

# Hospital Information Systems Shortage in Sub-Saharan African Hospitals: Opportunities and Challenges

Abd El Kader Moumouni<sup>1\*</sup>, Dede Regina Ajavon<sup>2</sup>, Komlan Agbeko Doleagbenou<sup>3</sup>,  
Dabou Abiba Tamou Tabe<sup>4</sup>, Kodjo Mensah Hobli Ahanogbe<sup>3</sup>, Massaga Dagbe<sup>5</sup>,  
Akoete Simon Gbessena<sup>1</sup>, Komi Amagnga<sup>6</sup>, Desama-Esso Banawe<sup>6</sup>, Tchilabalo Bamazi Amona<sup>6</sup>

<sup>1</sup>Department of Surgery CHU Kara, Kara, Togo

<sup>2</sup>Department of Gynaecology and Obstetrics CHR Tomde, Kara, Togo

<sup>3</sup>Department of Surgery CHU Sylvanus Olympio, Lomé, Togo

<sup>4</sup>Radiology Department CHR Tomde, Kara, Togo

<sup>5</sup>Radiology Department CHU Kara, Kara, Togo

<sup>6</sup>Department of Network and Computer Maintenance CHU Kara, Kara, Togo

Email: \*makmas2003@gmail.com

**How to cite this paper:** Moumouni, A.E.K., Ajavon, D.R., Doleagbenou, K.A., Tamou Tabe, D.A., Ahanogbe, K.M.H., Dagbe, M., Gbessena, A.S., Amagnga, K., Banawe, D.-E. and Amona, T.B. (2022) Hospital Information Systems Shortage in Sub-Saharan African Hospitals: Opportunities and Challenges. *E-Health Telecommunication Systems and Networks*, 11, 1-13. <https://doi.org/10.4236/etsn.2022.111001>

**Received:** December 2, 2021

**Accepted:** March 7, 2022

**Published:** March 10, 2022

Copyright © 2022 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

## Abstract

The HIS is recognised as an essential tool for optimising the management of a health establishment in particular and the health system in general. But it is still very little implemented in hospitals in the South. Open source HIS software, available on the Internet, can be a solution for starting a (HIS) project in these hospitals. A search on the Internet for open source HIS software allowed us to choose MedBoard, the second most popular open source software out of 381, to start an HIS project called PERFORMANCE at the Kara University Hospital in northern Togo. A questionnaire allowed us to assess the level of knowledge of health actors on hospital information systems. The results of this evaluation allowed us to strengthen our proposal. The analysis of the current computer park of the CHU Kara does not allow whatever the functionalities of MedBoard to implement PERFORMANCE at the CHU Kara. Logistics are needed to make PERFORMANCE work. The real difficulty to start and perpetuate HIS project is linked to the human factor.

## Keywords

Free Software, Hospital Information System, Performance Chu Kara

## 1. Introduction

A hospital information system (HIS) is an information system applied to the

health sector, and more specifically to health institutions [1]. It is the set of information, its circulation rules and its processing necessary for daily operations, management and evaluation methods and the strategic decision-making process in the hospital environment.

The HIS has become an essential tool for optimising the management of a health establishment in particular and the health system in general [2]-[7]. It has been observed that HIS are very poorly implemented in southern countries [3] [4] [5] [6]. There seems to have been a timid awareness over the past decade [6]. The construction of an HIS requires know-how and high-level engineering, which has not been easy to put in place in France [8]. In southern hospitals, open source HIS software, available on the Internet, can be a solution for starting this type of (HIS) project. But can an open source HIS software alone be sufficient to start this type of (HIS) project?

Our work will review the main open source HIS software on the Internet and through HIS project proposal in a hospital in the south of France where we work, we will try to see how open source software could be the solution for starting an HIS project.

This is a subject that has been the subject of several works during the medical informatics diploma course, particularly at the University of Aix Marseille in France.

#### Description of some open source software found on the internet

381 open source medical software are listed in order of popularity on the website <https://medfloss.org/node/271> [9].

For the description, we will choose 10 (Table 1) from the list of the most popular, therefore having a larger community and which are already implemented in Africa or in France but especially using the French language. These are: Open Clinic GA, Mediboard, CARE2X, Open EMR, Clinical Management System (CMS).

**Table 1.** Top ten (10) free software.

Rank	Project	Number of views
1	Open Clinic GA	278,608
2	Mediboard	183,212
3	Clinic Management System (CMS)	144,414
4	CARE2X	141,655
5	GNUmed	49,485
6	Caret	43,929
7	PatientOS	41,899
8	NOSH Charting System	39,568
9	WEASIS	38,100
10	NHapi	36,433

### **Open Clinic GA**

Open source integrated hospital information management system covering management of administrative, financial, clinical, laboratory, X-ray, pharmacy, food distribution and other data, extensive statistical and reporting capabilities.

### **Mediboard**

Mediboard is an open source health information system based on web technologies. Deployed in a public or private health centre, Mediboard manages all of its patient records as well as most of the workflows and schedules of its activity. In April 2011, more than 1.1 million patient records in France are managed by Mediboard.

### **Clinical Management System (CMS)**

CMS3.0 is an open-source clinic management system project jointly implemented by the Hong Kong Medical Association (HKMA) and the Information and Software Industry Association (ISIA), with financial support from the Government Chief Information Office (GCIO) under the Sector Specific Programme (SSP) for the medical and health sector, and was developed by the Mobigator Technology Group Home page: <http://cms.mobigator.com/>.

### **CARE2X**

Care2x integrates data, functions and workflows in a healthcare environment. It currently consists of four main components. Each of these components can also operate individually.

### **GNUmed**

The GNUmed project builds free, liberated open source Electronic Medical Record software in multiple languages to assist and improve longitudinal care. It is made available at no charge and is capable of running on GNU/Linux, Windows and Mac OS X. It is developed by a handful of medical doctors and programmers from all over the world. It can be useful to anyone documenting the health of patients including, but not limited to, doctors, physical therapists, and occupational therapists.

There are several companies that develop this health software (**Table 2**).

## **2. Materials and Methods**

We queried the internet search engines “Google” and “Yahoo” in French and in English with the following keywords: open source software in health, hospital computerisation, health information system in Africa, health information system, success criteria of an HIS, poor countries. We were thus able to visit several specialised and non-specialised websites dealing with the subject.

The results of this research enabled us to find documents that were used to better understand the problems of HIS in the countries of the South. The information contained in the documents of the master plan for health information systems of the Togolese Ministry of Health and the national health development programme (PNDS) of the Togolese government 2018-2022, was used to assess the situation in Togo. An analysis of the existing information system was made at the CHU Kara, the only one in the north of Togo where we practice, in order

**Table 2.** List of leading health software development companies.

Corporations	software	Countries/Regions
Beyaz.net (Consulting and Software Services Ltd.)	ClearCanvas, DVTK-DICOM Validation Toolkit, OsiriX Imaging Software	Europe, Africa, Georgia, Iran
Bika Lab Systems	Bika LIMS	Africa, Europe, America
Health Information Systems Programme	District Health Information Software 2 (DHIS 2), Resource and Patient Management System (RPMS)	Africa
Jembi	OpenMRS, Hearth	Africa
Libre Medecine	FreeMedForms, MedinTux	France
Mathieu Malaterre Consulting	Grassroots DICOM (GDCM), Visualization Toolkit (VTK)	France
Medical eXchange	OpenClinic GA	Africa, Europe
MediGrail LLC	OpenEMR (en)	Kenya
OpenXtrem	Mediboard	France, Africa
PatientOS, Inc	PatientOS (en)	Africa, Asia, Europe, America
Symeda Symeda	SORMAS (SORMAS)	Africa

to make our proposal for HIS project at the CHU Kara from a free software found on the internet.

A survey was conducted from 10 to 19 December 2021, using an electronic questionnaire. The questionnaire, for the 389 people working in the hospital and the 280 student trainees at CHU KARA, allowed us to assess the level of knowledge of health actors on hospital information systems. The results of this evaluation allowed us to strengthen our HIS PERFORMANCE proposal.

### 3. Results

#### 3.1. Current Status of the Health Information System

##### 3.1.1. Health Information System in Northern Countries: Example of France

The implementation of HIS in the so-called developed countries has been gradual. HISs are not perfect but they are better organised on a day-to-day basis. The beginnings were difficult. In France, in the 1980s, a programme for the medicalisation of the hospital information system was created in response to certain organisational and operational difficulties in health establishments [10]. It is the political will to set up technical support bodies in France, such as the OSIH (Observatory of Hospital Information Systems) or the ATIH (Technical Agency for Hospital Information) and others such as the RELIMS (Referencement des Editeurs de Logiciels et des Intégrateurs du Monde de la Santé) observatory, that has enabled the implementation of HIS in several hospitals in France. The computerisation of records and procedures is the main driver of this progress [11]. These bodies draw up procedure manuals and support staff at all

levels, as it is much more the non-technological factors, such as human characteristics (*i.e.* compatibility, information security expectations and self-efficacy) and organisational characteristics (*i.e.* management support, facilitating conditions and user involvement), that are important [7] [12]-[17].

The deployment of an efficient HIS requires the computerisation of the care system. There has been significant progress in this process under the impetus of the technical institutions set up by the French Ministry of Health.

The software used for the computerisation of this process is numerous and diversified according to the health establishment and the activity. Already in 2012, the RELIMS report (Referencing of Software Publishers and Integrators of the World of Health) mentioned that 370 software packages were in use in the CHU and CHR in France [18]. Even though this report does not specify how much open source software is used. Several HIS projects have been implemented in so-called developed countries thanks to OSS [3] [5] [6] [16] [17]. In 2018, in RELIMS, 317 companies and 864 software packages were declared and all of the professions in the institutions we met today are users of the HIS [18].

### 3.1.2. Situation of His in Southern Countries: Example of Togo

The modernisation of hospitals in Africa, especially in the south of the Sahara, only partially integrates the process of developing an efficient HIS [3] [5] [6]. Over the past decade, a small improvement has been observed in some countries [8]. Togo has 1337 health facilities, including three University Hospitals (UHCs) and six Regional Hospitals (RHCs) for the entire population, with a rate of attendance of 51.4% [19]. Management software has been deployed, but mainly for administration, revenue and pharmacy [20]. There is no HIS in these hospitals. Like several French-speaking African countries south of the Sahara, the Togo government has an ambitious programme to develop its health system through its PNDS programme (National Health Development Programme) 2018-2022 [21]. But there is no plan to deploy HIS in its public hospitals. In Togo's health information master plan, 17 recommendations mention the importance of an efficient hospital information system, but the implementation has not been spelled out. The software proposed is proprietary and more for administration and finance than for care in the large centres. In small centres, a few basic applications are recommended for community health data collection and epidemiological surveillance [22]. The advent of the pandemic in COVID 19 has revived old telemedicine projects which will make it possible to have computer equipment in the care units of Togo's hospitals with the support of UNDP. The applications used in the hospitals are total 29.

### 3.1.3. Assessment of the Existing Situation at Kara University Hospital

We will take stock of the existing situation in order to better make our proposal.

To date, there is no programme for setting up an efficient HIS.

93 actors in hospitals responded to online questionnaires. 75% were men. The average age was 38.3 years with extremes between 21 and 53 years. 50% had been working for more than 10 years in hospitals. 50% of the respondents were doc-

tors, 35% were administrators and the rest were paramedics at 23% and students at 2%.

90% of the respondents worked in the public hospital. 25% worked in the department of medicine and medical specialties, 20% worked in the department of surgery and surgical specialties, 20% worked in the department of gynaecology and obstetrics.

50% of them had an Internet connection and a telephone communication network installed by the government in hospitals.

65% used their personal computers for hospital work. 60% had never heard of free medical software and 71% did not know what it was.

23% had never heard of HIS and 47% did not know what HIS was for. Although 67% had never worked in a hospital with an HIS, all respondents would like to have a computer connected to the Internet in an intranet network.

The reason for the shortage of HIS in hospitals would be:

59% of the respondents thought it was the ignorance of the hospital actors.

For 60%, it is the lack of will of decision makers and the lack of will of caregivers.

### 1) Computer equipment at Kara University Hospital

At the Kara University Hospital, only the central administrative services and the financial services are the only ones to have their own computer to date. The care services do not have a computer. Even the secretariats. The exploration departments are centralised with only one computer and one printer as equipment. Thus, out of 50 computers and 33 printers in use in the entire university hospital, the general management and central services have monopolised 33 computers and 23 printers. That is 66% of the computers and 70% of the printers (**Table 3**).

Each doctor has a personal laptop. There is no intranet. No truly structured computer network is operational in the hospital apart from the free public wifi deployed by the University of Kara. There are no computers, so there is no network connection between the care services of the university hospital. However, a

**Table 3.** CHU Kara computer park.

Departments	Computers	Printers	Scanners
Direction	23	15	05
admissions and receipts	10	05	00
Infrastructure, equipment and supplies department	03	03	01
Radio and Lab	04	05	01
Pharmacy	08	02	00
Medical services and specialties	00	01	00
Mother and children (Gynecology and Pediatrics)	00	00	00
Surgical Services and Specialties	02	02	00
Total	<b>50</b>	<b>33</b>	<b>07</b>

SIGEP network connects the management to the cashier's office, admissions, radiology, laboratory, pharmacy and operating theatre departments for the management of sales and receipts (**Table 3**).

These computers are maintained by a computer maintenance technician.

## **2) Functioning of the services and the place of IT in data collection and management**

The medical record is paper. It records everything about the patient in relation to care.

In the whole process of collecting patient data, no IT tools are used. No computer programs are used for data storage apart from what happens in admissions and receipts. This data is used mainly for two purposes: patient follow-up and research.

Administrative and financial data are the priority of the UHC administration.

The HIS is almost non-existent at Kara UHC. Two software packages are used exclusively for pharmacy management and admissions management as well as accounting and cashiering. These are PHARMASOFT and SGIP (**Table 4**).

## **3.2. Project His Chu Kara Performance**

We propose to develop HIS at the CHU Kara called PERFORMANCE with the free software Mediboard, one of the most popular on the internet.

### **3.2.1. Objective**

Our objective is to set up an efficient HIS adapted to the Kara University Hospital, called PERFORMANCE, centred on the patient at the Kara University Hospital, based on open source software. It will enable the quality of services offered to the patient, the management of the University Hospital and clinical research to be optimised. PERFORMANCE will thus make it possible to:

- Better structure data collection and information sharing.
- Provide decision support at all levels.

### **3.2.2. Choice and Justification of the Open Source Software of the His Performance**

We chose Mediboard. It is one of the most popular open source HIS software on the internet. The most popular is Open Clinic GA and is widely used in Africa [7] [9]. Its French interface is a major element to take into consideration because Togo is a French-speaking country and the language barrier would be a major obstacle. With 183,214 views in December 2020, Mediboard is well known and

**Table 4.** Software used at CHU Kara.

<b>Software</b>	<b>Status</b>	<b>Deployment Site</b>	<b>Activities</b>
Pharmasoft	Owner	Pharmacy	Sales management and inventory management
Sigep	Owner	Admission, recipes, direction, lab and radiology	Revenue and expenditure management

evaluated by a large community. It is therefore regularly updated. Its programming language PHP, HTML, javascript suits us perfectly. The computer scientists of the University of Kara could be put to contribution. This software is already used in France and in several African countries such as Mali and Cote d'Ivoire [3] [5] [6]. Since 2011, Mediboard is used in Mali by 72 institutions [22]. Mali is a country with almost the same health realities as Togo. It is a neighbouring country. A one-month training course could be envisaged, to see how hospitals in Mali use this software.

Mediboard already includes all the business functions that we would like to implement, namely Patient administration Record management, Billing, Accounting, Laboratory, Statistical analysis, Coding, Radiology, Personnel management, Planning [23].

### 3.2.3. Expected Functionality of the HIS Performance with Mediboard

The Mediboard open source software will be adapted to the needs of the Kara University Hospital in order to meet the PERFORMANCE specifications (Figure 1).

The functionality of PERFORMANCE in infrastructure management will include:

- Secure access: authentication, SSL;
- Multi-establishment management;
- User management by practice/function;
- Advanced administration of user rights and permissions;
- Traceability of actions performed in the system: history by object and by user.

#### 1) Patient file management (administrative and medical) at Kara University Hospital

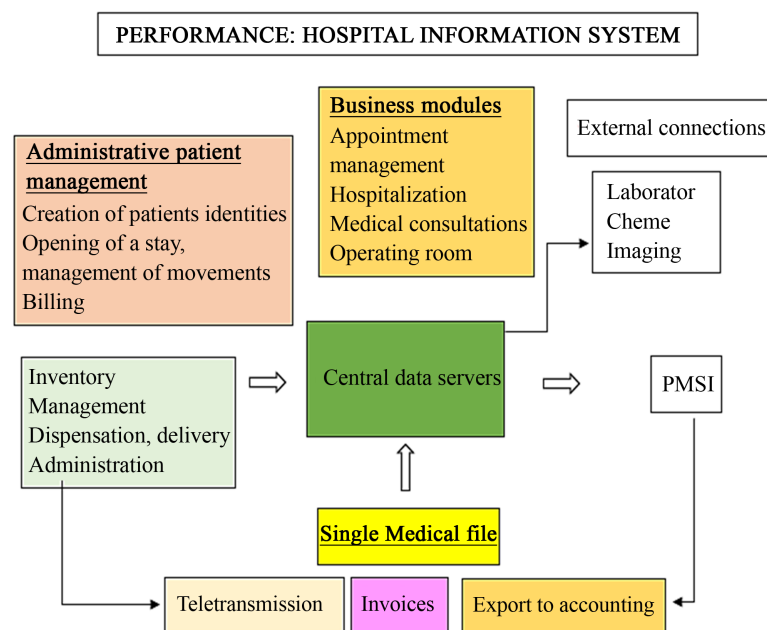


Figure 1. Features of HIS performance at CHU Kara.

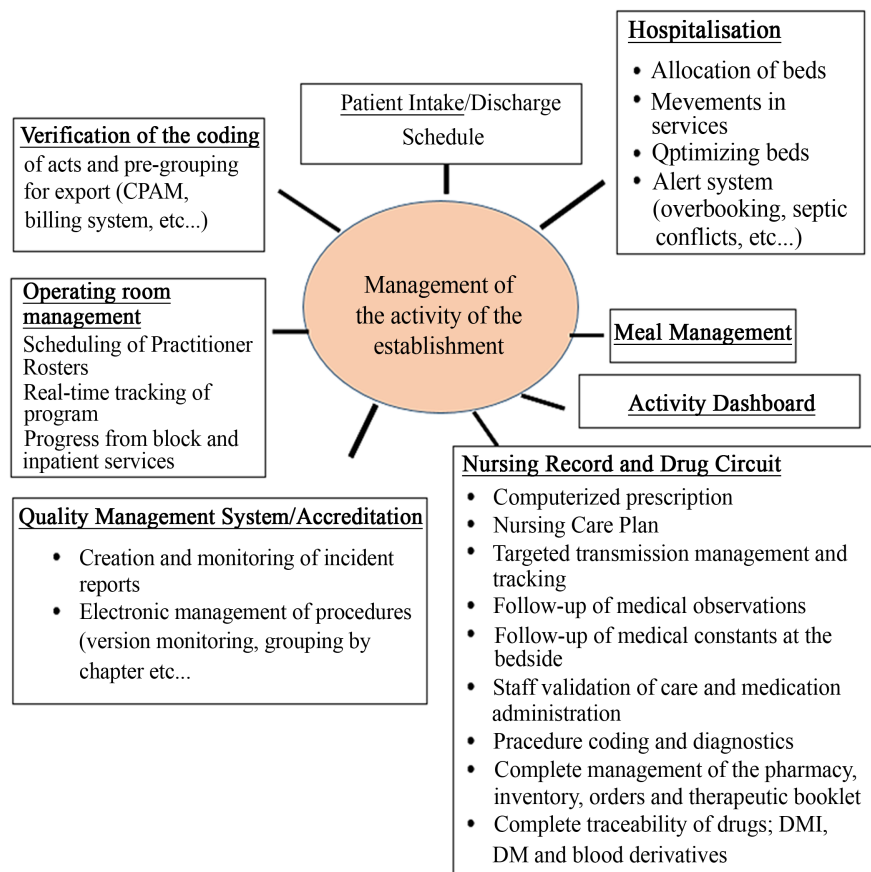


The functionality of PERFORMANCE with the Medboard software for the management of the patient file at the CHU Kara will include:

- Patient identity management (permanent patient identifier);
- An advanced search engine including phonetically related results;
- Management of stays, history and allergies;
- Clinical reception: admission and discharge of patients;
- Creation of files by INAM card (National Institute of Health Insurance Togo);
- Management of duplicate files (selective merging of files, stays and re-allocation of stays);
- Generation of documents based on templates: admission sheets, consents, information sheets, prescriptions;
- Electronic document management in all formats (images, PDF, etc.), with multi-page viewer;
- Annotation and alert systems shared between health professionals and facility staff.

## 2) Managing the activity of the health establishment at Kara University Hospital

PERFORMANCE will structure the management of the establishment's activity in seven parts (**Figure 2**).



**Figure 2.** Management of the establishment activity with performance.

### 3) Management of Practitioners' Activity at Kara UHC

The management of the practitioners' activity at Kara University Hospital will be structured in two parts in PERFORMANCE: consultations and clinical activity proper.

Management of clinical activity at the Kara University Hospital includes:

- The electronic admission form;
- Planning of operation slots;
- Planning of operating theatres (central theatre, gynaecology theatre);
- Direct coding of procedures in the room, during the operation;
- Automated production of operation reports, based on templates;
- Management of anaesthesia files.

## 4. Discussion

Free software refers to a computer programme whose users have the freedom to run, copy, distribute, study, modify and improve it [1] [2] [3] [5] [6] [7] [8] [10].

A computer program is free software if the user of that program has the four essential freedoms [1] [2] [9] [13]. These four freedoms are:

- The freedom to make the program work the way you want, for any purpose (freedom 0);
- The freedom to study how the program works, and to modify it to do your computing tasks as you wish (freedom 1); access to the source code is a necessary condition;
- The freedom to redistribute copies, thus helping others (freedom 2);
- The freedom to distribute copies of your modified versions to others (freedom 3); by doing this, you give the whole community a chance to benefit from your changes; access to the source code is a necessary condition.

Open source software has enabled the deployment of HIS projects in northern countries [6]. They give the initiated user freedom in practice to adapt it to his expectations, to the ergonomics he wants. In the field of health, as in many other areas, open source software represents an important asset, particularly when certain criteria are taken into account: the durability of the company, the protection of data resulting from the use of the software, and the potential influence of the company developing the software on medical practice [15].

Finding open source software to launch HIS project in the southern hospitals is a very good proposal. Our HIS PERFORMANCE project which is an adaptation of open source software to our reality of Kara University Hospital with the help of local computer scientists from Kara University could be a testimony. This is already underway in several African countries. This approach alleviates the expenses related to the acquisition of the software, knowing that in France, according to the base of analysis of the operating expenses of the HIS, in 2016, the expenses of the HIS, for 909 establishments, were 1129.5 million euros. Open source software is an appropriate solution to make the cost of the HIS project affordable to these countries. We can say that it is a catalyst for implementing an

HIS solution in these southern hospitals, as has already been done in Mali, Ivory Coast and other southern countries [3] [5] [6] [7] [12]. This deployment of HIS with Medboard software is the solution proposed by several authors [3] [5] [6] [22].

Open source software offers several other advantages, namely the durability of the company, the protection of the data resulting from the use of the software, and the potential influence of the company developing the software on medical practice [15].

An important question must be asked. Open source software offers several undeniable advantages, as demonstrated above, but is open source software alone sufficient to deploy an HIS? The answer is clearly no. Software alone does not make an HIS. It also requires IT equipment and qualified human resources. The construction of an HIS requires know-how and high-level engineering [9]. The computer equipment that constitutes the minimum to start a computerisation process is almost non-existent, even before mentioning a computerisation project. About 65% of health workers in our survey used their personal computers to work in the hospital. The hospital will only be able to install software on its own computers. Administrators must therefore first equip departments with computer equipment.

Without a computer, no free software, however powerful, can be deployed for an HIS. Technical support bodies such as ATIH and OSIS, created by the French Ministry of Health, would be of great interest in supporting HIS projects in hospitals in southern countries. Another approach would be to find out why there is a delay in the deployment of HIS in hospitals in the South when the managers of these hospitals have all been to Europe.

The modernisation of hospitals in Africa, especially in the French-speaking countries south of the Sahara, does not include the development of an efficient HIS in its process [6]. Several countries, such as Benin and Togo, have initiated ambitious programmes over the past few years that could help them establish real HISs, but this is not the case [21] [23] [24]. We can cite the PADSS project (Projet d'Appui au Développement du Système de santé) financed by the African Development Fund in Benin since 2004. Wouldn't the problem be initially a decisional will? This will to develop an HIS must be at all levels. It is therefore not only and truly the problem of money that is the brake. Jean-Michel Huet has been saying since 2010, talking about a wide range of investment opportunities that exist [24].

The difficulty of implementing HIS is much more related to the human factor than to the logistical and technological factor [7] [17]. From our survey, 53% of hospital managers did not know what is called a hospital information system and 67% of caregivers had never worked in a hospital with HIS. The lack of awareness of HIS by health actors is a major obstacle to their deployment. This is really the first difficulty. The software alone cannot therefore allow an HIS to be started up and, above all, to be sustained. It is the human factor that is the real

problem and the organisational factor [7]. It should be borne in mind that 50 years ago, countries such as China, which is highly developed today, were not very far from countries such as Côte d'Ivoire, which is still poor.

## 5. Conclusion

Implementing an HIS from open source software could be a solution to start an HIS in the hospitals of the South. For Togo, the Medboard software seems to us to be the most adapted to respond to the 17 recommendations of the master plan for health information systems in Togo. Open source software alone will not be enough. Political awareness is needed to set up bodies that will accompany hospitals in this new process [8]. And above all, hospitals must be provided with adequate computer equipment. It is up to the hospital technician to show the decision-maker the importance of an efficient HIS in a hospital.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

## References

- [1] Anonymous. Wikipedia.  
[https://fr.wikipedia.org/wiki/Syst%C3%A8me\\_d%27information\\_hospitalier](https://fr.wikipedia.org/wiki/Syst%C3%A8me_d%27information_hospitalier)
- [2] Stallman, R. (2021) What Is Free Software? GNU Operating System.  
<https://www.gnu.org/philosophy/free-sw.fr.html>
- [3] Bagayoko, C.O., Dufour, J.C., Bouhaddou, O., *et al.* (2010) Open Source Challenges for Hospital Information System (HIS) in Developing Countries: A Pilot Project in Mali. *BMC Medical Informatics and Decision Making*, **10**, Article No. 22.  
<https://doi.org/10.1186/1472-6947-10-22>
- [4] Guetibi, S. (2015) Development of the Hospital Information System by One of the Eight Principles of Quality Management.
- [5] Aubain, D. (n.d.) Open Source HIS Software a Solution for Starting This Type of Project in Hospitals in the South in Particular.
- [6] Bagayoko, C.O. (2010) Mise en place d'un Système d'Information Hospitalier en Afrique Francophone: Cinz@n, étude et validation du modèle au Mali. Ph.D. Thesis, Université de la Méditerranée Aix-Marseille, Jardin du Pharo.
- [7] Verbeke, F., Karara, G. and Nyssen, M. (2015) Human Factors Predicting Failure and Success in Hospital Information System Implementations in Sub-Saharan Africa. *eHealth-enabled Health*, **216**, 482-486.
- [8] Fieschi, M. (2004) Hôpital communicant et système d'information: L'air et la chanson. *Gestions Hospitalières*, 762-768.
- [9] All Projects (by Popularity)|Medical Free/Libre and Open Source Software. Medfloss Website.
- [10] Domin, J.P. (2014) Programm Médicalisation. *Open Edition Journal*, 69-87.  
<http://journals.openedition.org/hms/355>
- [11] Direction Générale de l'Offre des Soins de la France. ATLAS DES SIH 2018 État des lieux des systèmes d'information hospitalières.

- [https://solidarites-sante.gouv.fr/IMG/pdf/dgos\\_atlas\\_sih\\_2018.pdf](https://solidarites-sante.gouv.fr/IMG/pdf/dgos_atlas_sih_2018.pdf)
- [12] Kuhn, K.A. and Giuse, D.A. (2001) From Hospital Information Systems to Health Information Systems. Problems, Challenges, Perspectives. *Methods of Information in Medicine*, **40**, 275-287. <https://doi.org/10.1055/s-0038-1634170>
- [13] Anonymous. List of Open Source Health Software. Wikipedia.
- [14] Malik, M.A. and Khan, H.R. (2009) Understanding the Implementation of an Electronic Hospital Information System in a Developing Country: A Case Study from Pakistan. *Proceedings of the 32nd Australasian Computer Science Conference (ACSC 2009)*, Wellington, 19-27 January 2009.
- [15] Gropper, A. (2011) Open Source Health Software. <https://journalofethics.ama-assn.org/article/open-source-health-care-software/2011-09>
- [16] Anonymous. Open Source Medical Software. Wikipedia. [https://fr.wikipedia.org/w/index.php?title=Liste\\_de\\_logiciels\\_m%C3%A9dicaux\\_libres&oldid=168266216](https://fr.wikipedia.org/w/index.php?title=Liste_de_logiciels_m%C3%A9dicaux_libres&oldid=168266216)
- [17] Handayani, P.W., Hidayanto, A.N., Pinem, A.A., Hapsari, I.C., Sandhyaduhita, P.I. and Budi, I. (2017) Acceptance Model of a Hospital Information System. *International Journal of Medical Informatics*, **99**, 11-28. <https://doi.org/10.1016/j.ijmedinf.2016.12.004>
- [18] Direction Générale de l'Offre des Soins. Report on the Data Contained in RELIMS as of 12 December 2012.
- [19] Direction Générale de la Santé du Togo (2018) Annuaire des statistiques sanitaires du Togo. <https://www.worldcat.org/title/annuaire-des-statistiques>
- [20] Doumbia, M., Tchalla, N., Assignon, A., *et al.* (2018) Schéma Directeur Système d'Information (SDSI) du ministère de la santé du Togo, Version 1.
- [21] Ministry of Health of Togo. National Health Development Programme (PNDS) 2017-2022. [https://www.fichier-pdf.fr/2017/04/26/pnds-togo-2017-2022-version-definitive/sanitaires/oclc/157024899&referer=brief\\_results](https://www.fichier-pdf.fr/2017/04/26/pnds-togo-2017-2022-version-definitive/sanitaires/oclc/157024899&referer=brief_results)
- [22] Réseau Africain Francophone de Télémedecine (RAFT). A Hospital Management Software: Cinz@n. <http://raft.g2hp.net/un-logiciel-de-gestion-hospitalier-cinzn>
- [23] Sanogo, I., Foryt, S. and Mrabeh, T. (2005) Evaluation Report of the Support Project for the Development of the Health System of Benin (PADSS). [https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Benin\\_-\\_Health\\_System\\_Development\\_Support\\_Project\\_-\\_Appraisal\\_Report.pdf](https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Benin_-_Health_System_Development_Support_Project_-_Appraisal_Report.pdf)
- [24] Huet, J.M., Romdhane, M. and Tcheng, H. (2010) ICT and Health Information Systems in Africa, Health and Environment Programme. IFRI Note.