (%)
Digital registration systems produce more accurate patient records than manual systems	121 (26.77)	242 (53.54)	7 (1.55)	27 (5.97)	55 (12.17)
Digital registration systems produce more complete patient records than manual systems	95 (21.02)	257 (56.86)	14 (3.10)	43 (9.51)	43 (9.51)

Table 3 presents the assessment of data accuracy scores across registration system types. The findings show that respondents using digital registration reported a higher mean data accuracy score (3.05 ± 0.26) compared with those using manual registration (2.93 ± 0.35). The combined mean score was 2.97 ± 0.32. The difference in mean data accuracy scores between registration systems was statistically significant (t = −2.87, p = 0.004, CI: 2.93 - 3.01). The Table 3 further show that digital registration systems recorded a higher mean data completeness score (2.83 ± 0.43) compared with manual registration systems (2.52 ± 0.47). The combined mean score for all respondents was 2.64 ± 0.48. The difference in mean data completeness scores was statistically significant (t = −5.33, p < 0.001, CI: 2.58 - 2.69).

Additionally, the findings show that respondents using digital registration systems reported the highest mean overall data quality score (2.96 ± 0.36), while those using manual registration systems reported a lower mean score (2.72 ± 0.37). The combined mean score was 2.81 ± 0.38. The difference in overall data quality scores between registration systems was statistically significant (t = −5.15, p < 0.001, CI: 2.76 - 2.86).

Table 3. *Assessment of Data Accuracy and Completeness between Manual and Digital Registration System.*

Data Quality	Registration System	Mean ± SD	*t-test (equal variances),*	95% CI	p-value
Data Accuracy	Manual registration	2.93 ± 0.35	*−2.87*	2.88 – 2.98	0.004
	Digital registration	3.05 ± 0.26		2.99 – 3.10	
	Combined	2.97 ± 0.32		2.93 – 3.01	
Data Completeness	Manual registration	2.52 ± 0.47	*t = −5.33*	2.45 – 2.59	0.000
	Digital registration	2.83 ± 0.43		2.74 – 2.92	
	Combined	2.64 ± 0.48		2.58 – 2.69	
Overall Data Quality	Manual registration	2.72 ± 0.37	*−5.15*	2.67 – 2.78	0.000
	Digital registration	2.96 ± 0.36		2.89 – 3.03	
	Combined	2.81 ± 0.38		2.76 – 2.86	

Table 4 presents respondents' views on patient waiting time and service flow efficiency. A majority of respondents agreed that patients experience shorter waiting times under digital registration (85.4%), while 14.6% disagreed. Similarly, 89.6% agreed that digital registration reduces patient waiting time when compared with manual registration, while only 10.4% disagreed.

More than half of the respondents (56.2%) agreed that patients are registered within an acceptable waiting time, while 23.7% strongly agreed. A smaller proportion disagreed (12.2%), and 1.3% strongly disagreed. Long queues at registration points were acknowledged by most respondents, with 51.6% agreeing and 17.5% strongly agreeing, while 27.0% disagreed and 2.9% strongly disagreed. On the effect of registration delays on service delivery, 52.9% agreed and 12.4% strongly agreed that registration delays disrupt clinical service delivery less frequently, while 19.3% disagreed and 12.6% strongly disagreed. Most respondents also reported that digital registration improves patient flow across departments, with 61.5% agreeing and 32.3% strongly agreeing.

Manual registration was identified as a contributor to longer queues and congestion, as 51.8% agreed and 30.1% strongly agreed, while 11.3% disagreed and 1.3% strongly disagreed. A majority of respondents indicated that the registration system facilitates timely movement of patients, with 60.4% agreeing and 28.5% strongly agreeing.

Access to patient information was also reported as timely, as 57.1% agreed and 29.4% strongly agreed that patient information from the registration system is immediately accessible. Additionally, 62.2% agreed and 23.7% strongly agreed that the registration system supports efficient management of patient flow, while only small proportions expressed disagreement.

Table 4. *Patient Waiting Time and Service Flow Efficiency.*

Service Flow Efficiency Items	Strongly Agree n (%)	Agree n (%)	Undecided n (%)	Disagree n (%)	Strongly Disagree n (%)
Patients experience shorter waiting times under digital registration	–	386 (85.40)	–	66 (14.60)	–
Digital registration reduces patient waiting time compared to manual registration	–	405 (89.60)	–	47 (10.40)	–
Patients are registered within an acceptable waiting time	107 (23.67)	254 (56.19)	30 (6.64)	55 (12.17)	6 (1.33)
Long queues are common at registration points	79 (17.48)	233 (51.55)	5 (1.11)	122 (26.99)	13 (2.88)
Registration delays disrupt clinical service delivery less frequently	56 (12.39)	239 (52.88)	13 (2.88)	87 (19.25)	57 (12.61)
Digital registration improves patient flow across departments	146 (32.30)	278 (61.50)	–	12 (2.65)	16 (3.54)
Manual registration contributes to longer queues and congestion	136 (30.09)	234 (51.77)	25 (5.53)	51 (11.28)	6 (1.33)
The registration system facilitates timely movement of patients	129 (28.54)	273 (60.40)	35 (7.74)	15 (3.32)	–
Patient information from the registration system is immediately accessible	133 (29.42)	258 (57.08)	14 (3.10)	32 (7.08)	15 (3.32)
The registration system supports efficient management of patient flow	107 (23.67)	281 (62.17)	30 (6.64)	28 (6.19)	6 (1.33)

Table 5 shows the effect of registration system type on patient waiting time and service flow efficiency. The mean patient waiting time score for respondents using manual registration was 2.07 ± 0.23, while respondents using digital registration recorded a higher mean score of 2.17 ± 0.26. The mean difference between manual and digital registration was −0.099. The difference in mean waiting time scores was statistically significant (t = −3.24, p = 0.001). For service flow efficiency, the mean score among respondents using manual registration was 3.01 ± 0.55, compared with 2.99 ± 0.40 among those using digital registration. The mean difference was 0.015. The difference in service flow efficiency scores between the two registration systems was not statistically significant (t = 0.24, p = 0.807).

Table 5. *Effect of Registration System Type on Patient Waiting Time and Service Flow.*

Outcome Variable	Registration System	Mean ± SD	Mean Difference (Manual − Digital)	df	*t* value	*p* value
Patient Waiting Time	Manual	2.07 ± 0.23	−0.099	268	−3.24	0.001
	Digital	2.17 ± 0.26				
	Combined	2.11 ± 0.25				
Service Flow Efficiency	Manual	3.01 ± 0.55	0.015	268	0.24	0.807
	Digital	2.99 ± 0.40				
	Combined	3.00 ± 0.50				

The Table 6 below presents the distribution of respondents' satisfaction with the digital registration system. The findings show that a large proportion of respondents expressed overall satisfaction with the performance of the digital registration system, as 77.65% either strongly agreed or agreed with the statement, while 21.02% disagreed or strongly disagreed.

Most of the respondents indicated that the digital system reduced their workload, with 76.55% expressing agreement, while 16.81% disagreed. A similarly high proportion of respondents reported confidence in using the registration system, as 81.41% either strongly agreed or agreed, compared to 16.59% who expressed disagreement.

The results also show that 81.86% of respondents reported that adequate training was provided on the registration system, while 15.71% disagreed. Access to technical support was also viewed positively, with 80.53% of respondents agreeing that technical support was readily available when problems arose, compared to 16.37% who disagreed.

A majority of the respondents indicated that the digital registration system enhanced their work efficiency, as 87.16% either strongly agreed or agreed, while only 9.07% disagreed. Preference for digital registration over manual registration was also high, with 88.28% of respondents expressing agreement, while 11.73% expressed disagreement.

Ease of use of the digital registration system was affirmed by 93.58% of respondents, while only 5.31% disagreed. Similarly, 97.13% of respondents agreed that digital registration improved their efficiency in handling patient records, compared to 2.88% who disagreed. Satisfaction with the speed of patient registration was also high, as 87.61% of respondents expressed agreement, while 12.39% expressed dissatisfaction.

Table 6. *Healthcare Workers' Satisfaction with the Digital Registration System.*

User Satisfaction Items	Strongly Agree n (%)	Agree n (%)	Undecided n (%)	Disagree n (%)	Strongly Disagree n (%)
I am generally satisfied with the performance of the registration system	90 (19.91)	261 (57.74)	6 (1.33)	88 (19.47)	7 (1.55)
The system reduces my workload	134 (29.65)	212 (46.90)	30 (6.64)	76 (16.81)	0 (0.00)
I feel confident using the registration system	106 (23.45)	262 (57.96)	9 (1.99)	65 (14.38)	10 (2.21)
Adequate training was provided on the registration system	75 (16.59)	295 (65.27)	11 (2.43)	49 (10.84)	22 (4.87)
Technical support is readily available when problems arise	79 (17.48)	285 (63.05)	14 (3.10)	46 (10.18)	28 (6.19)
The registration system enhances my work efficiency	125 (27.65)	269 (59.51)	17 (3.76)	35 (7.74)	6 (1.33)
Overall, I prefer digital registration to manual registration	183 (40.49)	216 (47.79)	0 (0.00)	13 (2.88)	40 (8.85)
I find the digital registration system easy to use in my daily work	161 (35.62)	262 (57.96)	5 (1.11)	13 (2.88)	11 (2.43)
Digital registration improves my efficiency in handling patient records	176 (38.94)	263 (58.19)	0 (0.00)	7 (1.55)	6 (1.33)
I am satisfied with the speed of patient registration when using the system	122 (26.99)	274 (60.62)	0 (0.00)	27 (5.97)	29 (6.42)

The Table 7 presents the comparison of overall user satisfaction scores between manual and digital registration systems. The results show that respondents using the digital registration system recorded a higher mean satisfaction score (3.33 ± 0.47) compared to those using the manual registration system (2.91 ± 0.45). The confidence interval for the mean satisfaction score ranged from 3.24 to 3.42 for digital registration and from 2.84 to 2.98 for manual registration.

The mean difference in satisfaction scores between manual and digital registration systems was −0.42, indicating higher satisfaction among users of the digital system. The observed difference was statistically significant, as shown by the p-value less than 0.001.

Table 7. *Comparison of Overall User Satisfaction by Registration Type.*

Outcome Variable	Registration Type	Mean (SD)	95% CI for Mean	Mean Difference (Manual − Digital)	p-value
Overall User Satisfaction Score	Manual	2.91 ± 0.4	2.84 – 2.98	−0.42	<0.001
	Digital	3.33 ± 0.47	3.24 – 3.42		

Table 8 presents the adjusted linear regression analysis of factors associated with healthcare workers' satisfaction with patient registration systems. Age showed a statistically significant negative association with satisfaction, with satisfaction scores decreasing as age increased (β = −0.063; 95% CI: −0.111 to −0.015; p = 0.010). Sex was strongly associated with satisfaction, as male respondents reported significantly higher satisfaction than females (β = 0.590; 95% CI: 0.460 to 0.719; p < 0.001). Registered Midwives reported significantly lower satisfaction compared with those holding degree-level qualifications (β = −0.525; 95% CI: −0.837 to −0.213; p = 0.001). Monthly income was associated with satisfaction among respondents earning ₦71,000 ₦100,000, who reported significantly lower satisfaction compared with those earning at least ₦131,000 (β = −0.491; 95% CI: −0.862 to −0.120; p = 0.010).

Respondents with less than one year of use (β = 0.233; 95% CI: 0.062 to 0.404; p = 0.008), those with 4–6 years of use (β = 0.385; 95% CI: 0.063 to 0.707; p = 0.019), and those with more than six years of use (β = 0.593; 95% CI: 0.359 to 0.826; p < 0.001) reported higher satisfaction compared with those with 1–3 years of use, with the strongest effect observed among respondents with more than six years of experience.

Hospital affiliation was statistically significant, as respondents from Prince Abubakar Audu University Teaching Hospital reported lower satisfaction compared with respondents from other hospitals (β = −0.266; 95% CI: −0.410 to −0.122; p < 0.001).

Respondents with less than five years of experience reported higher satisfaction than those with 10–14 years of experience (β = 0.335; 95% CI: 0.049 to 0.622; p = 0.022), as did respondents with 15 years or more of experience (β = 0.176; 95% CI: 0.027 to 0.326; p = 0.021).

Respondents using manual-only systems reported significantly lower satisfaction compared with those using hybrid systems (β = −0.527; 95% CI: −0.678 to −0.376; p < 0.001). Digital-only use did not differ significantly from hybrid use (β = 0.027; 95% CI: −0.142 to 0.197; p = 0.750). Additionally, respondents working in clinics (β = −0.806; 95% CI: −1.040 to −0.573; p < 0.001), nursing stations or wards (β = −0.390; 95% CI: −0.652 to −0.128; p = 0.004), and outpatient departments (β = −0.262; 95% CI: −0.486 to −0.038; p = 0.022) reported lower satisfaction compared with those in administrative units. The strongest negative effect was observed among clinic staff.

Table 8. *Determinants of Healthcare Workers' Satisfaction with Patient Registration Systems.*

Background Characteristics	Adjusted β	95% Confidence Interval	P value
Registration system type			
Manual (Ref.)	0.000	–	–
Digital	−0.135	−0.281 – 0.011	0.069
Age (years)	−0.063**	−0.111 – −0.015	0.010**
Sex			
Female (Ref.)	0.000	–	–
Male	0.590***	0.460 – 0.719	<0.001***
Religion			
Christianity (Ref.)	0.000	–	–
Islam	0.025	−0.084 – 0.133	0.655
Marital status			
Married (Ref.)	0.000	–	–
Unmarried	0.553***	0.356 – 0.750	<0.001***
Highest professional qualification			
Degree (Ref.)	0.000	–	–
Diploma (ND/HND)	−0.525**	−0.837 – −0.213	0.001**
Master's degree	0.032	−0.090 – 0.154	0.606
Monthly income			
≥ ₦131,000 (Ref.)	0.000	–	–

Background Characteristics	Adjusted β	95% Confidence Interval	P value
Below minimum wage (₦70,000)	0.125	−0.108 – 0.358	0.291
₦71,000 ₦100,000	−0.491**	−0.862 – −0.120	0.010**
₦101,000 ₦130,000	0.036	−0.194 – 0.266	0.758
Professional cadre			
Allied health (Ref.)	0.000	–	–
Medical doctor	0.041	−0.184 – 0.265	0.722
Nurse/Midwife	−0.233***	−0.362 – −0.104	<0.001***
Others	−0.413**	−0.659 – −0.166	0.001**
Employment status			
Contract (Ref.)	0.000	–	–
Permanent	0.353	−0.241 – 0.947	0.243
Temporary	0.260	−0.321 – 0.841	0.379
Years using registration system			
1–3 years (Ref.)	0.000	–	–
Less than 1 year	0.233**	0.062 – 0.404	0.008**
4–6 years	0.385*	0.063 – 0.707	0.019*
More than 6 years	0.593***	0.359 – 0.826	<0.001***
Hospital affiliation			
Other hospitals (Ref.)	0.000	–	–
PAU Teaching Hospital	−0.266***	−0.410 – −0.122	<0.001***
Years of experience			
10–14 years (Ref.)	0.000	–	–
Less than 5 years	0.335*	0.049 – 0.622	0.022*
5–9 years	−0.029	−0.274 – 0.216	0.817
≥15 years	0.176*	0.027 – 0.326	0.021*
Type of registration used			
Hybrid (Ref.)	0.000	–	–
Digital only	0.027	−0.142 – 0.197	0.750
Manual only	−0.527***	−0.678 – −0.376	<0.001***
Department/unit			
Administration (Ref.)	0.000	–	–
Clinics	−0.806***	−1.040 – −0.573	<0.001***
Medical Records	−0.248	−0.514 – 0.018	0.068
Nursing station/ward	−0.390**	−0.652 – −0.128	0.004**
Outpatient department	−0.262*	−0.486 – −0.038	0.022*

Notes: β = adjusted linear regression coefficient; CI = confidence interval.
Reference categories have β = 0.000 by definition. ***p < 0.001, **p < 0.01, *p < 0.05.

4. Discussion

This study examined the effects of manual and digital registration systems on data quality, waiting time, and healthcare worker satisfaction in tertiary hospitals in Kogi State, Nigeria. The findings indicate that digital registration systems were associated with higher perceived data quality and better waiting-time performance than manual systems. In addition, healthcare workers using manual-only registration systems reported lower levels of satisfaction than those operating within hybrid registration environments.

The observed differences in data quality between manual and digital registration systems are consistent with earlier studies reporting that digital registration systems improve the completeness, consistency, and accessibility of patient information [24, 27]. Unlike paper-based records, digital platforms often incorporate standardized data entry formats and validation procedures that reduce omissions and documentation errors. This may explain why respondents in the present study associated digital registration with better-quality information. Similar findings have been reported in studies conducted in Nigeria and other low- and middle-income countries, where digital health records were found to enhance record management and support more reliable clinical documentation [24, 25, 30, 31]. More recent evidence has also shown that digital health technologies improve data interoperability, documentation quality, and information accessibility when supported by appropriate infrastructure and workforce capacity [33, 35, 36]. These findings reinforce the growing recognition that digital registration systems contribute to stronger health information management and improved continuity of patient care.

The findings relating to patient waiting time and service flow also align with previous research showing that digital registration systems can streamline administrative processes and reduce delays associated with patient movement through healthcare facilities [17, 22]. Registration serves as the entry point into the healthcare system, and inefficiencies at this stage can affect subsequent service delivery processes. Digital systems may facilitate faster retrieval of patient information and reduce repetitive documentation, thereby supporting smoother patient movement across service points. However, the coexistence of manual and digital registration systems in many healthcare facilities may limit the full realization of these benefits. Similar challenges have been documented in settings where hybrid registration systems remain necessary due to infrastructure limitations and intermittent system downtime [25, 32]. Recent studies further suggest that hybrid systems often represent a transitional phase in digital transformation, enabling healthcare facilities to maintain continuity of care while gradually expanding digital infrastructure and staff competence [36, 37]. Although hybrid systems may involve duplicate documentation in some settings, they can also reduce operational disruptions by allowing paper-based processes to complement electronic systems during network failures or power interruptions, which remain common in many low-resource healthcare environments [35, 37].

Healthcare worker satisfaction differed according to the type of registration system used. Respondents using manual-only registration systems reported significantly lower satisfaction than those using hybrid systems, whereas satisfaction among digital-only users was comparable to that of hybrid-system users. This finding suggests that reliance on exclusively manual registration processes may contribute to less favourable user experiences, possibly because of the additional effort required for documentation, record retrieval, and information management. The comparable satisfaction observed between digital-only and hybrid users may indicate that healthcare workers value both the efficiency of digital systems and the operational flexibility offered by hybrid approaches. In many hospitals, hybrid systems provide an additional safeguard against technical failures while allowing staff to benefit from electronic access to patient information. This combination may explain why hybrid systems performed better than fully manual systems and similarly to fully digital systems in terms of user satisfaction. Previous studies have similarly reported that healthcare workers tend to express greater satisfaction with systems that improve access to patient information and reduce administrative burdens [21, 38]. Recent reviews have also emphasized that user satisfaction depends not only on the technology itself but also on system usability, organisational support, adequate training, and seamless integration into routine clinical workflows [35, 38]. The finding is also consistent with the Technology Acceptance Model, which posits that technologies perceived as useful and easy to use are more likely to be accepted by users [3]. In practice, healthcare workers may derive greater satisfaction from registration systems that support efficient workflow and reduce routine administrative challenges.

Although the findings generally favour digital registration systems, they should be interpreted within the broader organisational context in which healthcare technologies operate. The benefits associated with digital systems are often influenced by factors such as staff training, technical support, infrastructure availability, and institutional commitment to digital transformation [34, 36]. Consequently, differences observed between manual and digital systems may reflect not only the characteristics of the technology itself but also the environment in which the technology is implemented and used. This suggests that successful digital transformation requires not only investment in digital infrastructure but also sustained organisational support, continuous capacity building, and implementation strategies that are responsive to local healthcare contexts.

5. Conclusion

This study found that digital registration systems were associated with better perceived data quality, improved healthcare worker satisfaction, and more favourable service delivery outcomes compared with manual registration systems

in tertiary hospitals in Kogi State. The findings suggest that digital registration systems can strengthen health information management processes and support more efficient healthcare delivery. However, the benefits of digital systems are likely to depend on the broader organisational and operational environment in which they are implemented. The study adds to existing evidence on the role of digital health technologies in improving healthcare service delivery in resource-constrained settings.

6. Strengths and Limitations

This study provides evidence on the influence of registration system type on data quality and healthcare service delivery outcomes using data obtained from healthcare professionals directly involved in patient registration and information management processes. The inclusion of different professional groups offered diverse perspectives on the use of manual and digital registration systems. In addition, the application of multiple linear regression analysis enabled the examination of the relationship between registration system type, other explanatory variables, and healthcare worker satisfaction.

However, some limitations should be considered when interpreting the findings. The cross-sectional design limits the ability to establish temporal or causal relationships. Data were based largely on respondents' perceptions and experiences, which may be influenced by recall bias and social desirability bias. Furthermore, the study was conducted in two tertiary hospitals in Kogi State, which may limit the generalisability of the findings to other healthcare settings with different levels of digital health implementation and organisational capacity.

7. Practical Implications

The findings highlight the potential contribution of digital registration systems to strengthening data management and healthcare service delivery within tertiary hospitals. Improved data quality and higher levels of user satisfaction suggest that digital registration systems may support more effective health information management and patient care processes.

The study also highlights the importance of adequate infrastructure, technical support, and continuous staff capacity development to ensure effective utilisation of digital registration systems. As healthcare facilities continue to expand the use of digital technologies, attention should be given not only to technology acquisition but also to the organisational factors that influence successful implementation and sustained use.

The evidence generated from this study may assist hospital administrators, health information managers, and policymakers in making informed decisions regarding investments in digital registration systems and broader health information management initiatives aimed at improving healthcare service delivery.

Abbreviations

FMoH	Federal Ministry of Health
FTHL	Federal Teaching Hospital Lokoja
HIM	Health Information Management
ICT	Information and Communication Technology
KSSH	Kogi State Specialist Hospital
NPC	National Population Commission
PAAUTH	Prince Abubakar Audu University Teaching Hospital
PHC	Primary Healthcare Centre
WHO	World Health Organization

Acknowledgments

The authors acknowledge the academic and institutional support provided by Rivers State University in facilitating this research.

Author Contributions

Olutunde Samuel Michael: Conceptualization, Methodology, Visualization, Writing – original draft, Writing – review & editing

Omokanye Akingbola Sunday: Visualization

Olatunde Raimi: Formal Analysis, Methodology, Visualization, Writing – review & editing

Owolabi Ruth Onajite: Conceptualization, Supervision, Writing – original draft, Writing – review & editing

Anthony Ike Wegbom: Conceptualization, Formal Analysis, Methodology, Supervision, Visualization, Writing – original draft, Writing – review & editing

Conflicts of Interest

The authors have declared that no competing interests exist.

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