

The Role of Hospital Information Systems in Universal Health Coverage Monitoring in Rwanda

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Abstract

In this retrospective study, the authors monitored the patient health coverage in 6 Rwandan hospitals in the period between 2011 and 2014. Among the 6 hospitals, 2 are third level hospitals, 2 district hospitals and 2 private hospitals. Patient insurance and financial data were extracted and analyzed from OpenClinic GA, an open source hospital information system (HIS) used in those 6 hospitals. The percentage of patients who had no health insurer globally decreased from 35% in 2011 to 15% in 2014. The rate of health insurance coverage in hospitals varied between 75% in private hospitals and 84% in public hospitals. The amounts paid by the patients for health services decreased in private hospitals to 25% of the total costs in 2014 (-7.4%) and vary between 14% and 19% in public hospitals. Although the number of insured patients has increased and the patient share decreased over the four years of study, the patients' out-of-pocket payments increased especially for in-patients. This study emphasizes the value of integrated hospital information systems for this kind of health economics research in developing countries.

Keywords:

Hospital information system; universal health coverage; monitoring health insurance; patient out-of-pocket payments; Rwanda.

Introduction

Providing universal access to health care remains a challenge for many low income countries especially because of the weakness of their health financing systems [1,6]. In the Sub-Saharan African context, Rwanda currently sustains one of the most elaborate health insurance schemes. Health care services are funded by both public and private health insurance organizations. Public health insurance schemes include the Rwanda Social Security Board (RSSB) and the Military Medical Insurance (MMI) which cover government employees and the Community Based Health Insurance (CBHI) schemes, also called Mutuelles de Santé, which cover the majority of the remaining population (according to the Ministry of Health, in 2012, more than 90% of the population was covered by CBHI [2]). Additionally, private health insurance (PHI) schemes are offered by a growing number of private health insurers. Public and private health insurance organizations have different objectives and therefore provide different levels of health insurance coverage to different groups of affiliates. CBHI schemes cover the majority of the population in the informal sector and those who are categorized as poor, very poor or indigents. RSSB and MMI schemes cover, respectively, the staff of the Public Service and staff of Security Services (Army and Police) and their

beneficiaries. PHI schemes cover patients from the formal sector and liberal professionals according to the level of insurance of their choice [3].

In general, CBHI schemes cover 90% of provided care delivery costs. RSSB and MMI cover 85% and PHI coverage varies between 85% and 100%. CBHI only covers health services provided by the public health facilities while affiliates of RSSB, MMI and PHI also have access to private health care.

Rwandan health insurance companies can freely negotiate tariffs with public and private health facilities for the care deliveries they wish to cover but the Ministry of Health can always enforce fixed tariffs for essential health services. Four tariff categories are used in Rwanda: (1) CBHI, (2) RSSB/MMI, (3) PHI and (4) people without health insurance. Invoice processing, payment status tracking and health care reimbursement rules have become increasingly complex [4]; some health facilities have therefore chosen to implement a Hospital Information System (HIS) to manage these activities.

From 2007 until 2014, the authors participated in the implementation of the open source OpenClinic GA HIS [4,5] in 17 public and private clinics and hospitals in Rwanda. OpenClinic GA is an integrated hospital information management system resulting from a research project at the Vrije Universiteit Brussel (VUB) that includes most of the modules commonly found in modern HIS [5], such as:

- Patient administration
- Admission, discharge and transfer (ADT) management
- Financial information management
- Reason for encounter and diagnostic coding
- Medical record management
- Lab information management
- Medical imaging
- Reporting and statistics

The software was developed in Java connecting over JDBC to the most popular ANSI SQL 92 compliant database servers (such as MySQL and MS SQL Server) and offers an easy to use web interface facilitating HIS deployment in often challenging technological settings commonly found in developing countries [4,5]. OpenClinic GA has been built according to the GEHR (Good Electronic Health Record) architecture [4]. The data model is patient oriented.

Currently OpenClinic GA is being used in more than 500 health facilities in 84 countries and 45 of these sites in Rwanda, Burundi, DR Congo, Mali, Senegal, Gabon and Congo Brazzaville are being closely monitored by the VUB ICT4Development research group [12]. OpenClinic GA has

gradually become the first medical Open Source software project downloaded over the world [11].

Using patient insurance and financial data available in OpenClinic GA systems from 6 Rwandan hospitals, and in order to determine the level of population health coverage in the hospital, this study aims to evaluate: (1) the percentage of patients with health coverage, consulting health facilities in Rwanda, (2) to what extent patients make use of the possibility to get private healthcare when this is covered by their health insurance plan, (3) the evolution of the level of reimbursement of different health service categories and (4) the evolution of patient payments for uncovered health services. This descriptive and analytical retrospective study was performed in 2 third level referral hospitals, 2 district hospitals and 2 private hospitals.

Methods

The study was conducted in 6 Rwandan hospitals:

- 2 national referral hospitals: the University Teaching Hospital of Kigali (CHUK) and the Neuro-Psychiatric referral Hospital Caraës-Ndera (Kigali) (NPH-CN).
- 2 district hospitals in the Eastern Province in the cities of Nyamata (DHNY) and Rwamagana (DHRW)
- 2 private hospitals in Kigali: La Croix du Sud Hospital (CDS) and La Médicale Polyclinic (LMED).

OpenClinic GA has been installed and implemented in these 6 hospitals since 2010 and was configured to cover all possible statuses of patients' health insurance. The financial module of the system manages the various patient health insurance schemes, care deliveries consumed by patients and all billing operations for patients and their insurers. We analyzed the health coverage information available in the HIS health insurance module for all patients treated between 1/1/2011 and 30/11/2014.

First, we isolated two patient groups from the database: those who presented to the hospital with at least one valid health insurance and those who had no health coverage. We then evaluated the evolution of health insurance coverage during the study period.

Secondly, for each outpatient visit and each inpatient admission, we determined the type of health coverage that applied. Four types of health service payments were distinguished: (1) patient direct payments (PATIENT), (2) public health insurance payments (RSSB/MMI), (3) private health insurance payments (PHI) and (4) community health insurance payments (CBHI). We then calculated the weighted average percentages for the different types of health coverage in those hospitals and compared them using the Chi² test in the Center for Disease Control's Epi Info.

Finally, we extracted the amounts paid by patients and insurers in each hospital and assessed the evolution of their proportions and the absolute amounts paid by the patients for health services (patient out-of-pocket payments).

Results

Health services coverage

We analyzed a total of 778,915 electronic records of patients who consulted the 6 hospitals. The distribution of patient numbers is shown in Table 1.

Table 1 - Number of Electronic Patient Records Analyzed

CHUK	NPH-CN	DHRW	DHNY	CDS	LMED	Total
216 389	32 128	92 907	89 218	170 852	177 421	778 915

The evolution of the proportion of patients who are covered by at least one health insurance scheme shows a steady increase in all six hospitals in the course of the 4 year study period, as shown in figure 1. In the Neuro-Psychiatric hospital of Ndera (NPH-CN), the health insurance coverage increased from 90% to 98% between 2011 and 2014 while at CHUK, it grew from 74% to 85%. In the district hospitals of Nyamata (DHNY) and Rwamagana (DHRW), health insurance coverage improved from 78% to 88%. Similar results were obtained from private hospitals, where health coverage grew from 63% to 72% at La Médicale (LMED) and from 70% to 76% at La Croix du Sud (CDS).

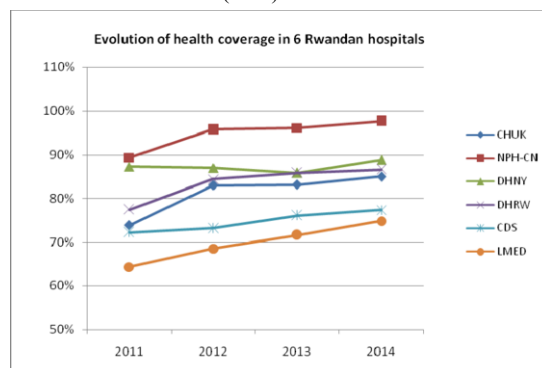


Figure 1 - Evolution of patient health coverage in 6 hospitals

Health insurance schemes in hospitals

For every out-patient encounter or in-patient admission, part of the health service costs must be paid by the insurer and the remainder by the patient, according to the patient's health coverage plan. A number of health services remain uncovered by some health coverage plans and therefore patients' out of pocket payments may vary considerably depending on the type of care that was provided. In this step, we analyzed the real reimbursement levels of different health insurance schemes over time, taking into account the uncovered parts of care.

A total of almost 2.9 million encounters (2,534,967 outpatients and 342,878 inpatients) have been analyzed, as shown in Table 2.

Table 2 - Numbers of Encounters Analyzed

	In-patient	Out-patient	Total
CHUK	92 103	639 447	731 550
NPH-CN	22 260	244 653	266 913
DHRW	110 941	224 817	335 758
DHNY	58 665	260 176	318 841
CDS	55 655	708 327	763 982
LMED	3 254	457 547	460 801
Total	342 878	2 534 967	2 877 845

The number of patients who were hospitalized at LMED is low because the use of OpenClinic GA for hospitalizations is very recent in this hospital. CHUK and CDS are 2 reference hospitals in Kigali, respectively, for the public and the private health sector. They contribute to a significant part of in- and

out-patients in our study. Figure 2 and figure 3 show the average proportion of insurance schemes coverage, respectively, for in-patients and out-patients in the 6 hospitals during the study period.

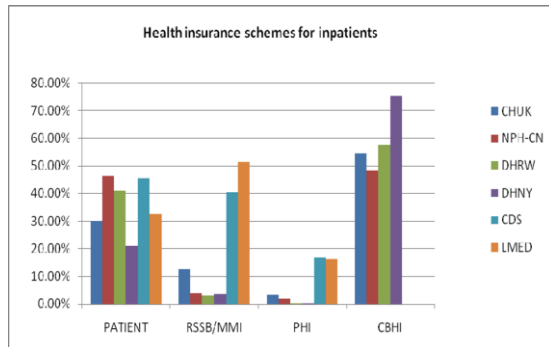


Figure 2 - Health insurance schemes for in-patients

In general, for in-patient encounters, the community based health insurance (CBHI) is the most commonly used scheme (weighted average: 60.7%) followed by public insurance (RSSB/MMI) with a weighted average of 27.7%, private insurance (PHI) for 12.9% and finally the patient directly paying for uncovered health services (PATIENT) in 37.6% of the cases. In over 45% of the in-patient encounters, patients paid directly for health care at NPH-CN and CDS due to certain care deliveries (especially hygiene supplies, specialty medicines) not being covered by the insurer. We noticed that the patient used direct payments for uncovered health services more frequently ($p < 0.0001$) in the in-patient encounters in the private hospitals (44.9%) than in district hospitals (37.9%) and tertiary public hospitals (34.5%). The public health insurance coverage scheme (RSSB/MMI) is most commonly used for in-patient encounters in private hospitals (51% at LMED and 40% at CDS). There is a statistically significant difference ($p < 0.0001$) between using public health insurance (RSSB/MMI) in private hospitals' (41.20%) and in public hospitals' (9.43%) in-patient encounters. At CHUK the RSSB/MMI scheme is used in 12.7% of in-patient encounters. The CBHI scheme is only used in public hospitals. It is used more frequently ($p < 0.0001$) in district hospitals (64.85%) than in third level hospitals (53.38%). Finally, patients with private health insurance (PHI) are more often hospitalized in private hospitals (16.8% of the in-patients) than in the public ones (2.8% of the in-patients).

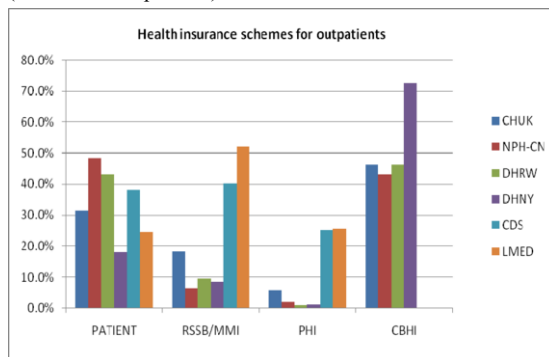


Figure 3 - Health insurance schemes for out-patients

Out-patient health coverage schemes follow a similar distribution. The CBHI scheme is more used (53.0% of the encounters) in out-patient encounters than other health

insurance schemes: RSSB/MMI (38.0%), PHI (22.4%) and PATIENT (24.6%). Out-patients are facing more uncovered health services in public tertiary hospitals (37.8%) than in district hospitals (35.2%) and private hospitals (34.2%). The RSSB/MMI scheme is more used in private (45.8%) than in public health facilities (14.9%). The CBHI scheme is also more used in district hospitals (63.2%) than in tertiary hospitals (45.5%). Patients with private insurance were more likely to consult private (25.3%) than public hospitals (5.0%).

Multiple insurance schemes can co-occur in the same encounter for the same patient.

Health services payment in hospitals

Between 2011 and 2014, the proportion of patient out-of-pocket amounts paid, compared to the total amounts paid for the health service costs, has declined significantly in private hospitals: from 36.8% to 27.6% at LMED (-9.3%) and from 29.9% to 24.4% in CDS (-5.5%). This proportion also decreased at CHUK from 21.6% to 17.5% (-4.1%) but remained stable at NPH-CN (14.2%) and increased slightly in district hospitals: from 13.2% to 15.0% at DHNY (+ 1.8%) and from 17.2% to 19.7% at DHRW (+ 2.5%). Figure 4 shows the evolution of patient out-of-pocket payment proportions for health services between 2011 and 2014 in the 6 hospitals.

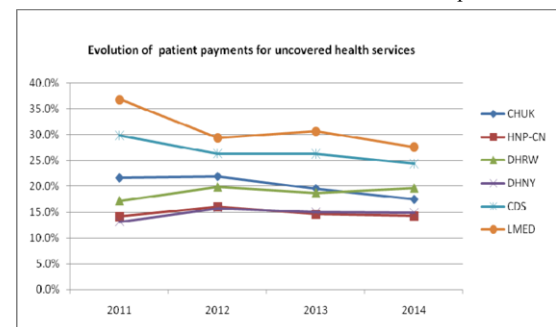


Figure 4 - Evolution of patient payment proportions for health services

The reason for the patient out-of-pocket payment proportion increase at DHRW is found in the increase of some non-reimbursable consumables (+ 2.6%), acts (+ 2.8%) and hospital stay (+ 2.6%).

Although the proportion of the amounts paid by patients has generally decreased during the study period, the absolute patient out-of-pocket payments for health services show a different trend as is demonstrated in figures 5 and 6.

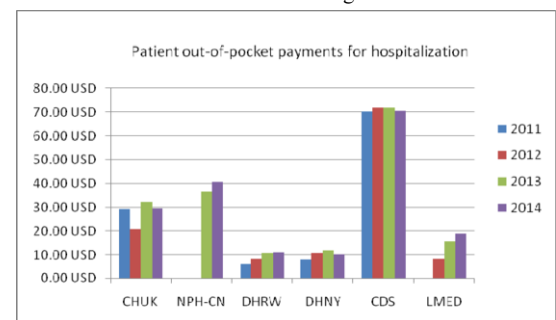


Figure 5 - Average amounts paid by the patient for health services for hospitalization

For hospitalization, the patient out-of-pocket amounts disbursed for health services at CHUK decreased the first year from 29.27USD to 20.67USD but then increased again. In 2014, the patient paid an average of 30.00USD for his hospital stay. At NPH-CN, patients' average payments for the hospitalization were 40.60USD in 2014 (NPH-CN began to use the invoicing module better in 2013). In district hospitals, patient out-of-pocket payments increased from 5.95USD at DHRW and 7.90USD at DHNY to 11.00USD and 10.15USD respectively. We noticed a large difference between patient payments in the two private hospitals: At CDS, the patient was paying around 70USD per hospitalization, while at LMED the patient out-of-pocket payments increased from 8.34USD to 18.88USD (LMED started to use the invoicing module well in 2012). The CDS experienced a period during which health care reimbursements were refused by some insurers before their accreditation as a "hospital" because their health service tariffs (especially for the hospital rooms) were too high (and the majority of the costs were not reimbursed by insurers) compared to other private hospitals and clinics.

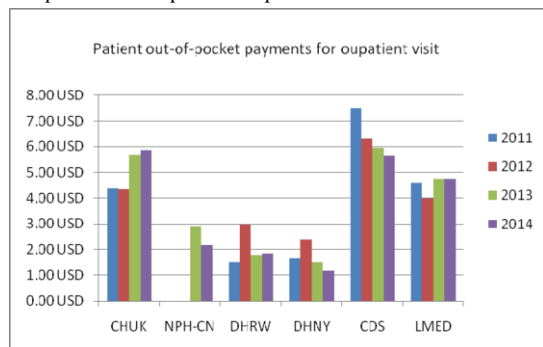


Figure 6 - Average amounts paid by the patient for health services in outpatient encounters

For out-patients between 2011 and 2014, patient out-of-pocket payments tended to increase at CHUK (from 4.38USD to 5.87USD), remain stable at LMED (around 4.50USD), and to decrease from 2012 in district hospitals (from 2.93USD to 1.83USD at DHRW and from 2.37USD to 1.15USD at DHNY), at NPH-CN (from 2.88USD to 2.19USD) and at CDS (from 7.49USD to 5.65USD). The decrease of patient out-of-pocket payments observed from the second year (2012) in district hospitals was explained by the increased number of insured patients and some consumables (gloves, syringes and needles) used during medical examinations which were initially charged to the patient and included in the global cost of the exams afterward. The decrease of patient payments observed at CDS was due to the increase of insured patients.

Discussion

This study focused on the monitoring of health coverage in Rwandan hospitals. The results showed that the health coverage in the 6 analyzed hospitals gradually increased between 2011 and 2014, reaching 98% at NPH-CN, 85% at CHUK, 88% in districts hospitals (DHRW and DHNY) and around 74% in private hospitals (LMED and CDS). Health coverage projections done in 2010 showed that in 2014, at least 92% of the population would have a valid health insurance for medical care in public health facilities [2]. This goal was reached at NPH-CN, a specialized national reference center for mental health care. Almost all patients treated at NPH-CN have a valid health insurance because the reference policy from district hospitals to tertiary hospitals enforces that

insurance. In addition, difficult social cases are directly covered by the Ministry of Health. The Rwandan government pays special attention to psychiatric disorders which are often associated with higher financial risks [7,9] in a country that still faces psychological trauma consequences of 1994's genocide and war.

The high level of insured patients seen in private health facilities is explained by private health care coverage offered by public insurance schemes (RSSB / MMI) and private insurances (PHI) as shown in figures 2 and 3. Patients covered by public or private insurance which reimburse private health care are more likely to consult private hospitals where they hope to receive better quality of care [8,9].

The proportion of patients' out-of-pocket payments compared to total health service costs has declined in private hospitals and at CHUK. It remained almost stable in other hospitals (figure 4). But the average amounts actually paid by patients for health services tended to increase for in-patients and to decrease for out-patients. The decrease of patients' out-of-pocket payments is explained by the fact that the number of patients with valid health insurance has increased and insurers accept reimbursing certain health services that previously were not covered. This assertion was also confirmed by the study of Ties Boerma and colleagues [10]. However, this assertion is not confirmed for in-patients where certain health services remain to be reimbursed only partially or not at all by health insurers.

Conclusion

The use of an open source hospital information management system enabled the detailed monitoring of universal health coverage in 6 Rwandan hospitals. The results show improvement in health coverage in both public and private hospitals in the period between 2011 and 2014 due to the role of public, community and private health insurance schemes. But efforts are still needed to further reduce the patients' out-of-pocket payments.

This study demonstrates the possibility to assess the level of universal health coverage in a developing country using hospital management systems. Although we targeted referral health facilities, this experience could also be applied to first-level health facilities such as health centers through an adequate ICT infrastructure based health information management.

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