electronic Journal of Health Informatics
http://www.ejhi.net
2010; Vol 5(1): e8

Monitoring of clinical activities and performances by using international classifications ICD-10 and ICPC-2: Three years experience of the Kigali *University Teaching Hospital*, Rwanda

Theobald Hategekimana[1], Candide Tran Ngoc[1,2], Denis Porignon[4], Michel De Jonghe[5], Frank Verbeke[1,3], Stefan Van Bastelaere[1,2]

[1]*Kigali Health Informatics Research Institute (KHIRI), Kigali University Teaching Hospital (CHUK), Rwanda*

[2]*Belgian Technical Cooperation (CTB), Kigali, Rwanda*

[3]*Vrije Universiteit Brussel, Department of Biostatistics and Health Informatics, Belgium*

[4]*Université Libre de Bruxelles, School of Public Health, Belgium*

[5]*Université Libre de Bruxelles, Department of General Medicine, Belgium*

Abstract

Measuring performances of health professionals and health facilities is a difficult task. However, with the appropriate information management tools, a lot of useful information can be collected from routine data registration activities.

Situated in the capital of Rwanda, the Central Kigali University Teaching Hospital developed in January 2006 its electronic patient record using both ICD10 and ICPC2 codes for the structured registration of diseases and procedures. In order to enable synoptic data analysis, individual codes have been grouped into a set of 174 disease groups (KHIRI Pathology Group Set –KPGS). To assess the activities and performances of the different clinical departments, outcome data were analyzed following a number of essential criteria: the caseload, the LOS (length of stay) load and the in-hospital mortality load.

A total number of 27784 patients were admitted during the study period. On the 27784 patients a total of respectively 30609 and 29447 diagnoses were recorded in ICPC2 and ICD10. The total of hospitalization days was 395256. 2759 patients died over the 3 years study period. Four ICPC classes covered more than 10% of the encodings each: A (general) 5649, D (digestive system) 6040, L (locomotors system) 3297 and R (respiratory system) counted for 4026 registrations. Comparable results could be obtained in the corresponding ICD classes A+B, K, M+S-T and J.

Linking ICD10 and ICPC2 codes to global patient data clearly enables the physicians and the hospital management to produce comparable, standardized and internationally valuable evaluations of the hospital activities and trends. It also opens the perspective of fixing objective priorities in

The *electronic Journal of Health Informatics* is an international journal committed to scholarly excellence and dedicated to the advancement of Health Informatics and information technology in healthcare. ISSN: 1446-4381

patient management and provides an interesting starting point for comparing health professionals' clinical performances in a standardized way.

Keywords: ICD-10, ICPC-2, 3BT, monitoring, in-hospital mortality load, length of stay load, case load.

1. Introduction

Unknown and underestimated for centuries, the performance of health professionals and the health system has today become a critical issue in a globalizing world. Having high-quality health care at the lowest possible cost has become a major concern for all [1-4].

Measuring performances however is difficult without the appropriate tools and the importance of using standardized and comparable information is obvious. New and performing information and communication technologies on the one hand and the development of internationally accepted classifications on the other hand, changed data management in the developed countries drastically. However evidences of these changes in developing countries, specifically in Central Africa, are scarce [5]. Sometimes questioned as quality improvement tool, the importance of health information linked to international classifications in order to analyse clinical activities in a standardized and comparable way is evident [6,7].

Commonly used and internationally validated classifications are the ICD and ICPC. ICD (International Classification of Diseases and Related Health Problems) was first introduced in London, in 1890, to assess the mortality in this city. The latest version, 10th, contains more than 12500 codes, on the etiological and physiopathological basis of disease states. Updated on a regular basis in collaboration with WHO experts, this classification is widely used and respected (see http://www.who.int/classifications/icd/en/index.html) [8,9].

On the other hand, the World Organization of National Colleges, Academies and Academic Associations of General Practitioners/Family Physicians, more commonly known as WONCA (http://www.globalfamilydoctor.com), introduced ICPC or the "International Classification on Primary Care" in 1987 [8]. ICPC is of a particular interest for data management in primary care [9,10]. The most recent version, ICPC-2e-v.4.0., released in September 2008, contains about 750 rubrics on disease entities. In order to take advantage of both types of granularity in classifying patients' clinical conditions, WONCA developed integrated mapping between ICD and ICPC. Both classifications are now accepted tools for data management at all levels of healthcare [5,11,12].

Following the war and genocide in Rwanda in 1994, the Government put health as a major component of its reconstruction efforts in designing a new health system. Beside health districts, the Central Hospital in Kigali was confirmed in its tertiary role and considered as the referral hospital for the capital city and a large part of the country as well.

Our study focuses on two aspects of patient data management in developing countries:

a) Is data entry - using international classifications - in health systems in developing countries feasible?

b) Can clinical activities be assessed and monitored in a comparable and standardized way by using these classifications and what added value can we expect by implementing such a system?

2. Methodology

2.1. Study site

Situated in the capital of Rwanda, with a population of more than 9 million inhabitants, the Central Kigali University Teaching Hospital is one of the national referral public hospitals of the country. It provides care to all inhabitants of the City of Kigali, with nearly 1 million inhabitants. [13] It has 425 beds, as of the 31st of December 2008. Annually there are over 9000 hospitalizations, 90 000 consultations and 13000 emergencies are dealt with. On December 31st, 2008 93 doctors were deployed: 38 specialists and 42 postgraduate trainees and 13 general practitioners.

The Central Kigali University Teaching Hospital started with its patient data management in 2000. In a first phase, covering 2000 – 2005, all data, including names, pathology, outcome and length of stay were managed under Microsoft Access®. To codify the pathologies, 510 codes were locally created. There was no link with national or international codes.

In 2005 the Kigali University Teaching Hospital stepped into a new era by starting the encoding of pathologies in both ICD-10 and ICPC-2, by using the Belgian 3BT (3B = Belgian Bilingual Biclassified; T = Thesaurus) in its French version. The database was run under Microsoft Access®. All patient data were systematically converted into both ICD-10 and ICPC-2 codes.

In 2007 the hospital started implementing an ambitious ICT (Information and Communication Technologies) Implementation Plan, including the development of the individual electronic patient file. The system manages all patients' administrative, financial and clinical data. A unique patient identification number is generated and a patient ID card printed. Diagnoses continue to be

encoded under ICD-10 and ICPC-2. All data generated since January 1st, 2006 were migrated from MS Access® into the new software (OpenClinic®) by means of an electronic transfer operation.

All departments were present and functional during the 3 years study period, except for gynaecology that reopened in January 2008 after rehabilitation of the buildings. The full dataset therefore only covers one year of gynaecological activities.

2.2. Study concept

This is a descriptive retrospective study in which the available data on our in-patients for the periods 2006 – 2008 are studied including patient ID-number, name, first name, date of birth, language, sex, diagnostic codes under ICD-10 and ICPC-2 classifications, department, date of admission and discharge and outcome. The study was approved by the Research Ethics Committee of the University Teaching Hospital of Kigali.

2.3. Material and methods

For a three year period, all the encodings listed above were done for all in-patients. This was done by a team of 2 encoders, both with paramedical background, under supervision of the statistician of the hospital. The encoders drew particular attention to the quality and accuracy of the administrative patient data, in order to allow further analyses on code and class related performance. For ethical reasons clinical data were only accessible for encoders and medical staff, administrative data were accessible for administrative staff.

The quality of the encoding in ICPC-2 and ICD-10 as performed by the paramedical encoders has been previously assessed in a double blind study in 2006. In this study, in order to evaluate reliability of data collection, a representative set of medical records has been encoded by both a physician-expert in the usage of health classifications and also 2 paramedical encoders. There was an absolute match in 70%, a small loss of precision in almost 20% of the diagnoses and no coding errors (e.g. wrong code applied) have been detected although they can't be excluded. The final conclusion has been that diagnostic encoding by paramedics, supported by the 3BT thesaurus, produced accurate data [14]. This presented an important prerequisite as at time of the beginning of the research project, physicians were not yet involved in clinical data-entry operations in the hospital and encoding by paramedics was the only practical way for collecting data.

To assess the activities and performances of the different clinical departments, data were analyzed according to a number of essential criteria (main study variables) using the statistical analysis modules of the OpenClinic® software:

a) The pathology classes globally and per department or the *case load* (percentage of total cases representing a specific clinical condition or group of clinical conditions)

$$\text{Case load} = \frac{Cc \times 100}{Ct}$$

Where:

Cc = total number of cases in the study dataset that have been linked to a specific clinical condition

Ct = total number of cases in the study dataset

b) The accumulated length of stay (*LOS*) per pathology class or the *LOS load* (percentage of total number of admission days that can be linked to a specific clinical condition or group of clinical conditions)

$$LOS = \sum Ccd$$

$$\text{LOS load} = \frac{100 \times \sum Ccd}{Ctd}$$

Where:

Ccd = number of admission days for every case in the study dataset that has been linked to a specific clinical condition

Ctd = total number of admission days in the study dataset

c) The accumulated mortality as recorded in link with the pathology classes or the *absolute class mortality.* The mortality was weighted both as *hospital mortality load* (percentage of total hospital mortality cases that can be linked to a specific clinical condition or group of clinical conditions) and as load for the pathology –linked mortality (percentage of patients with a specific clinical condition or group of clinical conditions that died), also called *class mortality load*

$$\text{Absolute class mortality} = Ccm$$

$$\text{Hospital mortality load} = \frac{100 \times Ccm}{Ctm}$$

$$\text{Class mortality load} = \frac{100 \times Ccm}{Cc}$$

Where:

Ccm = total number of mortality cases in the study dataset that have been linked to a specific clinical condition

Ctm = total number of mortality cases in the study dataset

Cc = total number of cases in the study dataset that have been linked to a specific clinical condition

In order to further render ICD-10 and ICPC-2 codes suitable for hospital management purposes, individual codes have been grouped into a set of 174 disease groups, the KPGS (KHIRI Pathology Group Set). The development of KPGS has been based on ICD-10 chapters with a set of codes within each chapter in order to address all common pathologies in the hospital. An example of this grouping is shown under **Tables 1 and 2**. The full set of 174 disease group codes can be provided by the authors on request.

	Surgery	Paediatrics	Internal medicine
Pathology group details	**KPGS 19A (Fractures)**: ICD-10 codes S02, S12, S22, S32, S42, S52, S62, S72, S82, S92, T02, T08, T10, T12, T14.2, T90.2, T91.1, T92.1, T93.1	**KPGS 01A (Intestinal infectious diseases)**: ICD-10 codes A00-A09	**KPGS 01B (Tuberculosis)**: ICD-10 codes A16-A19
	KPGS 190 (Other injury, poisoning and certain other consequences of external causes): ICD-10 codes S00-S01, S03-S11, S13-S21, S23-S31, S33-S41, S43-S51, S53-S61, S63-S71, S73-S81, S83-S91, S93-T01, T03-T07, T09, T11, T13-T14.1, T14.3-T19, T33-T90.1, T90.3-T91.0, T91.3-T92.0, T92.3-T93.0, T93.3-T99	**KPGS 01V (Malaria)**: ICD-10 codes B50-B54	**KPGS 01V (Malaria)**: ICD-10 codes B50-B54

Table 1: Example of mapping between 2 most important pathology grouping codes (KPGS) and ICD-10 codes per department

	Surgery	Paediatrics	Internal medicine
Pathology group details	**KPGS 19A (Fractures):** ICPC-2 codes L72-L76	**KPGS 01A (Intestinal infectious diseases):** ICPC-2 codes D70, D73	**KPGS 01B (Tuberculosis):** ICPC-2 code A70
	KPGS 190 (Other injury, poisoning and certain other consequences of external causes): ICPC-2 codes A80-A82, A84-A89, A92, B76-B77, D79-D80, F76, F79, H76,H78-H79, L77-L81, L96, N79-N81, R87-R88, S11-S13, S15-S19, U80, W75, X82, Y80, Z25	**KPGS 01V (Malaria):** ICPC-2 code A73	**KPGS 01V (Malaria):** ICPC-2 code A73

***T*able 2 :** Example of mapping between 2 most important pathology grouping codes (KPGS) and ICPC-2 codes per department

3. RESULTS

In order to evaluate feasibility of clinical condition classification according to international ICD and ICPC standards, discharge diagnoses of all in-patient records from the complete study period have been encoded. The resulting database of diagnoses has then been submitted to the hospital information system statistical analysis module in order to calculate the main study variables for all chapters (classes) of the ICD and ICPC classifications. A total number of 27784 patients were admitted during the study period.

Table 3 and **Table 4** show the overall performance of the hospital, on these patients. On the 27784 patients a total of respectively 30609 and 29447 diagnoses were recorded in ICPC (Table 3) and ICD-10 (**Table 4**). The total number of admission days was 395256. 2759 patients died over the 3 years study period. Four ICPC classes had more than 3000 encodings: A (general) 5649, D (digestive system) 6040, L (locomotors system) 3297 and R (respiratory system) counted for 4026.

ICPC-2 class	Total cases	Case load	Total LOS	LOS load	Absolute class mortality	Class mortality load	Hospital Mortality load
ICPC L (Musculoskeletal)	3297	11,87 %	87404	22,11%	94	2,85%	3,41%
ICPC A (General)	5649	20,33 %	80918	20,47%	937	16,59%	33,96%
ICPC D (Digestive)	6040	21,74 %	69719	17,64%	496	8,21%	17,98%

ICPC R (Respiratory)	4026	14,49 %	43831	11,09%	308	7,65%	11,16%
ICPC T (Metabolic, endocrine, nutrition)	2002	7,21%	30493	7,71%	238	11,89%	8,63%
ICPC K (Circulatory)	1483	5,34%	22483	5,69%	317	21,38%	11,49%
ICPC B (Blood, blood forming)	1524	5,49%	21905	5,54%	225	14,76%	8,16%
ICPC N (Neurological)	1266	4,56%	21532	5,45%	253	19,98%	9,17%
ICPC S (Skin)	617	2,22%	161,61	4,09%	59	9,56%	2,14%
ICPC U (Urinary)	786	2,83%	12436	3,15%	140	17,81%	5,07%

Table 3: Global case load, LOS load and mortality load under the ICPC-2 classification in 2006-2008.

The ranking of ICPC codes in Table 3 is done following the LOS load per code, and not alphabetically. Only the data for the 10 most important ICPC-2 classes are provided in this table.

ICD-10 class	Total cases	Case load	Total LOS	LOS load	Absolute class mortality	Class mortality load	Hospital Mortality load
ICD10 S (Injury, poisoning and external causes)	2748	9,89%	70229	17,77%	86	3,13%	3,12%
ICD10 A (Intestinal infectious diseases)	4458	16,05%	67202	17,00%	686	15,39%	24,86%
ICD10 J (Diseases of respiratory system)	3654	13,15%	39933	10,10%	274	7,50%	9,93%
ICD10 K (Diseases of digestive system)	2750	9,90%	34203	8,65%	271	9,85%	9,82%
ICD10 E (Endocrine, nutritional and metabolic diseases)	1942	6,99%	29155	7,38%	230	11,84%	8,34%
ICD10 B (Viral infections characterized by skin and mucous membrane lesions)	2453	8,33%	25964	6,57%	246	10,03%	8,92%
ICD10 N (Diseases of genitourinary system)	1633	5,88%	20300	5,14%	140	8,57%	5,07%
ICD10 T (Injury, poisoning and external causes)	831	2,99%	19424	4,91%	80	9,63%	2,90%

ICD10 I (Diseases of circulatory system)	1153	4,15%	18769	4,75%	220	19,08%	7,97%
ICD10 G (Diseases of the nervous system)	780	2,81%	15659	3,96%	180	23,08%	6,52%

Table 4 : Global case load, LOS load and mortality load under the ICD-10 classification in 2006 – 2008

The ranking of ICD codes in 4 is done following the LOS load per code, and not alphabetically. Only the data for the 10 most important conditions are given in this table. The results indicate that ICD-10 classification class A (infectious diseases) ranked on top with 4458 cases, and class J (respiratory system) covered 3654 cases.

Subsequently, as indicated in the methodology section, ICD and ICPC encoded diagnoses have been grouped into KPGS classes and all main study variables have been re-analysed for the whole hospital and for every separate department. The purpose of this operation was to reorganize data and analysis results in a way that is more useful for hospital management purposes.

	Surgery	**Paediatrics**	**Internal medicine**
Case load	19A: Fractures (37,99%) 190: Other injury, poisoning and certain other consequences of external causes (10,88%) 11J: Other diseases of the digestive system (8,58%) 140: Diseases of the genitourinary system (5,46%) 11D: Hernia (4,59%)	01A : Intestinal infectious diseases (20,66%) 01V: Malaria (14,52%) 10C: Pneumonia (11,70%) 160: Certain conditions originating in the perinatal period (7,42%) 04D : Nutritional deficiencies (7,05%)	01B: Tuberculosis (18,72%) 01V: Malaria (7,42%) 10C: Pneumonia (7,31%) 140: Diseases of the genitourinary system (6,63%) 10E: Other diseases of the respiratory system (4,58%)
LOS load	19A: Fractures (44,18%) 190: Other injury, poisoning and certain other consequences of external causes (10,68%) 11J: Other diseases of the digestive system (5,60%) 19B: Burns (5,21%) 140: Diseases of the genitourinary system (3,60%)	01A : Intestinal infectious diseases (13,88%) 04D: Nutritional deficiencies (10,64%) 10C : Pneumonia (10,26%) 01V : Malaria (8,50%) 160 : Certain conditions originating in the perinatal period (5,42%)	01B: Tuberculosis (27,30%) 140: Diseases of the genitourinary system (5,43%) 10C: Pneumonia (5,37%) 04B: Diabetes (4,32%) 09F: Other forms of heart disease (4,02%)

Mortality load	19A: Fractures (19,51%) 190: Other injury, poisoning and certain other consequences of external causes (13,66%) 11J: Other diseases of the digestive system (13,66%) 19B: Burns (11,22%) 170: Congenital malformations, deformations and chromosomal abnormalities (6,34%)	160 : Certain conditions originating in the perinatal period (14,32%) 04D : Nutritional deficiencies (13.62%) 01U : Other infectious diseases (12,57%) 01A : Intestinal infectious diseases (8,96%) 10C: Pneumonia (8,38%)	01B: Tuberculosis (28,96%) 140: Diseases of the genitourinary system (7,42%) 11H: Liver disease (7,15%) 10E: Other diseases of the respiratory system (6,15%) 10C: Pneumonia (4,98%)

Table 5: Top 5 ICPC-based KPGS ranking for Case load, LOS load and mortality load 2006-2008 per department

Four ICPC classes had more than 3000 encodings: A (general) 5649, D (digestive system) 6040, L (locomotors system) 3297 and R (respiratory system) counted for 4026. load and mortality loadTable 6 : top 5 ICD-10 –based KPGS ranking for Case load, LOS load and mortality load 2006-2008 per department

	Surgery	Paediatrics	Internal medicine
Case load	19A: Fractures (39,25%) 190: Other injury, poisoning and certain other consequences of external causes (9,14%) 140: Diseases of the genitourinary system (5,48%) 11D: Hernia (4,57%) 170: Congenital malformations, deformations and chromosomal abnormalities (4,20%)	01A: Intestinal infectious diseases (20,60%) 01V: Malaria (14,52%) 10C: Pneumonia (10,95%) 160: Certain conditions originating in the perinatal period (7,35%) 04D: Nutritional deficiencies (7,05%)	01B: Tuberculosis (15,27%) 01V: Malaria (7,42%) 10C: Pneumonia (6,82%) 140: Diseases of the genitourinary system (6,61%) 01A: Intestinal infectious diseases (4,54%)
LOS load	19A: Fractures (45,60%) 190**: Other injury, poisoning and certain other consequences of external causes (8,91%)** 19B: Burns and corrosions (5,59%) 13E: Osteopathies and chondropathies (4,25%) 140: Diseases of the genitourinary system (3,66%)	01A: Intestinal infectious diseases (13,84%) 04D: Nutritional deficiencies (10,65%) 10C: Pneumonia (9,62%) 01V: Malaria (8,50%) 160: Certain conditions originating in the perinatal period (5,33%)	01B: Tuberculosis (21,85%) 140: Diseases of the genitourinary system (5,42%) 10C: Pneumonia (4,98%) 09F: Other forms of heart disease (4,41%) 04B: Diabetes mellitus (4,18%)
Mortality load	19A: Fractures (20,49%) 19B: Burns and corrosions (12,68%) 190: Other injury, poisoning and certain other consequences of external causes (9,27%) 11G: Diseases of peritoneum (8,29%) 170: Congenital malformations, deformations and chromosomal abnormalities (6,34%)	160: Certain conditions originating in the perinatal period (14,55%) **04D: Nutritional deficiencies (13,62%)** 01D: Other bacterial diseases (11,64%) 01A: Intestinal infectious diseases (8,96%) 10C: Pneumonia (7,80%)	01B: Tuberculosis (24,16%) 140: Diseases of the genitourinary system (7,33%) 10E: Other diseases of the respiratory system (5,79%) 06A: Inflammatory disease of the central nervous system (5,70%) 09F: Other forms of heart disease (4,62%)

Table 6 : Top 5 ICD-10 -based KPGS ranking for Case load, LOS load and mortality load 2006-2008 per department

Table 6 shows the critical top 5 ICPV-2based pathology group ranking per department for case load, LOS and mortality load.

Finally, the obtained encoded clinical data has also been used to document the monthly evolution of case load, LOS load and mortality load for diseases with specific importance for the Rwandan population (clinical monitoring). **Figure 1** shows the evolution of the case load for 4 pathologies (tuberculosis, malaria, HIV and nutritional deficiencies) at the CHUK during the period 2006-2008. Tuberculosis, malaria and nutritional deficiencies were monitored because they rank in the top 5 major clinical conditions for the hospital. HIV was monitored for other research purposes. ICPC-2 codes were used to identify the cases and have proven to be very useful in implementing permanent monitoring systems for major clinical conditions and/or groups of clinical conditions.

Figure 1: Case load Monitoring :ICPC-2 based evolution of new cases for 4 critical pathologies in the period 2006-2008 (numbers on top of the bars indicate the number of months in the past data was collected)

As stated in the introduction, the first concern of our project was to assess the feasibility of capturing data using the international classifications ICPC-2 and ICD-10. Our three years experience has been convincing and has proven that using ICPC-2 and ICD-10 classifcations with the help of appropriate instruments in sub-Saharan hospitals is feasible:

a) All classification and coding operations used in the study are today fully integrated in routine patient registration procedures. Clinical information relevant for encoding is provided by the hospital physicians and encoded by dedicated hospital staff (2 paramedics).Every in-patient record is treated within 1 week after discharge.

b) The usage of appropriate tools (like the used 3BT based interface within the OpenClinic® environment) enables coding and classification by paramedics. This is a major advantage. Quality of the coding results has proven to be very acceptable [14]. Coding staff only needed a short training program (3 days initial training and half a day a month for follow-up)

c) Classification was performed simultaneously in ICPC and ICD. The less granular ICPC was used as an easy to use first-level coding gateway putting a real-time filter on the more complex and detailed ICD classification.

e) ICPC and ICD codes have all been mapped to 174 clinical conditions (KPGS codes) which provide useful entities for routine hospital management. The results of the KPGS mappings based on ICPC and ICD show a very high level of similarity (Tables 5 and 6).

The second and more important concern of our paper was to figure out whether clinical activities can be assessed and monitored in a comparable and standardised way by using these classification systems and what added value can we expect by implementing them into the hospital information management software.

a) Clinical activity and performance was assessed in our study using 3 key qualifiers: the caseload, the length of stay load and the mortality load for the hospital. These qualifiers can be automatically calculated by the OpenClinic® system for any clinical condition code (ICPC, ICD of KPGS). Usage of international classification systems enables comparison with other health facilities worldwide. However, very detailed clinical condition classification systems (like ICD) can lead to important statistical noise caused by large numbers of less common clinical conditions, Therefore, grouping of diagnostic codes into larger clinical entities (like the 174 KPGS codes the CHUK developed) appeared to be necessary. Furthermore, such diagnostic grouping also provided a way to deal with the absence of advanced diagnostic capabilities in certain hospital-departments. Development of diagnostic grouping codes has therefore proven to be an essential element for monitoring standards-based clinical activity data in our hospital.

b) **Tables 5 and 6** provide a detailed overview of the departmental (Surgery, Paediatrics and Internal Medicine) top 5 clinical conditions ran ked according to their scores for every of one of the 3 qualifiers under the KPGS grouping

c) The 3 key qualifiers (caseload, length of stay load and the global mortality load for the hospital) are essential for the hospital as both physician and management must have a clear view on how frequent health problems are, how do they weigh on the available beds and how their severity burdens population's health? Moreover knowing is an essential and critical element for all quality improvement programs and specifically for the accreditation process our hospital is involved in since 2007. The developed system helped us fixing clear priorities for all departments. Furthermore, we have been able to detect a number of weaknesses in hospital patient management in a number of departments based on excessive LOS load scores for specific pathologies.

d) Classification of clinical conditions also proved to be very useful for developing a permanent monitoring system for a number of important diseases our hospital has to deal with. Such monitoring can help us to evaluate the effects of specific programs to reduce prevalence, morbidity and/or mortality for selected clinical conditions (**Figure 1).**

4. Discussion

The actual paper aims at sharing three years of experience in data collection and data management in a sub-Saharan National Hospital.

Providing evidence about clinical activity, performance and pathology load is a difficult task for hospitals in developing countries. Surely, hospital clinicians mostly seem to have a good idea of the global activity profile of the department they are working in. However, this knowledge is often based on personal appreciation of their day to day activity and little or no formal quantification is involved. Structuring clinical information using international standards enabled our hospital to **formalize knowledge about clinical activity, performance and pathology load in a comparable way**. The results allowed to describe or discover particular aspects in the functioning of the institution:

a) For the surgical department it became clear that trauma patients are the number one concern. 19A - fractures not only counted for about 39 % caseload (Table 6), the 19A LOS load was even higher with 45 % and counted for 20 % of the mortality load in surgery. Further investigation learned us that femur fractures (ICPC-2 code L75) were responsible for the large majority of the LOS load and that special effort was needed to improve the corresponding treatment procedures. In the first quarter of 2009, '19A Fractures' case load and LOS load in the Surgery department dropped to respectively 23.89% and 25,38%, attesting an important improvement. Another interesting observation for surgery is that 19B – burns and corrosions ranks on the second place as far as departmental mortality is concerned, and ranks on the 3rd place for the LOS load, but 19B does not even rank in the caseload top 5.In the department of paediatrics intestinal infections, pneumonia, malaria, conditions originating in the perinatal period and nutritional deficiencies were composing the caseload top 5.

Nutritional deficiencies are responsible for a high LOS load (2nd position with 10%) and a high mortality load (2nd position with 13%). Malnutrition indeed remains a critical condition in Rwanda where respectively 52% and 18 % of the children under 5 are below -2SD for Height for Age and Weight for Age [15].

c) For internal medicine the analysis clearly demonstrates the burden of 01B - Tuberculosis, in the first place for caseload (17 %), LOS load (24 %) and mortality load (26 %). Malaria still ranks on number 2 for case load despite of intensive preventive campaigns countrywide, but is no longer in the LOS load and mortality top 5 at the hospital level.

d) If we have a look at the evolution of the total monthly new malaria cases in the hospital **(Figure 1)** we can see that these have been continuously decreasing during the last 3 years. This most likely demonstrates the results of the important sustained malaria-prevention efforts that have been developed in Rwanda during the past 5 years. Based on ICD and ICPC classifications, the system we developed enables permanent monitoring of any clinical condition, consisting of any group of ICPC and/or ICD codes

Experiences from this study have taught us that standardized clinical activity statistics can help us in documenting weaknesses in departments and clinical pathways (like femur fracture management in the Surgery department). Although statistical analysis of clinical activity cannot be held directly responsible for subsequent improvements in patient management, we believe that without it, a number of problems would never be detected.

Classification of discharge diagnoses has today become a standard procedure in the hospital. Since the beginning of 2009, the hospital has extended its standards-based clinical registration procedures implementing also real-time classification of reasons for encounter for in-patients and out-patients.

Limitations: Though evidence brought by our study on the feasibility and added value of using international classifications is clear, the approach has its limitations. The setting must be adequate and the health care provider must at least have access to adequate ICT tools and know how to use them. We worked with full time encoders and we did not yet shift to the planned encoding by the doctors and nurses themselves. It is our conviction that from a long-term perspective this might be a better option. Working with encoders requires a continuous validation of the data encoded by encoders.

Analysis of the generated result by both medical staff and management is a key factor of success. Involvement of the heads of departments and management is essential for the sustainability of the system to avoid generation of data without benefit for the hospital.

Today, only the global outcome parameters are being assessed (case load, LOS, mortality). No method has been put in place to distinguish confounders like available personnel per service, clinical qualifications, level of experience etc…). The used method is therefore only useful for providing global performance indicators for teams of care providers (not individuals) in a particular resource setting.

Future applications: An important opportunity of the implemented system is that healthcare providers can start comparing their clinical activities and performances in a standardised way both nationally and internationally. By using these international classifications amongst all levels of the health system, comparison of performances on certain classes of pathologies become an important tool in the decision making of health authorities and policy makers.

The fact that ICPC-2 and ICD-10 are now connected in an integrated system, also allows implementation of their use in the primary health care settings. Codes generated in health centres will in general be ICPC-2 based, but due to the integrated links between ICPC-2, ICD-10 and the KPGS, comparison of outcomes on the same conditions between health centres, district hospitals and referral hospitals are now possible. However, it is clear that still much work remains to be done on the KPGS implementation. Pathology grouping must be further refined during the next few years in order to address specific needs of hospital and health centre management.

Linking health costing and classification opens further perspectives of research in health financing, i.e. knowing what the cost of a condition is for an identified pathology per level of care. This can be achieved through linking of care delivery data for every in-patient episode to the corresponding clinical condition codes. Such a task however, will also need to involve development of *care consumption weight factors* providing information about the importance of any clinical condition in terms of care consumption.

Regarding quality of care, this set of data suggests that detection of bad clinical performance in terms of LOS or mortality could benefit from a more nuanced analysis to detect which kind of pathology is leading to discrepancies according to international standards. In order to achieve this, it is very likely that additional parameters must be taken into account: personnel skills, available human and material resources, social factors, etc.

Finally, health system strengthening analysis could be performed according to adequate use of referral facilities both at national and district levels. Malaria data suggests that, due to recent effective interventions at health system's peripheral echelons allowed to reckon a significant decrease of the workload due to this problem in the national hospital wards [16]. Further analysis should permit to define whether in-patient malaria cases can be treated more efficiently at lower levels of the Rwandan health system.

As a conclusion, this analysis provides interesting information regarding innovative methods to improve management capacity in large hospitals in developing countries. Further refinements and investigation using a similar methodology will increase quality and financial analysis capacity, which are beneficial for developing countries' health systems.

References

1. Rowe AK, de Savigny D, Lanata CF, Victora CG. How can we achieve and maintain high-quality performance of health workers in low-resource settings? Lancet 2005 Sep 17;366(9490):1026-35.

2. Naveh E, Stem Z. How quality improvement programs can affect general hospital performance. Int J Health Care Qual Assur Inc Leadersh Health Serv 2005;18(4-5):249-70.

3. Agyepong IA, Anafi P, Asiamah E, Ansah EK, Ashon DA, Narh-Dometey C. Health worker (internal customer) satisfaction and motivation in the public sector in Ghana. Int J Health Plann Manage 2004 Oct;19(4):319-36.

4. Jiang HJ, Friedman B, Begun JW. Sustaining and improving hospital performance: The effects of organizational and market factors. Health Care Manage Rev 2006 Jul;31(3):188-96.

5. Kamadjeu RM, Tapang EM, Moluh RN. Designing and implementing an electronic health record system in primary care practice in sub-Saharan Africa: a case study from Cameroon. Inform Prim Care 2005;13(3):179-86.

6. Portelli R, Brosi J, Collopy B. Matching ICD-9-CM codes to clinical indicators--is it the way to go? Health Inf Manag 1997 Dec 19;27(4):168-70.

7. Osler TM, Cohen M, Rogers FB, Camp L, Rutledge R, Shackford SR. Trauma registry injury coding is superfluous: a comparison of outcome prediction based on trauma registry International Classification of Diseases-Ninth Revision (ICD-9) and hospital information system ICD-9 codes. J Trauma 1997 Aug;43(2):253-6.

8. Wonca International Classiffication Committee. ICPC-2: International Classification of Primary Care (2e). Oxford University Press; 1998.

9. de Lusignan S, van Weel C. The use of routinely collected computer data for resaerch in primary care: opportunities and challenges. Family Practice 2006;23:253-63.

10. Britt H, Beaton N, Miller G. General practice medical records: why code? Why classify? Australian Family Physician 1995;24:612-5.

11. Okkes I, Jamoulle M, Lamberts H, Bentzen N. ICPC-2-E: the electronic version of ICPC-2. Differences from the printed version and the consequences. Fam Pract 2000 Apr;17(2):101-7.

12. Rodgers RP, Sherwin Z, Lamberts H, Okkes IM. ICPC Multilingual Collaboratory: a Web- and Unicode-based system for distributed editing/translating/viewing of the multilingual International Classification of Primary Care. Medinfo 2004;11(Pt 1):425-9.

13. Rwanda 2005: results from the demographic and health survey. Stud Fam Plann 2008 Jun;39(2):147-52.

14. De Jonghe M, Jamoulle M, Porignon D. Utilisation et évaluation du thésaurus belge 3BT adapté au Rwanda . Rev Méd Brux 2006;27:274-8.

15. World Health Organization. World health Statistics 2008. Geneva.; 2009.

16. Logie DE, Rowson M, Ndagije F. Innovations in Rwanda's health system: looking to the future. Lancet 2008 Jul 19;372(9634):256-61.

Correspondence

Dr Frank Verbeke
Vrije Universiteit Brussel
Faculty of Medicine and Pharmacy
Department of Biostatistics and Medical Informatics
Laarbeeklaan 103
B-1090 Jette (Brussels)
Belgium

Phone +32 (0)16 721047
Fax +32 (0)16 721048
http://bisi.vub.ac.be

frank.verbeke@vub.ac.be