Understanding the Influence of Health Information System Investments on Health Outcomes in Côte d'Ivoire:

A Qualitative Study

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ACKNOWLEDGMENTS

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ABBREVIATIONS

ARV	antiretroviral
CDC	United States Centers for Disease Control and Prevention
DIIS	Direction de l'Informatique et de l'Information Sanitaire/Department of Informatics and Strategic Information
DQA	data quality assessment
HIS	health information system
HSS	health systems strengthening
IP	implementing partner
M&E	monitoring and evaluation
MSHP	Ministère de la Santé et de l'Hygiène Publique/Ministry of Health and Public Hygiene
PBF	performance-based financing
PEPFAR	United States President's Emergency Plan for AIDS Relief
PMTCT	prevention of mother-to-child transmission
PNDS	Plan National de Développement Sanitaire/National Health Development Plan
PNLS	Programme National de Lutte contre le SIDA/National AIDS Control Program
PRISM	Performance of Routine Information System Management
RDQA	routine data quality assessment
RHIS	routine health information system
USAID	United States Agency for International Development
USG	United States Government
WHO	World Health Organization

INTRODUCTION

Health information is one of the six core functions of a health system, along with service delivery; human resources for health; medical products, vaccines, and technologies; financing; and leadership and governance (Figure 1, source: United States Agency for International Development [USAID], 2015). Investments in any one of these areas will affect and be affected by the other core functions of the health system. Assessing the broader effects of investments in HIV-specific health information systems (HIS) on the overall improvement of the larger health system can help explain how these investments can lead to improved HIV outcomes.

There have been substantial investments in Côte d'Ivoire's HIS over the past decade. In 2018 these investments were evaluated to contribute to an understanding of how HIS strengthening investments affect HIS performance, health system outcomes, and public health outcomes. The evaluation consisted of a document review with a resulting triangulation report (MEASURE Evaluation, 2018), and a qualitative study informed by key stakeholders in the country, the results of which are presented here.

Figure 1. USAID's vision for HSS core functions
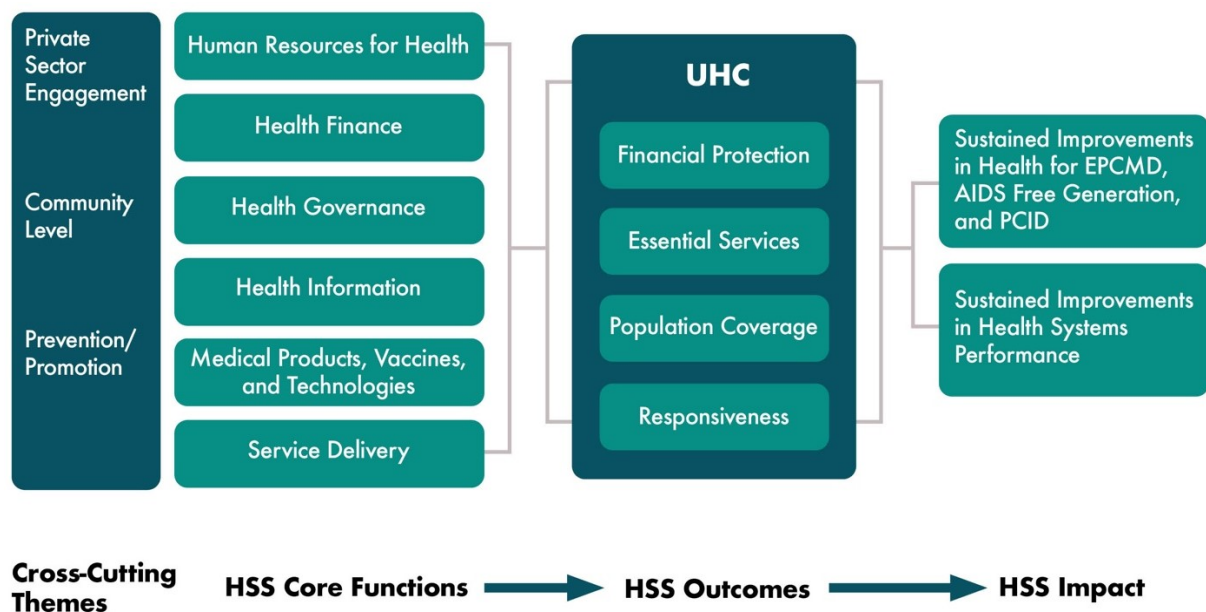
Source: USAID's Vision for Health Systems Strengthening 2015–2019, September 2015

* UHC: universal health care; EPCMD: ending preventable child and maternal deaths; PCID: protecting communities from infectious diseases

BACKGROUND

Côte d'Ivoire is one of the countries in West Africa that is most heavily affected by HIV. Of its population of almost 23 million, between 3.2 percent and 3.7 percent are estimated to be living with HIV (Institut National de la Statistique (INS)/Côte d'Ivoire & ICF International, 2012), and much higher rates are found in key population groups such as sex workers and men who have sex with men (Johns Hopkins University & Enda-Santé, 2014; UNC-LINKAGES & Enda-Santé, 2017). There are 20 health regions and 86 health districts in the country. The United States President's Emergency Plan for AIDS Relief (PEPFAR) is scaling up programs in 79 districts: 39 high-burden districts, of which 23 are "aggressive scale-up districts" and 16 "scale-up to saturation districts," plus 40 "sustained districts," as noted in the PEPFAR Country Operational Plans for 2017 and 2018. The HIV response in the remaining districts is managed by the National AIDS Control Program (PNLS) with support from the Global Fund.

Over the past 14 years, substantial investments in Ivorian HIV programming, including in the HIS, have been made by the United States Government (USG) through PEPFAR, as well as by other donors. Since the initiation of PEPFAR in Côte d'Ivoire, the information needs at the program and national levels have grown immensely, resulting in implementing partners grappling with shifting reporting requirements and data demands to show the success of programmatic investments year by year, and now quarter by quarter. The fast-paced and fluctuating reporting environment has resulted in parallel data collection systems, even while the USG is supporting national HIS development and implementation. In the past five years, the emphasis on data use for decision making has dramatically increased, meaning that the HIS must be able to handle HIV data and consistently produce reliable, timely, and accurate data to demonstrate health outcomes for HIV patients.

MEASURE Evaluation is a multi-country project funded by USAID that has funded activities in Côte d'Ivoire since 2004. MEASURE Evaluation focuses on strengthening HIS and training health and government professionals in monitoring and evaluation (M&E) of programs. Specifically, with funds from PEPFAR, MEASURE Evaluation works with the Ministry of Health and Public Hygiene (MSHP) to strengthen the country's routine health information system (RHIS), especially related to HIV, among its other activities. MEASURE Evaluation contributes technical leadership in the RHIS technical working group meetings, trainings, and formative supervisory support for technical activities.

Beginning in 2004, MEASURE Evaluation, along with other partners, has provided financial and technical support to the Government of Côte d'Ivoire to strengthen its health management information system and HIV M&E systems. This support has led to enhanced capacity across a wide range of health staff, particularly in the areas of data collection, quality control, and the use of information at all levels of the health system. MEASURE Evaluation, working closely with the MSHP, has played a leadership role in strategic planning and overall management of the HIS.

These efforts have resulted in data collection tools that capture the information necessary to monitor progress toward achieving 90 percent of people tested for HIV, 90 percent of people living with HIV being on treatment, and 90 percent of people on treatment experiencing suppression of the virus, known as "the Three 90s" (Joint United Nations Programme on HIV/AIDS [UNAIDS], 2014). These inputs have facilitated the government's ability to implement the Test and Start policy, which it adopted in February 2017. Test and Start is one of PEPFAR's key strategies to intensify efforts to identify people living with HIV and link them to essential care and treatment services.

Despite the participatory approaches employed and partner support for the development of the indicators, tools, and electronic systems, use of the government-supported data systems has not yet been maximized. Partners implementing HIV services still maintain their own parallel systems, which results in incomplete data in the ministry system that uses the DHIS 2 platform. Since data entry and analysis have

not yet been fully realized, data from these national systems have also not been used effectively. The Global AIDS Coordinator, Ambassador Birx, has called for continuous assessment of program performance to enable course corrections, identify efficiencies, and improve the achievement of targets. Until the national data systems are robust, inefficiencies will exist, and PEPFAR's efforts to bolster Côte d'Ivoire's self-reliance in providing adequate HIV care and services will be undermined.

METHODS

Scoping Visit Meetings

An initial scoping visit was conducted in Abidjan in September 2017 by two MEASURE Evaluation team members. The organizations and individuals participating in the scoping meetings were selected based on prior interactions between these stakeholders and MEASURE Evaluation's in-country team. A total of 18 organizations were visited during the scoping visit.

Sampling

Purposive sampling was then used to select 22 total entities for semi-structured interviews, in which 43 respondents participated. The participants represented the following:

- HIV program implementing partners (direct recipients and their local partners) and private HIV care providers
- USG agencies (e.g., USAID, United States Centers for Disease Control and Prevention [CDC])
- Multilateral agencies (e.g., UNAIDS, Global Fund)
- MSHP
- Advocacy groups for people living with HIV
- Regional and district health officers

Potential respondents were contacted by email and telephone to schedule an in-person interview during a flexible two-week period, based on each respondent's schedule. Potential respondents who did not respond or who had scheduling conflicts during the two-week interview period were re-contacted for interviews by an in-country MEASURE Evaluation staff person at a later date.

The respondents were comprised of government and nongovernment employees from different levels of the health system in Côte d'Ivoire. They included eleven Ivorian government participants or groups and nine nongovernment groups, of which six were implementing partners. Twelve participants/groups represented national-level organizations, four were regional, and six represented districts.

Research Questions and Instruments

The semi-structured interview guide (Appendix A) was designed to elicit responses to the main research questions:

- What were the major HIS strengthening interventions focusing on HIV in Côte d'Ivoire in the last 10 years?

- How are the major HIS strengthening interventions over the last 10 years associated with HIS performance, which is defined as data use and quality?

- How did the contextual factors and health system dynamics affect the implementation and outcomes of the HIS interventions?

- What health system outcomes were associated with the HIS interventions, specifically HIV program course corrections contributing to controlling the epidemic (meeting the 90-90-90 goals)?

- What barriers, incentives, and factors were involved in use of HIV data in the government-supported HIV data systems to improve data quality, analysis, and synthesis, and health programs and outcomes?

In addition to the main interview questions, prompts and follow-up questions were included in the guide.

Data Collection

The in-person interviews were conducted July 16–27 and September 17–21, 2018, in an office or meeting room at each participant's workplace that was separate from co-workers. They were conducted in French by a team composed of MEASURE Evaluation staff (US-based and in-country) and a representative of the MSHP DIIS. A MEASURE Evaluation staff person served as a note-taker in most interviews and asked clarifying questions, when necessary. Two voice recorders were used to record the interviews. Recording was not possible for one interview conducted by telephone, nor during the interviews with U.S. Government respondents, as recording devices were not permitted in that setting. Notes were also written by hand and on a computer.

MEASURE Evaluation submitted an application for this study to the University of North Carolina Institutional Review Board and the Côte d'Ivoire National Research Ethics Committee, including a protocol, consent form, and interview guide. The former determined that the study does not involve human subjects research and is therefore exempt from a full ethics review; the latter reviewed and approved the study. All interviews began with an introduction, during which written informed consent and permission to record were obtained, except in cases in which recording was not possible. The interview then proceeded using the interview guide, but the process was flexible enough to include other questions, as necessary.

In some cases, participants were not equally knowledgeable about all of the interview topics (e.g., details about the development of HIS tools or software, or actual use of the DHIS 2 or electronic medical records system [SIGDEP]), so more time was spent on topics with which they were more familiar.

Following data collection, both the audio files and handwritten notes were transcribed and translated into English, then reviewed for accuracy by the interviewers prior to analysis. The audio files and transcripts were stored digitally on a password-protected MEASURE Evaluation server. All transcripts and notes were imported into NVivo 10.0 for data analysis.

Data Analysis

We used framework analysis to analyze the data. The first step of this five-step process was to become familiar with the transcripts by reading and taking notes on them. The second step was to develop a coding scheme to systematically code the data (Appendix B). Analytical axes were identified according to their respective codes which, in turn, were grouped into key concepts. Some codes were empirical and theoretical based on what we expected to find, other codes were developed based specifically on the research questions, and some emerged from the narratives of the respondents themselves. The third step was to index, i.e., systematically apply the codes to the interview transcripts, using NVivo 10.0. The fourth step was to chart the data, which involved reviewing the coded text by theme, code, and type of informant. The final step was mapping and interpretation. The first draft of the report was shared with stakeholders in Côte d'Ivoire for comments before finalization.

Informal Meetings

In addition to the semi-structured interviews, informal meetings took place between staff from MEASURE Evaluation and the Department of Informatics and Strategic Information (DIIS). These meetings provided rich contextual information and the opportunity to clarify answers to questions that arose during the formal interviews.

RESULTS

Informants had varying levels of knowledge of key interventions, some having been involved in planning and implementation of interventions and others having detailed knowledge of only one intervention. However, overall, the respondents were a rich source of knowledge of the development of the HIS in Côte d'Ivoire during the study period. The interviews indicated that tremendous changes have taken place in HIV HIS in Côte d'Ivoire over the past 10 years, including the standardization of indicators and tools for HIV and the introduction of electronic tools for data collection and management. Yet, many challenges remain, and the HIS is still experiencing many of the same problems it had before the interventions were implemented.

Improvements in the HIS

This evaluation process began with a document review titled "Strengthening Côte d'Ivoire's Health Information System: Validating Data on the Effectiveness of Interventions" (MEASURE Evaluation, 2018), which identified several key HIS interventions that were also discussed by interview respondents. These included:

- Performance of Routine Information System Management (PRISM) assessments
- Data quality assessment (DQA) and routine data quality assessment (RDQA) tool development and implementation
- Standardization of indicators and tools
- Implementation of electronic systems like DHIS 2 (used for aggregate patient and facility HIV data) and the management tool for electronic patient files (*système d'information de gestion du dossier éléctronique du patient,* referred to as SIGDEP, versions 1 and 2).[1]

Many respondents described a pre-intervention context that made it challenging to collect and use data to monitor program process. One nongovernment respondent talked about the fact that prior to 2004, there was a lack of national indicators to measure the progress of HIV programs, the use of electronic HIS tools was very limited, and the number of people trained in M&E was limited. As a result, HIV indicators were not standardized and collected the same way throughout the country.

While the country had been using other electronic systems such as SIG-VISION for routine data aggregation and reporting since 1995, the introduction of DHIS 2 and SIGDEP 2 brought improvements to HIV programming. SIG-VISION was a Microsoft Access file that was a "stand-alone" mechanism that was difficult to update and became very slow as the volume of data increased. These data came from health facility reports entered into SIG-VISION at the district level, which were then sent to the region via CD, USB, or Internet. The data were transmitted in the same way from the regions to the national level. "With this tool, enormous difficulties were encountered in the entry and transmission of data at the central level," one government respondent commented. Many of the respondents who were users of this system echoed this complaint. Another government respondent commented that "some departmental directors and hospital directors were not trained on the old system. Even for those who were trained, they had trouble using the Access database to be able to export and easily make charts and figures to use them." In addition, a limited number of people were able to analyze the data, and the introduction of DHIS 2 was discussed as a great equalizer in terms of increasing the number of government stakeholders who could access and analyze the data. A government respondent shared that under SIG-VISION, "the

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[1] Respondents mentioned other tools, such as those used for logistics management and performance-based financing (PBF), but the focus of this review was the use of tools for HIV testing and care. PBF was seen as contributing to improved patient results, but PBF implementers developed their own system to track this, which contrasts with the ideal of having one unified system.

data extraction and presentation task was only done by the data manager. He is the one who communicated the information to the departmental directors." This was confirmed by another government respondent, who said that "the district medical officers were not trained in the use of this tool; rather, it was more the data managers."

Another major change was the development and use of standardized tools for HIV, which became more urgent with the rollout of DHIS 2. Prior to this, respondents described tremendous variation across facilities throughout the country in terms of what data were collected and when. One nongovernment respondent who was part of a team that visited the HIV sites said that they had encountered some sites in which "a blank sheet of paper […] was used for notification. So everyone used to notify according to what they wanted to see […]. So everyone had their own tools. The information was not standardized." Several respondents had been involved in the standardization of indicators by participating in working groups during the process of selecting the indicators. They agreed that this was a complicated and lengthy, but worthwhile, effort.

Improvements in Data Quality

The above-mentioned improvements to the HIV HIS system led to improvements in data quality. Respondents were aware of the need for high-quality data and expressed their appreciation for the various tools that had been introduced to improve data quality. As one nongovernment respondent said:

> *I think it is imperative for us to provide quality data because decisions are made based on the reports we make, so it goes without saying that our responsibility is great at this level. But to come to quality, it is quite a rigorous process, which motivates me personally to opt for the RDQA.*

This respondent further elaborated that conducting RDQAs, which highlight deficiencies, can be used to "make recommendations, a data quality improvement plan. And it improves data collection in terms of quality."

DHIS 2 has also been instrumental in improving data quality through internal validation and by making the data available more quickly. For example, one government respondent discussed how using DHIS 2 made data immediately available and meant that they no longer had to travel to collect data from facilities:

> *With SIG-VISION, we have to return to the base, return to* [the] *Hospital, which is 85 km away, to do the* [data] *entry. Now with DHIS 2, we have the data without going out. And when we enter the data here […], the regional manager can already access our data, which was not the case with SIG.*

Many of the respondents commented on the fact that the use of DHIS 2 has made it possible for data to be available in real time and that this has increased the accessibility of data at all levels of the health system for stakeholders who have access to DHIS 2. Implementing partners did not have the same access

to the data, despite their contributions to achieving HIV program objectives, and expanding access to stakeholders outside of the government health system has been debated. Currently, they must go through the official channels to access data: as one government respondent described the procedure, "The partner who needs information contacts the DIIS directly to obtain the information." The government concern is that this information will be used without the consent of the DIIS, and they will not have control over how the information is used. Either way, this increased access to data is contingent on reliable electricity and Internet access, a concern brought up by several respondents that will be discussed later.

SIGDEP 2 was also credited with increasing access to data, with one nongovernment respondent commenting, "This has helped us a lot to have this data more quickly, concerning the collection, compilation of HIV data, treatment, care and support since it is a computerized data management system."

The ability to program DHIS 2 with data validation parameters also contributed to improved data quality, as one government respondent shared: "Parameter setting with the DHIS 2 internal validation rules system enables avoiding entering absurd figures when entering data. The tool warns you of the error and you correct it." However, there were some concerns at the district level about the actual quality of the data that comes to them from facilities that do not have direct access to DHIS 2 and that submit their data to the district to enter and review. "Data from the centers are more or less incoherent data," said one district government respondent. "When they come to us, we have to do extra work here by calling them every time to ask. Whereas, if they had had the software at their level, they could have seen these inconsistencies and done what was necessary [to correct them]."

Box 1. Threats to data quality

Although many respondents highlighted ways in which data quality has improved over time, threats to data quality were still identified, as follows:

- Data entry errors at the primary collection points
- Inconsistent timely submission of reports across the country
- Incomplete data at some levels

District-level informants stressed how reliant they are on the health facilities to enter or record data correctly, completely, and on time, since DHIS 2 is not available in the facilities.

Another issue mentioned by several respondents is that the date of submission of data changes in DHIS 2 every time corrections are made, resulting in corrected data appearing as though it were submitted late. This is a problem, since timeliness is a dimension of data quality used to assess districts' performance. This quirk may have the unintended consequence of discouraging staff from correcting data when errors are identified.

The need to ensure SIGDEP 2 and DHIS 2 are interoperable is another necessary step to ensure data quality. Interoperability between these two systems would enable a reduction in the current necessity for double data entry. One related challenge may be the need for a linked indicator harmonization process.

The national data validation exercises were also mentioned as a possible threat to the quality of the data in the national DHIS 2 system. As one government respondent said, "the HIV program has designed an Excel matrix, parallel to our DHIS 2, … it sends them to be filled [by the districts] and come to validation [meetings] with this matrix. As a result, the same indicators that are in the DHIS 2 need to be filled in another matrix." This matrix is the one used in the validation meetings and updated with any corrections. It is unclear if the data in DHIS 2 are then updated after the data validation meetings. Another reason given as to why this is a threat to the data in the DHIS 2 is that data managers may prioritize completing the Excel file over entering the data in DHIS 2.

Changes to Data Use

Data use has been described as a continuum: to assess data quality, generate health statistics, develop information products, make data-informed decisions, and implement actions based on these decisions (MEASURE Evaluation, 2017; Nutley & Li, 2018). Respondents discussed how data use along this

continuum has improved since the introduction of the various HIS interventions. For example, respondents mentioned another benefit of DHIS 2, that since the data are available in real time and are accessible to staff at all levels of the health system, it is easier to review and provide feedback on them so that corrections can be made. This is described in the following example, provided by a government respondent:

> *We had a health facility that shared its dashboard on home deliveries and hospital deliveries. Automatically, all the actors realized that the number of home births was very high, unlike deliveries in institutions. Some actors started asking the question in the platform, "Are you sure it is the number of home births? Isn't there any input error?" Subsequently, the facility in question did in fact re-enter* [the data] *to say that there is indeed an error. It was the hospital deliveries that were higher than the home deliveries.*

With previous routine data collection systems, a mistake like this may have remained unnoticed indefinitely. The more time that passes after an error is made, the harder it is to correct, since it may not be identified until it has been aggregated with other facility and district data. In this case, the DHIS 2 allowed health system staff at the higher levels to see the possible error and to quickly identify which health facility was reporting it. This also demonstrates that staff at these higher levels were reviewing the data and knew enough about the indicator to recognize that the result did not make sense. This increased the awareness about data quality. Data use was also a positive change mentioned by several respondents, which was attributed to the nationwide efforts to train people at all levels of the health system on M&E principles. As one nongovernment respondent who participated in M&E trainings said, "After the training, we saw the importance of providing quality data, which would help us make good decisions. In other words, it is the collective awareness of the trained staff about the importance of providing quality data that made this activity a success."

In terms of improved analysis and information dissemination, the use of the electronic tools and standardized indicators has made it easier to analyze data, view key results, and compile reports. Data analysis prior to the DHIS 2 and SIGDEP 2 implementation was heavily reliant on the individual skills of a small number of staff. A few people were able to analyze the data using other programs such as Excel, but if that person left the district or facility, those skills may have gone with them. However, particularly with DHIS 2, analyzing indicators and developing reports is now easier since there are many built-in tools that can help the user accomplish these objectives. As one government respondent shared, "With SIG-VISION, I could not make the dynamic pivot tables. Maybe I wasn't equipped enough. But with the DHIS 2, we have a specific TCD tab which allows us to develop the table without difficulty, by simply selecting the indicators."

Another benefit discussed was that it was easier to access data to write reports. This was illustrated in the following two quotes that come from a government and a nongovernment respondent, respectively:

> *If I want the data for 2013, 2014, for example, when before it was difficult, we had to go outside and dig through the documents and try to make the tables. It was complicated and it was not sure that we would be able to retrieve this data later, whereas with DHIS 2 at any time and in time I would still have access to the data so it's very good software.*

> *I think one of the examples for me that is edifying is the national HIV report that the Ministry of Health through DIIS and PNLS is developing. This information, in the past I would say was not an easy thing to have. Today, with standardized data collection tools and a clear dictionary of indicators that allow us to know what is needed with SIGDEP and DHIS2, information is available from lower levels to the central level. This makes it possible to compile the data and prepare an annual report by region, by district without great difficulty.*

These sentiments highlight the importance of having easy access to current and past data when preparing health statistics reports at various levels of the health system. Report preparation and dissemination are important components of data use, and it is essential that reports are available in a timely manner. It is not useful to have annual reports that are delayed by one or more years.

Data use improvements were harder to quantify. This was thought to be due to the lack of documentation of when data-based decisions have been made; as one nongovernment respondent put it, "I think the data is used, decisions may be made, but it may be tracking those decisions that is the problem." However, several respondents gave illustrative examples of how data are used, including this nongovernment respondent's example of improvements to the quality of care:

> *We have staff who take care of the quality of care. When they go to the sites, they may notice that in the tools, for example, there is a certain percentage of people who do not receive a certain intervention. Therefore, it allows us to see at the facility level how to ensure that the people who are received in this facility receive all the interventions they need.*

This was just one example of how data have been used. However, while respondents felt that data use had improved, they were not able to describe how much.

Ongoing Challenges to the HIS

Despite the improvements and changes to the HIS described in the previous sections, many issues remain unchanged in the process of strengthening the HIS and continue to challenge it. This includes the continued use of paper forms, lack of funding for infrastructure and activities such as supportive supervision , tension between implementing partners and the government sector, and continued barriers to data use.

Paper Forms

While there has been a trend to digitize data collection, transmission, and analysis, the health system still relies on paper forms for data collection in facilities, which can pose several challenges to data quality. A major intervention was the development of standardized tools, which was seen as a great achievement by many respondents. However, implementation of these updated forms can increase the burden on providers, since they are now being asked to consistently collect a large quantity of data with many clinical data collection tools. These are still comprised primarily of paper tools that need to be printed, updated, and distributed. One nongovernment respondent lamented this situation, as follows:

> *If we could centralize all the information at once, or find it in one tool, so that the provider would not have to use for a pregnant woman a screening register for rapid tests, a prenatal consultation register, a PMTCT* [prevention of mother-to-child transmission] *register for mother/child follow up and then the ARV* [antiretroviral] *dispensation register, the doctor's prescription book. As you can see, for an HIV patient, it is at least 12 documents that need to be filled out, it is not easy.*

Standardization was universally acknowledged to be important, but solutions for managing the data burden are still needed, considering the volume of data being collected, the variety of registers or tools that could be streamlined, and the insufficient availability and qualifications of personnel tasked with data collection.

The issue of overworked clinicians and M&E officers was mentioned by several respondents as a major threat to data quality and to the overall success of the HIS system. As one district government respondent shared, every month "the medical officer alone has to compile the data for all the departments, and he is so overwhelmed that he often invents figures." The respondent recalled being in a hospital where the

medical officer had registered a case of yellow fever, yet this could not have been the case since this was a notifiable disease. If there had been a case of yellow fever, the reporting would have been made to the highest levels. Respondents also highlighted the lack of dedicated M&E officers to collect and enter data, resulting in clinicians doing this type of work in addition to their regular duties. Even in locations where there is an M&E officer (such as the districts), respondents worried that it was too much work for one person, who was not only in charge of HIV but also all other health programs.[2]

Data collection forms and registers are not static, since indicators can be changed, added, or removed in response to national and international priorities. Paper forms must be adapted when these changes take place, which was another challenge that respondents mentioned. There can be significant delays from the time a change is made at the national level to when the updated forms reach all health facilities. One nongovernment respondent said, "Sometimes we find ourselves at the sites with old versions of tools because of the shortage of the current version" and that there is still a question as to "who is responsible for the reproduction. Is it the government or the organizations?"

Limited Funding and Infrastructure

The discussion of funding was not limited to the printing and distribution of the paper forms. There were also concerns about funding other important components of the HIS intervention and the overall sustainability of the interventions. One of these components is supportive supervision, which respondents agreed is critical but not always prioritized. This was explained by a district-level government respondent when asked how often supportive supervision was conducted:

> *When we have time, it is done. But, there is always the problem of time, and that of means to go there. In the district, we only have one car. Even with the car, you must have funds to buy the fuel so that you can go to the sites to do coaching. We have a supervision scheduled, just now, with regard to PMTCT family planning. But our DD* [District Director] *went to China. The only car we have at our disposal is in Abidjan. The one here is an old car that is in poor condition. So we are here, and we cannot move.*

This quote highlights many of the challenges to implementing supportive supervision. Even so, respondents like this government employee felt that the supervisory process had been improved by the implementation of tools like DHIS 2 since "once the supervision teams arrive, the information already extracted at the central level can be compared with the information at the supervised level without any gap."

There were also ongoing concerns over the lack of funding to purchase computers for all facilities in need. Some respondents had participated in the development of guidelines to determine when a site should be computerized, which this nongovernment employee described as "when you have a site that has more than 100 patients [active on ART], the site must be computerized." However, the respondent continued that presently, "due to lack of means, we have sites with more than 100 patients that are not computerized." Another district-level respondent commented that it is sometimes a challenge to install the electronic tools at facilities, since many of the computers being used to complete health data entry and analysis are the staff members' personal computers. These limitations affected respondents' productivity, and as one government respondent shared, the work they are expected to perform "requires a number of modern tools, because computers need to be updated; you found that at the time of installation, the computers we had were not able to support the software." This type of situation had led them to redeploy

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[2] PEPFAR has advocated a specific policy change that would result in an M&E officer job description being included in the MSHP's official policy on human resources for health; while inclusion in the official health personnel rubric would facilitate hiring these officers, the MSHP has hesitated to make it official, presumably due to the associated financial obligation and competing budget requests across health areas and health regions.

staff, since they would not be able to perform their assigned duties without a functioning computer with installed software.

Infrastructural problems such as the limited Internet coverage and frequent disruption in Internet services were also mentioned by multiple respondents. This was despite several respondents citing use of the Internet as an improvement over previous systems: "With DHIS 2, there is no risk of data loss, since it works with the Internet," said one district-level government respondent. Another reminded us, "We are facing an Internet connection problem, so it will be difficult for us to collect the data. But you know that the advantage with technology is that you can access data anywhere with the Internet." Thus, while users indicated that having the Internet as a means of accessing the data was helpful, they were also frustrated that the Internet connection could be unstable, especially in more remote areas.

Sustainability of Interventions

The sustainability of these interventions is a constant concern, given that most elements required for an effective HIS are not one-time investments. Software and hardware must be continuously updated and replaced. People must be trained and re-trained, particularly in cases where there is high staff turnover. These concerns about sustainability were expressed not only regarding the HIS interventions but also the entire HIV program. As a nongovernment respondent soberly put it, "To pay for antiretroviral drugs, we wait for money to come from outside. If today PEPFAR and the Global Fund do not pay for ARVs, I can tell you that we will collect bodies in the streets."

Other nongovernment respondents also discussed the idea of the government taking full ownership of these activities and lamented that with donor assistance available, "The Ministry doesn't have any motivation to take the costs in its budget," and that there is not currently a strategy in place to ensure that this happens. This concern about the government not taking full ownership was expressed by at least one government actor as well:

> *The State must therefore be prepared to finance the maintenance of IT equipment but also to update staff training plans, which is also the other side of the coin, because we should not always rely on the partner, they helped us get started but they will not always help us pay for computers or train our own workers, it is up to us to manage that.*

Staff turnover is also a threat to sustainability. As one national-level government respondent said, "We have a small team, even if this team is threatened at times by turnover." Loss of staff can be disruptive to the work at all levels of the health system. People leave with the skills and knowledge they have gained, which requires new people to be trained and to learn their new duties, which can lead to delays in HIS interventions. This issue was a concern expressed by all types of respondents, including those from nongovernmental organizations: "We train a lot, but after that, even if we have a very high turnover, the partners come and take [people]." It is clear that despite planning and funding for training, there is no guarantee that the cadre of trained employees will remain on site or in the same organization.

Interaction with Implementing Partners

The relationship between implementing partners (IPs) and other organizations, including the government, was another factor. The HIV program in Côte d'Ivoire, as in other countries, has many stakeholders and actors, with everyone feeling the pressure to show results. As one nongovernment respondent remarked, "We all know today that the three 90s are no longer a matter for the partners but rather for the whole of Côte d'Ivoire, so the pressure is at all levels." Partners and donors are viewed as an integral part of combatting the epidemic, and there are many priorities that must be balanced. Ambivalence about partners is evident as well, in that stakeholders appreciate the work they do but also express some resentment regarding the amount of authority they have. "The partners exert pressure on the central level, which in turn puts pressure on us," said one district-level government respondent.

The considerable pressure of donor requirements on the HIS system contributes at times to the burden of data collection and the proliferation of individualized data collection systems. Despite the extensive interventions implemented in Côte d'Ivoire over the past 10 years to strengthen the national HIS, parallel or complementary tools are still being used by the IPs because, as described by a nongovernment respondent, "the national tools don't capture everything PEPFAR asks for, and PEPFAR is in a constant state of change." The topic of IPs' additional tools was mentioned by government and nongovernment respondents alike, at all levels. For example, a regional government respondent said:

> *Implementing partners do have their own information gathering systems that are somewhat parallel. They use the primary tools of the* [national] *system, but alongside these primary tools, they have other data collection systems that are perhaps led by their donors, who ask for a certain amount of information that we perhaps consider to be of little relevance at the national level.*

Partners were reported to be aware of the problem, but no potential solutions were cited. This matter is not restricted to HIV data needs. For example, a multi-lateral funding organization had recently begun a program in Côte d'Ivoire and had set up a parallel system to collect data, "But the real problem is that this system remains a parallel system. We would have liked to integrate these data in DHIS 2, that's our biggest challenge."

When asked about improvements in data quality, one respondent stated that they had observed great improvements in PEPFAR-specific data. One reason for this could be that IPs also have additional resources that they can commit to the sites where they work, such as supporting salaries for data monitoring assistants or data clerks. The role and its benefit are described by a nongovernment respondent:

> *The fact that we have human resources dedicated to data management activity makes it possible to have better results because the AMD* [data clerk] *at the site assists providers in the use of data collection tools, accompanies them in the preparation of the counseling and testing report and the PMTCT report, as the data are available.*

This means that the sites that have data clerks will be able to pay closer attention to the quality of the data being collected, transmitted, and used. But the data clerks are not in every site: one respondent said that the decision to place a data clerk at a site depended on the number of patients and the availability of resources. For example, when the site has 400 active patients, it is clearly justified; however, they argued that mobilization of a data clerk could also be justified when there are 200 active patients, but this is not always possible.

This also means that unlike DHIS 2 data, IPs with a mandate to provide technical assistance to clinics have access to the patient-level data in SIGDEP 2, since this is generally managed by the data clerk. As one district government respondent said, "They [the data clerks] have all the HIV data, since the management belongs to them. Often, when we need data, we turn to them. When we do not understand much, it is these people that we will see." In fact, district-level respondents claimed that they did not have a lot of knowledge about SIGDEP 2, since it was a site-level tool that was mostly managed by the partners.

Barriers to Data Use

While respondents felt that there had been some improvements in data use with the implementation of various HIS interventions, it was still generally felt that many barriers still existed with using the government HIS system. Although many improvements have been observed, they may not have reached the threshold necessary to see changes in data use. Barriers to data use were categorized into real and perceived data quality issues, lack of a data use culture, human resources challenges, and lack of supervision and coordination.

Real and Perceived Data Quality Issues

Data quality is a key consideration. Although it has improved, it continues to be a reason for low data use. The threats to data quality are discussed in Box 1. While some respondents provided examples of the data quality issues they had encountered, some felt that the actual improvements have not been well advertised and, therefore, stakeholders still assume that the quality of the data is poor. One government respondent indicated, "We often hear that 'in Côte d'Ivoire, the data are not reliable.'" In addition, while timeliness has gotten better, it could still be improved. As one government respondent said, "The biggest problem at this level is the promptness that has improved but has not yet reached the optimal level. Therefore, already, this situation creates a small brake to the systematic use of the data that are in the platform." There was also concern that the national HIS system does not contain all of the PEPFAR indicators, which has led to the creation of complementary/parallel reporting systems, as discussed above. This included the prioritization of Excel tools developed to inform data validation meetings.

Culture of Data Use

Respondents indicated that often the system was not maximized, as demonstrated by the fact that there is not yet a culture of data use at all levels. Some shared that only national-level indicators requested by donors are used. In addition, there was very little discussion of lower-level indicators, the reasons behind successes or challenges, or why there are some low outcomes at the district level. One of the nongovernment respondents explained, "We have a dashboard at the level of the regional directorate which is really very poorly used, because we only extract information related to global, not specific, objectives." Some respondents shared that the data were mainly used by partners and not by the existing health facilities. They also felt that low data use resulted from a misunderstanding between data use and presentation, and some equated presentation to use. Although data were analyzed and presented, little else was done with them, such as using them for decision making or improving health systems. One of the nongovernment respondents shared that:

> *In terms of analyzing and presenting, it is available anytime. Now what do we do with it? This is where major challenges still lie. The challenges that exist are that today, when you consider even the peripheral-level health facilities, outside of HIV,* [which] *thanks to the support of partners, benefit from data reviews, I do not often see the facilities themselves sitting down to do a frank review of their activity data. I do not see it very often, but everything we capture has to be analyzed in order to make decisions.*

This quote highlights a couple of issues. One is that once data are presented, there may not be any further analysis of the reasons behind low (or high) performance in key areas of health. Another issue is that non-HIV health data may not be getting the same level of scrutiny, because there is not the interest or resources.

The same respondent suggested that the system was not maximized, because there was a lack of interest at lower levels. The lack of a culture of data use at all levels—not just at lower levels—was mentioned by another respondent, who explained that data use is relatively new, thus not sufficiently developed. To develop this culture, the respondent said, more individuals need to be trained on using data beyond giving presentations at meetings. A nongovernment respondent explained that "we didn't used to have data, but now that we have it, we need to use it. We have trained people in collection and data use; how to transform the data into action is something we need to do." Another felt that in addition to the trainings, there needs to be a culture shift on the importance of data at all levels. Some respondents were frustrated that they could not mobilize staff at lower levels to be more proactive in their data use practices. For example, one nongovernment respondent said, "We sensitize the public service managers, but they do not enter [data] […] They enter data when they want, and they come up with arguments such as the

computer is out of order, while the computer is not out of order; they don't want to enter the data. We have done the awareness raising."

Human Resources

Many respondents reported the lack of capacity and human resources as a barrier to data use, which may also be linked to the struggling culture of data use. They felt that often there is a lack of personnel to analyze the data. Some indicated that there were not enough personnel to support the data collection and use process, or that personnel were available but were not trained. One nongovernment respondent shared, "It is necessary to really have human resources dedicated to the preparation of reports. This enables following up with the provider to see at the end of the day, if the tools are well filled out… So we need people who will be able to capture this information, report it, and also support them in analyzing the quality of the data. We really lack this."

Some of the respondents felt that even when people are trained in M&E or data collection, only a small number are trained to use the data. A government respondent felt that as a result, "Workers are over-stretched, and that is the real problem. Otherwise, we know there is data that should be analyzed." This problem of a small number of trained personnel exists at all levels, including the national level. In some cases, there is only one staff person trained on data collection and use, so if that specific person is not available, no progress is made.

Lack of Supervision and Coordination

A number of respondents agreed that some of the issues with low data use stemmed from the lack or low levels of supervision and coordination of different aspects of the data collection process. They suggested that lack of supervision and coordination did not improve the human resources dilemmas and even led to underutilization of the HIS software and poor data quality. A nongovernment respondent explained that although there is some supervision, it is not enough, and there is no accountability. The respondent felt that if expectations for each level were developed and integrated into the appraisal of job positions, supervisors would ensure that quality data are collected. The respondent shared that:

> [If] *structures have assigned results that could be achieved at the central or regional level, and peripheral level, it is pretty clear that things will be done. Like supervision, if you are told that you must supervise at least 75 percent and that this is part of your evaluation, for example, you will supervise people. So I admit that the* [data] *use is a real problem.*

This speaks to the need to have more accountability across the health system to ensure that personnel are making data-informed decisions at all levels.

HIS Interventions and the Health System

Respondents were asked about the role of other health system functions in the success of the various HIS interventions; as the HIS is just one part of the health system, the success of the HIS interventions is dependent on the strength of the whole system. Respondents often mentioned other health system functions when asked about how the HIS interventions affected HIV testing, treatment, and viral load. For example, when asked about how HIS interventions affected viral load testing, a nongovernment respondent focused on the importance of having more laboratories with trained technicians who could conduct viral load testing: "In terms of viral load for patients, laboratory technicians in our labs are trained […]. In the past, […] we had to send the samples to Abidjan. Today we do it on site and it allows service availability at the level of viral load." They felt that human resources, governance, the availability of medicines or vaccines, and service delivery practices affected the implementation and use of the HIS

interventions to varying degrees. They also acknowledged that the improvements of the various health systems functions did not happen in isolation, and an improvement in one could improve the other.

Human Resources

Many respondents indicated that an intervention was successful because of the concerted effort to train health personnel on the use of the various interventions and the creation of new roles linked to the use of the HIS tool. "We need to recognize that success of any activity depends on human resources," said one regional-level representative of a nongovernment partner.

Between training and creation of new roles, more respondents discussed the impact of training sessions on the interventions' success. The capacity of the staff at various levels was strengthened, and trainings were held for staff members depending on the HIS intervention. Respondents felt that this improved the quality of their reports, improved the available services, and in some cases, expanded the range of services provided. Another respondent felt that the introduction of the DHIS 2 led to the identification of gaps in the capacity of the health personnel and that training staff members improved their output. The nongovernment respondent said, "I think it was the software that captured this information there, and after analysis it turned out that he [a staff member] needed training that will be corrected very quickly. So, for me these software programs allow on some level the ability to solve problems when the analyses are done." In some districts, roles such as head of M&E were created specifically for the HIS intervention.

Although many respondents noted positive attributes of human resources, there were equally as many human resource-related problems identified. Some respondents felt that there was still a lack of qualified personnel, which stemmed primarily from the lack of funding and overburdened existing staff. They also suggested that the low numbers of personnel were due to funding issues. They felt that the creation of new roles did not happen at every health facility and that these added roles should go beyond data analysis. One government respondent said:

> *There is not enough staff for services in general, and exclusively staff dedicated to health information management. At this level, they are insufficient in number. The computer tool has not long been used in the processing of health information. It is difficult today to have a CSE [conseiller suivi et évaluation,* or data manager]. *Human resources are lacking.*

The general feeling is that training must be ongoing, given the issue of staff turnover discussed above. Respondents expressed a shortage of trained personnel, and when they did have a trained person, there was a threat to the continued use of the electronic data collection system if the person was transferred, sick, or went on leave. These gaps in human resources have ramifications for the use of the HIS, and the timeliness, availability, and quality of the data produced from the HIS system.

One nongovernment respondent also lamented the way human resources were distributed throughout the country and felt that it was not equitable in all regions of the country. He was specifically talking about clinicians, but even the case of clinician distribution can also affect the use of HIS, since in many facilities it is the clinicians who are responsible for data collection and submission. He stated:

> *We realize that the distribution of human resources is not in conformity with that defined by WHO* [World Health Organization]*, because these resources are concentrated in the South, in the capital, but within the country we do not find the same number. There is no balance between the ratios, which has a negative impact on patients' access to health care providers.*

There may be reasons for this unequal distribution, e.g., greater population density and greater health needs; nonetheless, this is problematic when trying to achieve health goals equitably across the country. It

also gives the health workers in the other regions the impression that their region is being neglected, which can affect morale and worker productivity.

Governance and Leadership

Governance and leadership were mentioned by respondents as being important to the implementation and success of any HIS intervention. Not surprisingly, there were varying opinions on how this has been managed in Côte d'Ivoire. Respondents shared that leadership from the government and the provision of the necessary tools, equipment, and resources facilitated successful implementation of HIS activities. One government respondent provided a detailed response as to what was needed to have strong leadership:

> *For leadership, you still have to have a conducive environment, you have to have administrative arrangements that allow it because if you are the head of a health district, and you do not share your district's vision with your collaborators, you cannot be a leader; because it is when you share the vision of the district and that vision leads your collaborators to support you. So I think it's the work environment that reinforces leadership. If you are self-centered, you will not be a good leader because you cannot gather staff around you. It is when you are transparent, you delegate tasks, you motivate your initiatives, you encourage good practices that things develop, and there are a number of factors that reinforce leadership.*

Two respondents working with DHIS 2 suggested that good governance was manifested in the government's commitment and enthusiasm in implementing the system. One government respondent said:

> *They* [the government] *were really interested in making it go fast, and we were also going to adapt according to the new directives.* [...] *All this really created an enthusiasm around use.* [...] *Everyone was really mobilized for the deployment of the platform, and the deployment was really successful.*

This respondent felt that there was strong leadership to carry out these activities and listed the specific guidelines handed down from the MSHP to allow technical partners to carry out the various HIS initiatives as examples of this leadership. However, some nongovernment respondents felt that national leadership and vision was sometimes lacking, with one person commenting that HIV was not the minister's priority and that it was difficult to get his attention. It was also evident that the decision to implement the various HIS interventions came from the central or national level, and the districts were expected to follow the directive. As one government respondent said when asked about the district input into the use of various interventions, "The district has nothing to say. When they simply say you have to come for training; [they say]—this is the new software you have to use to enter data. It comes from the central office." Still others talked more specifically about leadership at the district or regional level, which was supportive of the HIS interventions once it was decided at the central level to implement them.

A few respondents perceived challenges related to governance. One respondent felt that the poor management of an intervention led to a lack of interest from staff members; consequently, staff capacity was not maximized. A nongovernment respondent said, "Site managers' poor management of their employees pushes people more or less to not really express themselves. So we cannot really know if this person X or this person Y really masters the tool." The respondent also acknowledged that this was not a problem in all facilities or districts.

Some respondents were also concerned with mismanagement of resources. For example, one nongovernment respondent discussed the financial support received from IPs but noted that upon arrival at their sites, the requisite equipment and materials may not be available:

> *The negative aspect is that the partner puts funds at our disposal for the implementation of a certain number that will facilitate our work but once on the ground, we often find with the greatest sadness that these tools are nonexistent. This means that funds allocated for the purchase of certain tools are either diverted or poorly managed such that tools are lacking in the field.*

This poor management was noted at all levels of the health system. Another respondent further explained that sometimes the funds are not equally distributed within the health sector, which affects the unequal distribution of health providers and needed resources in the country.

Availability of Medicines and Vaccines

Many respondents measured success by the ability to use the HIS tools to predict the demand of medication based on the number of active patients. The availability of medications was integral to controlling the HIV epidemic and achieving viral suppression. An accurate prediction would ensure that the correct amounts of medication are requested from the central store, and having these distributed in a timely manner to facilities could prevent stockouts. One nongovernment respondent described working with an IP who "provides information, and that allows us to know the areas where there are medicine shortages and the areas where there are overstocks. Then quickly the deficit is filled. We take some from the other side and supply the site that was in need."

Respondents also reported several issues with the availability of medicines and vaccines and noted that sometimes mismanagement leads to these problems. A nongovernment respondent explained that poor management leads to stockouts or a surplus of medication at risk of expiring. The respondent described a need for "better distribution of resources, but the resources may not only be money, but I mean in terms of distribution of drugs throughout the territory, and then the very management of these drugs. Because it is not normal that there are stockouts in one site while in other sites there are expirations or the risk of expiration of medicines."

Some respondents indicated that there is sometimes a shortage of commodities and medications, including malaria prevention drugs for pregnant women. Two respondents explained that this could lead to facilities being parsimonious with their stock of medications, which can affect the continuity of care. They felt that facilities sometimes withhold larger, longer-term refills of medications from patients because they are worried about stockouts. This fear of having stockouts was also cited as a barrier to implementing national HIV policies. One nongovernment respondent discussed encountering this concern when simultaneously trying to maintain fidelity to the Test and Treat policy and the differentiated care model. The latter attempts to reduce the frequency of clinical visits and increase the supply of ARVs from one month to three months for patients whose clinical status does not require an in-person checkup:

> *At the level of new policies, if we take Test and Treat, at the same time that the person discovers his positive status, we must treat him. […] With the differentiated care model, stable patients have a certain number of drugs they must be given. It turns out that for the sites, they do not, in fact, want to practice the differentiated care model, because normally when the patient is stable, we have to give him a certain amount of medication so that he does not* [have to] *come back all the time. But unfortunately, sometimes we give it for a month, because we are afraid of stockouts.*

This quote highlights the interconnectedness of all the health system functions in terms of having a system that tracks medications, a drug distribution system, and a policy in place to help improve outcomes of people living with HIV. In this case, stable patients may be at risk of nonadherence if they have to return to the clinic for their medications monthly rather than every three months.

Health Financing

Some of the concerns with health financing were discussed above in the section "Sustainability of Interventions." Additionally, two respondents specifically suggested that funding contributed to the success of the interventions in enabling the hiring of personnel, the acquisition of equipment, and subsequent training sessions. One of the respondents also suggested that the funding appeared at different stages of the intervention. The government respondent said:

> *We have had the contribution of certain financial partners. Even those who were not at the heart of the project at the beginning. At the implementation level, we saw some who systematically used their resources to deploy this platform in their support area or also some who made equipment available for the implementation of DHIS 2.*

Respondents felt that funding was also a source of challenges in implementation for several reasons. Some explained that funding was needed for all aspects of HIS interventions, including equipment, infrastructure needs, medication, human resources, and service delivery. However, fluctuations in funding slowed implementation of some interventions. One nongovernment respondent familiar with DHIS 2 shared that "I think for DHIS 2, we took some time to buy the servers. We had to buy them, and then we had to train people, we had to have the money. So the DHIS 2 process took time, if only for the acquisition of the equipment. And then, once we had it, to mobilize funding for training, that took time."

Another nongovernment respondent further explained that in addition to inadequate financial resources, some respondents suggested that there were delays in disbursement of funds, which consequently caused other delays. The respondent said that "delays, donor deliveries, government purchase may be delayed." One respondent also suggested that delays in funding were the result of an overdependence on external funds. This nongovernment respondent said, "We are highly dependent on external sources" for ARVs and for implementing HIS interventions. There seemed to be an uneasiness about relying on the Global Fund or PEPFAR to fund many of these interventions. But even with this substantial support, respondents still felt the financing was stretched.

Service Delivery

A few respondents felt that the HIS interventions had improved service delivery, which is crucial to retaining people in treatment and achieving viral suppression. One government respondent felt that DHIS 2 gave them access to data used to make more informed decisions concerning service provision. The respondent said:

> *There is better health service delivery thanks to this application in the sense that data analysis is easily done with DHIS 2. We can easily conduct the analysis of prenatal consultation data for example; HIV data to see good performance and make decisions to be able to act on providers or supervisions, so indirectly the software can influence the delivery of different structures.*

Another respondent further elaborated that the HIS tools enabled them to identify gaps in their service provision, resulting in a redistribution of the roles of health personnel to address these gaps.

Importantly, some respondents felt that the lack of integration of the various HIS tools used affected service delivery efforts. Although in some facilities all the HIS tools were available, one respondent felt that the tools used in the different facilities and districts did not "talk to each other." Using the HIS tools in isolation led to unnecessary duplication of efforts in following patients and sometimes led to misuse of the limited resources available. The nongovernment respondent explained, "It is true that there is SIGDEP, but we have the same person on the active [HIV] patient list in Dimbokro, we have the same person in Abidjan, the same person in Korhogo. This means that in the end we have five people, when actually it is the same person that goes [to each of these different clinics]." To address this, the

respondent suggested that a unique identifier coding system should be used at the national level, which would allow health providers to better follow up patients. The respondent further explained that this would be important when following HIV cases "so that this person, tomorrow if he/she is HIV positive, can keep his same number; even if we can have a partial code and tomorrow if the person goes elsewhere, the same number follows him, to avoid all there is, such as counting and other [data tasks], which can be a barrier to decision making."

Contextual Factors

Respondents discussed many contextual factors that are important to consider when weighing the success of HIS investments over the past 10 years, including donor support and partnerships, government policies and infrastructure, and environmental and political climate. Although not every respondent discussed each factor in detail, they mostly agreed that all contextual factors have an influence on outcomes, are interdependent, and should not be taken lightly. These topics are discussed in the following section.

Donors and Partnerships

The theme of complicated relationships between the government and its partners described in a previous section was considered a very important contextual factor. The donor and partner relationships were seen as very valuable, since many of the HIS interventions could not be implemented without them, but that also meant that donors had a significant influence on what they thought the country's priority should be. One respondent stated that HIV was not the priority of the MSHP, but it was the priority of PEPFAR, an example of how national and international priorities may not align. Yet, donors provided funds for computers, equipment, training workshops, software updates, and Internet connectivity. Others emphasized the importance of technical support from donors and partners outside of funding. The donors and partners shared their skills and expertise from implementing similar interventions in other regions and developing HIS systems. One government respondent explained that this strengthened the system and "helped to improve reporting, i.e., timeliness and completeness."

There was also concern among some respondents about the exclusion of some key health stakeholders, mainly the private sector and community groups. One nongovernment respondent shared that there is also unequal distribution of HIS interventions between the private and public sectors, and often the private sector is left out. This affects the success of the system because "if the private sector does not benefit from it [HIS interventions], why would I [the private sector] be interested." Thus, the private sector would have no incentive to participate in the improvement of the health system if they are not included in the planning and discussions of improving the HIS. One nongovernment respondent noted the importance of including stakeholders from the private sector in the development of national policy. This garners the support of the private sector and encourages their participation even if they are not funding recipients. The respondent explained that if "the private health sector does not feel or is not sufficiently taken into account in public policy and guidelines at the health level, it can have an impact, because we do not really feel we are taken care of. When we look even at the PNDS [National Health Development Plan], etc., we are not sufficiently supported, so it can have a negative effect."

Community workers also felt excluded from many of the HIS interventions. As a nongovernment respondent said, "So today when you use some software such as DHIS 2 and OpenELIS [electronic laboratory information system], the community workers don't have access to these tools, we don't even know how it works." However, it was felt that community workers needed to know how these systems work and to have access to the data, since they are an integral part of controlling the HIV epidemic.

Government Policies and Infrastructure

Another contextual factor reported was national-level policy. Respondents felt that the most influential factor was whether a policy had government priority. They explained that for health policies to be implemented and succeed, they would need to be a priority for the government. One government respondent noted that "in government policy, if health occupies a prominent place, it is certain that the health sector will be of quality." Such policies can provide clarity in the strategies used when implementing procedures that are critical to the health system. A nongovernment respondent described, "Any success begins with a clear policy. And I think that the State [national government] must first be able to adopt a policy aiming to integrate HIV into the implementation of activities so that everything that follows can really be done successfully."

The respondent further explained that policies could boost morale in the workforce, as has occurred with previous policies. Others agreed that policy had the potential to boost morale among the health workforce and encourage continued engagement of this workforce. Some respondents talked about the "Road Map" that was developed by the MSHP that helped health personnel understand their larger contribution to accomplishments in the health system. As one nongovernment respondent said:

> *We had the impression that HIV activities were the partners' business, but since I would say six months ago and very recently with the Road Map, the context has changed. In the past, when my employees went to a site and witnessed that a provider was trained but did not conduct the activity, you didn't have other means and so the departmental director, I would even see him, but… But since the Road Map was given and they are bound by objectives and they will be evaluated at the end of the quarter… things have really started to move. I was in a district where the director told me that now when he goes to bed he thinks about his results. That was not the case not so long ago.*

Another further explained that policies, specifically the Road Map, could assist in the proper disbursement of funding because the policy provides guidance on the objectives for health system strengthening. If the policy is not followed, it is also important that the necessary sanctions be applied.

Political Climate

The environmental and political climate of the country were also cited as very important contextual factors that could have positive and negative effects on the health system. The political climate is influenced by who is in power, and changes in national political leadership often lead to changes in key ministry positions. Some individuals in the Ministry can be champions for specific HIS interventions and can move the planning and implementation process forward. An intervention can be greatly delayed if the champion is lost. As one government respondent explained, "Political will is an important factor in the implementation of programs, because decisions are made by the central administration before they are implemented." A positive political climate will enhance the implementation of an intervention.

Conversely, respondents were keenly aware of how political unrest can completely disrupt civil life, including the provision of health services. One nongovernment respondent recalled the political crisis of 2010:

> *When I think of the crisis we experienced here in 2010, the situation was very difficult in any case, in our zone particularly, for activities, for interventions and all that, and so the crisis is something we do not want because even for the delivery of ARVs it was very difficult here. Fortunately, in any case in [this health] zone, the peak of the crisis lasted between 3 and 5 days. But if it had lasted longer it would have been difficult for patients and at the same time for data collection. But it lasted three to five days, and in any case all health providers were allowed to go about their work.*

The crisis affected all aspects of the health system: computers were seized, resources were lost, service delivery was slowed down or suspended, and the use of HIS tools was suspended. It disorganized the health system, and even if patients sought care, no patient records were available. One government respondent explained, "I was in the CNO [Center North West] zone. When you are in these zones, nobody has any information on you [as the patient] regarding health, and this deeply affects the HIS." They all agreed that political stability is vital, and thus, "Peace is necessary for the continuation of activities."

DISCUSSION

While there were some caveats, the overall sentiment among respondents was that HIV-related HIS in Côte d'Ivoire has seen tremendous improvements over the last 10 years. The standardization of indicators made it possible for all facilities across the country to collect the same information, and implementation of PRISM, DQAs, and RDQAs has contributed greatly to the improvement of the quality of the indicator data collected. The adoption of electronic tools like SIGDEP 2 and DHIS 2 that used open-source platforms has also increased the availability of data, the quality of data, and to some extent, the use of data. There have been many changes, but some of the key issues remain regardless of the platform being used for data collection and transmission. The following are some key points:

- Improving data quality is a perpetual effort. While there have been great improvements, the struggle to maintain high-quality data is never-ending. Key stakeholders, including from government and donors, must accept that this is an ongoing investment. Even with all the improvements, many challenges were recorded that warrant further attention.

- Data use is hard to measure. Some respondents questioned the assertion that the government system was underutilized and not informing decision making. However, almost all agreed that measuring data use is difficult and that many instances of data use occurring at all levels of the health sector may not be being captured.

- While there have been tremendous investments in electronic solutions that require significant procurement of hardware, it is important not to overlook other critical activities that are part of HIS improvement, such as supportive supervision. This requires people's time and transportation. It can be easy to neglect these visits, but they play an important role in providing feedback to lower levels of the health system, which can lead to improvements in the overall HIS. These visits also help connect the dots for workers at lower levels in terms of their role in the HIS.

- The human element is an important part of the Health Information Systems Strengthening Model, because the HIS cannot function without people implementing these interventions and using the data for informed decision making. This means that people need to be trained, assessed, remunerated, supervised, and informed of how the health system is progressing in achieving its goals.

- HIS investments must be put into the context of the entire health system. There are six core functions of the health system, as discussed in the Introduction, and the HIS interventions will be affected by and will affect the other core functions of the health system. An intervention in one of the core functions will only be as strong as the health system that surrounds it. For example, data management personnel roles are not codified in the health system. Once they are codified, the MSHP could allocate budget line spending to support those salaries.

- Given the nature of the work, there is a tremendous amount of coordination that takes place between the central government, the various levels of the government health system, nongovernment actors (i.e., local nongovernmental organizations and the private sector), and the international donors and implementing partners (Figure 2). This also means that there are tensions between all of these sectors as they try to navigate sometimes distinct priorities. These exist in all development programs and need to be addressed.

Figure 2. Relationship of central government and stakeholders
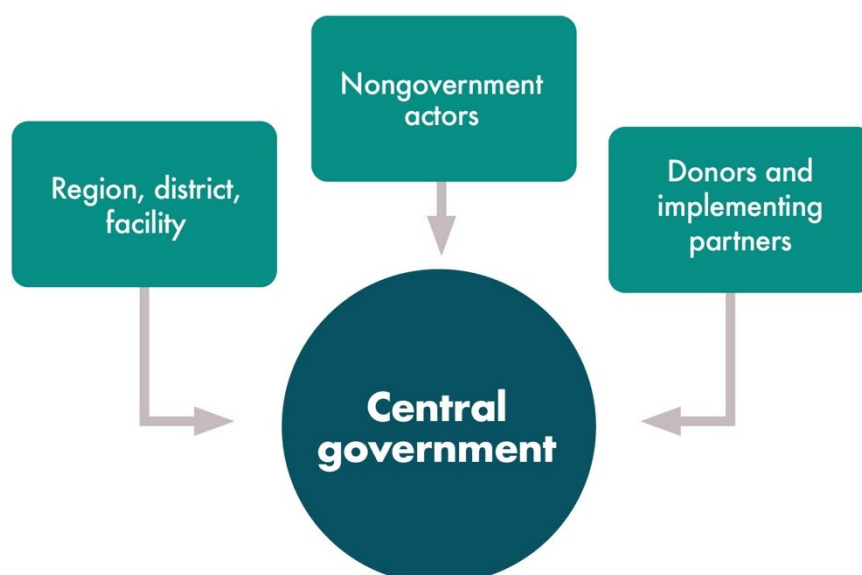
- Interoperability between SIGDEP and DHIS 2 is a need described by the respondents that MEASURE Evaluation has been funded to implement. The "culture of data use" goes beyond understanding how to extract report data; this understanding and skills building exist at some levels—primarily among IPs and at higher levels of government, but at the district and facility levels skills may be lacking. The beneficiary focus of training activities along the data use continuum in Côte d'Ivoire has been regional and national, with peripheral levels tending to express a more limited understanding of the principles and possibilities of applying data to decision making that could contribute to ending the HIV epidemic.

- For most of the life of PEPFAR, the private sector in Côte d'Ivoire has not been a focus of HIV planning and programming. With an estimated 50 percent of the population seeking health care in the private sector, this is an important partner in ending the epidemic. Private sector representation has indicated interest in further PEPFAR and government collaboration on HIV programming going forward.

- Many respondents benefitted from M&E trainings in the past, and these respondents demonstrated a clear understanding of HIS data needs in-country.

RECOMMENDATIONS

- Continue to fund interoperability efforts if they are not yet complete, specifically between SIGDEP 2 and DHIS 2.

- Encourage discussion across stakeholders to further streamline data collection efforts, reduce the need for supplemental data collection platforms among implementing partners, and identify means for the government to adequately share data regularly and in a timely manner with stakeholders, such as community and private sector partners that may not contribute data to the national DHIS 2 database.

- Continue to fund or increase funding for supportive supervision down to the facility level.

- Adopt and fund an official data manager (or similar) position within the government health structure.

- Explore ways to broaden inclusion of the private sector in HIV elimination efforts.

- Consider the benefits of funding in-depth M&E training for people in positions of leadership. Even if they do not remain in a current position, many personnel that have been trained in the past are still operating in the field of HIV. Contributing to a cadre of health administrators and policymakers that have this background can only benefit efforts to end the epidemic.

- Visualize saturation as the goal of developing a culture of data use. The people producing the data at the facility level must understand the connection between data collection, program shifts intended to improve performance, and improved health outcomes in their local population and beyond.

CONCLUSIONS

The HIS of Côte d'Ivoire has seen many improvements in the past 10 years, but challenges remain. For example, there have been many efforts to improve data quality and there is evidence of improvement, but this is a difficult and continuous task. Sustained efforts are needed to maintain what has been achieved and to continue working to improve the HIS and the entire health system to successfully manage the HIV epidemic. It is clear from this research that there is a commitment in the country to data quality and data use, including investing at the facility level, the acknowledged source of data generation and key influence on data quality. Stakeholders understand the need to continue efforts to develop a culture of data use that will result in a corps of health providers and policymakers that is well-positioned to make data-based HIV programming decisions. Stakeholders at all levels of HIV programming perceive the value of these investments in Côte d'Ivoire's HIS and their link to achieving the Three 90s and subsequent control of the epidemic.

It is also critical to view any improvements in the HIS in the broader context of the entire health system and other social and political factors that can either be supportive or prohibitive of HIS success. Many of the lessons learned in Côte d'Ivoire can help other countries at different stages of their HIS development and in the HIV epidemic. Therefore, it is important to disseminate what has been learned in this context.

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APPENDIX A. INTERVIEW GUIDE

[Read aloud] I am going to read a list of major HIS interventions identified through document review. Please indicate whether or not you implemented this HIS intervention, was a beneficiary of this intervention (for example participated in a training or used a tool developed by the intervention), heard of the intervention, or never heard of it. Once we have identified a few interventions that have directly impacted you, we will focus our interview on those interventions.

[Ask the following questions for the HIS intervention from which the participant has benefited or that the participant has implemented]

1. What were the specific activities of the intervention?

    Probes: for example, were there: trainings, tool development, technical working group creation, assessment of current situation, procedure development?

2. Can you tell me about any policies, strategies, or guidance that facilitated this intervention? Follow-up question: What kind of leadership was necessary to implement this activity? Was there a champion for this activity?

3. Do you think the activities of the intervention were implemented as intended? Were there any delays or situations when the activities were not fully implemented?

4. How do you think the activities affect HIV data collection? How do you think the activities affect HIV data collection? For example, did it affect the forms used for data collection? Did it change data was collected (paper to electronic)? Did it affect how often data is collected? Other ways?

5. How do you think the activities affected HIV data availability and quality?

    Probes: was it easier to access the data from various levels of the health system?

6. Do you believe this intervention led to changes to how data was used? How so?
    Probes:

    a. Synthesis
    b. Analysis
    c. Decision-making
    d. Policy change

7. Were there any changes in data management in terms of

    a. Data flows?
    b. Data quality supervision practices?
    c. Responsibilities in data management?

8. How did the activities affect data analysis practices?

   Probes:

       a.   How did responsibilities change?

       b.   How did timelines change to accommodate analysis?

       c.   Did the activity involve new Software?

       d.   Did staff have to acquire new skills in order to work with data?

9. How did the activities affect the dissemination of information to those who needed it most?

       a.   Can you provide an example? Tell me about it.

10. How do you think the other health system functions (human resources for health, health service delivery practices, availability of medicines or vaccines, health finance, or governance) affected the success of the intervention?

    For example, were there any critical issues in the type of staff available to implement this activity? Were there other interventions happening to improve service delivery that may have interfered with this activity? Were there any major changes in the leadership of the MOH during this time?

    Follow up: How did the intervention interact with the other health system functions?

11. How do you think the intervention have an effect on health system outcomes, such as people receiving essential services, population coverage, responsiveness of the health system, or financial protections for people using the health system?

12. What were the lasting effects of the HIS intervention on the health system?

13. What were the programmatic course corrections that were made as a result of the health information system improvements?

14. What system changes were made that facilitated better HIV testing coverage?

15. What system changes were made that facilitated better retention of patients for HIV treatment?

16. What system changes were made that facilitated better viral load suppression?

17. When you think about the HIS intervention and your observations of its impacts on the health system, what contextual factors do you consider important?

        a.   Political, environmental, public health crises

        b.   Government policies and infrastructure

    c.   Public health organizations and partnerships

    d.   Donor funding availability such as PEPFAR, Global Fund

18. There has been a significant investment in the government HIV HIS systems, yet we have been told that use of the data in these systems remains low. Why do you think that is?

What are the barriers to using these systems?

What could be done to promote the use of the government system?

APPENDIX B. ORGANIZATIONS INCLUDED IN INTERVIEWS

Government	Nongovernment
United States Centers for Disease Control and Prevention (CDC)	Abt Associates Private Sector Health Program
United States Agency for International Development (USAID)	Ivorian Network of PLHIV (RIP+)
MSHP Department of Strategic Information and Informatics (DIIS)	ACONDA-VS Côte d'Ivoire
MSPH National AIDS Control Program (PNLS)	Ariel Glaser Foundation
Regional Health Office—Abidjan II	Elizabeth Glaser Pediatric AIDS Foundation
Regional Health Office—Gbêkê	ICAP Côte d'Ivoire
Regional Health Office—Gboklé Nawa San Pedro	Health Alliance International (HAI)/San Pedro
District Health Office—Abobo Ouest	World Bank PRSSE (PROJET DE RENFORCEMENT DU SYSTEME DE SANTE ET DE REPONSE AUX URGENCES EPIDEMIQUES)
District Health Office—Port Bouet-Vridi	Alliance Côte d'Ivoire
District Health Office—Bouaké Nord-Est	
District Health Office—Bouaké Sud	
District Health Office—San Pedro	
District Health Office—Soubré	

APPENDIX C. CODEBOOK

Code	Definition
Leadership	Discussions of leadership needed to implement/develop an HIS intervention
Delays implementation	Discussion of delays in any of the HIS interventions
Pre-implementation	Discussion of what the HIS situation was like before the study period
Circuit	Discussion of the circuit of data collection and transmission in-country
M&E training	National-level efforts to train staff on M&E
HIV Indicators	
Harmonization	Harmonization of HIV indicators
Standard tools	Development and deployment of standard tools for HIV indicator collection
Training on use	Training on the collection and use of HIV indicators
Revisions	Revisions and updates to HIV indicators
Paper tools	
Use	Use of paper tools
Limitations	Limitations or problems with paper tools
Versions	Discussion about the different versions of tools and how this caused problems
DHIS 2	
DHIS 2 deployment	Discussions about the development and deployment of DHIS 2
DHIS 2 use	Discussions about the use of DHIS 2 for collection, review, etc.
DHIS 2 limitations	Limitations to the use of DHIS 2. Who has access? Training? Internet?
DHIS 2 benefits	Benefits to using DHIS 2 over the previous systems
SIGDEP 2	
Precursors	Discussion of tools or what was done prior to SIGDEP 2
Limitations/challenges	Discussion about limitations of SIGDEP 2 or challenges in using it
Usefulness	Benefits or usefulness of SIGDEP 2
HIV data	
Frequency of dc	Changes in the frequency with which HIV data is collected (dc = data collection)
Availability of data	Changes in the availability of data with new interventions
Data quality	Effects of HIS interventions on data quality
Data use	Changes to data use as a result of intervention

Management	Changes to data use
Analysis	Changes to how data are analyzed because of HIS interventions
Improvements	Major HIS improvements that have been observed due to various HIS interventions
Capacity building	
Training and support	Discussion of training or other capacity building to help users
Shortage of capacity	Discussion about ongoing challenges with not having enough capacity to maintain and use the system
Information dissemination	Ways in which information is being disseminated since the interventions have been implemented
Other health system functions	These codes address how the HIS intervention affected or was affected by these other core functions.
Service delivery	
Human resources	
Governance	
Financing	
Drugs/vaccines	
Sustainability	Discussion about the sustainability of these interventions, including government ownership, planning, financing, training
Health outcomes	Improvements in population health outcomes related to HIS intervention
Impact	Discussions of the impact or long-term effect of the HIS intervention
HIV programming	Improvements or changes made to HIV programs based on data that became available due to intervention
Achieving 90-90-90	Discussion of how interventions are helping achieve targets
HIV testing	HIS interventions affect HIV testing
Retention	HIS interventions contributing to changing or improving retention
Viral load	HIS interventions contributing to changing or improving viral load
Contextual factors	Discussion of the contextual factors they see as important in the success of the HIS intervention
Political	Political factors that supported or were barriers to HIS intervention success
Environmental	Environmental factors that supported or were barriers to HIS intervention success
Donor	Donor priorities that can influence HIS investments and interventions
HIS data use	
Low data use	Reasons why they think data use generated from government systems are not used more
Examples of data use	Examples of when and how data have been used

Measuring data use	Challenges in measuring instances of data use
Culture of data use	Discussions about whether there have been changes in the culture of data use over time
Lack of coordination	Discussions about lack of coordination between various stakeholders working in HIS
System not maximized	Discussions about the SIGDEP 2 or DHIS 2 not being used to their full potential