Health Research Policy and Systems

STUDY PROTOCOL

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The Guideline Uptake in Digital Ecosystems (GUIDE) study: protocol for implementation research on the impact of WHO SMART guidelines digital adaptation kits to improve quality of care

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Abstract

Background Despite the potential for digital tools to facilitate guideline uptake, translating paper-based narrative guidelines into digital formats is resource-intensive and may compromise the fidelity to the recommended content. The World Health Organization (WHO) launched the SMART Guidelines initiative, in which digital adaptation kits (DAKs) are a foundational component. DAKs comprise software requirements documentation, including detailed data dictionary and algorithms--derived from WHO guidelines =for encoding within digital systems.

Methods This implementation research consists of a formative assessment and impact evaluation on integrating DAKs within national digital systems to improve service delivery outcomes for antenatal care (ANC), family planning, and HIV in two countries (Ethiopia and Ghana). The formative phase will assess the requirements to customize the DAKs to align with the national protocols and subsequently incorporate the localized DAKs' content into the respective nationally endorsed digital systems: Bahmni in Ethiopia and DHIS2 tracker in Ghana. The impact evaluation will assess the effect of using the DAK-upgraded digital systems using pre–post designs in Ethiopia and Ghana. Primary outcomes of adherence to guideline recommendations will be assessed when digital systems incorporate country-adapted DAK content in comparison with the existing practice. Guideline knowledge questionnaires and in-depth interviews with software developers, health workers and facility managers will supplement the impact evaluation.

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Discussion This research represents one of the first impact evaluations focused on integrating DAKs into existing national digital systems and the effect on service delivery outcomes. The mixed-methods study design will provide learnings for future scale-up and replication across other countries. We expect final results to be available in 2026, and preliminary findings will be shared at relevant fora.

Trial registrationhttps://www.isrctn.com/ISRCTN18394724. Registration date: 21 December 2022.

Keywords Digital, Antenatal care, HIV/AIDS, Family planning, Electronic medical records, Health management information systems, Clinical decision support systems, Guidelines

Background

The World Health Organization (WHO) develops evidence-based guidelines to improve the quality of care, support informed decision-making and promote equitable health practices, which must then be adapted and implemented across diverse settings [1–7]. Translating these guidelines, often presented in paper-based narrative formats, into actionable processes can pose challenges for consistent implementation and uptake. Various strategies have been explored, with digital tools increasingly being used to reinforce and standardize recommended practices [1–3, 8–12]. However, while digital solutions can support implementation, transforming narrative clinical and data recommendations into functional digital tools is resource-intensive and may risk compromising fidelity to the original guidance [13, 14].

To address these challenges, the WHO introduced the Standards-based, Machine-readable, Adaptive, Requirements-based and Testable guidelines framework – SMART – to provide a systematic approach for embedding WHO recommendations into digital systems [13]. Digital adaptation kits (DAKs) are a core step within the SMART guidelines approach, serving as a critical bridge between narrative WHO guidelines and interoperable digital solutions (Fig. 1) [13]. DAKs distil WHO recommendations into standardized, modular components that can be integrated into digital health systems used at the point of care, such as electronic medical records. By translating guideline recommendations into software specifications, DAKs provide software developers with a blueprint for embedding decision-support prompts, structuring workflows and standardizing data models within digital systems, as a pathway to improving quality of care and program monitoring.

Each DAK package contains generic components, such as business process workflows, core data elements, decision-support algorithms, linkages to indicators and functional requirements that can be adapted to local contexts and incorporated into digital systems (Supplementary Annex 1). DAKs are published with an overview document accompanied by four linked Excel spreadsheets detailing: (a) data elements in a structured data dictionary, (b) decision-support logic with defined inputs and outputs of clinical algorithms, (c) definitions and calculation formulas for aggregate indicators and (d) functional and nonfunctional system requirements.

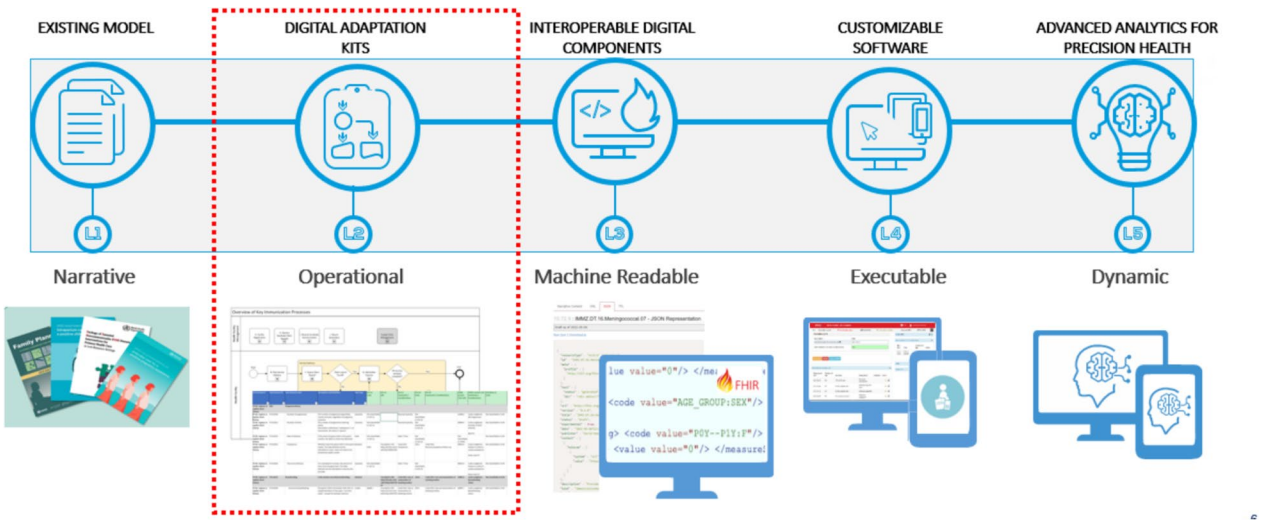

Fig. 1 Digital adaptation kits within overall SMART guidelines framework

Furthermore, the data dictionaries and decision-support logic in DAKs form the foundation for structured, machine-readable guidance through alignment with Health Level Seven (HL7) and its Fast Healthcare Interoperability Resources (FHIR) specification, an internationally recognized standard for the representation and exchange of health data to facilitate interoperability.

SMART guidelines DAKs were originally published for antenatal care (ANC), family planning and human immunodeficiency virus (HIV) [15–19], and this initiative has since expanded to additional health topic areas, including tuberculosis, immunization, child health in humanitarian settings, surveillance, self-care interventions, postnatal care and intrapartum care. While this approach has gained momentum across technology and public health communities[20, 21], there have not been extensive evaluations on the impact of introducing DAKs within countries' existing digital systems and the resulting effect on service delivery and adherence to guideline recommendations.

Implementation strategy and research hypothesis

The Guideline Uptake In Digital Ecosystems (GUIDE) study examines the process of adapting and integrating DAKs into national contexts and evaluating the effect on adherence to national protocols. The adaptation and implementation of DAKs include reviewing and comparing the WHO generic DAKs to align with country guidelines, protocols and data elements in the health management information system (HMIS) [22]. We hypothesize that embedding WHO recommendations on clinical protocols and data for program monitoring into point-of-care digital tools, such as electronic medical records and patient tracking systems, can reinforce guideline adherence and enhance quality of care. Unlike common approaches to digital health research where a new digital system is introduced, this study will upgrade the content of nationally endorsed digital systems in Ethiopia and Ghana, Bahmni and DHIS2 Tracker, respectively. These two systems are digital tools that capture individual/client health information and are used by health workers providing care at the facility level. Furthermore, the two selected digital systems are designated as global digital public goods, indicating they are open-source software supported by a community of practice, deployed across several countries and designed to be interoperable [23]. In conducting the research using digital systems vetted by both the software development communities and the respective government health entities, we expect the learnings from this study will have global relevance.

Methods/design

This implementation research examines how DAKs are localized and integrated into national digital systems, and the resulting impact on service delivery outcomes (Table 1). The antenatal care (ANC), family planning, and HIV DAKs will be used [15, 16, 19] to update the digital systems in the two countries, as these were the first set of DAKs developed and the only ones available at the time of research conception.

The study consists of a formative assessment of the requirements for adaptation and integration into national digital systems, followed by an impact evaluation through a pre–post design to measure the effect on service delivery outcomes (Fig. 2).

Intervention

The intervention involves adapting generic ANC, family planning and HIV DAK content to national guidelines through stakeholder consensus (see Supplementary Annex 1 for details). Each adapted DAK will be integrated into the country's supported digital system (Bahmni in Ethiopia and eTracker in Ghana). This process includes stakeholder and software team consultations to review content and identify necessary system enhancements. Localization entails reviewing data elements and decision support logic to decide whether to adopt, modify or remove them for the national DAK package [22, 24].

Phase 1: Formative assessment

The formative phase aims to understand the requirements for adapting and localizing the generic DAKs to specific country contexts, using insights from WHO's broader engagement in the implementation of DAKs [22]. This phase will include a desk review of national reporting tools (such as paper registers and tally sheets) and service delivery protocols to map and align the generic DAKs to the country context. Outputs from the preliminary mapping are subsequently reviewed and validated through stakeholder consultations among ministry of health (MOH) focal points in the relevant health programme areas and digital health, software development teams, implementing partners and healthcare workers.

Data collection

A desk review and stakeholder consultations will be conducted to compile national documentation, including clinical protocols, policy resources, HMIS tools (e.g. registers) and digital health requirements, where available. Research teams will first perform pre-mapping to identify high-level differences between the

Table 1 Summary of key study outcome measures and methods

Phase	Domain	Outcome measure	Method/tools
Phase 1: Formative assessment	DAK adaptation	• Proportion of generic DAK content for data dictionary and decision support logic removed during local adaptation, and type of content removed • Proportion of generic DAK content modified for data dictionary and decision support logic during local adaptation, and type of content modified • Proportion of localized content required to be added to the generic DAK, and type of content added • Proportion of country-adapted DAK content integrated into the digital system (fully implemented elements of the country-adapted DAK out of all elements of the country-adapted DAK) • Proportion of semantic data standards [e.g. International Classification of Diseases (ICD)] executed within the digital system • Experience of software development teams in using the DAKs – qualitative measure	• DAK country adaptation log • In-depth interviews (IDIs) with software developers
Phase 2: Impact assessment	Guideline content knowledge	• Change in knowledge of family planning (FP) guideline recommendations • Change in knowledge of ANC guideline recommendations • Change in knowledge of HIV guideline recommendations	• Guideline knowledge pre/post questionnaire
	Process evaluation	• No. of health workers trained on DAK-enhanced system • No. of facilities using DAK-enhanced system • Proportion of health workers using the digital module to record and submit consultation on antenatal care, family planning or HIV • Average form submissions using the DAK-enhanced system per week per health worker • Daily length of time of when DAK-enhanced system is used (i.e. is the digital system being used during working hours, or left aside during times of service provision) • Proportion of data fields completed within form submissions (completeness of data) • Feedback from health workers and managers on DAK-enhanced system – qualitative measure	• Implementation reports • System-generated data from digital systems • IDIs with health workers and managers
	Impact on quality of care/ adherence to protocol	ANC: Proportion of pregnant women receiving haemoglobin test during ANC of all pregnant women with ANC 1 contact (Ethiopia) ANC: Proportion of pregnant women screened for HIV during ANC of all pregnant women with ANC 1 contact (Ethiopia) ANC: Proportion of pregnant women with ANC 1 contact treated for syphilis during ANC (Ethiopia)	• Extraction from service delivery records

Table 1 (continued)

Phase	Domain	Outcome measure	Method/tools
		ANC: Proportion of pregnant women re-tested for HIV at ANC contact during 26–34 weeks of gestation if HIV negative at ANC 1 contact (Ghana)	
		ANC: Proportion of pregnant women re-tested for syphilis at ANC contact during 26–34 weeks of gestation at ANC 1 contact (Ghana)	
		HIV: Proportion of people living with HIV (PLHIV) who have defaulted to refill medication (Ghana)	
		FP: Proportion of FP clients screened for sexually transmitted infection (STIs) (Ethiopia and Ghana)	• Observation • Extraction from service delivery records
		FP: Proportion of new FP clients who counselled on available family planning methods (Ethiopia and Ghana)	
		FP: Proportion of clients who continue using modern contraception (Ethiopia and Ghana)	

ANC antenatal care, *DAK* digital adaptation kit, *FP* family planning, *ICD* International Classification of Diseases, *IDIs* in-depth interviews, *STI*, sexually transmitted infection

generic WHO DAKs and national protocols. This will be followed by a systematic comparison of data elements and decision-support logic in the DAKs against country guidelines to develop a country-specific DAK package. Each data element and decision-support input will be classified as maintained, modified or removed; similarly, elements present in national documentation but not in the WHO DAKs will be flagged to remain as part of the country-specific DAK package. A multistakeholder country team, comprising national and subnational technical focal points for digital health and relevant health programs (e.g. ANC, family planning and HIV), will validate the outputs of this comparison.

The study will also conduct in-depth interviews (IDIs) with local technology teams and obtain data on the feasibility and acceptability of integrating the DAK content within existing digital systems. The IDIs will use interview thematic guides designed for each participant type to be administered at the end of the first study phase. All the IDIs will be audio-recorded using a digital voice recorder.

Analysis

The standardized logs of DAK adaptation will be reviewed to summarize differences between WHO and national guidelines to quantify the level of country customization, including common removals, modifications and additions. The qualitative findings from the IDIs will undergo an initial rapid analysis to flag key themes and considerations [24]. In addition, there will be a detailed analysis and coding using grounded theory and inductive processes for grouping themes [25, 26]. A framework analysis will be used in which responses will first be reviewed for familiarization of themes and then coded emergent categories [25]. A codebook will be created to define the various themes that will be used during coding, their definition and illustrative quotes exemplifying the theme. Two individuals will analyse transcripts using NVivo coding software.

Phase 2: Impact evaluation

The second phase comprises the impact evaluation, designed as a pre–post assessment and aligned to the differing availability of health facilities and availability of client samples. (Fig. 1). Baseline and endline quantitative data will be extracted from de-identified client health records across ANC, family planning and HIV (Ghana only). In addition, we will conduct focus group discussions (FDGs) and (IDIs with software development teams on their reflections on the DAK integration process and with health workers and supervisors on their experience with using the DAK-enhanced digital systems (Fig. 1). The total duration of the impact evaluation will be 18 months, with 6 months dedicated to baseline, implementation and endline phases.

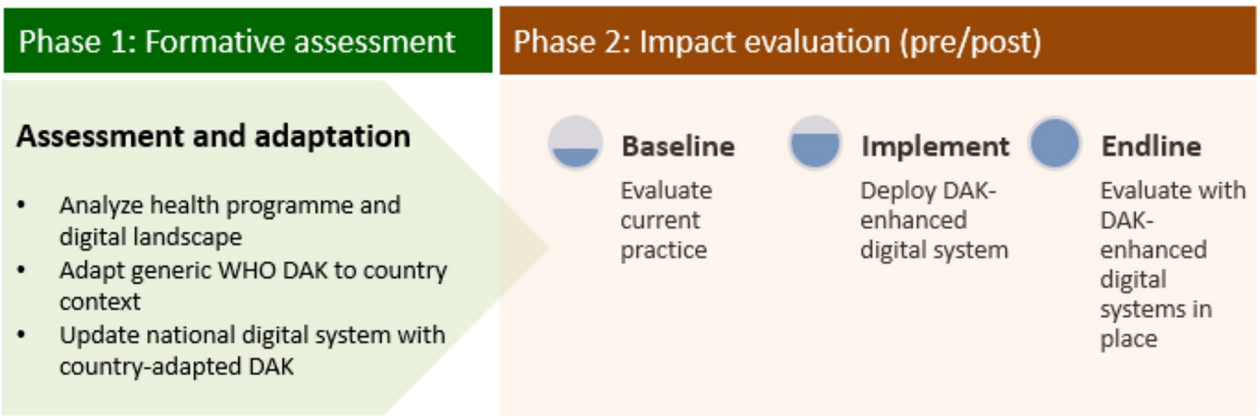

Fig. 2 Overview of study design

Participants and setting

The Ethiopian arm of the study will be conducted in three primary healthcare facilities deploying the Bahmni electronic medical record within Bahir Dar City, in the Amhara region of northwest Ethiopia. Bahir Dar City has a population of 406 663, of which 82 268 are women of reproductive age and an estimated 13 705 are pregnant women [27]. Bahir Dar city has 9 primary clinics, 56 medium clinics, 41 speciality clinics, 10 speciality centres and 11 health centres. According to the Ethiopian Service Standards, a health centre is defined as a health facility at the primary level of the healthcare system, which provides promotive, preventive, curative and rehabilitative outpatient care, including basic laboratory and pharmacy services, with the capacity of 10 beds for emergency and delivery services [28].

The Ghana arm of the study will be conducted in eight primary healthcare facilities in seven districts: four districts (Bongo, Kasena-Nankana, Bolgatanga East and Bolgatanga) in the Upper East Region and three districts (Upper West Akim, Nsawam Adoagyiri and Akuapim South Districts) in the Eastern Region. The seven districts were selected to have diverse urban, peri-urban and rural settings for the health facilities. Four facilities (Zuarungu, Coronation, Bongo and Navrongo) are located in the selected districts in the Upper East Region, and the other four (Adieso, Pokrom, Nsawam and Asuboi) are located in the selected districts in the Eastern Region. As primary healthcare facilities, these centres represent the first point of contact between the formal health delivery system and the client. These facilities are mostly headed by a physician assistant and staffed with program heads in midwifery, laboratory services, public health, environment and nutrition. Each health centre serves a population of approximately 20 000 and provides basic curative and preventive services for adults and children, as well as reproductive health services [29].

Inclusion/exclusion criteria

For both phases, the inclusion criteria of health facilities include the following:

- Available country-supported digital system for ANC, family planning and HIV
- Monthly client volume within required sample size
- Primary health care facilities that provide ANC, family planning and HIV services

Sample size

In Ethiopia, sample sizes were calculated for key outcomes: HIV or haemoglobin testing at first ANC contact and STI screening among family planning clients. Baseline values were obtained from service records in June–July 2023. To detect a 15% change with 80% power and 5% error, 244 records per outcome per period were needed. For the evaluation, 500 client records per site will be sampled at baseline and endline (Table 2).

In Ghana, sample sizes were calculated for three outcomes: HIV re-testing among pregnant women, counselling on all available family planning methods for new clients and antiretroviral therapy (ART) refill default among people living with HIV (PLHIV). Baseline rates were estimated from service records and prior studies, with 30% for ANC and family planning outcomes and 45% for HIV outcomes. To detect a 15% change with 80% power and 5% error, 80 client records per site per period are needed for ANC and family planning, and 85 records per site per period for PLHIV (Table 3).

Sampling

We will sample consecutively on business days (Monday through Friday) until the sample size has been reached. Sampling may also be adapted to align with high-volume days or specific service days, for example, if ANC services are provided on a particular day. For the qualitative component, this study will engage with all health workers and facility managers from the study facilities and all individuals within the software development teams variations.

Recruitment and informed consent

In Ethiopia, client health cards and registers are stored at the health facility. Owing to feasibility considerations, informed consent for extracting these records will be obtained through permission from the health facility managers to provide access to these paper-based records. Once permission has been granted, data entry clerks will enter de-identified health information onto the case reporting form.

In Ghana, as individuals themselves keep the client health records, informed consent will be obtained directly from participants. Informed consent will be obtained from service-seeking/client participants who will be approached when they come to the site facilities after they have received services. For both countries, information and clearance for healthcare workers' participation in the interviews will be conducted with MOHs and regional and district directors of health. Health workers will be approached/asked to participate without their supervisor present. Permission from health facility managers will be obtained before staff (healthcare workers) who have used the upgraded digital systems are interviewed. The interviews will be conducted during working hours. Interviewers will call participants to arrange a convenient time, and participants have the right to reschedule the interviews.

Data collection

The data collection will employ a pre–post design, and all selected facilities will cycle through the following steps (Table 4):

1. Baseline period – Data collection based on existing practice/without introduction of the updated digital system
2. Implementation – This includes ensuring that all systems/equipment/supplies are installed, staff are trained and DAK-related updates are incorporated into the digital system (detailed in the description of intervention)
3. Endline/full implementation period – Facilities will implement the DAK-adapted digital systems

Outcome measures will be collected from extractions of de-identified data from the service delivery records (e.g. client health cards and registers) to obtain information pertaining to the different outcome measures. For family planning, in which incompleteness of service delivery was observed in the first phase of the study, the study team will also use an observation form to assess the appropriateness of the contraceptive method provided during the consultation/counselling. To evaluate changes in data quality and reporting, the study will record information on data completeness, defined as the proportion of data elements for selected indicators available in the

Table 2 Sample size calculation for Ethiopia

ANC indicator with numerator (*N*) and denominator (*D*)									**Baseline value (*p*1)[a]**
Proportion of pregnant women tested for HIV at ANC 1 contact *N* Number of pregnant women tested for HIV at ANC 1 contact *D* Total number of pregnant women who attended ANC 1 contact									159/311 (51%)
Proportion of pregnant women receiving haemoglobin test at ANC 1 contact *N* Number of pregnant women receiving haemoglobin test at ANC 1 contact *D* Total number of pregnant women who attended ANC 1 contact									64/311 (21%)
FP Indicator with numerator (*N*) and denominator (*D*)									**Baseline value (*p*1)**
Proportion of FP clients screened for STIs *N* Number of clients screened for STIs during FP consultation *D* Total number of clients during FP consultation									0/464 (0%)
***p*1**	***p*2**	**Relative risk**	**Alpha**	**Power**	**ICC**	**DE**	**Sites per period**	***n* per site per period**	**Total *N* per period**
0.5	0.65	1.3	0.05	0.8	0.05	5.55	2	508	1016

[a] Estimation based on site facility records June–July 2023.

ANC antenatal care, *DE* design effect, *FP* family planning, *ICD* International Classification of Diseases, *ICC* intraclass correlation coefficient, *STI* sexually transmitted infection

Table 3 Sample size calculation for Ghana

ANC indicator with numerator (*N*) and denominator (*D*)	**Baseline value (*p*1)**
Proportion of pregnant women re-tested for HIV during 26–34 weeks of gestation if negative for HIV at ANC 1 contact *N* Number of pregnant women re-tested for HIV during 26–34 weeks of gestation *D* Total number of pregnant women at 26 weeks of gestation who tested negative for HIV at ANC 1 contact	34%[a]
FP indicator with numerator (*N*) and denominator (*D*)	**Baseline value (*p*1)**
Proportion of new FP clients counselled on family planning methods *N* Number of new FP clients who had a discussion of seven appropriate FP methods *D* Total number of new clients visiting family planning clinic	39%b
HIV indicator with numerator (*N*) and denominator (*D*)	**Baseline value (*p*1)**
Proportion of PLHIV who have defaulted to refill medication *N* Number of clients with HIV who have defaulted *D* Total number of clients with HIV (new and old) for the reporting period	46%[a]

*p*1	*p*2	Alpha	Power	Relative risk	ICC	CAC	Sequences	Sites per period	*n* per site per period	Total *N* per period
0.3	0.45	0.05	0.8	1.50	0.02	0.95	2	6	80	480

[a] Estimation based on site facility records, December 2023 and January 2024. [b]Based on prior study in study area among postpartum women.

ANC antenatal care, *DE* design effect, *FP* family planning, *ICD* International Classification of Diseases, *ICC* intraclass correlation coefficient, *PLHIV* people living with HIV, *STI* sexually transmitted infection

national health management information system (HMIS), and accuracy [30], defined as the proportion of concordance between indicator data values in the facility monthly reports, generated by the digital system or manual tally, with data values in the national HMIS [30]. We will also document the characteristics of study facilities using a shortened version of the Service Availability and Readiness Assessment (SARA), a tool designed to evaluate the availability of health services and the readiness of facilities to provide them [31].

Routine monitoring will be conducted to document inputs and activities, such as training, follow-up coaching and system usage. In addition, we will conduct pre- and post-assessments on changes in knowledge related to guideline content to determine whether DAKs have been able to augment understanding of national and WHO clinical protocols. The pre–post tests will be taken at baseline prior to the use of the DAK-upgraded system and one month after the use of the DAK-adapted system. The assessment will be based on questions, half of which will be asked as part of the pre-intervention and the other half post-intervention, randomly selected from a question bank. Questions will be similar in complexity but different enough to reduce the testing effect of using the same set of questions twice for both the pre- and post-assessment. The pre–post assessment will also include questions to assess changes in digital literacy as a supplement to the monitoring of the use of the digital system.

Data analysis

For impact analysis, selected indicators at baseline, prior to health workers' use of the digital system upgraded with the country-specific DAKs, will be compared with endline, when the final versions of the country-adapted DAKs are embedded in the digital system and used following implementation. Null and alternative hypotheses for comparing the indicators estimated as proportions can be expressed formally as: H0: $p1 = p2$ versus H1: $p1 <> p2$, where $p1$ and $p2$ are respective proportions at baseline and after implementation. Hypothesis testing at a $p = 0.05$ significance level will be conducted by regression analysis using generalized linear models (GLM) with log link to estimate the relative risk, i.e. probability of outcome after DAKs implementation relative to the probability of outcome prior to DAKs implementation, using random intercept by facility to account for correlation

Table 4 Data collection distribution across facilities in Ethiopia and Ghana

Country	Cluster	Baseline	Implement	Endline
Ethiopia	Facility 1	*N* = 500	• Launch DAK-enhanced modules • Train health workers • Field test • Monitor implementation	*N* = 500
	Facility 2	*N* = 500		*N* = 500
Ghana	Facility 1	*N* = 80		*N* = 80
	Facility 2	*N* = 80		*N* = 80
	Facility 3	*N* = 80		*N* = 80
	Facility 4	*N* = 80		*N* = 80
	Facility 5	*N* = 80		*N* = 80
	Facility 6	*N* = 80		*N* = 80

due to clustering and adjusted for potential confounding. Each health domain will be analysed separately, and appropriate subgroup analyses will be conducted on the basis of client or health worker characteristics. This data will be analysed separately for each country and not be pooled.

Discussion

The WHO SMART guidelines initiative, in which DAKs are a foundational component, seeks to harness the widespread momentum in digitalization as an opportunity to reinforce guideline recommendations, standardize health and data content and foster transparency and collaboration in the design of digital systems [32–35]. As more DAKs are developed to complete a primary healthcare approach to digitalization, there is a need to rigorously evaluate the effect of DAKs on intended outcomes, including adherence to guideline protocols and data-use-related considerations. As the study is powered on service delivery outcomes across three health domains – ANC, family and HIV – this provides a diversity of health programme characteristics to inform the replicability of the implementation process and guide WHO's strategic approach to ensure their intended impact across diverse programmatic and digital health national contexts. To our knowledge, this research represents one of the first impact evaluations focused on the SMART guidelines DAKs, using a software-neutral approach, in which the evaluation is centred on the content and requirements documentation without being tied to any specific digital application. In addition, the insights on the practical use of DAK will contribute to understanding the implications for other SMART guidelines components, such as the machine-readable layer and harnessing data standardization for advanced analytics and artificial intelligence approaches [13, 36, 37].

A strength of the study lies in its alignment with national strategies and use of existing government-led digital systems, which can facilitate a pathway for scale-up and sustainability in optimizing ongoing investments. The two digital systems – Bahmni and DHIS2 tracker – are considered as digital health public goods, defined as open-source platforms implemented across multiple countries and supported by a global community of practice [38]. This provides an opportunity to generate generalizable lessons for DAK development and implementation to extend beyond the selected research sites. Likewise, the use of DAKs within existing digital systems will require operating within the functional constraints and implementation modalities of the available digital systems. For example, both Bahmni and eTracker are intended to be point-of-service digital systems. However, shortages of devices and infrastructural challenges limit health workers' ability to use these digital systems in real-time during service delivery and may impede the intended benefits of decision-support [39, 40]. To mitigate this, the study will provide additional equipment to bolster the availability of devices; however, further concerted efforts and resource mobilization will be needed to ensure these digital systems can be used at the point of service to improve the quality of care.

The planning of this study also highlighted pragmatic considerations for digital health implementations and guideline uptake, and how DAKs may contribute to standardization and quality of care. Initially, the study planned to rely on monthly indicators reported in the HMIS for evaluating the outcome measures. However, challenges in obtaining reliable indicators from the aggregate HMIS required extracting data from the service delivery records to manually calculate the outcome indicators and estimate baseline rates. Although this is linked to the challenges of paper-based reporting and inconsistent indicator definitions [41–43], the streamlining of data flows conducted in this study will provide insights into strengthening data flows between point-of-service and aggregate HMIS digital systems. In addition, the research will also confront challenges related to broader health systems, such as human resource and supply chain gaps, which can affect the study outcomes. These externalities will be documented as part of the process monitoring to help contextualize the findings and highlight key factors. Lastly, as with all digital health implementations, the study will encounter fundamental questions of digital governance and coordination, digital literacy and change management [44–46].

Conclusions

Digital health approaches for accelerating guideline uptake remain a topic of continued exploration, in which the WHO SMART guidelines initiative offers a new mechanism for overcoming bottlenecks in transitioning guidelines for use in digital systems. This implementation research will reveal critical findings on the impact of this emerging approach within the realities of national contexts and inform the strategic direction of SMART guidelines to advance countries' digital health transformations with quality of care at the core.

Contributions to literature

- Uptake of guidelines is a common challenge in which digital tools are being leveraged to reinforce recommended practices at the point of service.
- The WHO SMART guidelines initiative, which includes digital adaptation kits, translates narrative guidelines into formats that can be more readily incorporated into digital systems.
- The study assesses the approach of using digital adaptation kits to upgrade existing national digital systems with recommended content standards, without introducing a new digital tool, to maximize sustainability and optimize existing resources.
- This implementation research represents one of the first efforts to evaluate the impact of this software-neutral digital health approach on improving adherence to guideline recommendations and inform replicable processes for countries to effectively utilize digital adaptation kits.

Abbreviations

ANC	Antenatal care
DAK	Digital adaptation kit
DHIS2	District Health Information System 2
EMR	Electronic medical record
FGD	Focus group discussion
FHIR	Fast Healthcare Interoperability Resource
FP	Family planning
HIV	Human immunodeficiency virus
HMIS	Health management information system
ICD	International Classification of Diseases
IDI	In-depth interview
MOH	Ministry of health
PLHIV	People living with HIV
STI	Sexually transmitted infection
WHO	World Health Organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12961-025-01397-7.

Additional file1

Acknowledgements
We wish to thank the various stakeholders in Ethiopia: the Ministry of Health, Amhara Regional Health Bureau and leadership of the research health facilities and in Ghana: the Ministry of Health, Ghana Health Service (Policy, Planning, Monitoring and Evaluation Division, Family Health Division and National AIDS/STI Control Program) and more specifically, Dr Kofi Issah and Dr Chris Fofie, for their support during the initial engagements in soliciting information and documents for the development of the protocol.

Author contributions
T.T., R.M., A.M.H., F.B.D.V., B.F.E., E.T.M., H.R., S.S.T., A.N., D.K.A., H.A.W., K.S., K.K.G., W.P., O.T., M.B., S.D., N.R.,G.M., L.S., B.T. and C.G. contributed to the conception and design of the research; S.S.T. refined the methodology and data analysis plan for the quantitative assessments; A.M.H., F.B.D.C., B.F.E., E.T.M., H.A.T., A.N., J.A., S.D., D.K.A., H.A.W., K.S., K.K.G., S.A., A.A., S.M., B.T. and C.G. contextualized the protocol and site details to their respective countries; M.B., S.D., W.P., N.K. and O.T. provided technical inputs related to their guideline area of expertise; G.G.C. standardized the data collection process across the two countries; T.T. and R.M. coordinated the overall protocol development process. All authors reviewed and approved the submitted version of the manuscript.

Funding
This work was funded through the UNDP-UNFPA-UNICEF-WHO-World Bank Special Programme of Research, Development and Research Training in Human Reproduction (HRP), a cosponsored programme executed by the WHO. Funding for the country adaptation of the HIV DAK was provided by the President's Emergency Fund for AIDS Relief through the United States Centers for Disease Control and Prevention and The Global Fund to Fight AIDS, Tuberculosis and Malaria.

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
The study was approved by the WHO/HRP Research Project Review Panel (RP2), the WHO Ethical Review Committee (A66031) and the National Ethics Committees of the two countries [University of Gondar, Ethiopia Institutional Review Board (VP/RTT/05/752/2024) and Ghana Health Service Ethics Review Committee (GHS-ERC: 025/07/22)]. The entire research team will take necessary measures to ensure the safety of the participants.

Consent for publication
Not applicable – this manuscript does not include individual person's data in any form.

Competing interests
The authors declare no competing interests.

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Received: 8 October 2024 Accepted: 3 September 2025
Published online: 09 October 2025

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