

## PATIENT IDENTIFICATION AND HOSPITAL INFORMATION MANAGEMENT SYSTEMS IN SUB-SAHARAN AFRICA: A PROSPECTIVE STUDY IN RWANDA AND BURUNDI

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### ABSTRACT

For many sub-Saharan health facilities, accurate patient identification remains a challenge. Poor national person identification systems, inefficient identification procedures, the use of weak search criteria and sometimes fraudulent practice consist some of the underlying causes.

In this study, patient identification effectiveness has been compared between 27 sub-Saharan hospitals using paper based procedures and 6 health facilities in the same region that had implemented a hospital information management system.

Based on a simple metric, results show a significant ( $p < 0.001$ ) improvement reducing identification errors from 64.6% before to 2.3% after information system implementation in a sample of 1 private and 5 public hospitals in Rwanda and Burundi.

**Keywords:** Patient identification systems - Africa - Hospital information systems

### RESUME

Pour la majorité des structures sanitaires en Afrique sub-saharienne, l'identification correcte des patients reste un défi. Des systèmes nationaux défectueux pour l'identification des personnes naturelles, des procédures d'identification inefficaces, l'usage de critères d'identification peu spécifiques et parfois des pratiques frauduleuses sont à l'origine de ce problème.

Dans cette étude, l'effectivité de l'identification des patients a été comparée entre 27 hôpitaux sub-sahariens qui utilisaient des procédures papier et 6 structures sanitaires dans la même région qui avaient implémenté un système informatisé de gestion d'informations hospitalières.

Sur base d'une métrique simple, il a en plus été démontré que les erreurs d'identification sont réduites de façon significative ( $p < 0.001$ ) après implémentation d'un système d'information dans 1 hôpital privé et 5 hôpitaux publics au Rwanda et au Burundi.

**Mots-clés:** Systèmes d'identification des patients - Systeme d'information Hôpitalière

### INTRODUCTION

Accurate identification of patients remains not less than a headache in many countries in the sub-Saharan region. Still, correct patient identification remains a cornerstone of safe & high quality healthcare. A series of reasons explain the defective patient identification procedures in Sub-Saharan hospitals: a decentralized patient administration is often found in larger hospitals where the implementation of a certain level of financial and managerial autonomy of clinical departments has promoted the multiplication of duplicate administrative patient management systems (every department wanting to take care of its own bookkeeping). As a result, patients end up with multiple department specific medical records and ID numbers. Added to this, the absence of a master patient index (MPI) [3] is a general rule: no central patient

identification systems are in place that refer to existing departmental patient records.

Also, encounter-centered instead of patient-centered filing systems are being found in many hospitals. Patient files are arranged in the archiving system based on the last encounter date. If a patient can't remember the time of this last encounter, it becomes very hard to retrieve his file.

Often weak patient identifiers are in use: the most used identification elements are the names of the patient, the date of birth or an internal department-specific medical record number. Different problems exist with these kinds of identifiers:

1. Many patients do not know their exact date of birth. Even the year of birth can be an approximate.
2. Patient names are not stable: newborns often get a temporary name that changes at a later stage. Some patients do not even know the exact spelling of their name.
3. As explained above, one patient can have many medical record numbers within one and the same health facility. It

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is often not feasible for the patient to memorize all of these record numbers or even to keep track of them.

National person identification instruments could surely significantly improve unique patient identification practices in Sub-Saharan health facilities. Unfortunately, very few countries have been able to implement accurate and comprehensive person-identification procedures guaranteeing the unambiguous identification of their citizens from the day they are born. In many places still, fragmentary identification systems enabling the coverage of at least part of the population can be found:

- a. At the age of 16, Rwandans receive a national ID card [1] integrating machine readable identification codes that could easily be used for health record identification purposes. Nevertheless, children under 16 years old, who are not being covered by this procedure, still make up a very important portion of the patient population.
- b. A similar situation exists in the Democratic Republic of Congo [2] where all adults that are eligible to participate in political voting, get a unique identification number in the form of a 'voting card'. Here again, children and other non-eligible citizens such as immigrants, displaced people, military and mentally handicapped persons are being left out.

In a number of cases, patients will also voluntarily provide erroneous identification data to the health facility, such as when they want to take the identity of another patient who benefits from a health insurance coverage plan or if they still have outstanding hospital bills and want to avoid to have to pay for these before getting access to new healthcare services. Some may have judicial reasons for not being identified. These situations are not uncommon in a number of countries and therefore also consist a real problem.

The inability in health facilities to correctly re-identify patients which already have an existing health record leads to frequent creation of duplicate patient records, resulting most often in information loss. A survey we conducted in 30 health facilities in Rwanda, Burundi, Mali, Ivory Coast and the Democratic Republic of Congo showed that 28 (93%) of the hospital management teams recognized patient identification being an important health care problem in their facility.

ICT-based health facility information systems have been reported several times to bring significant improvements to many inefficiencies that exist in hospitals in developing countries [5,6,7,8,9]. In this study, we wanted to evaluate to what extent the advent of hospital information management systems in sub-Saharan health facilities could also bring relief to the patient identification issue.

## METHODS

### Purpose of the study

The purpose of the study was to evaluate the effect of hospital information systems (HIS) implementation on

patient identification effectiveness in a set of sub-Saharan health facilities.

### Study concept

This is a comparative prospective study evaluating patient identification effectiveness based on a simple output metric.

### Materials

Patient identification metrics calculation was to be based on pre- and post HIS implementation samples of out-patient consultations in public and private hospitals in Rwanda and Burundi. A total of 7 public hospitals and 20 private health facilities were studied in the pre-implementation phase of which a total of 6 also provided post-implementation data after they had introduced software based health information management tools in their institution.

### Methodology

Step 1: develop a patient identification effectiveness metric enabling the evaluation of paper-based and software-supported patient identification activity.

Step 2: Apply the patient identification metric to a sample of out-patients visiting hospitals and clinics which have no access to a computerized hospital information management system.

Step 3: Apply the same metric to a sample of out-patient visits in a subset of these hospitals after they have implemented a hospital information management system and compare the results to what was obtained in step 2.

## RESULTS

### Step 1: development of a patient identification metric

For every out-patient that would visit the hospital on the days of the survey, a maximum of 3 questions were to be asked at the moment the patient left the registration desk:

- Is this your first visit to this health facility?
- If it isn't your first visit, did the registration staff manage to retrieve your existing medical and/or administrative record?
- If your record wasn't found, did the registration staff try to find it?

Based on these simple questions, the following 4 possible results could be produced for every encounter:

1. The patient has never visited the hospital before and therefore no medical record exists
2. The patient has already visited the hospital before and his medical record was retrieved
3. The patient has already visited the hospital before, a new file was created because the existing medical file could

not be found although the receptionist tried to find it 4. The patient has already visited the hospital before, a new file was created because the receptionist did not even try to find the existing one

The most interesting data are being provided by Result 2 (which we call a patient identification success) and Results 3 and 4 (which we call patient identification failures), as cases producing Result 1 are irrelevant for measuring patient identification effectiveness.

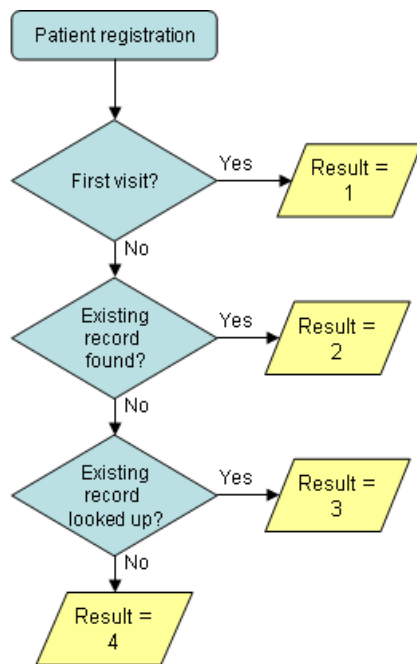


Figure 1: Patient identification survey process diagram

**Step 2: perform a pre-implementation patient identification survey**

An initial pre-implementation survey was conducted in 2007 in 7 Rwandan public hospitals evaluating patient identification results for all patient encounters that took place on 3 randomly selected different days of the week (in order to eliminate staff-related or day-of-week related bias). In 2011, the same data was also collected for a large public hospital in Burundi. All hospitals had a paper based out-patient registration/identification system. The survey produced the following results:

Facility	CHK	NYA	RUT	MUH	KIB	HMK	RWA	CHB	Mean
N	355	271	279	384	104	25	298	85	1801
Result 1	41%	41%	29%	43%	68%	68%	29%	40%	45% (+13%)
Result 2	17%	16%	11%	12%	22%	28%	24%	38%	21% (+7%)
Result 3	8%	22%	36%	29%	6%	0%	37%	21%	20% (+12%)
Result 4	34%	20%	24%	16%	4%	4%	10%	1%	14% (+9%)

A surprising element was the fact that in 14% of the encounters in the studied public hospitals, the registration clerk did not even try to look up the existing paper record. Very often this was due to the reception staff getting so frustrated after numerous failing file retrieval attempts, that they abandoned the procedure of file retrieval whenever they had the opportunity.

Reducing the results to patient identification success and failure produced the following table:

Facility	CHK	NYA	RUT	MUH	KIB	HMK	RWA	CHB	Mean
N	210	159	198	220	33	8	212	51	548
Success	29%	28%	16%	21%	70%	88%	34%	63%	43% (+22%)
Failure	71%	72%	84%	79%	30%	13%	66%	37%	57% (+22%)

This learned us that on average in the group of public hospitals that participated in the survey, only 43% of the existing patient records could be retrieved, which was a very disappointing score (although some facilities performed much better than the others).

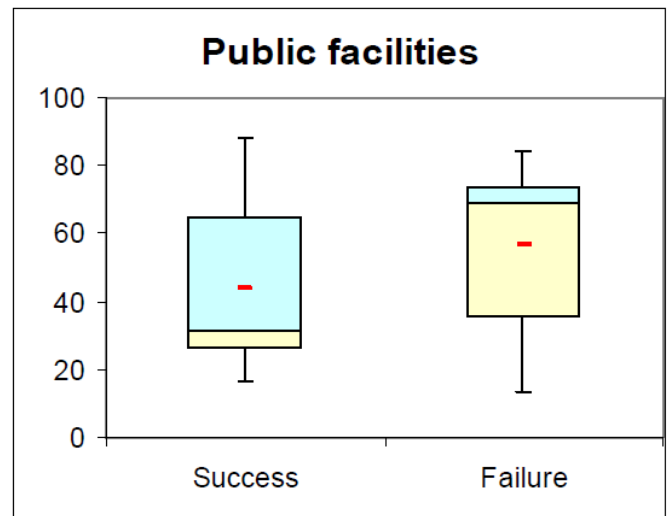


Figure 2: pre-implementation patient identification results in a sample of 7 public hospitals

During interviews we had with hospital managers, it also became clear that many of them expected the problem to be worse in public hospitals compared to the private health sector. Therefore, using the same method, we also collected patient identification from 20 private health facilities. All of them used a paper based patient identification and administration system. This clearly confirmed that the situation was much better in the sample of private hospitals (only 3% non-lookups), but still for 24% of the out-patients, identification procedures failed. Statistically, 3 of the evaluated facilities were to be considered outliers. Nevertheless, their results being



## DISCUSSION

Most if not all analyzed health facilities had serious trouble to reliably identify their patients in the initial pre-implementation phase. Also, none of them used a unique facility-wide patient record. Patient identification took place at different clinical departments of the hospitals, resulting in patients having their health information scattered over sometimes up to 10 different health records in one and the same institution. Moreover, different filing logic was used in separate hospital departments, which pretty much excluded practical solutions for merging health information that was captured in different health records for the same patient.

Post-implementation evaluation demonstrated that the implementation of health information management systems brought a number of significant advantages in terms of patient identification effectiveness. Different reasons have been identified.

First of all, a unique facility wide identification number was generated for every patient coming to the hospital. Electronic or paper based data capture of administrative, financial and clinical information had then been systematically linked to this unique number. Consequently, the functional value of the unique ID had significantly increased.

One of the participating hospitals (the University Teaching Hospital of Kigali) had produced barcoded patient identification cards. By the end of 2011, some 106.000 patient ID cards had been printed by the hospital information management system. These identification cards only contained basic identification information such as:

- Names of the patient
- Date of birth
- Gender
- A maximum 5-letter code referring to the paper based archiving system
- A barcode representing the unique sequential identification number of the patient in the HIS database



Figure 5: sample patient ID card at CHUK

When patients came to the hospital for the first time, an identification card was generated at the reception desk for free. Patients were then supposed to bring their ID card in subsequent visits in order to enable quicker and more accurate identification and consequently faster retrieval of their patient record. For patients who forgot to bring their ID card or lost it, a new one was printed against a small printing fee (400 Rwandan francs, equivalent to 65 dollarcent). A 2010 survey covering 1.052 out-patients that presented at the CHUK in the course of 2 consecutive days, suggested that the small fee consisted an effective motivator: almost 95% of patients that already had received an ID card at a previous encounter, carried it with them when coming back for a new consultation, as is shown in the following table:

Total patients	1052	
New patients	319	30,32%
Known patients	733	69,68%
Known patients with ID card	694	94,68%
Known patients without ID card	39	5,32%

The multi-criteria search engine that was built into the hospital information management system also proved a significant improvement compared to prevailing paper based patient identification practices. Although the majority of patients were retrieved using the unique record identifier (almost 59% of the searches), patient names (27,2%), national ID card number (8.6%), date of birth (4.1%) and family relationships (1.1%) also contributed to the improved identification accuracy.

Biometric identification instruments for which support was provided by the hospital information management system have also been tested. Fingerprint registration and recognition was first introduced in CHUK by the end of 2007 using standard Microsoft Fingerprint Readers which cost less than 50 USD. After some trial and error testing with different fingerprint recognition thresholds, acceptable results could be obtained in a field study on 342 out-patients producing fingerprint refusal rates (FRR) of less than 1 false rejection in 342 and fingerprint acceptance rates (FAR) of less than 1 false acceptance in 300.000 (the last figure being provided by Griaule Biometrics [4] who supplied the fingerprint recognition libraries, as we never detected a false acceptance in the field tests)



**Figure 6:** Fingerprint reader used at CHUK

Fingerprint recognition had initially been integrated with 2 purposes in mind: patient identification and user authentication. In the end, although the results were technically satisfying, neither of these processes have been put in production for a number of reasons:

1. Patient acceptance of fingerprint enrollment appeared to be low and many patients worried about possible consequences of having their fingerprints stored in a government-owned hospital database (some of them explicitly asked if they had done something wrong)
2. With many of the agricultural workers, fingerprint

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identification showed to be not successful due to multiple small skin lesions covering the fingertips.

3. With young children, fingerprint recognition was only effective during a 6 to 12 months period after enrollment, fingerprint vectors having changed too much at later times.

4. Many patients needed a lot of assistance during fingerprint enrollment making it a lengthy process causing waiting queues in front of the registration desks to become longer.

5. Other identification methods (such as patient ID cards) had proven to be more effective and efficient alternatives to fingerprint recognition

It was concluded that hospital information management systems implementation significantly improved patient identification effectiveness in the sample of hospitals that were studied. Today, the developed identification metric continues to be used in 22 health facilities in Rwanda, Burundi and the Democratic Republic of the Congo.

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