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Assessing the alignment of the Cameroon health information system data sources with international standards: a mixed sequential study

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Abstract

Purpose

In Cameroon, health information system (HIS) data is generated through numerous and uncoordinated sources. The purpose of this study is to assess the alignment of each data source in Cameroon with international standards.

Methods

The study used a mixed (quantitative-qualitative) sequential explanatory design among experts manipulating HIS data sources over three months, from February to July 2025. The Demand and Readiness Tool for Assessing Data Sources in Health Information Systems (HIS DART) was used to determine the alignment of the HIS data sources with international standards. Twenty-seven (27) participants completed the quantitative component, from which 12 were purposively selected for in-depth interviews. IBM SPSS software version 27 and Nvivo 11 Enterprise 20 v1.7.2.1560 were used to analyse quantitative and qualitative data respectively.

Results

Of the twelve data sources assessed, eleven presented defined standards, from which 8(73%) complied with international standards. Completely aligned sources were Logistics Management Information System (National Essential Medicines List), and Public Health Surveillance System (International Health Regulations 2005). Individual records, Health infrastructure information system, Population-Based Surveys, Civil Registration Vital Statistics System, Collective Intervention Records, and Health Accounts showed partial alignment. Conversely, Human Resources for Health Information System, Health Facility Assessments and Population Census were not aligned. Interoperability between systems was the major identified challenge.

Conclusion

The Cameroon HIS is partially aligned with international standards but it does not guarantee the production of reliable, continuous, and usable data for strategic public health decisions. Institutional, technical, and human capacity building is needed to transform these sources into an effective tool for health governance.

Introduction

National health information systems (HISs) form the basis of health data, helping to improve health outcomes for populations worldwide through better-informed health care policy, planning, and

management [1]. The World Health Organisation (WHO) emphasises the importance of an HIS, i.e., a set of interoperable, comprehensive and integrated data systems that enable the sharing, use and reuse of collected data [2]. Achieving sustainable development goals (SDGs), particularly those related to health, depends heavily on high-quality, comprehensive, and interoperable data from these systems.

To ensure this quality and facilitate the comparison of key health indicators over time and between countries, international organisations such as the WHO and other United Nations (UN) agencies, through their member states, have developed technical standards for health data [3]. These standards provide common nomenclature and taxonomies to establish comparable key health indicators [3].

In Cameroon, national data sources include population surveys, administrative data, medical records, civil registries, epidemiological surveillance systems, and digital tools such as District Health Information Software second version (DHIS2) [4, 5]. These data sources are often used to observe trends and significant disparities in populations relationships with health systems [6]. However, they often operate independently, without an established interoperability framework or coordination system. This fragmentation of data sources within the HIS affects the reliability, accessibility, and timeliness of data, thus limiting the country's ability to monitor key health indicators and make informed decisions [7].

The level of alignment of data sources with national and international standards is underexplored in Cameroon. The Demand and Readiness Tool for Assessing Data Sources in Health Information Systems (HIS DART) provides a framework for assessing the alignment of data sources with national and international standards[7]. We believe that this study is the first to apply the comprehensive HIS DART framework to assess the normative alignment of all data sources in a national HIS in Central Africa.

The findings of this study will improve health data management in Cameroon to support initiatives for universal health coverage (UHC) policy launched in April 2023[8] by proposing a standardised evaluation of the HIS in accordance with national and international standards. This will hence promote better resource allocation and enable effective participation in the global monitoring of Sustainable Development Goals (SDGs).

Conceptual Framework: The alignment model proposed by the HIS DART tool

To assess the alignment of the Cameroon HIS data sources, we used the conceptual model of the HIS DART. This model stipulates that the responses recorded in each HIS DART questionnaire determine the ability of data sources to generate data that is aligned with international standards. The HIS DART conceptual framework is structured around four complementary analytical dimensions:

(1) An enabling environment: It includes political will and a legislative framework for data collection and management.

(2) Data attributes: This describes the characteristics of the data produced by the source and its alignment with international or national standards. Data attributes cover the definitions, classifications, coding mechanisms, and methodologies essential to ensuring that data can be analysed statistically and compared over time or across different units of analysis (such as establishments, subnational areas, or countries).

(3) Collection mechanisms and interoperability: In accordance with the defined standards, collection mechanisms are the processes of collecting data (on paper or in electronic form), and interoperability are the mechanisms for exchanging them.

(4) Coverage, completeness, and quality indicators: These mainly concern the skills, motivation, and human resources available to implement the standards.

These four analytical dimensions were used to assess and classify the various HIS data source. The HIS DART questionnaire contains 12 modules to which are allocated a set of questions per each dimension. This framework allows us to analyse not only whether standards are being adopted but also why and where the bottlenecks in the alignment process lie. Successful and sustainable alignment requires consistency and mutual reinforcement across these four analytical dimensions.

Methods

Type of study

This study adopted a mixed sequential explanatory design [9], combining a quantitative and a qualitative phase. The quantitative phase aimed to determine the level of alignment of the data sources while the qualitative component that was based on semi-structured in-depth interviews aimed to provide a complementary explanatory understanding of the quantitative findings with respect to the perceptions and uses of the HIS.

Study population and sampling strategy

A total of 27 participants were targeted for the quantitative component. These were institutional actors, who were defined as professionals holding technical, managerial, or decision-making responsibilities related to the production, management, analysis, or dissemination of health information within the HIS. They were identified through the Health Information Unit (HIU), which coordinated the mapping of institutions responsible for the HIS data sources assessed in this study. These institutional experts were statisticians, public health specialists, medical doctors, finance and banking experts, managers, heads of departments, directors, and HIS focal persons. All of them met the selection criteria for both the quantitative and qualitative phases, which were: working in one of the selected structures (ministries, agencies, national programmes); being directly involved in the collection, analysis or dissemination of HIS data; having at least two years of experience in a position related to the data source being assessed;

having been designated by the hierarchy of the structure; and having consented to participate in one of the phases. After the quantitative phase, 12 participants were purposively selected for the qualitative phase in accordance with the principle of data saturation [10–12], based on their profiles identified in the quantitative phase.

Data collection

Table 1 presents a detailed description of the twelve data sources that were assessed in this study. Except Financial Management Information System, there existed defined standards for the other eleven data sources.

Table 1

Data sources and the identified available defined standards in Cameroon.

(*Source*: *Standards and Best Practices for Data Sources. MEASURE Evaluation (2018).*

Module	Data sources	Description of data produced by the source	Available defined standards in Cameroon
1	Individual records	Patient-level data on diagnoses and service interventions.	ICD-11
2	Health infrastructure information system	Health facility data on infrastructure and services.	Master Facility List (MFL)
3	Human resources information system	Health personnel data and the types of health occupations.	ISCO-08, HWR
4	Logistics management information system	Data on the availability and cost of essential medicines and health commodities.	NEML
5	Financial management information system	Financial data on budget estimates, revenues, and expenditures.	Not applicable
6	Health facility assessments	Data on the readiness of facilities to provide services.	SPA, SARA
7	Population census	Data for estimates of the population exposed to risk or service coverage.	United Nations Statistics Division Principles and Recommendations for a Population and Housing Census
8	Population-based surveys	Health and socioeconomic data at the household and individual level.	DHS, MICS
9	Civil registration vital statistics system	Birth, death, stillbirth data, and cause of death data.	United Nations Statistics Division Principles and Recommendations for a Vital Statistics System ICD-11
10	Public health surveillance system	Data on reportable disease conditions and threats to public health.	IHR 2005
11	Collective intervention records	Data on services that target the general population.	ICHA-HC6
12	Health accounts	Expenditure data by financer, provider, and type	SHA ICHA

Module	Data sources	Description of data produced by the source	Available defined standards in Cameroon
		of healthcare consumed.	

Key:

ICD-11 - International Classification of Diseases, eleventh revision

ICHA-HC6 - Classification of Health Care Functions, Preventive Care

MFL - Master Facility List (minimal data elements in signature and service domains)

ISCO-08 - International Standard Classification of Occupations, 2008 revision

HWR - Health Workforce Registry (minimal data elements)

NEML - National Essential Medicines List

SPA - Service Provision Assessment (tools and methodology)

SARA - Service Availability and Readiness Assessment (tools and methodology)

HIS - Health Interview Survey (tools and methodology)

DHS MICS - Demographic and Health Survey, Multiple Indicator Cluster Survey

(tools and methodology)

IRH - International Health Regulations

SHA ICHA - System of Health Accounts, International Classification for Health Accounts

Following the authorisation of the ministry of public health, the HIU facilitated data collection by mapping the relevant structures and identifying key stakeholders to whom the ministerial authorisation and the information notices were communicated. This permitted participants to acquaint themselves with the study objectives and their role in the study. Variables collected were socio-demographic characteristics such as sex (male or female), age (in years), professional qualification, and managerial responsibility. For the qualitative phase, we conducted 12 semi-structured in-depth interviews that lasted 25–55 minutes each. The interviews were scheduled after a preliminary interview form was distributed to facilitate scheduling the interview, taking into consideration the availability of the participant. All interviews were conducted by the interviewer and recorded using an audio recorder. The topics discussed during the in-depth interviews were: the main strengths and weaknesses of the national HIS, the most reliable data sources from the participants' perspective, awareness and use of standards, coordination between subsystems, technical or organisational challenges to data integration,

stakeholder willingness to harmonise data according to international standards, availability of qualified personnel for data management, and recommendations for improving data standardisation practices in Cameroon.

Ethical considerations

The study obtained an ethical approval reference No. 5094 CEI-Udo/07/2025, from the Institutional Ethics Committee for Human Health Research at the University of Douala, and the authorisation No. D30-281/L/MINSANTE/SG/DROS/CRSPE/BBM of Ref/V/T from the Ministry of Public Health. Relay authorisations to all relevant programmes, institutions, and departments, were also addressed by the HIU of the ministry to request their cooperation in the study. Written informed consents were obtained from every participants before their inclusion in the study. Data confidentiality was ensured through the anonymization of responses and secure data storage.

Methodological innovation

The choice of HIS DART as the main tool is motivated by its pioneering nature in this context. Unlike generic HIS assessment tools, HIS DART focuses specifically on aligning data sources with national and international standards. Its full application to a national African HIS, particularly in a French-speaking country such as Cameroon, constitutes a methodological innovation in this research.

Data analysis

Each of the two sections was first analysed separately then integrative [13]. For the quantitative component, the score (in percent) for each module was obtained by summing the total score obtained for that module, dividing by the number of questions in that module, and multiplying by 100. We then grouped the scores as follows: score≤50% = source is not aligned; score of 50% to 75% = partially aligned; and score≥75% = source is completely aligned. We conducted a descriptive analysis of the quantitative data using the IBM SPSS software version 27. Before thematic content analysis, the in-depth interviews which were recorded in digital audio format were transcribed verbatim and analysed using Nvivo 11 Enterprise 20 v1.7.2.1560 (QSR International Pty Ltd.) [14]. The stages of the analysis were as follows: review of the transcript corpus, coding of all interviews, cross-sectional analysis to highlight emerging subthemes (categories), and categorisation to organise and classify emerging themes inductively and deductively[15, 16]. The deductive coding process drew on the dimensions of the HIS DART framework, notably the enabling environment, data attributes, interoperability mechanisms, and data quality dimensions. At the same time, inductive coding helped to highlight context-specific implementation challenges and institutional dynamics that had not initially been accounted for in the analytical framework. Additional subthemes emerging from participants' experiences and perceptions were equally identified inductively. Overall, the analysis generated deductive codes derived from the HIS DART framework and international HIS standards, and inductive codes drawn from participants' experiences and the contextual realities of the Cameroonian HIS. The codes were progressively grouped

into broader analytical categories, then synthesised into final themes incorporating both qualitative and quantitative findings. The deductive categories included the legal and regulatory environment, the adoption of international standards, data interoperability mechanisms, data completeness and quality, and institutional governance. The inductive categories included reasons for low interoperability, challenges related to the implementation of standards, financial dependence on donors, poor allocation of human resources, irregular data production, and challenges of political and institutional coordination.

The integration of the two approaches provided a comprehensive understanding not only of the level of formal alignment of HIS data sources, but also of the operational barriers affecting their effective implementation. Figure 1 illustrates systematically how the deductive and inductive codes were grouped into analytical categories and then into final themes.

A sequential explanatory approach guided the harmonious integration of quantitative and qualitative results. The quantitative findings on alignment, scores, and dimensions per module served as a structural basis. The qualitative results were contextualised, deepened, and explained by providing the perspective and experience of the system's stakeholders [17]. For each module or group of modules (according to the typology presented in Table 6), the analysis first presented the quantitative results (state of alignment). It was then enriched and illustrated by the qualitative results, which shed light on the underlying "whys" behind the scores and gaps identified (e.g., reasons for low interoperability and challenges in implementing standards such as the ICD-11) [18]. Data triangulation highlighted areas of convergence (confirming the robustness of the findings) and areas of divergence (revealing contrasting perspectives), thus providing a nuanced and multidimensional understanding of the alignment of the Cameroon HIS [19].

Results

Socio-demographic characteristics of the participants

A total of 27 people participated in the quantitative phase. The mean age of the respondents was 39.5 ± 7.8 years. The breakdown by professional qualification was as follows: 44.4% statisticians, 25.9% public health experts, 22.2% doctors, and 7.4% finance and banking experts. The minimum years of longevity in service was 4 years, and the maximum was 24 years. In terms of position of responsibility, 63% of the participants were managers, 25.9% were department heads, and 11.1% were directors (Table 2). Twelve participants agreed to participate in in-depth interviews.

Table 2
Socio-demographic characteristics of the respondents

Variables	Frequency (n)	Proportion (%)
Sex		
Female	7	25.9
Male	20	74.1
Age (years)		
27–37	10	37.0
38–48	14	51.9
49–59	3	11.1
Professional qualification		
Statisticians	12	44.4
Public health	7	25.9
Doctor	6	22.3
Finance and banking expert	2	7.4
Managerial responsibility		
Manager	17	63.0
Head of department	7	25.9
Director	3	11.1

Integrated thematic results

Theme 1. Regulatory alignment is in place, but operational implementation remains weak.

Quantitative findings revealed that 9 (81.81%) of the 11 data sources for which standards had been defined complied with international standards. However mixed results for this theme showed that only eight (73%) of these 11 data sources complied with international standards. The completely aligned sources were the Logistics Management Information System (NEML), and the Public Health Surveillance System (IHR 2005). Individual Records (ICD-11), Health Infrastructure Information System (MFL), Population-Based Surveys (DHS, MICS), Civil Registration Vital Statistics System, Collective Intervention Records (ICHA-HC6), and Health Accounts (SHA, ICHA) showed partial alignment, mainly due to implementation constraints, as earlier highlighted by the qualitative findings. Conversely, the Human Resources for Health Information System (ISCO-08), Health Facility Assessments (SPA/SARA), and Population Census were not aligned (Table 3).

On the other hand, qualitative analysis showed that the poor alignment of data sources was mainly due to the poor implementation of regulations in place, as stated by this participant:

"...in reality, we have no problem with the laws in Cameroon; they are well defined, but their implementation could be improved..." (**HIU executive, male, 34**)

Other participants highlighted the fact that Cameroon, like many other low- and middle-income countries has the tendency of making decisions that are in favour of the interest and requirements of the NGOs and international organisations who often fund certain implementations. To back this point, this senior executive stated:

"...I think that the question today is no longer about knowing which data sources are aligned or not, but rather how these sources are often implemented... I would say it is much more about pleasing the WHO and certain non-governmental organisations, and about making money, than about establishing a normative framework. That is the reality for me..." (**Director of Archives and Statistics at BUNEC, male, 37 years old**)

Table 3
Alignment status of health information system data sources in Cameroon

Module	Data sources	International reference standards	State of alignment	Main justification
1	Individual records	ICD-11	Partial	ICD-11 is in pilot phase in only 33 health facilities
2	Health infrastructure information system	Master Facility List (MFL)	Partial	MFL does not cover pharmacies/laboratories
3	Human resource information system	ISCO-08, HWR	Not aligned	No official register, classification not applied
4	Logistics management information system	National Essential Medicines List (NEML)	Aligned	NEML adopted and updated
5	Financial management information system	No specific standards identified	Not applicable	No clearly adopted international standard
6	Health facility assessments	SPA/SARA	Not aligned	Tools not used in the 2024 census
7	Population census	United Nations Statistics Division Principles and Recommendations for a Population and Housing Census	Not aligned	Ten-year cycle not respected (last census in 2005)
8	Population-based surveys	DHS, MICS	Partial	Methodology respected, but irregular periodicity
9	Civil registration vital statistics system	United Nations Statistics Division Principles and Recommendations for a Vital Statistics System ICD-11	Partial	ICD-11 in pilot phase; low data completeness
10	Public health surveillance system	IHR 2005	Aligned	IHR adopted but limited integration into DHIS2
11	Collective intervention records	ICHA-HC6	Partial	Standard known but uneven application
12	Health accounts	SHA, ICHA	Partial	Methodology followed in 2018–2019, but no regular production

Key:

ADX: Aggregated Data Exchange

DHS: Demographic and Health Survey

HWR: health workforce registry

ICD-11: International Classification of Diseases, Eleventh Revision

ICHA: International Classification for Health Accounts

ICHA-HC: International Classification for Health Accounts-healthcare functions

IHR 2005: International health regulations 2005

ISCO-08: International Standard Classification of Occupations 2008

MFL: Master Facility List

MICS: Multiple Indicator Cluster Survey

NEML: National Essential Medicines List

SARA: Service Availability and Readiness Assessment

SHA: System of Health Accounts

SPA: Service Provision Assessment

Theme 2. Analysis according to the HIS DART dimension

Analysis revealed that the strengths of the Cameroon HIS lie more in the adoption of legal and regulatory frameworks rather than in their operational application (Table 4). The dimensions "Enabling environment " and "Data attributes " are relatively well-established, whereas "Interoperability" and "Indicators of coverage, completeness, and quality " showed significant gaps. For example, although the ICD-11 is recognized, its use remains limited to only 33 pilot establishments.

Table 4
Strengths and weaknesses of the data sources with respect to the HIS DART assessment dimensions

Module	Enabling environment	Data attributes	Collection mechanisms and interoperability	Coverage/completeness/quality indicators
1	A legal framework exists, but is rarely enforced	ICD-11 in pilot phase	Low use of EMR; paper still dominant	High coverage for hospital care, low coverage for outpatient care
2	MFL under development, text in progress	Unique identifiers are assigned to certain healthcare facilities	Limited interoperability via ADX/FHIR	85% of health facilities in MFL, excluding conflict zones
3	Obsolete laws (2013)	No ISCO-08 application	Fragmented system (SIGIPES, WhatsApp)	No register → no reliable indicators
4	NEML adopted and updated	Standardised pharmaceutical data	eLMIS is not interconnected, and various tools	Complete public data, incomplete private sector data
5	Solid budgetary framework	No international standard	No integration with DHIS2	General indicators are available, but little disaggregation
6	2024 inventories completed	No standardised tools (SPA/SARA)	Electronic collection, low interoperability	Coverage ≈ 85%, conflicts and missing land titles
7	Compliant with United Nation standards	Compliant data (2005)	No formal interoperability with data from the Ministry of Health	Projections used but based on old data
8	Strict legal framework, uncertain funding	DHS, MICS was well applied	CAPI/CSPro used, no exchange with HIS	High response rate (99%), nationally representative
9	Laws are compliant but rarely enforced	ICD-11 recognised, limited application	An electronic system, but not very functional	Low reporting rate (< 9%), unreliable data
10	IHR 2005 adopted	Standardised case definitions	DHIS2 is used, with low interoperability	Incomplete data, partial coverage

Module	Enabling environment	Data attributes	Collection mechanisms and interoperability	Coverage/completeness/quality indicators
11	Detailed legal framework	ICHA-HC6 partially known	Fragmented collection (ODK, Kobo) and DHIS2	Repetition of activities, uneven coverage
12	No permanent legal framework	SHA-ICHA applied in 2018–19	No interoperability with other systems	Good quality but irregular production

Key:

ADX: Aggregated Data Exchange

CAPI: Computer-assisted personal interviewing

CSPro: Census and Survey Processing System

DHS: Demographic and Health Survey

DHIS2: District Health Information Software second version.

ICD-11: International Classification of Diseases, Eleventh Revision

ICHA-HC: International Classification for Health Accounts-healthcare functions

IHR 2005: International health regulations 2005

ISCO-08: International Standard Classification of Occupations 2008

eLMIS: electronic Logistics Management Information System

MFL: Master Facility List

MICS: Multiple Indicator Cluster Survey

NEML: National Essential Medicines List

ODK: Open Data Kit

SARA: Service Availability and Readiness Assessment

SHA: System of Health Accounts

SIGIPES: Integrated Human Resource and Payroll Management System

SPA: Service Provision Assessment

Of the 4 dimensions used to assess the twelve data sources of the HIS using the HIS DART, most participants considered “enabling environment” to be generally better than the other three, followed by attributes of the data. Much remains to be done on mechanisms of data collection and interoperability between systems, as well as on data quality, mainly due to noncompliance with schedules. Here are a few comments that illustrated this point:

"The regulatory framework is generally well established in our country, but I am concerned about the lack of funding for regular surveys" (**NISRO, male, 47 years**).

"The ministry to which we report attaches great importance to compliance with UN standards, and the same is true for the other ministries responsible for these data sources" (**HBUCERP, male, 53 years**).

"No interconnection with other HIS digital platforms... however, some efforts can be noted, such as the global open facility registry (GOFR) and the database management system (DMS), which are the two means we are currently using for data exchange" (**HDDOSTS, female, 43 years**).

Nevertheless, all participants applied the efforts made by the NIS with respect to the coverage, comprehensiveness, and quality of the data produced by this institution.

The quantitative and qualitative assessments objectively demonstrated a low level of performance in terms of interoperability and in the mechanisms of data collection. Thus, the challenges relating to interoperability are both technical and organisational.

Theme 3. Typology of data sources

Overall, the quantitative analysis showed that the Cameroon HIS is generally only partially aligned with international standards. The results highlighted significant variations across different categories of data sources, with institutional systems being the weakest. The main shortcomings were related to the implementation of standards, the regularity of data production, and the integration of information systems (Table 5).

Table 5
Summary typology of data sources

Category	Aligned sources	Partially aligned sources	Non-aligned sources
Institution-based	Logistics management information system (NEML)	¬ Individual records (ICD-11), ¬ Health infrastructure information system (MFL)	¬ Human resources information system (ISCO-08), ¬ Health facility assessments (SPA/SARA)
Population-based		¬ Population-based surveys (DHS, MICS), ¬ Civil registration vital statistics system (CRVS)	¬ Population census (United Nation standard)
Other sources	Public health surveillance system (IHR)	¬ Collective intervention records (ICHA-HC6), ¬ Health accounts (SHA)	Financial management information system**
***Data source is non applicable as it lacks defined standards*			

Key:

CRVS: Civil registration vital statistics system

DHS: Demographic and Health Survey

ICD-11: International Classification of Diseases, Eleventh Revision

ICHA-HC: International Classification for Health Accounts-healthcare functions

IHR 2005: International health regulations 2005

ISCO-08: International Standard Classification of Occupations 2008

MFL: Master Facility List

MICS: Multiple Indicator Cluster Survey

NEML: National Essential Medicines List

SARA: Service Availability and Readiness Assessment

SHA: System of Health Accounts

SPA: Service Provision Assessment

However, in-depth interviews revealed that population-based data sources such as BUCREP surveys and projections, as well as institutional sources are the most reliable in Cameroon:

"Most indicators are monitored by data from DHS, such as that from 2018, and the MICS surveys from 2023, as well as studies such as the Cameroon Population-based HIV Impact Assessment (CAMPHIA) and many others" (**HDNPHO, male, 46 years**). Another participant stated, "The projections made by BUCREP and the data from the health sector are key data for our health system, so I think that as the data from the health sector are collected daily, the sources based on institutions are the most reliable" (**HBUCERP, male, 53 years**).

Although several participants agreed that population-based data are the most reliable, this is tempered by the fact that the frequency of collection is not adhered to.

"The data we collect is of very good quality, but infrequent owing to noncompliance with the schedule" (**NISRO, male, 47 years**).

Some major shortcomings identified

The quantitative indicators revealed objective shortcomings in terms of completeness and frequency and highlighted structural weaknesses in human resources information systems, whilst the qualitative findings demonstrated these weaknesses to stem primarily from constraints relating to governance, funding, implementation and workforce management. These shortcomings were:

i) Limited interoperability: The system operates in siloes with very limited automated exchange between data sources

"The interoperability we talked about last time remains very limited to date" (**HDDOSTS, female, 43 years**).

"No interconnection with other HIS digital platforms" (**HIUE, male, 34 years**).

"Interoperability is virtually non-existent, but efforts are being made, notably with the implementation of an interoperability pilot project in 40 health facilities currently" (**ITUNIT, male, 41 years**).

"There are many platforms, which are not very interoperable between the structures that own them" (**HNPHO, male, 46 years**).

ii) Standards implemented only in the pilot phase: Several international standards are not being rolled out nationally, as these participants stated:

"ICD-11 is still in the pilot phase in only 33 health facilities" (**DASBUNEC, male, 37 years**).

"As I was saying, we have adopted the UN recommendations, and we are using ICD-11, even if it is only in 33 health facilities at the moment, as it is still in the pilot phase." (**HIU, male, 34 years**).

iii) Outdated demographic data: The last general population census was conducted in 2005, affecting the reliability of all population-based health indicators.

"The law requires censuses to be conducted every 10 years, but in Cameroon, things do not always go according to the law, as you well know" (**HDBUCREP, male, 53 years**).

iv) Insufficient human resources: Lack of qualified personnel for data management and the application of technical standards.

"I can assure you that this is a very critical issue for our health system at present, because resources are not only insufficient but also not used where they should be used" (**HNPHO, male, 46 years**).

"I would say that staff are not in the right place, which is why we think there is a lack of human resources. For me, the problem lies in recruitment, which is based on affinity" (**HR, male, 30 years**).

v) Irregular data production: Several sources produce data on an ad-hoc basis rather than continuously and systematically. This was the view point of a participant:

"There are inconsistencies in healthcare data and a lack of external audits" (**HPSO, female, 38 years**).

"In terms of coverage of areas, we do this, although the insufficient frequency of censuses can pose a real problem" (**HDBUCERP, male, 53 years**).

"The data we collect is of very good quality, but the frequency is low owing to noncompliance with the schedule" (**NISRO, male, 48 years**).

"The quality of surveillance data varies depending on the disease, with some conditions being better documented than others...this may be because some data are collected regularly while other data are not" (**DDLMEP, male, 37 years**).

Discussion

Methodological innovation: the contribution of HIS DART

This study is particular for its pioneer use of the HIS DART in a French-speaking African population. While this tool has mainly been used for sectoral assessments, our comprehensive application to assess all 12 modules sets an important methodological precedence. This finding demonstrates the feasibility and usefulness of the HIS DART in the context of institutional fragmentation, which characterises the health systems of many low- and middle-income countries.

Unlike other studies on HISs in Cameroon which often relied on composite indicators or perception surveys, our HIS DART-based approach allowed for objective and standardised assessments, facilitating future comparisons with other countries. Our results perfectly illustrate the tensions between the different areas of the HIS DART. For example, the individual records module showed alignment of the

data attribute (adoption of ICD-11) but a disconnect in terms of mechanisms and interoperability, and coverage/comprehensiveness/quality indicators (limited to 33 facilities, low use of EMR-electronic medical records). This dissonance explains the partially aligned status: the standard exists, but the mechanisms to deploy it and the capacity to apply it are lacking.

The case of the logistics management information system (module 4) demonstrated that successful alignment requires consistency across four areas: the regulatory framework (National Medicines Policy), the technical standard (National Essential Medicines List), collection mechanisms and interoperability (an electronic logistics management information system), and coverage, completeness and quality indicators (trained personnel).

Implications for strengthening HISs

We observed fragmentations between the different data sources, reflecting insufficient governance of the HIS as a whole. As noted by Mamuye et al., the lack of an overall architecture and standardised exchange protocols is a major obstacle to the production of usable data [20].

Our study concurs with the conclusions of Viviane Ndoungué et al. [21] on the low effective application of the IHR 2005 despite its formal adoption. This discrepancy between normative adoption and operational implementation is a recurring phenomenon in the health systems of resource-limited countries. Furthermore, following our mixed sequential approach, finding revealed that the 'Enabling environment' dimension scored relatively higher than the Interoperability and Data quality dimensions, suggesting that regulatory frameworks are in place but they remain insufficiently implemented. This implies that the problem lies not in the adoption of the international standards but rather in the inconsistent, unsustainable and fragmented implementation of these standards within the national institutions. This convergence suggests that regulatory alignment efforts alone are not sufficient to ensure the functional integration of the HIS. Rather, concerted effort geared towards strengthening institutional capacity, interoperability, governance, and human resources is needed in order to achieve technical alignment. This finding is crucial in guiding HIS strengthening interventions toward concrete integration and implementation actions.

Our results are consistent with studies conducted in other African countries. For example, the study by Okoroafor et al. in Nigeria [22] also identified similar challenges in the classification of medical professions and the lack of a national registry of health personnel. Similarly, the work of Huang et al. [23] on civil registration vital statistics system (CRVS)-DHIS2 integration highlights the same technical and governance obstacles as those identified in our study.

However, our research makes an original contribution through its systemic approach and the use of the HIS DART, allowing for a more comprehensive and standardised assessment.

Strengths and limitations of the study

This study has several strengths, including a rigorous mixed-method approach that provides an in-depth understanding of the phenomenon, as well as the innovative use of the HIS DART for standardised and reproducible assessments. It also benefitted from access to key informants owing to institutional support from the Ministry of Public Health, a comprehensive systemic analysis of all HIS data sources, and the integration of a conceptual framework for interpreting the results.

However, this study was limited by the fact that it focused only on the central level (Yaoundé), which limits generalisation to the regional and district levels. The sample size for the qualitative phase was modest. There was also a risk of social desirability bias in participants' responses, but measures such as document review and online verification of certain information were used to minimise this limitation, as were difficulties in accessing certain sensitive or undocumented data. There are also inherent limitations to the HIS DART, which does not cover all aspects of data quality.

Despite these limitations, this study provides a robust and nuanced assessment of the normative alignment of the Cameroon HIS, with important implications for public policy.

Strategic recommendations for policymakers

On the basis of the results of this study, we propose a prioritised action plan to improve the alignment of the HIS with international standards. These recommendations that are summarised in Table 6 are addressed to decision-makers at the Ministry of Public Health and its partners and are derived directly from the in-depth interviews.

1. Create a multisectoral framework headed by the HIU, chaired by the Secretary General of the ministry, with a mandate to steer the normative alignment and interoperability of systems.
2. Finalise and formalise the Master Facility List (MFL) by including all types of establishments (pharmacies, laboratories, traditional practitioners) and integrate it into theDHIS2.
3. Launch an accelerated training programme on ICD-11 for several health professionals per year, with materials adapted to the local context.
4. Adopt a national health data interoperability policy e.g. Fast Healthcare Interoperability Resources (FHIR), or Aggregated Data Exchange (ADX) that defines exchange standards and facilitates cross-sector governance.

Medium-term priorities

1. Develop and deploy a health data exchange platform (Health Data Hub) that bases on standardised data norms to enable the interconnection of all subsystems.
2. Create a National Health Personnel Register aligned with ISCO-08, integrating data from different ministries and institutions.
3. Automate the capturing of civil status data via a CRVS by the DHIS2, a pilot activity that is already deployed and implemented in 40 centres, and ensure an incentive remuneration for civil registrars.
4. Establish the annual production of National Health Accounts by legal provision, using the SHA 2011 methodology.

Long-term priorities

1. Achieve full national deployment of ICD-11 and Electronic Medical Records (EMR) in all healthcare facilities.
2. Organise a general census of the population and housing by 2030, in accordance with international standards and the ten-year cycle.

Table 6
Priority action plan

Priority	Concrete action	Responsible body	Indicators of success
High	Adopt an interoperability policy	HIU with BUNEC, BUCREP, and other ministerial departments of public health.	Ministerial decree published
High	Extend ICD-11 to 100% of hospitals	DLMEP, DOSTS, HIU, NPHO with BUNEC	100% of hospitals use ICD-11
High	Organise the 2030 general census	BUCREP with NIS and other stakeholders	Census conducted and validated by the United Nations
High	Create the National Personnel Register	HWR with MINFOPRA	Operational platform with 80% of personnel registered
Average	Deploy the data exchange platform	HIU with technical partners	Interconnection of 3 major systems (DHIS2, eLMIS, MFL)
Average	Automate civil status data	BUNEC with HIU	Reporting rate > 50% in pilot centres

Key:

BUCREP: Central Bureau of the Census and Population Studies (Cameroon)

BUNEC: National Civil Status Registry Office

DHIS2: District Health Information Software second version

DLMEP: Directorate for the Control of Diseases, Epidemics, and Pandemics

DOSTS: Directorate for Healthcare Organisation and Health Technology

eLMIS: electronic Logistic Management Information System

HIU: Health information Unit

HIU: Health Information Unit

HWR: Health Workforce Registry Implementation considerations

ICD-11: International Classification of Diseases, Eleventh Revision

MFL: Master Facility List

MINFOPRA: Ministry of Public Service and Administrative Reforms

NIS: National Institute of Statistics

NPHO: National Public Health Observatory

Conclusion

The Cameroon HIS is partially and fragmentarily aligned with international standards. While significant progress has been made in the formal adoption of technical standards, their operational implementation remains limited by gaps in interoperability, human capacity, and data governance. Our study, which is innovative in its use of the HIS DART provides not only a detailed diagnosis but also a replicable methodological model for other countries facing similar challenges. The sequential mixed approach revealed tensions between the different layers of the system (political-legal, technical-normative, organisational, and human) and identified the real bottlenecks.

The implementation of the proposed recommendations, under strong leadership and within a framework of multisectoral coordination could transform the Cameroon HIS into a robust digital public good capable of producing reliable, comparable, and timely data to improve clinical and public health decision-making. This would optimise the allocation of health resources, monitor progress towards UHC, report on the performance of the health system, and contribute to the monitoring of the SDGs. The transformation of the HIS is not only a technical issue but above all a matter of governance, leadership, and political commitment. Cameroon has the opportunity to become a regional leader in strengthening health information systems by building on the lessons learned from this study and adopting a strategic, integrated, and sustainable approach.

Abbreviations

ADX
Aggregated Data Exchange
BUCREP*
Central Bureau of the Census and Population Studies (Cameroon)
BUNEC*
National Civil Status Registry Office
CAMPHIA
Cameroon Population-based HIV Impact Assessment
CAPI

Computer-assisted personal interviewing
CRVS
Civil registration vital statistics system
CSPro
Census and Survey Processing System
DMS
Database Management System
DHIS 2
District Health Information Software second edition
DHS
Demographic and Health Survey
DLMEP*
Directorate for the Control of Diseases, Epidemics, and Pandemics
DOSTS*
Directorate for Healthcare Organisation and Health Technology
DRFP
Directorate for Financial Resources and Assets
EMR
Electronic Medical Record
EPI
Expanded Programme on Immunisation
FHIR
Fast Healthcare Interoperability Resources
GOFR
Global Open Facility Registry
HIS
Health Information System
HIS DART
Demand and Readiness Tool for Assessing Data Sources in Health Information Systems
HR
Human resource
HWR
Health Workforce Registry
ICD-11
International Classification of Diseases, eleventh revision
ICHA
International Classification for Health Accounts
ICHA-HC
International Classification for Health Accounts-healthcare functions
ICHI

International Classification for Health Interventions
IHR
International Health Regulations
ISCO
International Standard Classification of Occupations
eLMIS
electronic Logistics Management Information System
MFL
Master Facility List
MICS
Multiple Indicator Cluster Survey
MINFOPRA*
Ministry of Public Service and Administrative Reforms
MoPH
Ministry of Public Health
NDCP
National Drug Control Program
NEML
National Essential Medicines List
NIS
National Institute of Statistics
NPHO
National Public Health Observatory
ODK
Open Data Kit
SARA
Service Availability and Readiness Assessment
SDG
Sustainable Development Goal
SHA
System of Health Accounts
SIGIPES*
Integrated Human Resource and Payroll Management System
SPA
Service Provision Assessment
UN
United Nations
WHO
World Health Organisation
*

French acronyms

Declarations

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The authors declare that they have no conflicts of interest that could influence the results of this study.

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Author contributions

FFO, BBT, and MN designed the study, collected data, performed statistical analysis. FFO, BBT, LD, MNN and GNT drafted the manuscript. GNT, MN, and MN scientifically supervised the study and provided critical oversight of the research design. All the authors reviewed and approved the final version of the manuscript.

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Data availability:

The data for this study is available upon reasonable request from the corresponding author, in accordance with confidentiality and ethical rules.

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Figures

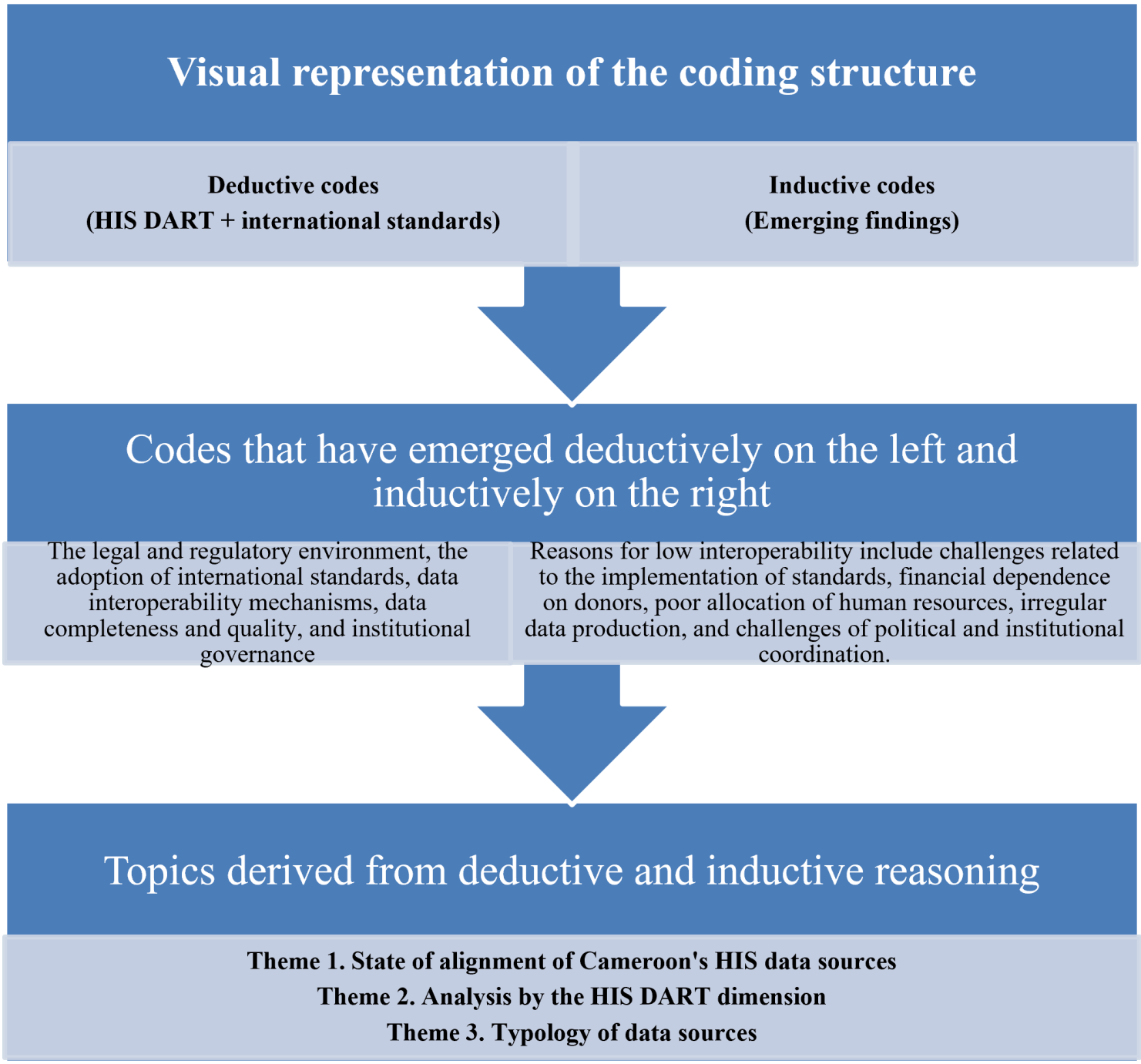


Figure 1

Schematic presentation of the coding structure and generation of subthemes.