Will It Deliver? Anticipated Impact of Integrated Health Information Systems on Sustainable Healthcare Delivery in South-western Nigeria

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ABSTRACT

Investment in digital health is justified by the benefits it is expected to bring to healthcare delivery, yet studies in low- and middle-income countries (LMICs) usually report impact as a single composite score. The dimensions along which an Integrated Health Information System (IHIS) is expected to add value are rarely separated and compared. To disaggregate the anticipated impact of IHIS into nine dimensions and rank them, and to identify which of six implementation determinants best predict overall anticipated impact. A cross-sectional survey of 303 clinical and non-clinical health workers in 20 federal and state hospitals in Lagos, Oyo, Ondo, Ekiti and Osun States, Nigeria; 300 respondents provided impact data. Analysis used descriptive statistics, Friedman and paired comparisons, Pearson correlation, multiple regression with heteroscedasticity-robust standard errors, and Partial Least Squares Structural Equation Modelling (PLS-SEM) with 5,000 bootstrap resamples. All nine dimensions scored high (M = 3.547–3.896). Dimensions concerned with information quality, trustworthiness and governance scored 0.29 points higher (95% CI 0.25–0.34) than those concerned with speed, cost and usability. The composite score was high (M = 3.779, SD = .647). In PLS-SEM (R^2 = .507), only financial and economic factors (β = .267, p < .001) and CEO and leadership characteristics (β = .383, p < .001) had significant paths to the composite. Innovation and technology attributes, user acceptance, organisational readiness and policy environment did not. Multiple regression (R^2 = .488) gave the same pattern. Health workers expect IHIS to benefit every dimension of healthcare delivery, most strongly data and information quality and least strongly usability, cost and speed. Expected benefit was most closely associated with leadership and financing rather than with technology attributes. Because the outcome is an expectation reported at one point in time, the findings should be tested against objective outcome data.

KEYWORDS

Health information systems, sustainable healthcare delivery, anticipated impact, digital health, PLS-SEM, Nigeria

I. INTRODUCTION

Investment in an Integrated Health Information System (IHIS) is justified by what the system is expected to do for healthcare delivery: faster access to accurate patient records, better clinical decisions, stronger data security and more efficient hospital operations. Yet assessments of digital health impact in LMICs often report a single composite score, such as overall satisfaction or perceived benefit. Collapsing a multidimensional construct into one number hides which aspects of delivery a system is believed to strengthen and which it is not. A composite cannot separate a system seen as producing trustworthy clinical data but awkward to use from one that is easy to use but yields doubtful data. The two profiles call for different improvement priorities, yet a composite would score them identically.

This study therefore separates the anticipated impact of IHIS into nine dimensions: output and data usefulness, perceived healthcare service improvement, security, privacy and availability, patient information quality, governance and functionality expectation, availability and deployment preference, speed and performance, cost and affordability, and ease and usability. Anticipated impact here means the benefit health workers expect an integrated system to deliver; the questionnaire asked what IHIS 'will' do, not what a system already in use has done. The data come from 303 clinical and non-clinical health workers in 20 hospitals in Lagos, Oyo, Ondo, Ekiti and Osun States, Nigeria. The study also asks which implementation determinants (technology attributes, user acceptance, organisational readiness, financing, policy or leadership) most strongly predict anticipated impact when modelled jointly. This question matters because Nigerian evidence on the impact of digital health records is thin. Olukorode et al. (2024), reviewing electronic medical record (EMR) impact in Nigeria, found the evidence limited and scanty in its coverage of outcomes. Akwaowo et al. (2022) showed that Nigerian clinicians and senior management personnel recognise the usefulness of EMRs. What health workers expect IHIS to deliver, and which organisational conditions are linked to those expectations, has not been examined across several impact dimensions at once?

The study makes two contributions. First, it offers a more granular assessment of anticipated IHIS impact than is usually available for Nigeria, ranking nine dimensions instead of reporting one composite and testing whether the ranking forms distinct tiers. Second, it tests which of six implementation determinants best predicts the composite, using regression and PLS-SEM so that the two sets of estimates can be compared. The level of IHIS adoption in each hospital is not modelled, because it was collected in a separate institutional questionnaire that cannot be linked to individual respondents (Section 3.1).

II. LITERATURE REVIEW

A. Theoretical framework: what should IHIS impact look like?

The World Health Organization's health systems strengthening framework treats health information systems as a foundational building block whose value emerges through effects on governance decisions, workforce planning, financing efficiency and service delivery (WHO, 2007). On this view, IHIS impact should appear across several functionally distinct

dimensions rather than as one undifferentiated benefit. Suter et al. (2017) describe key principles for integrated care, including comprehensive continuum-of-care services, patient focus, and performance management and governance structure. These map closely onto the nine dimensions measured here and offer a normative benchmark against which the empirical ranking in Section 4 can be read. Sustainability frameworks for healthcare delivery treat sustainability as a multidimensional concept. The nine impact indicators used here are intended to operationalize that multidimensional construct.

B. Data usefulness

Data usefulness, meaning whether system output is accurate, timely, detailed and trustworthy, is consistently identified as central to realising digital health value, because health information systems exist to support clinical decisions, service planning and accountability rather than as ends in themselves. Sacramento et al. (2025), in a systematic review of tools used to evaluate health information systems in LMICs, stress that evaluation frameworks are needed because a system can be widely adopted and still fail to produce useful output. This bears directly on the expectation tested here: if health workers regard IHIS as a source of reliable information, data usefulness should rank among the most strongly anticipated dimensions.

C. Service improvement and quality of care

The link between health information systems and quality of care is among the most heavily studied topics in health informatics. Randomised trials have shown that clinical decision-support components can reduce medication errors and improve adherence to guidelines. In Zanzibar, a cluster-randomised trial of a mobile phone communication intervention improved skilled attendance at delivery (Lund et al., 2012). In Nigeria, a review of studies on EMR impact concluded that introducing EMRs meaningfully increased the quality of the data.

D. Security, privacy and governance

Security, privacy and governance have become more prominent in the LMIC digital health literature as systems become networked and data volumes grow. The Nigeria Data Protection Act 2023 established the Nigeria Data Protection Commission and a legal framework for regulating the processing of personal data, reflecting national recognition that IHIS sustainability depends on public and professional trust in data protection as much as on technical function. Bostan et al. (2024) report that data protection, confidentiality, ownership and ethics frequently emerge as important issues in LMIC electronic health record deployments, though they are sometimes overshadowed by more visible technical and financial concerns. Measuring security and privacy as a separate, rankable dimension, as is done here, allows that pattern to be examined directly instead of being absorbed into a general impact composite.

E. Determinants of anticipated impact

Governance and financing are repeatedly described as structural enablers of digital health value, ahead of technology attributes taken alone. If expectations of IHIS reflect the

organisational conditions in which health workers practise, the determinants most closely tied to those conditions, leadership and finance, should carry more weight than innovation attributes or individual user acceptance. This study tests that expectation by modelling six determinants jointly against the nine-dimension composite.

F. Expectation and experience

The outcome in this study is expectation, not experience. Health workers were asked what IHIS 'will' deliver, and some may work in hospitals with limited or partial systems. Expectations matter for implementation because they shape willingness to engage with a system, but they are not a measure of realised benefit, and the findings should be read accordingly. Section 6.3 returns to this limit.

G. Research gap

To the author's knowledge, no published Nigerian study has disaggregated anticipated IHIS impact into nine dimensions, tested whether the ranking forms tiers, and identified which implementation determinants predict the resulting composite using two complementary estimation methods. This study supplies that assessment.

III. METHODOLOGY

A. Design and sample

The study used a quantitative, cross-sectional survey design (Creswell & Creswell, 2018). The data come from the health-worker questionnaire, administered to clinical and non-clinical staff in 20 hospitals in Lagos, Oyo, Ondo, Ekiti and Osun States (Appendix A). Lagos is represented by only two hospitals, because obtaining approval and distributing questionnaires there proved difficult and costly; hospitals in Ekiti and Osun, which lie in the same south-western region, were sampled to complete the sample. Hospitals were selected through multi-stage purposive sampling, stratified by ownership (federal and state hospitals; private hospitals could not be accessed). The sample comprises four tertiary institutions, three federal and one state-owned teaching hospital, and 16 state specialist and general hospitals. The accessible population across both questionnaires in the wider study was estimated at 2,450. Yamane's finite-population formula (e = .05) gave a minimum sample of 344, which was increased to about 400 to allow for non-response. In all, 303 health-worker questionnaires were retained, and 300 of them contained impact responses and are analysed here. The number of questionnaires distributed was not recorded, so a response rate cannot be reported. The sample of 300 exceeds common minimum-sample guidance for PLS-SEM models of this size (Hair et al., 2022). A separate institutional questionnaire was administered in the same hospitals. Because hospital identifiers were not recorded in the datasets, its responses cannot be linked to individual health workers, and it is not used here.

B. Instrumentation and reliability

Respondents rated statements on a five-point Likert scale from strongly disagree (1) to strongly agree (5) (1 = strongly disagree, 5 = strongly agree). Every item correlated

positively with the rest of its scale (corrected item–total r of .38 or more for the determinant scales and .34 or more for the impact items), so no item required reverse scoring. Six determinants were measured: innovation and technology attributes (8 items), user acceptance and capacity (6), organisational readiness (9), financial and economic factors (10), policy and regulatory environment (7), and CEO and leadership characteristics (5). Anticipated impact was measured with 44 items in nine groups. Items were worded as expectations, for example 'Adoption of IHIS will…' and 'I believe IHIS will…' The composite outcome, sustainable healthcare delivery (SHD), is the mean of the nine-dimension means; in PLS-SEM it is estimated from all 44 items as one construct. Table 1 gives the reliability of each impact dimension.

Table 1. Reliability of the nine impact dimensions and the composite outcome

Impact dimension	**Items**	**Cronbach's α**
Output/data usefulness	5	.879
Perceived healthcare service improvement	8	.941
Security/privacy/availability	5	.864
Patient information quality	3	.829
Governance/functionality expectation	5	.833
Availability/deployment preference	3	.803
Speed/performance	5	.791
Cost/affordability	4	.827
Ease/usability	6	.842
Sustainable healthcare delivery (composite)	44	.967

C. Data analysis

Invalid Likert entries (values outside 1–5, in four items) were recoded as missing before scores were computed, and isolated missing responses were replaced with the item mean for PLS-SEM. The analysis proceeded in five steps.

- Dimension means were ranked, and the equality of the nine means was tested with a Friedman test; the upper and lower tiers were compared with a paired *t*-test on each respondent's tier means.
- Pearson correlations related each determinant to the composite.
- Multiple regression estimated each determinant's independent contribution, with HC3 heteroscedasticity-robust standard errors because a Breusch–Pagan test indicated non-constant variance (MacKinnon & White, 1985).
- PLS-SEM re-estimated the six-predictor structural model with a path-weighting scheme and reflective (mode A) measurement, using a purpose-written implementation of the standard algorithm in Python 3.12 (NumPy 2.5, SciPy 1.18, statsmodels 0.15; the script is supplied as supplementary material). Paths are reported with bootstrapped standard errors, *t*-values and percentile confidence intervals (5,000 resamples), together with R^2, f^2 and inner-model variance inflation factors (VIF) (Hair et al., 2019, 2022; Sarstedt et al., 2021).
- Discriminant validity was assessed with the heterotrait–monotrait ratio (HTMT; Henseler et al., 2015).

- As robustness checks, SHD was also modelled as a reflective construct measured by the nine-dimension means, and predictive relevance was assessed with ten-fold cross-validation repeated ten times, comparing PLS prediction errors with a linear-model benchmark. Reliability, composite reliability and AVE from this implementation agreed with those from an earlier SmartPLS run to within .003. Data handling complied with the Nigeria Data Protection Act 2023 (Federal Republic of Nigeria, 2023).

IV. RESULTS

A. Sample characteristics

Of the 303 respondents, 57.8% were female and 41.3% male (1.0% missing); 41.6% were aged 31–40; 53.5% were clinical and 38.3% non-clinical staff, with the remainder in other categories or missing; 48.8% had 1–10 years of work experience; and 50.2% reported intermediate ICT literacy and 20.8% advanced literacy. The profile covers clinical and administrative functions alike.

B. Measurement model

All six determinants and the SHD construct had Cronbach's α and composite reliability above .70 (Table 2). Average variance extracted (AVE) fell just below .50 for financial and economic factors (.486) and for SHD (.422). Both were retained because their reliability is high; SHD is a broad 44-item construct, and its loadings range from .35 to .78. All HTMT values were below .90, but the pair's user acceptance–organisational readiness (.88) and innovation–user acceptance (.85) were at the conservative end of the range, so these constructs overlap. The largest inner VIF was 3.53, below the usual limit of 5. When SHD was instead measured by the nine-dimension means, its AVE rose to .63 (composite reliability .94) and the structural results were unchanged (Section 4.8).

Table 2. PLS-SEM measurement model (N = 300)

Construct	Items	Cronbach's α	Composite reliability	AVE	Loading range
Innovation/technology attributes	8	.872	.899	.528	.60–.78
User acceptance/capacity	6	.862	.896	.592	.64–.86
Organisational readiness	9	.892	.915	.551	.45–.82
Financial/economic factors	10	.882	.904	.486	.64–.75
Policy/regulatory environment	7	.851	.887	.529	.66–.79
CEO/leadership characteristics	5	.868	.904	.654	.77–.85
Sustainable healthcare delivery (SHD)	44	.967	.969	.422	.35–.78

C. Ranking of the nine impact dimensions

All nine dimensions recorded high mean scores (Table 3). Output and data usefulness ranked highest (M = 3.896, SD = .810) and ease and usability lowest (M = 3.547, SD = .800). The composite SHD score was high (M = 3.779, SD = .647).

Table 3. Ranking of the nine impact dimensions (N = 300)

Rank	Impact dimension	*M*	*SD*	95% CI	Tier
1	Output/data usefulness	3.896	.810	3.804–3.988	Upper
2	Perceived healthcare service improvement	3.889	.864	3.791–3.987	Upper
3	Security/privacy/availability	3.872	.813	3.780–3.964	Upper
4	Patient information quality	3.870	.903	3.768–3.972	Upper
5	Governance/functionality expectation	3.867	.782	3.778–3.955	Upper
6	Availability/deployment preference	3.861	.806	3.770–3.952	Upper
7	Speed/performance	3.613	.771	3.526–3.701	Lower
8	Cost/affordability	3.592	.841	3.496–3.687	Lower
9	Ease/usability	3.547	.800	3.457–3.638	Lower

D. A two-tier structure

The nine means were not equal (Friedman χ^2 (8) = 183.6, $p < .001$). Table 3 suggests two tiers: a gap of .25 points separates the sixth-ranked dimension (availability and deployment preference) from the seventh (speed and performance), far larger than the gaps within either tier. A paired comparison supports this. The mean of the six upper-tier dimensions (3.876) exceeded the mean of the three lower-tier dimensions (3.584) by 0.29 points (95% CI 0.25–0.34), t (299) = 12.39, $p < .001$, dz = 0.72. The sixth and seventh dimensions also differed (t (299) = 6.21, $p < .001$), whereas speed and ease of use did not (difference = .07, p = .076). The upper tier contains dimensions concerned with information quality, trustworthiness and governance. The lower tier contains those concerned with the practical experience of operating the system: speed, cost and usability.

E. Bivariate correlations

All six determinants correlated positively with the composite outcome (all $p < .001$). CEO and leadership characteristics showed the strongest relationship (r = .615), followed by financial and economic factors (r = .602), organisational readiness (r = .548), policy and regulatory environment (r = .464), user acceptance and capacity (r = .453) and innovation and technology attributes (r = .409).

F. Multiple regression

The six determinants together explained 48.8% of the variance in the composite (R^2 = .488, adjusted R^2 = .478, F (6, 293) = 46.6, $p < .001$; Table 4). Only financial and economic factors (B = .240, $p < .001$) and CEO and leadership characteristics (B = .300, $p < .001$) were significant. Organisational readiness, innovation attributes, user acceptance and policy environment were not.

Table 4. Multiple regression of the SHD composite on six determinants (N = 300)

Predictor	*B*	Robust *SE*	β	*p*	VIF
Innovation/technology attributes	.048	.048	.068	.316	2.28
User acceptance/capacity	.003	.060	.005	.953	3.31
Organisational readiness	.067	.070	.086	.334	3.57
Financial/economic factors	.240	.069	.275	< .001	2.54
Policy/regulatory environment	.028	.054	.033	.610	1.89
CEO/leadership characteristics	.300	.051	.375	< .001	1.55

G. PLS-SEM structural model

The PLS-SEM model explained 50.7% of the variance in SHD (R^2 = .507, adjusted R^2 = .497). Financial and economic factors (β = .267, t = 3.79, p < .001, 95% CI .130–.407) and CEO and leadership characteristics (β = .383, t = 6.41, p < .001, 95% CI .259–.495) were the only significant paths (Table 5). Leadership had a medium effect (f^2 = .188) and finance a small one (f^2 = .058). The other four paths had confidence intervals spanning zero and f^2 of .008 or less. The regression and PLS-SEM therefore agree on which determinants matter and on their order.

Table 5. PLS-SEM structural paths to sustainable healthcare delivery (N = 300)

Path	β	Boot. *SE*	*t*	*p*	95% CI	f^2	VIF
Innovation/technology attributes → SHD	.094	.066	1.43	.152	−.032, .227	.008	2.26
User acceptance/capacity → SHD	.019	.079	0.25	.806	−.142, .174	.000	3.28
Organisational readiness → SHD	.084	.087	0.96	.335	−.087, .257	.004	3.53
Financial/economic factors → SHD	.267	.071	3.79	< .001	.130, .407	.058	2.49
Policy/regulatory environment → SHD	.015	.063	0.23	.816	−.106, .137	.000	1.89
CEO/leadership characteristics → SHD	.383	.060	6.41	< .001	.259, .495	.188	1.58

H. Robustness and predictive relevance

Two checks addressed the weaknesses of the 44-item outcome construct. First, SHD was re-specified as a reflective construct measured by the nine-dimension means. Its loadings were .61–.84, its AVE was .63 and its composite reliability .94. The model gave R^2 = .505, and again only financial and economic factors (β = .282) and CEO and leadership characteristics (β = .374) were significant (bootstrap p < .001 for both), with all other paths at p ≥ .21. Second, ten-fold cross-validation repeated ten times gave a positive predictive Q^2 for all 44 SHD indicators (median .20, range .09–.29), and the PLS prediction errors were lower than those of a linear-model benchmark for 40 of the 44 indicators. The model therefore predicts new cases better than a mean-only baseline and mostly better than a linear benchmark.

V. DISCUSSION

A. Broad but uneven anticipated benefit

Every dimension recorded a mean in the high range, so health workers in the sampled hospitals expect IHIS to benefit healthcare delivery. The two-tier structure is the more informative result. Respondents were more confident that IHIS will deliver on its core informational promise, with useful, secure, high-quality and well-governed data, than that it will be fast, affordable and easy to use. This matters for where effort should go. Information quality is where the case for IHIS is already accepted. Speed, cost and usability are where expectations are weakest, and where implementers have most to prove. The pattern is consistent with Sacramento et al. (2025), who argue that adoption does not guarantee useful output, and with the concerns about funding, infrastructure and skills reported in LMIC electronic health record studies (Bostan et al., 2024).

B. Leadership and finance

Financial and economic factors and CEO and leadership characteristics were the only determinants with significant independent paths to the composite, in both regression and PLS-SEM. This agrees with the emphasis on governance and financing as enablers of digital health value (WHO, 2021; Olayiwola et al., 2026). It also fits the content of the two scales, which concern budgeting, cost–benefit analysis and macro-economic conditions on one side and executive inventiveness, ICT knowledge and involvement on the other. A reasonable reading is that health workers who see well-led, adequately financed institutions also expect IHIS to deliver more. Because the design is cross-sectional and both sides are self-reported, this is an association and not evidence that leadership or finance causes the expectation.

C. The determinants that did not contribute

Organisational readiness was positively correlated with the composite ($r = .548$) but added little once leadership and finance were in the model. The determinants overlap: readiness and user acceptance had an HTMT of .88, and readiness and finance were strongly related. The non-significant paths therefore do not show that readiness, user capacity, technology attributes or policy are unimportant. They show that, among these respondents, their effects are not separable from those of leadership and finance.

D. Implications for impact evaluation

The outcome here is expectation, not realised benefit. Evaluations that rely on health workers' views should say which of the two they measure, and should pair expectation measures with objective data such as waiting times, referral completion and medication-error logs. Given Olukorode et al.'s (2024) observation that Nigerian evidence on EMR impact is scanty and limited in outcome coverage, the nine-dimension ranking offers a template that can be repeated in hospitals with operating systems and compared with realised outcomes.

VI. CONCLUSION, IMPLICATIONS AND LIMITATIONS

A. Conclusion

This study disaggregated the anticipated impact of IHIS into nine dimensions among health workers in South-western Nigerian hospitals. Expectations were uniformly high but tiered: stronger for information quality, trustworthiness and governance than for speed, cost and usability. Of six implementation determinants, only financial and economic factors and CEO and leadership characteristics retained a significant independent association with anticipated impact, in both regression and PLS-SEM.

B. Practical and policy implications

Two implications follow. First, hospital and national improvement efforts should target the lower-tier dimensions (system speed, cost and usability), where anticipated benefit lags most behind the upper tier and where a poor day-to-day experience could erode confidence. Second, digital health governance frameworks should treat leadership development and sustainable financing as primary levers for realising IHIS value, rather than relying on technology procurement alone.

C. Limitations

The outcome is anticipated, not realised, impact, and it is self-reported by health workers from purposively selected hospitals in five south-western states, chosen partly for accessibility and approvals, so the findings cannot be generalised to all Nigerian hospitals. Lagos is represented by only two hospitals, and Ogun State was not sampled. Private hospitals were not sampled, because access for data collection was very difficult and distribution costs were high, so the findings describe the public sector only. The cross-sectional design cannot establish causal direction, and single-source self-report may inflate associations through common-method variance. Respondents are nested within 20 hospitals, and leadership and finance are institutional characteristics. Hospital identifiers were not recorded, so clustering could not be modelled, and standard errors may be understated. The 44-item SHD construct has an AVE of .42 and some low loadings, although a model using the nine-dimension means (AVE .63) gave the same results, and predictive relevance was assessed only by cross-validation within the same sample. The two-tier structure was tested with paired comparisons but not with a formal factor or cluster analysis.

D. Directions for future research

Future studies, with adequate funding, should extend the sample to private hospitals, to Ogun State and to more Lagos facilities, and should record hospital identifiers in all instruments, so that hospital-level adoption can be linked to health-worker responses and analysed with multilevel models. They should pair expectation measures with objective outcomes in hospitals that operate integrated systems, and test whether the two-tier structure reflects a distinct underlying factor structure through exploratory or confirmatory factor analysis.

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