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Improving the Quality of Clinical Coding through the Training of Health Records and Information Officers in Selected Hospitals, Nairobi City County, Kenya

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Abstract

Clinical coding quality is increasingly becoming an important arm in health and statistics. The objective of this research was to establish whether training could improve the quality of clinical coding in Nairobi City County Hospitals. A before-and-after interventional design was used for the study. The study was conducted at Mbagathi County Referral Hospital and Mama Lucy Kibaki Hospital, with the latter acting as the control group. The study took the form of a baseline and two follow-up studies. The intervention was training on ICD-10. A sample of 612 subjects with 306 cases from each hospital was audited. Pretesting was conducted at Mama Lucy Kibaki Hospital. Data analysis was done using Statistical Package for Social Science (SPSS) Version 25. Fisher's Exact and Paired T- test were conducted to establish the significance of differences between the two groups. The study revealed a low proportional (52%) of files were coded in MCRH than in MLKH (62%) therefore, biasing the intervention to MCRH. The mean for MLKH was 3.63 ± 0.916 compared to 3.56 ± 726 for MCRH. The mean difference of on how to use of ICU-10 was 0.25. The mean speed of coding was better in MCRH (4.00 ± 1.000) than in MLKH (3.13 ± 1.458). Coding of cause of death was wanting in MCRH (4.00 ± 1.453) than in MLKH (4.13 ± 0.35). Completeness also varied across. The difference in coding of external injury files between MLKH and MCRH prior to and after intervention was explicit. Coding of external injury files in the intervention arm improved to 100% from 97.3%. While that of control arm enhanced from 50% to 83.3%. The fisher exact p value was <0.001 before intervention but reduced 0.018 post intervention. Coding for medical procedure files was much less complete before training at 33.3% in MLKH and 93.3% in MCRH. However, coding changed to 83.3% and 100% correspondingly after the training. The Fisher Exact p-value for coding of medical procedures was <0.001 prior to training and 0.001 after training. Accuracy in assigning the appropriate code for diseases and injuries significantly varied after training (p=<0.001) contrary to indifferent (p=0.665) before training. However, the difference before (p<0.001) and after the intervention (p<0.001) in assigning the appropriate code for medical procedure was evident. Accuracy in assigning the appropriate code for death certification also varied significantly before (p=0.009) and after the intervention (p<0.001). The study revealed mean difference after the training. T-Test was statistically significant in death certification (t=-12.283; d.f=38; p=0.000), assigning the appropriate code for medical procedure (t=-6.969; d.f=42; p=0.000) and assigning the appropriate code for external causes of injuries (t=-4.953; d.f=73; p=0.000). Appropriate code for comorbidities was (t=-7.473; d.f=78), p=0.000), correct code for diseases and injuries (t=-5.015; d.f=226; p=0.000). The study findings support the hypothesis that training of health records and information officers significantly improved the quality of clinical coding. Based

on the results, coding was influenced by both coder awareness level, keenness in documentation and interpretation. The study revealed the importance of adequate training, planning and awareness as key ingredients to effective implementation of ICD-10. Enhanced training improves documentation, which in turn enables providers to analyze patient details, thereby leading to better care coordination and health outcomes. The study recommends greater investment in staff through ICD-10 training and recruitment as well as IT systems across all hospitals within the county.

Keywords: Clinical coding; Health records; Hospitals

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Introduction

The International Classification of Diseases (ICD) is the customary instrument used in diagnostics for epidemiology, clinical purposes and health management [1]. It includes an examination of specific cohorts and their overall well-being. The ICD tool is important in monitoring incidence or prevalence of specified diseases and other health related problems. Therefore, ICD provides an overall picture of the health status of people and countries. ICD is used widely in the health sector by health care providers, policy-makers and facilities. ICD is applicable in classification of diseases and other health related problems recorded in the different forms of health and vital records like health records and death certificates. The annals enable easy loading and retrieval of information multiple reasons, one being compilation of national statistics on mortality and morbidity by the WHO Member States [2].

Disease classification is defined as a system used in the categorization of morbid entities in accordance with an established criteria [3]. The axis of the classification depends on the intended use of the compiled statistics. The tenth revision of the International Statistical Classification of Disease and Related Health problems famously known as ICD-10 is the latest in the series. The contents of ICD-10 have been divided into three major volumes. Volume 1 is a tabular list that contains reports of the 10th revision international conference, the classification at three and four character levels and classifications of neoplasm morphologies, a special tabulated list of morbidity and mortality, nomenclature regulations and definitions.

Volume 2 is an instructional manual that brings together the write-ups on the classification and certification in volume 1. It has the background, instruction and guidance manual on the use of volume 1 and the historical background of the ICD. Volume 3 contains an index with an introduction and more expanded instructions for its use. Each volume of the ICD has two sections. The first section has an alphabetical order of the components with their codes while the second section has a numerical tabular list of the codes of the same contents [4]. The clinical coding in Kenya is based on the WHO [5] guidelines on International Statistical Classification of Diseases and Related Health Problems published in 2006. However, these guidelines were designed having in mind the developed world; thus there is need for relevant authorities to initiate a training manual for the coders so as to reflect applicability within the local context (WHO) [6].

Work on the 10th revision of the ICD started in September 1983 when a Preparatory Meeting on ICD-10 was convened in Geneva [7]. International Classification of Diseases-10 contains codes for diseases, signs and symptoms, abnormal findings, complaints, social circumstances, and external causes of injury or diseases [8]. World Health Organization (WHO) brought out the 10th version of ICD-10 in 1993 for methodical coding of illness and death causes in the medical records of medical organizations to be used for reporting by the member states. In global health estimates technical paper [9] the countries that have adapted accuracy and completeness in reporting using coding method were included in their 2010–2012 report [10]. The inclusion criteria included level of completeness of recorded mortality data.

The pace of implementation and adoption of ICD-10 in many countries, Kenya included, is diverse and does not live up to the reported standards put forth by WHO [11]. Understanding and acceptance of ICD as reporting tool is major concern [12]. The use of ICD in developed countries such as Kenya is unique and challenging due to its clinical nature [13]. Failure to follow some basic rules of coding as well as misreporting by clinicians is also a major hindrance to ensuring high quality clinical coding [14]. Clarity of abbreviations is a major concern and source of error in clinical coding [15]. Also touted as a major source of error are incomplete or inaccurate code descriptions which vary from coder to coder or from one health professional to another. Training and awareness have been advanced as a remedy, yet trials of their effect are limited.

Materials and Methods

The study was carried out at Mama Lucy Kibaki County Hospital and Mbagathi County and Referral Hospital both public hospitals in Nairobi City County. Mama Lucy Kibaki County Hospital was selected as the control site while Mbagathi County and Referral Hospital was the intervention site based on the results of the baseline study.

This was an interventional trial that used a before-and-after

study design with quantitative method. An initial baseline study was used to establish the gaps in the quality of clinical coding both for diseases and procedures in medicine coding; followed by intervention (training), and an after-training follow-up study. Houser et al., [16] noted the increasing use and resourcefulness of the quasi-experimental designs like before-and-after studies in medical informatics research.

A sample size was 306 coded files from each facility for each of the three studies (Baseline, 1st follow-up and 2nd follow-up) was randomly selected from all wards of the hospitals. Data from the Clinical Coders who are Health Records and Information Officers was collected using a self-administered questionnaire containing both closed and open-ended questions for the level of training for the coders. A check list was used to audit the coded files. The research adopted both quantitative and qualitative techniques using questionnaires, focus group discussions and in-depth individual discussions for key informants. Data was analyzed using descriptive statistics. A composite index to assess quality of coding was generated from the auditing criteria, the index was compared between the two facilities both at baseline and in the follow-up, and the influence of independent factors was also analyzed. Data was analyzed using SPSS version 25. And hypothesis testing done at p-value cut off of 0.05. Quality of coding was measured using paired T-test.

Results

Seventeen coders were, enrolled in the study and there was comparable gender distribution with slight male predominance 10 (58.8%). Eleven (64.7%) of the coders had worked in the current facilities for less than 5 years. Considerable number of coders 15 (88.2%) were educated past certificate level. About three quarters of the clinical coding health records and information officers were, trained on ICD. The median years of experience were 11 as shown in **Table 1**.

The clinical coders in the two facilities depicted variance in five key competence variables. There was a slight mean difference in understanding of ICD coding. The mean for MLKH was 3.63 ± 0.916 compared to 3.56 ± 726 for MCRH. The mean difference of MLKH (4.25 ± 0.886) and MCRH (4.00 ± 866) on how to use of ICU-10 was 0.25. The mean speed of coding was better in MCRH (4.00 ± 1.000) than in MLKH (3.13 ± 1.458). Coding of cause of death was wanting in MCRH (4.00 ± 1.453) than in MLKH (4.13 ± 0.35). These competence findings infer that health information professionals in MCRH were need of clinical coding training than their peers in MLKH **Table 2**.

The completeness in coding of comorbidities files improved from 91.1% to 98.7 after the intervention in MCRH. While files in MLH changed by 0.1% from 98.2% to 98.3%. Whereas the difference was statistically significant before training p=0.020. The converse was true after intervention with p=0.638 as shown in **Table 3**.

The difference in coding of external injury files between MLH and MCRH was 27.3% before training. Nonetheless, this reduced to 16.7% after the training. Coding of external injury files in the intervention arm improved to 100% from 97.3%. While that of control arm enhanced from 50% to 83.3%. The difference in coding of external injury files was statistically significant prior to intervention and after intervention. However, the strength of evidence reduced from p-value of <0.001 to 0.018 as shown in **Table 4**.

The study analyses revealed variations in accuracy of coding for diseases and injuries. The variance was statistically significant after training but non-significant before.

Accuracy for external caused injuries before and after the training varied considerably by hospital. The difference was statistically significant at both surveys ends. The accuracy of coding external cause of injury varied from 64% to 85% **Table 5**.

Accuracy in assigning the appropriate code for diseases and injuries varied in the two facilities. Among records of 191 files in MLKH, 2 (1%) were not coded, 52 (27.2%) wrongly coded, while 137 (71.7%) rightly coded. For MCRH files, 3 (1.3%) not coded, 53 (23.3%) wrongly coded and 171 (75.3%) rightly coded. After the intervention accuracy of coding improved in both facilities. There was no wrongly coded file in the MCRH but 30

Table 1 Demographic characteristics.

Demographic characteristic				
Variables	Values	Health Facility, Frequency (%)		
		MLKH	MCRH	Total
Gender	Male	4 (40)	6 (60)	10 (58.8)
	Female	4 (57.1)	3 (42.9)	7 (41.2)
Years of services in current Hospital	< 1 year	1 (50)	1 (50)	2 (11.8)
	1–5 years	4 (44.4)	5 (55.6)	9 (52.9)
	5 –10 years	1 (33.3)	2 (66.7)	3 (17.6)
	10–15 years	1 (100)	0	1 (5.9)
	>15 years	1 (50)	1 (50)	2 (11.8)
Education Level	Certificate	0	2 (100)	2 (11.8)
	Diploma	2 (28.6)	5 (71.4)	7 (41.2)
	Degree	3 (60)	2 (40)	5 (29.4)
	Masters	3 (100)	0	3 (17.6)
Experience (in HRIM)	Median=11 (IQR=4, 20)			
Ever had a short ICD coding training	Yes	6 (50)	6 (50)	12 (70.4)
	No	2 (40)	3 (60)	5 (29.4)

Table 2 Competencies in Clinical Coding.

Competencies of clinical coding				
Variables	Values	Health Facility, Frequency (%)		
		MLKH	MCRH	General
ICD-10 policy guidelines	Poor	1 (12.5%)	1 (11.1%)	2 (11.8%)
	Average	2 (25%)	2 (22.2%)	4 (23.5)
	Good	4 (50%)	6 (66.7%)	10 (58.8%)
	Excellent	1 (12.5%)	0	1 (5.9%)
	Mean	3.63 ± 0.916	3.56 ± 726	3.59 ± 0795
How to use ICD-10	Average	2 (25%)	3 (33.3%)	5 (29.4%)
	Good	2 (25%)	3(33.3%)	5 (29.4%)
	Excellent	4 (25%)	3(33.3%)	7 (41.2%)
	Mean	4.25 ± 0.886	4.00 ± 866	4.12 ± 0.857
Speed of Coding	Very Poor	1 (12.5%)	0	1 (5.9%)
	Poor	2 (25%)	1 (11.1%)	3 (17.6%)
	Average	2 (25%)	3 (33.3%)	5 (29.4%)
	Good	1 (12.5%)	3 (33.3%)	4 (23.5%)
	Excellent	2 (25%)	2 (22.2%)	4 (23.5%)
	Mean	3.13 ± 1.458	4.00 ± 1.000	3.41 ± 1.228
Coding of cause of death	Very Poor	0	1 (11.1%)	1 (5.9%)
	Poor	0	1 (11.1%)	1 (5.9%)
	Average	2 (25%)	0	2 (11.8%)
	Good	3 (37.5%)	3 (33.3%)	6 (35.3%)
	Excellent	3 (37.5%)	4 (44.4%)	7 (41.2%)
	Mean	4.13 ± 0.35	4.00 ± 1.453	4.0 ± 1.173

Table 3 Completeness in Coding Comorbidities.

Completeness in coding external injury files						
	Pre-training			Post training		
	Complete	Incomplete	Fisher exact	Complete	Incomplete	Fisher Exact
MLKH	6 (50.0)	6 (50)	0.000	10 (83.3)	2 (16.7)	0.018
MCRH	72 (97.3)	2 (2.7)		74 (100)	0	
Total	78 (90.7)	8 (9.3)		84 (97.7)	2 (2.3)	
Completeness for medical procedure files						
MLKH	9 (33.3)	18 (66.7)	0.000	20 (83.3)	7 (16.7)	0.001
MCRH	40 (93)	3 (7.0)		43 (100)	0	
Total	49 (70.0)	21 (30.0)		63 (90)	7 (10.0)	

Table 4 Completeness in coding external cause of injuries.

Completeness in coding comorbidities files						
	Pre-training			Post training		
	Complete	Incomplete	Fisher exact	Complete	Incomplete	Fisher Exact
MLKH	113 (98.2)	2 (1.7)	0.020	113 (98.3)	2 (1.7)	0.638
MCRH	72 (91.1)	7 (8.9)		78 (98.7)	1 (1.3)	
Total	185 (95. 4)	9 (4.6)		191 (98.5)	3 (1.5)	
Completeness in coding death certification files						
MLKH	27(90.0)	3 (10.0)	0.054	28 (93.3)	2 (6.7)	0.065
MCRH	28 (71.8)	11 (28.2)		39 (100)	0	
Total	55 (79.7)	14 (20.2)		67 (97.1)	2 (2.9)	

(13.2%) were wrongly coded lower from 23.3%. The net effect was increase of rightly coded file to 86.8% from 75.3%. There was slight improvement in MLKH. Rightly coded files increase by 0.5% to 72.2% as shown in **Table 6**. The variance was significantly (p=<0.001) different after training but non-significant before (p=0.665).

Table 5 Appropriate coding for diseases and injuries.

Appropriate coding for diseases and injuries								
	Pre-training				Post training			
	Not coded	Wrongly coded	Rightly coded	F. exact	Not coded	Wrongly coded	Rightly coded	F. exact
MLKH	2 (1)	52 (27.2)	137 (71.7)	0.665	1 (0.5)	52 (27.2)	138 (72.2)	0.000
MCRH	3 (1.3)	53 (23.3)	171 (75.3)		0	30 (13.2)	197 (86.8)	
Total	5 (1.2)	105 (25.1)	308 (73.7)		1(0.2)	82 (19.6)	335 (80.1)	
Appropriate code for external causes injuries								
MLKH	6 (50)	2 (16.7)	4 (33.3)	0.000	2(16.7)	5(41.7)	5 (41.7)	0.000
MCRH	2 (2.7)	22 (29.7)	50 (67.6)		0	4 (5.4)	70 (94.6)	
Total	8 (9.3)	24 (27.9)	54 (62.8)		1 (0.2)	82(19.6)	335 (80.1)	

Table 6 Quality of clinical coding before and after training.

Quality of clinical coding before and after the training						
Group	N	Pre(Mean + SD)	Post (Mean + SD)	t	df	Sig (2 tailed)
Comparison in Assigning the Correct Code for Diseases and Injuries						
MLKH	191	1.71 ± 0.479	1.72 ± 0.463	-0.253	190	0.080
MCRH	227	1.74 ± 0.469	1.87 ± 0.339	-5.015	226	0.000
Comparison in Assigning the Appropriate Code for Comorbidities						
MLKH	115	1.61 ± 0.525	1.63 ± 0.521	-0.498	114	0.619
MCRH	79	1.38 ± 0.647	1.90 ± 0.443	-7.473	78	0.000
Comparison in Assigning the Appropriate Code for External Causes of Injuries						
MLKH	12	0.83 ± 0.937	1.25 ± 0.754	-2.159	11	0.054
MCRH	74	1.65 ± 0.535	1.95 ± 0.228	-4.953	73	0.000
Comparison in Assigning the Appropriate Code for Medical Procedure						
MLKH	27	0.59 ± 0.888	1.15 ± 0.818	-4.507	26	0.000
MCRH	43	1.33 ± 0.606	1.98 ± 0.151	-6.969	42	0.000

Discussions

To study the effect of training of health records and information officers on quality of clinical coding in selected level four Hospitals Nairobi County, Kenya. The results are discussed and compared with other similar studies in this chapter. The conclusion and recommendation are also provided.

General attributes of the coders relative to coding

The study revealed slight male predominance and well-educated clinical coding health records and information officers. The education level of the coders resonates with level four hospitals in Kenya. This infers that the clinical coding health records and information officers are well qualified to undertake the assigned roles and tasks. The findings resonates with recommendation by the World Health Organization that classified clinical coding as a major and exclusive responsibility of HIM professionals [17]. World Health Organization further specified that clinical coders require knowledge of medical terminology, legal aspects of health information, health data standards, and computer- and/or paper-based data management.

Education is an integral element in health information management Darvish et al. [8] . Well-educated clinical coders are efficient and well versed in their roles. Ndidi [18] that clients will more likely listen to knowledgeable providers when being educated about coding issues, which is of utmost importance, supports this. The respondents' mean industry experience was eleven; however, period for working in the current station was less than five years. This is lower than 15.46 years reported by Santos et al. [19]. The short period in workstations may be attributed to reorganization of staff during the inaugural period of devolution.

Competences of clinical coding

Training on International Classification of Diseases (ICD-10) was high. The survey results confirmed that hospitals are following recommended guidelines to prepare and plan through training for the implementation of ICD-10 coding systems. The importance of adequate planning and better preparation as essential ingredients to the successful implementation of ICD-10 is well documented [19]. The adequacy of training the coder receives influences her or his ability to synthesize large amounts of information and assign precise code [20]. This finding affirms that credentialed health management professionals in the two facilities perform clinical coding. This finding resonates with Taiwo et al., which reported that ICD-10 coding and classification of diagnoses and procedures and the process is being managed by the right workforce (HIM professionals) which reassures effectiveness. The current study result also reveals that employers have sharpened the skills of the coders and the coders have embraced the opportunity to grow their skills [21]. Continuing education of coders, or lack thereof, also influences coding accuracy, as the codes and coding rules expand and change annually [22].

The importance of International Classification of Diseases (ICD-

10) is well documented Nichols [23]. Enhanced training improves documentation that in turn enables providers to analyze patient details, thereby lead to better care coordination and health outcomes. Coding performed by improperly trained or distracted clinical staff can cost an outlet in reimbursement, delayed billing and compliance risk. According to Ndidi, a professional coder must be knowledgeable in all coding systems and know how to convey the information concisely and in several different styles [24].

Knowledge on usage of ICD-10 and speed of coding

The baseline study revealed variance in the five coding competencies. The study echoes with a statement that the issues that Health Information officers confront vary depending on the experience, size, and complexity of the health facility [25]. The understanding of ICD coding process was better in MLKH compared with MCRH. This means that the coders in MLKH were well informed than the colleagues in MCRH on the common language that health care providers utilize to code every possible medical injury, illness, or accident. Kayina et al., [26] reports fewer Health Information officers with proper knowledge of ICD-10 Kayina, Sharma and Agrawal [26].

Clinical coders in MLKH were more knowledgeable than those in MCRH on how to use ICD-10. It is evident from the current study that clinical coding practices and, especially, implementation need training to boost its optimum efficiency in MLKH [27]. The effect of training is well advanced by WHO. WHO noted that intellectual abilities and social adaptation may change over time, and, however poor it is, it might improve because of training and rehabilitation [28]. The mean speed of coding was better in MCRH than in MLKH. The findings may reveal that experience and education is not a good predictor for coding since coders in MLKH were more educated and experienced than MCRH. However, the current study could not validate the speed of coding relative to quality due to study methodology and insufficient sample size [29,30].

It is also possible that clinical coders do engage in other duties, which influence their speed. A preposition supported by Taiwo et al., who reported that the role of health information managers is often broad necessitating the need for a wide range of skills and competencies on any given day [31]. Hennessy et al. [32] reported that the quality of coded data is influenced by two major factors. First is clarity, precision and completeness of documentation. Second is the accuracy and consistency of the coder. Elsewhere, it is reported that the main error sources include variance in clinical knowledge, the quality of written records, the depth of coder training and experience levels, the hospital's quality control efforts, as well as unintentional and intentional coder errors such as misspecification, unbundling, and upcoding [32].

Knowledge on coding of cause of death

Coding of cause of death files was wanting in MCRH than in MLKH prior to the intervention. Inaccuracy of coding death files or severe or life-threatening conditions has been explained Hennessy et al., [32]. According to O'Malley and Lezzonias cited by Hennessy et al., the process of assigning ICD codes is complicated, more of an art than a science. The many steps in the process of coding death or life-threatening conditions may trigger the emotional perspective of coders, therefore introducing numerous opportunities for error. Poor coding of cause of death files, the less knowledge on how to use ICU-10, and that of ICD coding biased the clinical coding training intervention to MCRH. Therefore, study accepts the hypothesis that Health records and information officers in Nairobi City County Hospitals, Kenya were not competent in clinical coding.

Completeness of clinical coding before and after the training

Variability in completeness by health records and information officers in Nairobi City County Hospitals was the focus of this objective.

Completeness in diagnosis reporting files

The study found no significant variance in completeness for diagnosis reporting files pre- and post-training. However, files were completely coded after the intervention in MCRH. In general, incompleteness reduced from 2.6% to 0.2% after the training. Though this difference was not statistically significant, it provides a strong indication of significant return on investment for training time. Just as this present study suggests returns in training, similar findings were reported by Stanfill et al. [33] that of particular importance is the strong indication of a significant return on investment for staff training time.

Incompleteness and inaccuracy in coding diagnosis files have been widely reported in Chongthawonsatid . Chongthawonsatid in a study on national health data of Thailand observed that records were often incorrect and incomplete even though there were standard coding guidelines available (Chongthawonsatid). Complete coding provides supporting clinical information necessary for referral, treatment and diagnosis [34].

Completeness in external injury files

The study found significant difference in coding of external injury prior and after intervention. However, the strength of evidence reduced after training. For example, the difference in coding of external injury files was 27.3% between MLKH and MCRH before training. Nonetheless, this reduced to 16.7% after the training. Coding of external injury files in the intervention arm improved to 100% from 97.3%. While that of control arm enhanced from 50% to 83.3%. The baseline survey may have triggered coders to start coding external injury files. This learned behavior would directly contravene the goal of ICD-10 system Horsky et al., [15] .The management may have also enhanced the step of coding processing such as completeness checking, diagnosis and procedure coding, code checking and coding auditing. A previous study found that external causes of injury were not coded in a reliable, complete and valid manner.

Completeness coding medical procedure files

Coding for medical procedure files was much less complete before training at 33.3% in MLKH and 93.3% in MCRH. However, coding changed to 83.3% and 100% correspondingly after the training.

The difference was statistically significant before and after training but with reduced strength. The inconsistency in completeness in medical procedures have been reported Chongthawonsatid . Chongthawonsatid found that the discharge summaries had the most coding errors and incomplete spaces.

Completeness in coding of comorbidities

It is important to identify comorbidities and code appropriately for the purpose of creating patient comorbidity profiles and comorbidity index Youngson et al., The current study reported improved completeness in coding of comorbidities files from 91.1% to 98.7% after the intervention. The difference was statistically significant before training but insignificant after. Coding comorbidities files remains a challenge across. This is attributed to the need to differentiate between several codes for comorbidities during documentation. Added specification such as detailed description of laterality and location in the patient's body have compounded the problem. The validation of the codes themselves, a key area of determining the optimal strategy for defining comorbid conditions is undefined. With the current work-load, coders may find themselves facing a choice between complete, accurate and "close enough" coding when time constraints preclude further refinement of the process [35].

Completeness in coding death certification

Difference in completeness in coding death certification files was 28.2% between MLKH and MRCH before training. The difference however reduced to 6.7% after training. Completeness in MCRH enhanced to 100 from 71.8%. While that of MLKH increased to 93.3% from 90%. Although the current study reported improved coding after intervention, the suitability of ICD to documentation causes of death has been questioned Lu, Lunetta and Walker [35]. The ICD-10 does not provide sufficient detail and attributes of health conditions [36]. For example, injury-related deaths may be coded as unspecified because medical certifiers fail to report sufficiently detailed information on the death certificates to allow coders to assign specific codes. On the other hand, the cause of death is sometimes described in terms of symptoms, rather, than attributed to a specific underlying cause. More efforts should focus on training medical certifiers to report specific information relevant to injury prevention on death certificates. The difference was non-significant before and after the intervention. Completeness in medical abbreviations files was perfect at 100% before and after intervention. The study accepts the hypothesis that level of completeness of clinical coding differ before and after training of Health records and information officers in Nairobi City County Hospitals, Kenya.

Accuracy of clinical coding before and after the training

Accuracy in coding diseases and injuries files: Study analyses revealed variations in appropriately coding for diseases and injuries. The two facilities shared similar traits in clinical coding diseases and injuries before intervention. The findings suggest that coders have similar understanding of ICD-10 codes. Nonetheless, accuracy of coding improved after the intervention in MCRH suggesting that the training was impactful. Rightly coded files increased to 86.8% from 75.3% while wrongly coded files decreased to 13.2% from 23%. There was slight improvement of 0.5% in MLKH of rightly coded files. The variance was statistically significant after training but non-significant before. Based on the results, coding is influenced by both coder awareness level, keenness in documentation and interpretation. Kirpich, Marsano, McClain [24] support this result.

Accuracy in coding external cause's injuries files: Likewise, accuracy for external cause's injuries before and after the training varied considerably by hospital. Accurate coding was 33.3% and 67.5% in MLKH and MCRH respectively. However, accuracy improved to 94.6% from 67.5% in MCRH compared to that of MLKH that increased to 41.7% from 33.3%. The difference was statistically significant at both surveys ends. The current study results are similar to those from studies examining coding of injuries in general and other medical diagnoses [37]. The accuracy of coding external cause of injury varied from 64% to 85% in a similar study. However, Kirpich, Marsano, and McClain examined broader groups of codes using ICD-9-CM codes while this study used ICD-10 codes, which provide a more detailed approach to specify the type of maltreatment, the level of certainty of the cause of the injury, and the suspected perpetrator.

Accuracy in coding medical procedure files: Appropriateness in medical procedure was dissimilar before and after the intervention in the two facilities. This infers that coding practices are not uniform and are based on practices at individual hospitals. For example, practices for medical procedure were considerably efficient in MCRH after intervention. Rightly, coded files increased to 97.7% from 39.5%. While in MLKH, the accuracy increased to 40.7% from 25.9%. The difference was statistically significant before and after the intervention. A recurring issue found in this study is the positive impact of the intervention to coding including the appropriate coding of medical procedure. These results strengthen the theory that high-quality medical record documentation is best achieved when coders are informed, supervised or when responsibilities are shared. These findings agree with a report by Farzandipour et al., [38] that high-quality medical records are more likely when healthcare practitioners, health information management professionals and administrators work together, acting as a 'documentation triangle'.

Accuracy in coding death certification files: The study found statistical variation in accurately coding death certification files. Efficiency improved in MCRH with rightly coded files increasing to 92.3% from 5.1%. While that of MLKH, increased from 6.7% to 36.7%. Social implications of coding appropriately deter coders from inputting codes to death files [39]. This may explain the inaccuracy in the baseline. There was no significant effect in coding and interpreting medical abbreviations before and after the training. We can deduce from this finding that the level of understand among coders in the two facilities is equal and alike. One factor discussed when examining coding accuracy is the use of Electronic Medical Records (EMR). This study was limited to manual coding since the facilities were using paper medical records during this time period. Based on the results, coding is influenced by both coder awareness level, keenness in documentation and interpretation. The study rejects the

hypothesis that level of accuracy of clinical coding differ before and after training of health records and information officers in Nairobi City County Hospitals, Kenya.

Quality of clinical coding before and after the training

Diagnosis reporting: The quality of diagnosis reporting was the same prior and after intervention. The t-test was statistically indifferent. A ''diagnosis'' is a word label applied to the disordered anatomy and physiology (the disease) presumed to be causing a person's constellation of symptoms and signs [40]. The certainty of a diagnosis depends upon multiple factors such as the participants (patient, clinician, and medical staff), disease type, current state of medical knowledge and technology, context within which the diagnosis is made, and translation of coding changes into practice by O'Malley et al. The current results of diagnosis reporting prior and after intervention are expected since the study participants did not change. The findings contrast with Farzandipour et al., who reported that coding in diagnosis reporting continues to be variable and those factors such as clarity of documentation, incomplete information in medical records and lack of attention to detail can lead to unreliable and inaccurate diagnosis coding. The present study was limited to effect of training among coders; however, there is need to undertake a research to address the role of other health providers in improving the quality of coding particularly in diagnostics.

Single diagnosis Files (simple files): The baseline quality of clinical coding for simple files was average prior but improved to good in the post-intervention period. The paired t-test of the pre-test and post-test results of assigning the correct code for diseases and injuries was statistically significant in the intervention arm. But, this was insignificant in the control arm. Nonetheless, the quality of coding improved by 7.5% in the intervention arm. The training may improve the skills and enhance the attention of the coders in coding simple files. The preposition is supported by the observation that the coders' experience, attention, and persistence also affect the accuracy of coding [41].

Comorbidities (Complex files): Quality of coding comorbidities files was 47% at baseline. The proportion of well-coded complex files rose to 71%, representing one of the best improvements after training. The change in the mean of assigning the appropriate code for comorbidities between the pre-test and the post-test stage was 37.7%. The paired sample t-test was significant in intervention but not in control. The finding alludes that the training intervention heightened awareness in numerous codes representing comorbidities, and complications, which improved the coding in the intervention arm. Cartwright reported similar finding on a study titled ICD-9-CM to ICD-10-CM Codes: What? Why? How? Cartwright advances that information on numerous codes that represent more specific anatomic sites, etiologies, comorbidities, and complications, and will improve the ability to demonstrate and code comorbidities. On the other hand, the certainty of the quality of the coding varies based on disease factors (type, knowledge, and progression) and physician/coder factors (experience with the disease and knowledge of coding tools for the disease) [42].The current study did not focus on errors influencing code accuracy in a facility; therefore, further research examining which factors influence the quality of the physician's diagnosis and the extent to which these factors affect the coding is greatly needed.

External causes of injuries and disease: Coding for external causes of injuries and disease increased by 18.2% and was statistically significant at the intervention establishment. There was increase in the control site; however, not statistically significant. There was improvement in practice in both control and intervention. Whereas the improvement may be ascribed to intervention sites, the change in the control arm may be attributed to acquired syndrome courtesy of the baseline survey. The finding alludes that the existence of codes does not assure that the coders will use these codes consistently and accurately. The findings resonated with McKenzie et al., who alluded that the practice of coding episodes in hospitals differs and varies relative to personnel and social support. It is important to note that in coding injuries and disease episodes special rules apply (WHO). Although the ICD is primarily designed for the classification of diseases and injuries with a formal diagnosis, not every problem or reason for coming into contact with health services can be categorized in this way (WHO). The finding of this study has implications for the quality of future injury data [43,44]. To realize the objectives of the ICD-10 injury classification scheme, a defined supervisory mechanism informing the consistent and accurately used of ICD-10 need to be developed.

Procedures

The paired sample t-test of the pre-test and post-test results of assigning the appropriate code for medical procedure was statistically significant at both study sites. The mean increased by 0.65, which indicated an increase of 48.9% in intervention. While that control increased by 0.56 (5.9%). The discernible finding may be attributed to the fact that many potential errors originate with the coder. It is also important to note that the current study intervention centered on ICD-10 standards and not the coders work procedures. Therefore, appropriate code for medical procedure was the same before and after the intervention since work ambience was affected by the training. These findings agree with the report by O'Malley et al., [45] that since coders go through voluminous records while coding, quality and accuracy of coding medical procedure will only change when work ethic or work load is slightly tweaked. For example, Lloyd and Rissing as cited by O'Malley et al., [45] reports that when 11 experienced, active medical coders reviewed 471 medical records and were told they would be reevaluated, all of the coders differed in one or more data fields for more than half of the records. It is important to reiterate that the ICD-10 is one of the most vital epidemiologic tools. The t-test was statistical indifferent. The current results of diagnosis reporting prior and after intervention are expected since the study participants did not change. The paired t-test of the pre-test and post-test results of assigning the correct code for diseases and injuries was statistically significant in the intervention arm [46]. Therefore, completeness and accuracy are the gold standard for effective and efficient quality coding. The study rejects the hypothesis that quality of clinical coding does not differ before and after training of health records

and information officers in Nairobi City County Hospitals, Kenya.

Coding of causes of death, death certification, and indexing: The mean of coding of cause of death, death certification, and indexing increased by 19.5%. T-test was statistically significant in intervention but insignificant in control. The study reveals therefore that short and specific tailored made education session is an effective strategy to change coders' behaviour and improve the cording of the death, death certification, and indexing files. This study results are consistent with Esmaeili et al., as cited by Farzandipour et al., which proved educational intervention to be an effective means of improving providers' behaviour regarding medical record documentation. This contrasts with other research which has short term educational intervention to be none effective means in changing coders behaviour and improve the coding of the death, death certification, and indexing files [47,48]. Multiple combination of methods and complementary strategies would, however, be more effective and efficient since there is no single best way to improve coders' practices [49].

Interpretation of medical abbreviations: There was no difference in the level of interpretation of medical abbreviations between the pre-test and the post-test stage in both the control and intervention groups. I would submit that this single strategy of training intervention was not the most effective ways of encouraging coders to learn, understand and interpret medical abbreviations. These are areas domiciled to medical colleges [50]. The finding resonates with the finding by World Health Organization that the ICD training and implementation alone could not cover all the information required and that only a 'family' of disease and health-related classifications would meet the different requirements in public health [51].

As such, strategies should be developed to integrate and practice ICD-10 coding with medical abbreviations in medical institutions. The finding contrast with studies that have reported positivity of medical staff education in improving accuracy of medical and interpretation of medical chart and abbreviations [52]. Adequate training, planning and awareness as key ingredients for effective implementation of ICD-10. This study also revealed that extensive time taken to code a record does not necessarily result in an increase in coding quality [53]. The study findings support the hypothesis that training of health records and information officers will significantly improve the quality of clinical coding [54]. The study provides a strong indication of a significant return on investment for staff clinical coding training.

Conclusion

- The study revealed deployment of well-educated clinical coders in tandem with the recommendation by WHO that clinical coding is a major and exclusive responsibility of HIM professionals.
- The findings revealed variance in key clinical coding competencies. The understanding of ICD coding and on how to use ICD-10 was high. This infers that coders are familiar with common language/codes for medical injury, illness, or accident. The study reports variability of speed of coding. However, the current study could not validate the speed of coding relative to quality due to study methodology and insufficient sample size.
- There was a marked variation in completeness. There was absolute completeness in diagnosis reporting files. However, the external causes of injury were not coded in a reliable, complete and valid way. Coding for comorbidities, death certification and medical procedures were inconsistent and incomplete.
- Inaccuracy was indifferent. Study revealed inaccuracy in coding diseases and injuries, external causes and file medical procedure before training. Medical procedure was dissimilar before and after the intervention in the two facilities. Nonetheless, accuracy of coding improved after the intervention. This infers that coding practices are not uniform and are based on practices at individual hospitals. The study also found statistical variation in accurately coding death certification files. There was no significant effect in coding and interpreting medical abbreviations before and after the training.
- The study revealed enhanced quality of coding after training. This infers that training of health records and information officers significantly competence which in turn improve the quality of clinical coding. Quality of coding in improved in comorbidities files, simple files, complex files, coding causes of death, death certification, and indexing. However, the quality of coding in diagnosis reporting files was the same prior and after intervention. The proportion of well-coded complex files rose to 71%, representing one of the best improvements after training. Coding causes of death, death certification, and indexing increased by 19.5%.
- The study reveals therefore that short and specific tailored made education session is an effective strategy to change coders' behavior and improve the cording of the death, death certification, and indexing files.

Recommendation

There are several implications from this research that may guide policy makers, managers, practitioners, HIM professionals and scholars in the context of ICD coding.

Recommendation from the study

- The study reveals the importance of tailored short-term training as an effective strategy to change coders' behaviour and improve quality of coding. Grounded on the finding, undertaking clinical coding awareness is advanced for policy makers and practitioners in health management.
- The findings revealed variance in key clinical coding competencies. The understanding of ICD coding and on how to use ICD-10 was high. The coders in this study benefited significantly on the key areas of ICD policy guideline, ICD-10 use and coding of cause of death. However, understanding on coding of complex, and comorbidities files were still key concern. A detailed training on the ICD-10 or new version is necessary to mitigate the shortcomings and enhance efficiency of ICD-10.

- It is also important to note coding completeness varied. The study revealed absolute completeness in diagnosis reporting files. However, the external causes of injury were not coded in a reliable, complete and valid way. Coding for comorbidities, death certification and medical procedures were inconsistent and incomplete. This finding implies that coders have differences skill and competencies to each coding standard. Skills difference may be due to exposure or education. There is need therefore for training tailored for these specific coding challenges.
- From the study findings complemented by reviewed literature, there is inaccuracy in coding diseases and injuries, external causes and filing medical procedure. The study also found statistical variation in accurately coding death certification files. This infers that, coding is influenced by coder awareness level, keenness in documentation and interpretation. There is therefore to raise awareness and importance of keenness in documentation. Supervisory roles should also be enhanced to reduce external cause of keenness.
- The study reports that short comings in application of single method training in improving coding and therefore recommends multiple combination of methods and strategies to improve coders' practices. For example, to realize the objectives of the ICD-10 injury classification scheme, a defined supervisory mechanism informing the consistent, complete and accurate application of ICD-10 need to be developed.

Recommendation for Further Research

- First, this study was a self-assessment one, therefore there is need for non-self-assessment to validate or reject the study finding.
- Secondly, the present study was limited to effect of training among coders; however, there is need to undertake research addressing the role of other health providers in improving the quality of coding particularly in diagnostics and cause of death.
- The current study did not focus on errors influencing code accuracy in facility; therefore, further research examining which factors influence the quality from an institutional perspective and the extent to which these factors affect the coding is greatly needed.

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