Development and Implementation of Patient Management Information System of Kampala International University Teaching Hospital(KIU-TH), Bushenyi District, Uganda

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The study evaluatedthe effectiveness of the existing/current patient management information system (EPMIS) design of KIU-TH and the effectiveness of the proposed patient management information system design of KIU-TH in Bushenyi District, Uganda. To test the null hypothesis of there is no significant difference between the existing/current PMIS design and the proposed PMIS design of KIU-TH in Bushenyi District, Uganda. This study employed quasi-experimental designs, descriptive survey, and comparative analysis design approach. The data were analyzed using means and t-test.The findings revealed that the existing PMIS was fairly satisfactory with an overall mean of (2.84). On the other hand, the findings revealed that the proposed patient management information (PPMIS) was effective with an overall mean of (3.22). In addition,the findings also revealed that there was significant difference between the existing PMIS and the proposed PMIS (t=-5.069, sig. =0.000).It was concluded that Orlando's nursing process theory by Orlando (1972) is a suitable guideline for designing a user friendly patient management information system.Based on the findings of this study, it is recommended that the KIU-TH management implement the proposed PMIS in order to improve on the quality of patient service delivery at the KIU teaching hospital.1

Introduction

The Institute of Medicine (2001) estimates that of the 98,000 Americans dying each year from preventable medical errors, one-fifth of these errors are linked to the lack of prompt access to patient health information. Therefore, it is important to review the literature to determine the best approach to patient health information management and to recommend a model that would address the problems mentioned above.

According to Frasher *et al* (2007) recent studies have shown up to 24% loss to follow-up information of HIV patients in Africa during treatment and many patients not being started on treatment at all. Some programs for prevention of maternal–child transmission have more than 80% loss to follow-up of babies born to HIV-positive mothers. These patients are at great risk of dying or developing drug resistance if their antiretroviral therapy is interrupted.

Chaulagai *et el* (2005) also asserted that in many developing countries, lack of reliable data and grossly inadequate appreciation and use of available information in planning and management of health services were two main weaknesses of the health information systems in Malawi.

According to Mandelli and Giusti (2005) the first attempt at establishing a Health Information System (HIS) in Uganda dates back to 1985. This first HIS was mainly designed for capturing and analyzing data concerning specific communicable and non-communicable disease. It was still a vertical – or disease oriented – approach, which soon appeared to be too narrow and specific. The need of collecting and generate more useful information with a broader impact on management aspects called for a first revision of the HIS in the year 1992. Despite its launching, nonetheless, it did not focus much on capturing patient management data/information. In addition, to make matters worst, most of the systems were on standalone computers thus depriving most health workers from accessing and sharing the relevant patient data and information.

Nsekuye (2007) also asserted that sincehealth management information system(HMIS) quality concerns like accuracy, completeness and timeliness of reports have been more commonly assessed and reported about in a number of studies, relatively less documentation is found on the actual utilization of the information generated from HMIS reports to manage individual patients.

Furthermore Smolij & Dun (2006) also asserted that inadequate or misleading patient health information can lead to medical errors, inaccurate decision making, and increased cost in form of data/information duplications thus time consuming when needed faster.

Research and development projects have shown the need for strengthening hospital management information systems (HMIS), patient management information system inclusive, but this has proven to be a difficult task, especially in developing countries including Uganda (Igira *et al*, 2009). In addition, althoughdisease surveillance reports and monitoring of key output indicators within the health sector seem to be the areas with the most remarkable advance,nonetheless,little has been mentioned on the importance of the use of information system for monitoring performance indicators such as capturing and provision of patient data or information for assisting

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health care staffs in assessing, diagnosing, planning, implementation of preventive care plans and evaluation of patient conditions(Mandelli and Giusti ,2005).

Review of Related Literature

Patient Management Information System

In this research, patient management information system (PMIS) has been operationalized as an information system used by health professionals to keep track of patient's health related information. In other words PMIS is an information system that keeps data/information on all the activities whose primary purpose is to promote, restore or maintain health of the patient. Despite the above definition, authors like Adam (2009), define patient management information systems as being any tool used to assist in the delivery of clinical care from the point of care initiation to completion. Patient information management systems have helped doctors' offices become more efficient. Instead of writing everything down by hand, medical staff can input information directly into a system that will do all the storing and filing for them. Also, patient information management systems make patient data easily accessible. The tools include paper-based systems, telecommunications capabilities, health care organizations and information technology systems. In other words, patient information management systems are electronic databases that store patient files in a centralized location. Adam further asserts that effective implementation and use of health information technology came with growing medical complexity the need for effective documentation, billing, professional communications and medical Legal document.

In a research concluded by Kalyowa (2001) it was concluded that there was lack of a credible Vital Registration System which could be used for monitoring of some health and demographic indicators in the communities. For example, for a period of one year, it was found that malaria contributed the highest proportion (24.2%) of death among the first 10 killer diseases.

According to Droma *et al* (2009), much as a patient record management systems in hospital today necessitate a competent administration when handling patients, generating reports from cashier, patient details which serves as a key factor for the flow of business transactions in St Francis Hospital Nsambya, unfortunately the current Record management system leads to misplacement of drug details, payment details, and late release of reports and insecurity to records.

Patient Assessment and information system

According to Richardson *et al* (2005), whereasall network reported assessment tools were completed in paper format, three of the assessment tools (8%) were also transferred into electronic patient notes. This means that a few of assessment tools were reported to be exclusively electronic in their format and recording.

Furthermore, according to Evans *et al* (1993) a hospital information system was designed in a study to be utilized as resources to assess the attributable effects of adverse drug effects (ADEs) on hospital length of stay and cost of hospitalization. In addition, nursing acuity data was used to help adjust severity of illness within DRG groups and actual hospital costs were used instead of estimated costs.

Patient diagnosis and information system

Availing the laboratory test result or patient's diagnosis data/information to health workers helps in illness and disease management. Pennisi *et al* (2001) found that in the event of patients being re-admitted to the unit, it is crucial to have ready access to all the information regarding previous hospital stays, including diagnostic images, to avoid the need for time-consuming searches through the hospital s paper-based archives.

Planning process and information systems

A study by Ammenwerth and colleagues'(2001) revealed that seven nurses (58 percent) agreed that the PIK software application saved time for care planning, but only three agreed that PIK saved time for documentation of tasks or for report writing. The majority of nurses agreed that with PIK, nursing documentation is more complete (10 nurses), legibility is better (9 nurses), and that the quality of documentation is better (8 nurses).

Implementation of patient care/intervention

A study finding by Daniels (2012) revealed a high rate of antiretroviral-related errors occurring on admission to the hospital and throughout a patient's hospital stay. The high frequency of errors emphasized the need for targeted interventions aimed at preventing these errors and quickly identifying and resolving errors that do occur. Several interventions aimed at decreasing this error rate were instituted, including the addition of computer alerts for incorrect doses and drug interactions to the pharmacy order-entry system; distribution of an educational pocket-sized card among the staff; addition of commercially available combination antiretroviral products to the hospital formulary; updates of the computerized prescriber-order-entry (CPOE) system to include common dosage defaults.

Patient evaluation process and information system

In Heje *et al* (2010) study it was found that 33% of the responding general practitioners (GPs) reported that the patient evaluation had raised their attention to the patient perspective on the quality of general practice care.

Philip *et al* (1994) in a study intended to develop and evaluate an information system for monitoring impact of acute hospital care on health status of elderly patients, burden on carers, and consumer satisfaction with care,discharge evaluation was only feasible to follow-up evaluation.

Null Hypothesis

H0: There is no significant difference between the current/existing and proposed PMIS in K.I.U teaching hospital in Bushenyi District, Uganda.

Methodology

Employing the quasi-experimental (pre-test post-test techniques) and descriptive survey (descriptive comparative) designs, data were collected using researcher devised questionnaires with items on patient assessment, diagnosis, planning for treatment, implementation of preventive care, and evaluation of patient conditions. Using the Sloven's formula, a minimum sample size of 102 was obtained, though 150 questionnaires were administered to respondents, only 71% were retrieved. The purposive and simple random sampling procedures were utilized to select from a sample of 102 KIU-TH health staffs in Bushenyi District, Uganda.The Cronbach's Alpha coefficient test indicated that the questionnaires were acceptable at above 0.5 (α=0.822). The data were analyzed using summary statistics such as means andranks. The null hypothesis was tested using Student's two independent samples t-test.

The following mean range was used to arrive at the mean interpretation of the individual indicators:

Mean range	Response mode	Interpretation
3.26-4.00	Strongly Agree	Very Effective
2.51-3.25	Agree	Effective
1.76-2.50	Disagree	Ineffective
1.00-1.75	Strongly Disagree	Very Ineffective

Findings

Level of Performance of the Current/Existing Patient Management Information system (PMIS) in KIU-TH

The first objective this studywas to evaluate the performance of the current/existing patient management information system (PMIS) in KIU-TH in Bushenyi District, Uganda. Current/existing PMIS in this study was conceptualized in terms of whether it is paper based or electronically managed information system in the health care setting.

Table 1

Level of the Performance of Existing PMIS (Assessment, Diagnosis, Planning, Implementation and Evaluation)

Types of constructs	Mean	Interpretation
A. Assists in *assessing* patients by providing information about the right:	2.998	Effective
B. Assists in the *diagnosis* of patients by providing information that:	2.75	Effective
C. Assists in the planning process by providing information:	2.78	Effective
D. Assists in the implementation of patient care/interventions by providing information:	2.87	Effective
E. Assists in the evaluation process by providing feedback information about:	2.78	Effective
Average mean	2.84	Effective

Source: Primary data, 2012

For interpretation of responses on Table 1 the following numerical values and descriptions were followed:

Effectiveness of the Current/Existing PMIS

Mean range	Response mode	Interpretation
3.26-4.00	Strongly Agree	Very Effective
2.51-3.25	Agree	Effective
1.76-2.50	Disagree	Ineffective
1.00-1.75	Strongly Disagree	Very Ineffective

A. In Assessing Patients

Results in table 1 indicate that effective performance(2.998) was experienced in capturing and providing data or information in assisting KIU-TH health care staffs assess patients.This finding is contrary to the findings of Richardson *et al* (2005) which indicated no assessment tools were reported to be exclusively electronic in their format and recording.

B. In Diagnosis of Patients

Results in table 1 indicate that the level of the performance of the current/existing PMIS is effective (mean=**2.75**) in terms of providing information that assists the health staffs in the diagnosis of patients. Contrary to the above findings,Pennisi *et al* (2001) found that in the event of patients being re-admitted to the unit, it is crucial to have ready access to all the information regarding previous hospital stays, including diagnostic images, to avoid the need for time-consuming searches through the hospital s paper-based archives. The possibility to access clinical information and diagnostic images using a single computer programme proved to be useful both for evaluating the patient's conditions immediately after the imaging procedure and for monitoring the patient's progress over

time by comparing the different diagnostic images and imaging procedures. In addition, the findings in a research conducted by Kalyowa (2001) it was concluded that there was lack of a credible Vital Registration System which could be used for monitoring of some health and demographic indicators in the communities.

C. Planning process of handling patient

Results in table 1 indicate that effective performance (mean=2.78) of the current/existing PMIS was experienced in capturing and retrieving information that assists the health staffs in planning process to handle patients.This findings is in line with the findings of a study by Ammenwerth and colleagues (2001) which revealed that seven nurses (58 percent) agreed that the PIK software application saved time for care planning, however only three agreed that PIK saved time for documentation of tasks or for report writing. Nonetheless the majority of nurses agreed that with PIK, nursing documentation is more complete (10 nurses), legibility is better (9 nurses), and that the quality of documentation is better (8 nurses). However, Ammenwerth and colleagues did not tie these findings to patient outcomes or changes in nursing practice. The conclusion that the introduction of a care planning system alone, without supporting organizational change, will not work is also supported by Spranzo's work.

D.In the Implementation of patient care/interventions

Results in table 1 indicate that effective performance (mean=2.87) of the current/existing PMIS was experienced in capturing and retrieving information that assist the health staffs in implement patient care or interventions. This finding is in agreementwith the findings of Daniels (2012) which revealed a high rate of antiretroviral-related errors occurring on admission to the hospital and throughout a patient's hospital stay. The high frequency of errors emphasized the need for targeted interventions aimed at preventing these errors and quickly identifying and resolving errors that do occur. Several interventions aimed at decreasing this error rate were instituted, including the addition of computer alerts for incorrect doses and drug interactions to the pharmacy order-entry system; updates of the computerized prescriber-order-entry (CPOE) system to include common dosage defaults. A follow-up analysis was conducted after these interventions were implemented to evaluate their effectiveness. Of the 78 patients identified during the post-intervention analysis, 12 (15%) had at least one error in their initial drug regimen versus 49 patients (72%) in the pre-intervention study (p < 0.001). In conclusion Antiretroviral medication error rates decreased after the implementation of targeted interventions that included distributing an educational pocket-sized card, adding alerts to the pharmacy order- entry system, incorporating default dosages into the CPOE system, and adding combination antiretroviral to the formulary.

E. In the evaluation process of handling patient

The result on table 1 indicate that effective performance (mean=2.78) of the current/existing PMIS was experienced in the capturing and retrieval of information to assist health staffs in evaluating process of handling patient conditions. Contrary to this finding Heje *et al* (2010) conducted a study on general practitioners (GPs) and found out that 33% of the responding GPs reported that the patient evaluation had raised their attention to the patient perspective on the quality of general practice care.

Level of the Effectiveness of the Proposed Patient Management Information System (PMIS) Design of KIU-TH

The second objective of this study was to determine the effectiveness of the proposed PMIS. The proposed patient management information system (PMIS) is conceptualized as a system that was designed in order to overcome and address some of the shortcomings discovered from the current/existing PMIS research findings. After designing the proposed PMIS the same health workers were given the system to use and test its effectiveness in retrieving the data and information they need for their work as per data/information requirements that is supposed to meet the Orlando's nursing process theory. Thereafter, they were asked to rate the extent to which the proposed PMIS is effective in capturing and retrieving data/information they need for their duties as per requirements of Orlando's nursing process theory. The four likert scales were used to rate all questions. The four likert scales where 1=Strongly Disagree; 2=Disagree; 3=Agree; 4=Strongly Agree.

Table 2 Level of the effectiveness of proposed PMIS
(Assessment, Diagnosis, Planning, Implementation and Evaluation)

Types of constructs	Mean	Interpretation
A. Assists in *assessing* patients by providing information about the right:	3.164	Effective
B. Assists in the *diagnosis* of patients by providing information that:	3.25	Effective
C. Assists in the planning process by providing information:	3.15	Effective
D. Assists in the implementation of patient care/interventions by providing information:	3.27	Very Effective
E. Assists in the evaluation process by providing feedback information about:	3.27	Very Effective
Average mean	3.22	Effective

Source: Primary data, 2012
For interpretation of responses on 2, the following numerical values and description were followed:
Level of effectiveness of Proposed PMIS

Mean range	*Response mode*	*Interpretation*
3.26-4.00	Strongly Agree	Very Effective
2.51-3.25	Agree	Effective
1.76-2.50	Disagree	Ineffective
1.00-1.75	Strongly Disagree	Very Ineffective

A.   Effectiveness In assessing patients

Results in table 2 indicate that the proposed PMIS design is effective in capturing and providing data or information that assist the health staffs in assessing patients with a (mean=3.164)as compared to that in table 1(mean=2.998) with low mean.This finding is contrary to the findings of Droma *et al* (2009), which found that current patient record management systems at St Francis Hospital Nsambya unfortunately leads to misplacement of drug details, payment details, and late release of reports and insecurity to records. However, despite the later problem the has been solved by developing new system.

B.   Effectiveness In the diagnosis of patients

Results in table 2 indicate that the design of the proposed PMIS is effective in capturing and providing data or information that assist health staffs in diagnosing patients with a mean (3.25) which is higher than that of the existing PMIS in table 1(mean=2.75). This finding is in agreement with the findings of Pennisi *et al* (2001), whereby they recommended that in the event of patients being re-admitted to the unit, it is crucial to have ready access to all the information regarding previous hospital stays, including diagnostic images, to avoid the need for time-consuming searches through the hospital's paper-based archives. Furthermore, their findings also indicated that the possibility to access clinical information and diagnostic images using a single computer programme proved to be useful both for evaluating the patient's conditions immediately after the imaging procedure and for monitoring the patient's progress over time by comparing the different diagnostic images and imaging procedures.

C.Effectiveness In the planning process of handlingpatients

The result on table 2 indicate that the design for the proposed MIS is effective in capturing and providing data or information that assist health staffs in a planning process of handling patients with a mean (3.15) which is higher than that of the existing PMIS on table 1(mean=2.78). This findings are in agreement with the findings of a study by Ammenwerth and colleagues'(2001) which revealed that seven nurses (58 percent) agreed that the PIK software application saved time for care planning, but only three agreed that PIK saved time for documentation of tasks or for report writing. The majority of nurses agreed that with PIK, nursing documentation is more complete (10 nurses), legibility is better (9 nurses), and that the quality of documentation is better (8 nurses). However, Ammenwerth and colleagues did not tie these findings to patient outcomes or changes in nursing practice. The conclusion that the introduction of a care planning system alone, without supporting organizational change, will not work is also supported by Spranzo's work.

D.Effectiveness In the implementation of patient care/interventions

Result in table 2 indicate that majority of the items about the design of the proposed PMIS is very effective in capturing and providing data/information that assists health staffs in the implementation of patient care or interventions   with a mean (3.27) which higher than that of the existing PMIS on table 1(mean=2.87).This finding is in line with the findings of Daniels (2012)which revealed that high frequency of errors emphasized the need for targeted interventions aimed at preventing these errors and quickly identifying and resolving errors that do occur. Several interventions aimed at decreasing this error rate were instituted, including the addition of computer alerts for incorrect doses and drug interactions to the pharmacy order-entry system; updates of the computerized prescriber-order-entry (CPOE) system to include common dosage defaults. A follow-up analysis was conducted after these interventions were implemented to evaluate their effectiveness. In conclusion Antiretroviral medication error rates decreased after the implementation of targeted interventions that included

distributing an educational pocket-sized card, adding alerts to the pharmacy order- entry system, incorporating default dosages into the CPOE system, and adding combination antiretroviral to the formulary.

E.Effectiveness In the evaluation process of handling   patients

Results in table 2 indicate that the design of the proposed PMIS is very effective in capturing and providing data/information that assists health staffs in the evaluation process of handling patients with a mean(3.27) which is higher than that of the existing PMIS in table 1 (mean=2.78). This finding is in agreement with the findings of Pennisi *et al* (2001) whose findings also indicated that the possibility to access clinical information and diagnostic images using a single computer programme proved to be useful both for evaluating the patient's conditions immediately after the imaging procedure and for monitoring the patient's progress over time by comparing the different diagnostic images and imaging procedures. To the contrary, the findings of Philip *et al* (1994) findings in a study intended to develop and evaluate an information system for monitoring impact of acute hospital care on health status of elderly patients, put burden on careers, and consumer satisfaction with care. They also found that only nursing staff were able to change their practice.

Compared to the current/existing PMIS, the proposed PMIS design has proven to be very effective in capturing and providing data/information assists health workers in both the implementation of patient care/intervention and evaluation process of handling patients.

Testing null Hypothesis

Table 3 The significant difference between Current /Existing and Proposed PMIS

	Type of PMIS	Mean	t	Sig. (2-tailed)	Interpretation	Decision on H_0
Overall difference	Existing	2.8349	-5.069	0.000	Significant difference	Rejected
	proposed	3.2200				

Source: Primary data, August 2012   p<0.05, r=0.000

Table 3 show that the mean of the proposed PMIS (mean=3.2200) is slightly higher than that of the existing PMIS (mean=2.8349), with a (t=-5.069, sig. =0.000) implying that there is a significant difference between the existing and proposed MIS with reference to the effectiveness of the design in terms of assisting the health workers in capturing and providing data/information for assessing patients.   Thus, the null hypothesis was rejected.   This is finding is contrary to Evans *et al* (1993) a hospital information system was designed in a study to be utilized as resources to assess the attributable effects of adverse drug effects (ADEs) on hospital length of stay and cost of hospitalization. This approach emphasized the difference between study patients and their matched control patients rather than overall differences between patients with and without ADEs. In addition, nursing acuity data was used to help adjust severity of illness within DRG groups and actual hospital costs were used instead of estimated costs.

Conclusion

Null Hypothesis was tested and the result indicated that there was a significant difference between the existing and the proposed PMIS design, thus, the null hypothesis was rejected. Once the proposed PMIS is implemented it will be capable of capturing and providing data or information to assist KIU-TH health staffs in assessing, diagnosing, planning, implementing and evaluation of patient conditions. According to Richardson et al(2005) although all the reported assessment tools were completed in paper format, nonetheless, three of the assessment tools were also transferred into electronic patient notes.

When the event of patients being re-admitted to the unit occur, it is crucial to have ready access to all the information regarding previous hospital records by trying to avoid the need for time-consuming searches through the hospital paper-based archives. However, the possibility to access clinical information and diagnostic images using a single computer programme prove to be useful both for evaluating the patient's conditions immediately after the imaging procedure and for monitoring the patient's progress over time by comparing the different diagnostic images and imaging procedures (Pennisi *et al* ,2001).

Ammenwerth and colleagues' (2001) asserted that PIK software application saved time for care planning, especially in documentation of tasks or for report writing.

According to Daniels (2012) a high rate of antiretroviral-related errors occurring on admission to the hospital and throughout a patient's hospital stay calls for targeted interventions aimed at preventing these errors and quickly identifying and resolving errors that do occur. Indeed, several interventions aimed at decreasing this error rate were instituted, including the addition of computer alerts for incorrect doses and drug interactions to the pharmacy order-entry system; updates of the computerized prescriber-order-entry (CPOE) system to include common dosage defaults.

Heje *et al* (2010) reported that the patient evaluation had raised attention to the patient perspective on the quality of general practice care. Job satisfaction had improved among general practitioners who had developed a more positive attitude to patient evaluations. This implies that the use PMIS to evaluate patients will give them more jobsatisfaction.

Recommendation

Kampala International University Teaching Hospital (KIU-TH) needs an improvement in its service delivery by using patient historical data and information, hence, it is imperative for KIUTH management adopt and implement the proposed PMIS in order to improve on the quality of patient service delivery at the teaching hospital. In addition, there is a need to introduce, equip and train health workers on how to use electronically based Patient Management Information System (PMIS), more specially encourage more women health workers to learn and use the PMIS in executing the duties effectively and efficiently. Furthermore, there is a need to continuously review the design of any existing PMIS such that it can capture and provide the right data or information to enable the health workers to predict and forecast patient's future situation and conditions. In addition, it is recommended that the proposed PMIS should be capable of capturing and providing data or information for reducing patient's waiting time. In other words, the proposed PMIS should be capable of capturing and providing data or information to assist health workers in the diagnosis of patients as well as assist in the evaluation process by providing feedback information about patient condition and situation.

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