

Research paper

Design and implementation of an automated patient master name index management system in teaching hospitals.

(A case study of Uniosun Teaching Hospital, Osogbo, Osun State, Nigeria.)

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This study is centralized on the Design and Implementation of an Automated Patient Master Name Index Management System as a tool to reforming Health Information Management Practice in Nigeria Teaching Hospitals specifically Uniosun Teaching Hospital, Osogbo, Osun State, to electronically solve encountered problems of duplication of patient data, improper documentation of patient master name index, inadequate identification of patient information in the master name index, loss and mismatch of patient data, time wastage (prolonged patient waiting time), data redundancy, cost, uniformity and dispersion which limits the effective continuation of patient care due to patient's loss or misplacement of reference cards. This problem was tackled in the past by maintaining a paper-based Master Name Index (MNI) card cabinet, which takes time and requires a rigorous search in the Master Name Index storage (cabinet, drawer, shelf.). This study thoroughly investigates and appraises the existing manual paper-based Master Name Index card system, intending to determine the need to design and implement a new computerized format of the existing manual system. Subsequently, an automated Patient Master Name Index management system is being designed to bring about improvement in duplication of patient data, documentation of patient master name index, identification of patient information in the master name index, loss and mismatch of patient data, time wastage (prolonged patient waiting time), data redundancy, cost, uniformity, and dispersion which affects the effective continuation of patient care, taking advantage of computer characteristics and features such as accuracy, speed, memory (storage capacity), automation and reliability. The designed system facilitates patient registration in the Master Name Index database, adding, saving, deleting, refreshing, printing patient health record data, and quick patient information retrieval by querying or searching the database with any of the patient's candidates' keys. This study is being designed and implemented with Microsoft Access Database.

Keywords: Design, Implementation, Health Information Management, Patient, Master Name Index.

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INTRODUCTION

BACKGROUND OF THE STUDY

A Master Patient Index (MPI) aims to identify individual patients by storing and analyzing demographic information and assigning a unique identifier to that person (Colleaga, 2018). . This database holds information in a centrally accessible location for all healthcare providers, thus allowing personal healthcare records to be shared more quickly. By following a successful implementation plan used by many in the industry, an effective MPI can be established. (Colleaga, 2018).

The Master Patient Index (MPI) (also Master Person Index) is a database maintained by a health care organization to identify a patient and their medical record. The MPI began as a paper-based card file system arranged alphabetically by the patient's last name. In larger institutions, the patient was assigned a medical record number, and this number was linked to the patient's chart. The medical record number became the unique identifier for patients being treated at a facility. It was used to avoid duplication at patient registration to provide a connection to one authentic record. As institutions became computerized, an increasing amount of data was housed in the MPI. This data now includes demographics and visit information. The data elements suggested for use in an MPI to index and search records that have been recommended by AHIMA (American Health Information Management Association) are Internal patient Identification, Patient Name, DOB, DOB qualifier, Gender, Race, Ethnicity, Address, Alias/pervious name, S.S. #, Facility identification, Universal patient identifier (if available), Account number, Admission date, Discharge date, Service type, Patient disposition. (Hopkins, 2018).

An MPI may also contain non-patient data elements such as guarantors, healthcare practitioners, payers, employers, and others. If more than two centers in an organization use the same database, it may be called an Enterprise Master Patient Index or EMPI.

The integrity of the MPI must be maintained in order for it to function correctly. An accurate MPI consists of only one medical record number for each person. Errors at registration are the usual cause of MPI inaccuracies. (Hopkins, 2018). The three problems that often occur at registration are duplicate medical record numbers, overlap, and overlay. A duplicate medical record number exists when one person has two or more different medical record numbers within one organization. An overlap occurs when a person has more than one medical record number within an integrated delivery network or enterprise and an overlay happens when two patients are assigned the same medical record number. Regular audits of the MPI database must be done to identify any errors before they are compounded. The unique identification of a patient within an organization is the first step in ensuring that data is consistent and comparable.

STATEMENT OF THE PROBLEM

The health sector in Nigeria faces so many challenges that have certainly brought about a rapid decline in the quality of health care delivery. It is observed that in many health institutions in Nigeria, health records departments still operate a paper-based Master Name Index (MNI) cards storage which takes time and requires a rigorous search in the Master Name Index storage (cabinet, drawer, shelf) which is the same in the case study of this research. In most tertiary health institutions, existing patients will have to tender the reference card to enable the health information manager to retrieve his/her case folder, register it and transfer it to the nurse's table for them to take the vital signs before it eventually gets to the doctor for treatment. However, suppose the patient is unable to present the reference card. In that case, he/she will be asked about his biodata and, in most cases, search through the master name index storage, which seems stressful and takes lots of time before being eventually retrieved.

With these manual processes involved in searching for the patient details from the patient master name index cabinet, most of them waste much time in the hospital, if not the whole day. Patients often leave their homes very early in the morning to be among the first group to see the doctor. Otherwise, they end up becoming the last or not even seeing the doctor at all. This situation discourages most patients and sometimes forces them to turn to non-professionals or even self-medication for quick recovery. Moreover, the volume of work for the health information managers is much due to insufficient health information management staff in the hospital. Patients outnumber the doctors, nurses, health information managers, and other medical personnel that too much is required.

The problem caused by using the manual method of keeping and retrieving outpatient information can only be solved by computerizing the master name index manual system. Regarding these problems encountered, the need to Design and Implement an Automated Patient Master Name Index Management System arose to solve the problem.

AIM AND OBJECTIVES OF THE STUDY

This study aims to design and implement an Automated Patient Master Name Index Management System in Teaching Hospitals in Nigeria, aiming to automate and improve the paper-based Patient Master Name Index practice, which is currently in existence in most teaching hospitals in Nigeria. The case study selected from Nigeria Teaching Hospitals for this research work is Uniosun Teaching Hospital, Osogbo, Osun State. This research work centers on the following objectives.

- i. To design an automated patient master name index management system that is aimed at an accurate, faster, and reliable patient's master name index practice.
- ii. To implement the designed system in Nigerian Teaching Hospitals.
- iii. To evaluate the designed and implemented patient's master name index system by testing it to ensure that it suits user needs.

SIGNIFICANCE OF THE STUDY

This study has general significance and advantages over paper-based patient master name index management systems. It solves several problems, which includes: duplication of patient data, improper documentation of patient master name index, inadequate identification of patient information in the master name index, loss and mismatch of patient data, time wastage (prolonged patient waiting time), data redundancy, cost, uniformity, and dispersion.

This study is significant to the hospital, health information managers, patients, and researchers. This study will help the health information managers in the hospital to know and value the importance of operating a computerized patient master name index management system in order to reduce the effect of duplication on patient health record management. The study is significant to the hospital because it will help the hospital know the difference between adopting a paper-based patient master name index system and adopting an Automated Patient Master Name Index Management System.

The study is significant to the patient; it will reduce patients waiting time when an effective automated patient master name index system is in place. The study will also help researchers with more information and guide on designing and implementing an Automated Patient Master Name Index Management System.

SCOPE OF THE STUDY

This research, Design and Implementation of an Automated Patient Master Name Index Management System is sampled from the overall scope of Teaching Hospitals in Nigeria. The case study selected from Nigeria Teaching Hospitals for this research work is Uniosun Teaching Hospital, Osogbo, Osun State. Uniosun Teaching Hospital was selected due to the ease of data collection, design testing, and also a straightforward presentation of research outcomes to the hospital health record management department for implementation due to the hospital proximity. However, this research work was tested at the health record unit at GOPD (General Out-Patient Department).

DEFINITION AND TERMS

MPI – Master Patient Index

PMNI – Patient Master Name Index

Design: is a process of conceptualization, planning, modeling, and execution of electronic media content delivery. (Wikipedia, 2021). It is a plan for arranging elements in such a way as best to accomplish a particular purpose.

Implementation: is the process of realizing the design as a program (Marchese, 2019). It is the process of putting a decision or plan into effect; execution. It is the process of realizing the design as a program.

Design and implementation is the stage in the development engineering process at which an executable system is developed. (Marchese, 2019)

Automated: is the technique of making an apparatus, a process, or a system operate automatically. (ISA, 2016). It is concerned with performing a process utilizing programmed commands combined with automatic feedback. This is to control and process data by the use of a computer. It helps to solve problems and solutions more manageable.

Patient: a person receiving or registered to receive medical treatment. (Vocab24, 2020)

Patient Master Name Index: is a database maintained by a health care organization to identify patients across separate clinical, financial, and administrative systems and is needed for information exchange to consolidate the patient list from the various databases (IHS, 2017). It contains records for all the patients.

Management: is the process of dealing with or controlling things or people. It is the process of getting activities completed efficiently with and through other people. (Term Paper, 2018)

System: is a set of things working together as parts of a mechanism or an interconnecting network; a complex whole. (Watts, 2020).

Hospital: Is A hospital is a health care institution providing patient treatment with specialized medical and nursing staff and medical equipment. (WHO, 2020).

Teaching Hospital: or Medical Centre provides medical education and training to future and current health professionals. A teaching hospital, or academic medical center, is a hospital that partners with medical and nursing schools, education programs, and research centers to improve health care through learning and research. (C.S. Mott Children's Hospital, 2021).

Health Information Management: HIM is the practice of acquiring, analyzing, and protecting digital and traditional medical information vital to providing quality patient care. It is a combination of business, science, and information technology. (AHIMA, 2021).

Data: means characteristics or information, usually numerical, that are collected through observation. (OECD, 2021).

Database: A database is an organized collection of structured information, or data, typically stored electronically in a computer system. A database is usually controlled by a database management system (DBMS). (ORACLE, 2021)

Information: Information is processed, organized and structured data. It provides context for data and enables decision-making. (Wikipedia, 2021).

Computer: A computer is a machine that can be programmed to carry out sequences of arithmetic or logical operations automatically. (Wikipedia, 2021).

RESEARCH WORK ORGANIZATION

The research is explained in detail from:

Chapter One: which contains the preliminary part of the research that discusses the background, problems, objectives, significance, scope, limitation, the definition of terms, and the study organization of the research.

Chapter Two: discussed the review of literature of various researchers in the field.

Chapter Three: explained the system design and methodology that explains the methods used.

Chapter Four: elucidated the system analysis, Implementation, and Integration that delivers the implied system of the work.

Chapter Five: explicated the summary, recommendation, and conclusion of the research.

LITERATURE REVIEW

This chapter reviews previous literature related to the design and implementation of an automated patient master name index.

The review cut across these regions: Africa, America, Asia, Australia and Europe. Countries studied in these regions are the United States, Canada, Australia, Nigeria, Sub-Sahara African Countries, e.g., Kenya, Taiwan, Denmark, Brazil, and Sri Lanka.

Both foreign and local journal articles were read and reviewed, with the current practice of paper-based health records, electronic health records, and patient master name index to comprehend how each of them is of benefit to designing and implementing an automated patient master name index system.

Among the Journals reviewed include: Journal of Technology Research, Global Health Action Journal, Perspectives in Health Information Management Journal, International Journal of Medical Informatics, Applied Clinical Informatics Journal (PubMed), International Federation of Health Information Management Associations Journal, Dental Research: An International Journal (DRIJ), International Journal for Quality in Health Care, Computer Methods and Programs in Biomedicine Journal. (Science Direct), British Medical Journal, Scientific data Journal, Journal of the Australian Healthcare & Hospitals Association, Journal of the American Medical Informatics Association, among others.

Researchers and erudite scholars have published several pieces of literature related to this research which guides on the essential considerations to consider in the design and implementation of an automated patient master name index.

MAIN BODY OF REVIEWED LITERATURE

SYSTEMATIC REVIEW OF RELATED LITERATURE								
S/N	Author	Year	Title	Journal	Country	Method	Summary Findings/contribution of	Limitations
1	Banton & Filer	2014	The impact of multiple master patient index records on the business performance of health care organizations	Journal of Technology Research Volume 5 – October, 2014	United States	Paper-based and computer-based.	This finding is significant to health information management organizations leaders because it demonstrates a divide in the awareness and perception of system users and managers.	The data and information used for this study are collected from online surveys, which might not be 100% accurate.

2	Beck et al.	2018	Developing and implementing national health identifiers in resource-limited countries: why, what, who, when, and how?	<i>Global Health Action Volume 11, 2018 - Issue 1</i>	United States	Computer-based	The development of linked medical records across health services and the use of de-identified personal health information to monitor, evaluate and improve health services.	This study technically focuses on New Hampshire Insurance Department Systems only.
3	Bian et al.	2019	Implementing a hash-based privacy-preserving record linkage tool in the OneFlorida clinical research network	<i>JAMIA Open, Volume 2, Issue 4, December 2019, Pages 562–569</i>	United States	Computer-based	Access to privacy-preserving RL methods and tools is mission-critical for these national CRNs developing massive electronic data collections on their patients.	The scope of the study is narrow, just within Florida, USA.
4	Bowman	2013	Impact of electronic health record systems on information integrity: quality and safety implications	<i>Perspectives in Health Information Management Journal</i>	United States	Computer-based	EHR systems can transform healthcare delivery when these technologies are designed, implemented, and used appropriately.	The study did not mention the patient master name aspect of the EHR practice.
5	Chukwu	2017	The Case for a Unique Digital Patient ID Scheme in Nigeria	<i>Journal of Health and Medical Informatics 8: 267</i>	Nigeria	Computer-based	Unified Identifiers have been shown to increase the impact and reach of health and other social services. Notwithstanding, Nigeria and most developing countries still struggle with uniquely identifying patients.	This study emphasized the need for a digital Patient Identifier, but none was designed nor implemented.

6	Crew & Houser.	2020	Overcoming Challenges of Merging Multiple Patient Identification and Matching Systems: A Case Study	<i>Perspectives in Health Information Management Journal</i>	United States	Computer-based	Patient matching continues to be a challenge for hospitals and health information exchanges. With increased technology and informatics, patient identification and matching issues can be resolved effectively and efficiently.	This situation increases hospital expenses and increases the integrity of the patient medical records endangers.
7	Culbertson, et al.	2017	The Building Blocks of Interoperability. A Multisite Analysis of Patient Demographic Attributes Available for Matching	<i>Applied Clinical Informatics Journal (PubMed)</i>	United States	Paper-based	Availability of emerging attributes such as email and phone numbers are increasing while SSN use is declining. Understanding the relative availability of patient attributes can inform strategies for optimal matching in healthcare.	This study is only particular about which of the patient attributes should be used as a primary attribute.
8	Dainton & Chu	2017	A review of electronic medical record-keeping on mobile medical service trips in austere settings	<i>International Journal of Medical Informatics Volume 98, February 2017, Pages 33-40</i>	Canada	Computer-based	Quality record keeping on mobile MSTs should consider the potential for EMRs to support organizational accountability, clinical data management, and integration of evidence-based decision support.	There is a need for further research to accurately determine the benefits of such EMRs on clinicians, patients, and the broader health system, and the facilitators and barriers to deployment of EMRs on MSTs.

9	Grannis et al.	2019	Evaluating the effect of data standardization and validation on patient matching accuracy	<i>Journal of the American Medical Informatics Association, Volume 26, Issue 5, May 2019</i>	United States	Paper-based	Data standardization can improve match rates, thus ensuring that patients and clinicians have better data to make decisions to enhance care quality and safety.	This study was carried out on data standardization only; Automation was not conceived in the study.
10	IFHIMA	2018	Patient Identification and Master Patient (Person) Index	<i>International Federation of Health Information Management Associations Journal</i>	Australia	Paper-Based	Any care organization that delivers care or wellness services to individuals should have an MPI	Automation was not conceived in the study.
11	Janett &Yeracaris	2020	Electronic Medical Records in the American Health System: challenges and lessons learned	<i>Ciencia & saude coletiva, 25(4), 1293–1304. Mar 2020.</i>	Brazil	Computer-based	There is strong evidence for the benefits of an EMR in terms of efficiency, reliability, and care quality, especially in primary care. Some of these benefits are counterbalanced by clearly defined risks and drawbacks of EMR systems. Critical features of EMR systems have been identified.	This study is only peculiar to South America.
12	Jayathissa et al.	2018	Developing A Functional Prototype Master Patient Index (MPI) For Interoperability Of E-Health Systems In Sri Lanka	<i>Dental Research: An International Journal (DRIJ) Vol.2, No.1</i>	Sri Lanka	Computer-based	The development and implementation of an MPI have facilitated the long due need for interoperability among health information systems in Sri Lanka.	This MPI version is the early version paramount need to refine the things with the later versions.
13	Jayatissa et al.	2018	Review On Master Patient Index	<i>Dental Research: An International Journal (DRIJ)Vol.1, No.1</i>	Sri Lanka	Paper-Based	The study shows that Master Patient Index is an asset to patients, the medical staff, and health care providers.	Automation was conceived but not thoroughly discussed.

14	Just et al.	2016	Why Patient Matching Is a Challenge: Research on Master Patient Index (MPI) Data Discrepancies in Key Identifying Fields	<i>Perspectives in Health Information Management Journal</i>	United States	Paper-based and computer-based.	No amount of advanced technologies or increased data capture will eliminate human errors. To improve patient matching, increasing the use of more sophisticated technologies is critical.	The study indicated and focused mainly on the existing patient.
15	Kierkegaard	2015	Interoperability after deployment: persistent challenges and regional strategies in Denmark	<i>International Journal for Quality in Health Care, Volume 27, Issue 2, April 2015, Pages 147–153</i>	Denmark	Computer-based	Denmark's recent approach to overcoming interoperability challenges provides valuable knowledge-transfer lessons for countries facing similar struggles of a fragmented eHealth infrastructure. For policymakers and health planners, the Danish approach can serve as a learning opportunity.	The scope of this study does not go beyond Denmark and other European countries.

16	Li et al.	2015	Building a National Electronic Medical Record Exchange System – Experiences in Taiwan	<i>Computer Methods and Programs in Biomedicine Journal.</i> (Science Direct)	Taiwan	Computer-based	Inter-institution EMR exchange can make it much easier for people to access their medical records, reduce the waste of medical resources, and improve the quality of medical care.	It is more challenging to encourage hospitals to participate in an EMR exchange than to implement an EMR system because sharing medical records with other hospitals or clinics does not produce a financial incentive
17	Maina et al.	2019	A spatial database of health facilities managed by the public health sector in sub-Saharan Africa	<i>Scientific data Journal</i> , 6(1), 134.	Kenya (Sub-Saharan African Countries)	Computer-based	The definitions of health facility levels provided in national health policies and across country-specific MFLs varied between countries hence the arbitrariness of health facility definitions used here. This has been noted previously and demands the development of uniform health service delivery definitions across Africa.	This study made use of a repository and some existing datasets. It was not tested for incoming data.
18	McCoy et al.	2013	Matching identifiers in electronic health records: implications for duplicate records and patient safety	<i>British Medical Journal</i>	United States	Computer-based	The percentage of records having matching patient identifiers is high in several organizations, indicating that the rate of duplicate records or records may also be high.	This study's primary focus is on the duplication of patient records only.

19	Oleribe et al.	2019	Identifying Key Challenges Facing Healthcare Systems in Africa and Potential Solutions	International Journal of General Medicine	Nigeria	Paper-based	The underdeveloped healthcare systems in Africa need radical solutions with innovative thought to break the current impasse in service delivery.	This study discussed lie within human resources and management. Automation was not conceived.
20	Scott et al.	2018	Going digital: a checklist in preparing for hospital-wide electronic medical record implementation and digital transformation	<i>Journal of the Australian Healthcare & Hospitals Association</i>	Australia	Computer-based	This evidence-based, field-tested checklist guides hospitals planning EMR implementation and separates readiness for EMR from a readiness for digital transformation.	This study is only to prepare hospitals for EMR implementation and digital transformation.
21	Sittig et al.	2020	Current challenges in health information technology-related patient safety	<i>Journal of the American Medical Informatics Association, Volume 26, Issue 5, May 2019</i>	United States	Computer-based	Safety of health IT needs to be improved substantially. Although scientific knowledge has improved, a great deal still needs to be learned, and much remains to be done.	The use of any features and functions of complex health IT-based clinical applications can create risks to patients, the organization responsible for their care, or even the developers of these systems.

22	Zech et al.	2016	Measuring the Degree of Unmatched Patient Records in a Health Information Exchange Using Exact Matching	<i>Applied Clinical Informatics Journal</i>	United States	Paper-based	This study will alert organizations to issues with data quality and the process used to match records and could inform how organizations choose to tune parameters for the algorithms they employ to match records.	This study dwells majorly on the Measurement and awareness and the Degree of Unmatched Patient Records.
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SUMMARY

There are many limitations concerning the paper-based patient master name index management practice. On the one hand, there are benefits that the paper-based has provided in the absence of a computer-based system. Most research suggests that the master patient index should be a computerized process to eradicate manual practice in developing countries completely. It was discovered that the paper-based master name index practice is majorly in Africa and some parts of Asia.

These works of the literature revealed that some health information managers do not want to accept the automated system because of the fear of computers taking over their. However, for the patient master name index system to grow and function effectively, there must be great embracement of computing to the existing manual system.

Also, this chapter discussed the patient identifier, patient hospital monitoring, and duplication of patient data. Regarding the reviewed literature, the ratio at which a hospital embraces technology in the master patient master name index function effectively can not be compared to the rate at which those who do not. Also, this chapter overlooks the various patient identity being adopted in various health institutions in various regions.

Hence, the purposes of this literature review are to read and examine various techniques being adopted in various hospitals and various countries and also to see how it was being designed and implemented, which will help the researcher to contribute distinctively to knowledge by solving the problem encountered in the manual master name index practice.

RESEARCH METHODOLOGY

Research Methodology is the idea of which research is arranged or done according to plan. This methodology is based on critical examination undertaken, with the act to find new facts and information that would enhance patient master name index management system empowerment and improve the quality of care in terms of efficiency and effectiveness. This methodology used examines the methods that are necessary to achieve an effective patient master name system.

DATA SOURCING

In this research work, data collection was carried out in the General Out-Patient Department, Uniosun Teaching Hospital, Osogbo. In gathering and collecting needed data and information for the patient master name system analysis, two major fact-finding techniques were used in this research work, and they are:

- i. Primary source
- ii. Secondary source

PRIMARY DATA SOURCE

Primary data source refers to the sources of collecting original data in which the researcher used an empirical approach such as a personal interview.

SECONDARY DATA SOURCE

The need for secondary sources of data for this kind of research cannot be over-emphasized. The secondary data were obtained from registers, cards, forms, notes, journals, Library sources.

METHODS OF DATA COLLECTION

ORAL INTERVIEW

An oral Interview was carried out between the researcher and the health information managers in the hospital, which was used for the studies, and some patients were also interviewed. Reliable facts were obtained based on the questions posed to the staff and patients by the researcher. The questions asked include; since when has the manual system has been in existence, most of the staff claimed to have met the manual system being in used years ago, also how stressful it is to use, they admit that is stressful, especially when they have more than one patient at once. It was also asked if they think an automated system will ease their work, and most of them acceded that it will. Patients who were present at the unit were also asked what their view on the manual system was. Also, if they think that the automated system will be better than the manual system, most of them believe that it will save their time and be faster.

STUDY OF MANUALS

Manuals and reports used by health information managers were studied, and much information concerning the system in question was obtained.

EVALUATION OF FORMS

All available necessary forms that are needed and available in the department were assessed. These include admission card, Master Name index card, Patient folder, Tracer Card Etc. These forms helped immensely in the design of the new system.



Figure 2. This shows the cabinetsimplified to file the master name index card alphabetically.



Figure 3. shows Cabinets labeled A-Z collection, where the health information manager in charge of the master name index unit files the master name index card from A-Zalphabetically.

ANALYSIS

INPUT ANALYSIS

The input to the new system is derived from the manual patient master name index card. When a patient visits the hospital, the health information manager fills the patient's master name index card on behalf of the patient and keeps it in the card cabinet after a reference card has been issued to the patient. The manual patient master name index card data structured the input pattern into the new system design. The patient data required for data entry into the system includes; Hospital Number, Occupation, Surname, Religion, Other Names, Phone, Date Of Birth, Date Admitted, Age, Date Transferred, Address, Ward, Sex, Date Discharged, Marital Status, Consultant, Diagnosis.

PROCESS ANALYSIS

An analysis was carried out based on the patient information collected from the patient through the new system. The data were tested and processed to see if the researcher successfully designed and implemented an automated patient master name index system. Also, the result attained after testing and processing the new system proves that the researcher was able to come out with the best patient master name index card automated system to aid the problems associated with the manual system, which elongates patient waiting time.

OUTPUT ANALYSIS

The output can be generated by searching for a candidate key of the patient's candidate keys; this will automatically pop up all the information collected about the patient. It will be displayed on the screen. The search bar is situated above the status bar in the database. Also, the output can be printed out as a hard copy.

LIMITATIONS OF THE EXISTING SYSTEM

Many problems are associated with the existing system. The existing system involves the use of a manual method to store master name index data/information. The paper-based system has proved defective as the objective of the system has not been accomplished. Problems associated with the existing system include the following:

- i. It wastes time
- ii. It occupies much space
- iii. Lack of Accuracy
- iv. Time wasted in searching/sorting for workers' duty information.
- v. Poor security and protection.
- vi. Misplacement and mismanagement of checkup and treatment files.
- vii. Much time is being wasted by the patient while in a queue.

MPI SYSTEM USER NEEDS

It is imperative to get the user, which is the health information manager, fully involved such that problem management change does not affect the system use. The stakeholders who will use the system were approached during the proposed system, and the following needs were mentioned:

- i. An MPI system that improves the efficiency of patient master name index information storage and retrieval.
- ii. An MPI system that is easy to learn and use.
- iii. A fast MPI system produces results that will be read at the point of care, reducing waiting time and increasing time to attend to the patients.
- iv. An MPI system that is faster, flexible, and convenient.
- v. An MPI system restricts access to information only to authorized personnel.
- vi. An MPI system that store data and product report timely and accurately.

JUSTIFICATION FOR THE NEW SYSTEM

The new system will have the following characteristics, which will be an improvement to the current system in use:

- i. The new patient master name index system will help health information management use a computer system to find patients' information quickly.
- ii. Accuracy is maintained, as the computer information will yield an accurate result.
- iii. It will reduce the space consumed by the previous paper-based system.
- iv. The speed of operation of the automated patient master name index system is high compared to the manual method.
- v. It will reduce the cost of printing hospital paper master name index cards.

SYSTEM DATABASE DESIGN

Microsoft Access database was used for this system because of its simplicity and ease of use. Since the research is not commercial, the macros and modules used are attached with Microsoft Access. The tables are described below:

1. PatientTable: a table to fill patient personal data to get indexed in the patient master name index system, which is the same for inpatient and outpatient.
2. PatientMNIForm: a form to input and fill patient data into the patient MNI database.
3. DBMSControls: The patient master name index subsystem controls the hospital MNI database's creation, maintenance, and use.

Field Name	Data Type
HOSPITAL NUMBER	Number
SURNAME	Short Text
OTHER NAMES	Short Text
DATE OF BIRTH	Date/Time
AGE	Number
ADDRESS	Short Text
SEX	Short Text
MARITAL STATUS	Short Text
OCCUPATION	Short Text
RELIGION	Short Text
PHONE NUMBER	Short Text
DATE ADMITTED	Date/Time
DATE TRANSFERED	Date/Time
WARD	Short Text
DATE DISCHARGED OR DIED	Date/Time
CONSULTANT	Short Text
DIAGNOSIS	Short Text
PHOTO	Attachment

Figure 4. PATIENTTABLE DESIGN

HOSPITAL NUMBER	<input type="text"/>	OCCUPATION	<input type="text"/>
SURNAME	<input type="text"/>	RELIGION	<input type="text"/>
OTHER NAMES	<input type="text"/>	PHONE NUMBER	<input type="text"/>
DATE OF BIRTH	<input type="text"/>	DATE ADMITTED	<input type="text"/>
AGE	<input type="text"/>	DATE TRANSFERED	<input type="text"/>
ADDRESS	<input type="text"/>	WARD	<input type="text"/>
SEX	<input type="text"/>	DATE DISCHARGED/DIED	<input type="text"/>
MARITAL STATUS	<input type="text"/>	CONSULTANT	<input type="text"/>
PATIENTMNIFORM DESIGN		DIAGNOSIS	<input type="text"/>



Figure 6. DBMS CONTROLS

The Add, Save, Delete, Refresh, Search, Print, and Close buttons are the DBMS controls controlling the hospital MNI database's creation, maintenance, and use.

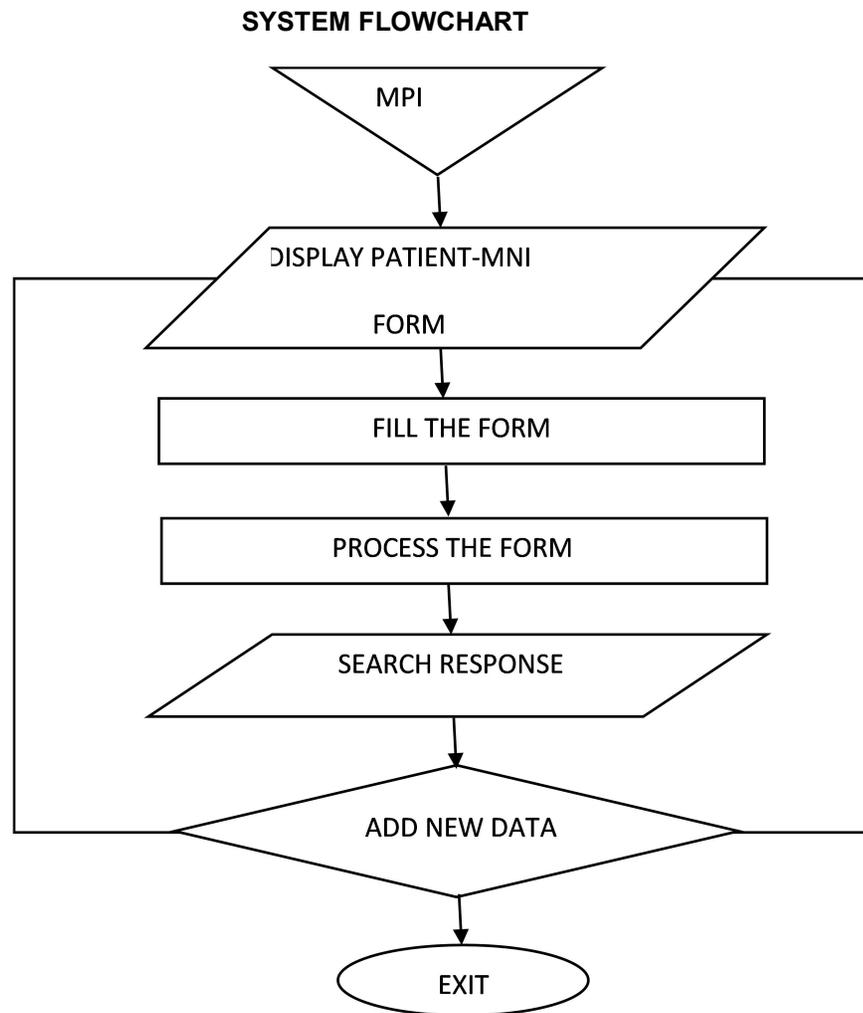


FIGURE 7. SYSTEM FLOWCHART

SYSTEM IMPLEMENTATION, TESTING, AND INTEGRATION

CHOICE OF DEVELOPMENT TOOLS

The development tools are defined as the essential required devices used during the design of the computer-based processing and publishing system to enable the researcher to design an effective and efficient system. Some components were needed to be added to the system when the development of the system was at an initial stage. These components can be referred to as system development tools. The under-listed tools were chosen and used because of their features and ease of accessibility. These tools are briefly discussed below:

OPERATING SYSTEM

The design was carried out on a laptop computer with the following specification:

- Operating System: Windows 8.1 Pro with Media Center.
- Processor: Intel © Core™ i3 CPU M 380 @ 2.53GHz
- RAM: 4.00GB
- System Type: 64-bit operating system, x64-based processor.

In the final implementation phase, the system was tested on four other computers that ran Windows 7, Windows 8, Windows 10, and Mac OS 11.

MICROSOFT ACCESS DATABASE

Microsoft Access is a database management system (DBMS) from Microsoft that combines the relational Microsoft Jet Database Engine with a graphical user interface and software development tools. It is a member of the Microsoft 365 suite of applications, included in the Professional and higher editions or sold separately. (Microsoft, 2021).

Microsoft Access stores data in its format based on the Access Jet Database Engine. It can also import or link directly to data stored in other applications and databases.

It is a relational database management system that runs as a server providing multi-user access to several databases. Microsoft access is owned and sponsored by Microsoft Corporation. It is free for open source and not for profit research as it was designed for three principles, performance, ease of use, and simplicity. It is a perfect tool for developers and administrators to establish, maintain and configure applications.

It is an easy-to-use tool for creating database designs from templates or scratch. With its rich and intuitive design tools, access can help create appealing and highly functional applications in a minimal amount of time.

HARDWARE AND SOFTWARE REQUIREMENTS

HARDWARE REQUIREMENT

Computer hardware includes the physical parts, such as a case, central processing unit (CPU), monitor, mouse, keyboard, computer data storage, graphics card, sound card, speakers, and motherboard. (Wikipedia, 2021). The computer system hardware components refer to the physical part that makes up the computer system. The system can be implemented for an effective operation if the following hardware components are at least met. For the efficient work of the system, the following hardware is required;

- Storage: 13-20 gigabyte of storage.
- Memory: 128MB of ram and above.
- Keyboard: Enhanced keyboard
- Drivers: CD ROM 48x and above, 3.5 (1.44MB) FDD drive
- Mouse: Enhanced serial or parallel mouse
- CRT: 15" Svgacolored monitor
- Model: Pentium 580 mml and above
- Printer: Optimal (black and white or colored)

SOFTWARE REQUIREMENTS

Software is a set of instructions, data, or programs used to operate computers and execute specific tasks. (Webopedia, 2020). It is the opposite of hardware. Computer software is a collection of computer programs and related data that provides the instructions for telling a computer what to do and how to do it. In other words, the software is a set of programs, procedures, algorithms, and documentation concerned with the operation of a data processing system. Program software performs the function of the program it implements, either by directly providing instructions to the computer hardware or serving as input to another piece of software. The following list of software is needed for adequate implementation of the system:

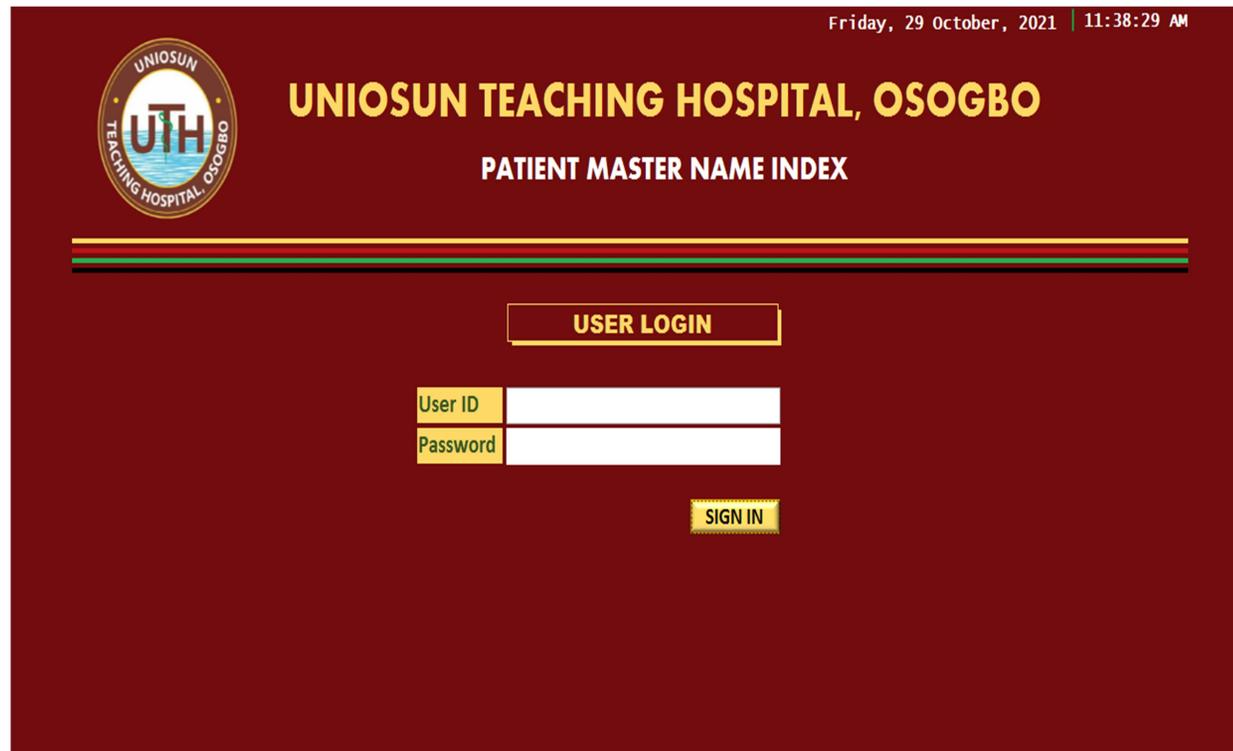
- Windows XP/7/8/8.1/10/11 or Mac OS 10/11/12
- Microsoft Access (Any Version)
- Anti-virus program (updated).

SYSTEM IMPLEMENTATION

Implementation is the realization of an application or execution of a plan, idea, model, design, specification, standard, algorithm, or policy. (Foss et al., 2011). It also realizes a technical specification or algorithm as a program, software component, or other computer systems through programming and deployment. The purpose of system implementation is to make the new system available to Health Information Managers at Uniosun Teaching Hospital and positionan ongoing support and maintenance of the system within the hospital. This entails that all steps taken to educate both the patient and the health information management department on using the new system and confirm that all data required at the start of operations are accurate and ensure that the new system is functioning correctly.

SYSTEM IMPLEMENTATION DESIGN

In any good database design, effort should be made to remove entirely or, at worst, reduce redundancy with a simple and understandable interface. The database design is achieved using Microsoft access database. Below is the structure of the file designed in the database.



Friday, 29 October, 2021 | 11:38:29 AM

UNIOSUN TEACHING HOSPITAL, OSOGBO

PATIENT MASTER NAME INDEX

USER LOGIN

User ID

Password

SIGN IN

Figure 8. The User Login to the Patient Master Name Index Management System

The figure above explains and shows the user login interface of the designed system, which prevents unauthorized users from accessing the system to input patient information into the database for proper security.

Wednesday, 17 November, 2021 | 6:07:55 PM



UNIOSUN TEACHING HOSPITAL, OSOGBO

PATIENT MASTER NAME INDEX

DATA ENTRY

HOSPITAL NUMBER		OCCUPATION		 PHOTO
SURNAME		RELIGION		
OTHER NAMES		PHONE NUMBER		
DATE OF BIRTH		DATE ADMITTED		
AGE		DATE TRANSFERED		
ADDRESS		WARD		
		DATE DISCHARGED/DIED		
SEX		CONSULTANT		
MARITAL STATUS		DIAGNOSIS		

ADD
SAVE
DELETE
REFRESH
SEARCH
CLOSE

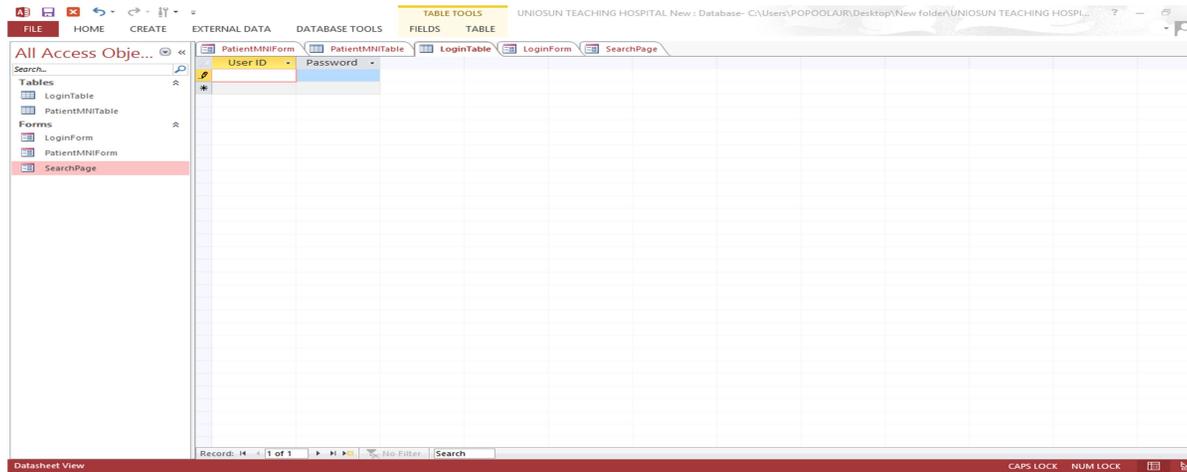
Figure 9. Patient Master Name Index Management System Data Entry Form

Figure 9. The health information manager make use of this form to input the patient data that has been in practice manually; this interface serve as the input interface to type in the data of the patient; as seen, there are DBMS control buttons on the page which allows the health information manager to add, save, delete, refresh database, print and close database.

SEARCH ALL

Figure 10. Patient Master Name Index Management System Search Page

Figure 10. The health Information manager uses this to search patient information that has been saved; this page also displays all the saved patients alphabetically, making it easy to search for patient information.



User ID	Password

Figure 11. Patient Master Name Index Management SystemUser login table (repository)

This is where all the user ids of all health information managers that login into the database will be saved.

HOSPITAL N.	SURNAME	OTHER NAM	DATE OF BIR	AGE	ADDRESS	SEX	MARITAL ST.	OCCUPATIOI	RELIGION	PHONE NUM	DATE ADI

Figure 12. Patient Master Name Index Table (database repository)

Figure 12 The is where all the information gathered from the patients will be stored, i.e., hospital number, surname, other names, date of birth, age, address, sex, marital status, occupation, religion, phone number, date admitted, date transferred, ward, date discharged/died, consultant, diagnosis. All this information is stored in the patient master name index table. Also, if the database is queried, it will derive its response and feedback from this table.

SYSTEM TESTING

System testing involves the various activities carried out to uncover possible problems that might still be found in the designed system. Testing involves the testing of the system designed to see how it works. It also involves testing for each tuple to see its functionality.

Frequent system testing overcomes the weakness that was not found in earlier usual testing. This includes system failure; the testing started with low volumes of patient data to a much volume of patient data. This test is carried out by the researcher, who is also a System Analyst and Designer. The system is tested for recovery and fall back to ensure that no data had been lost during the emergency.

USER TEST

This is the process of educating the user on how to operate the system. Orientation was organized for the users to educate them on how the system works. It involved practical training given to the user to acquaint them with the way the system works. The system was used practically by the user after they had gone through some series of training concerning how the system works.

SYSTEM INTEGRATION

System integration is defined in engineering as the process of bringing together the component subsystems into one system (an aggregation of subsystems cooperating so that the system can deliver the overarching functionality) and ensuring that the subsystems function together as a system, and in information technology as the process of linking together different computing systems and software applications physically or functionally, to act as a coordinated whole. (Wikipedia, 2021).

At this stage, it was ensured that the manual master name index system that the hospital uses is in line with the system design. The user acceptance test is conducted to ascertain whether the system is working according to its specification. The system was tested during the implementation phase, and all the system's features as required are in place. The automated patient master name index management system is working perfectly.

ADDITIONAL INTEGRATION

The research did not only design and automate the patient master name index system, but It also added creative ideas that were not in the existing system, such as the addition on a photo section in order to quickly identify a patient by his facials and to determine a false patient that might have stolen the complete patient information claiming that he/she is the one.

Also, a user login page was conceived and added to ensure security and prevent unauthorized users.

Moreso, a Phone number section was added to the interface, which did not exist in the previously practiced patient master name index system;the phone number of a patient is one of the unique keys to quickly identify a patient because it is not easy for two or more patients to use a single phone number.

SUMMARY, LIMITATION, CONCLUSION, RECOMMENDATION, GENERALIZABILITY OF THE RESEARCH FINDINGS, AND RECOMMENDATIONS FOR FURTHER STUDIES

SUMMARY

The research work was focused on teaching hospitals in Nigeria, in which Uniosun Teaching Hospitals was selected as a case study. This research looked into the various problems associated with the existing patient master name index system, which are problems of duplication of patient data, improper documentation of patient master name index, inadequate identification of patient information in the master name index, loss and mismatch of patient data, time wastage (prolonged patient waiting time), data redundancy, cost, uniformity, and dispersion. With all these problems being sorely examined, a solution was proffered to eliminate these existing problems. With the Design and Implementation of an Automated Patient Master Name Index Management System such problems are considered to be history, in the sense that this new system can provide as well as guarantee the following:

- Easy patient master name index management.
- Eliminate duplication.
- Reduction of time spent retrieving a patient case folder.
- Reduces the number of errors made during registration in the master name index.
- Reduces cost of production of master name index cards

The system design methods used in achieving this research work were emphasized comprehensively in the chapters of this research work.

LIMITATIONS OF THE STUDY

During this research, Design and Implementation of an Automated Patient Master Name Index Management System in Teaching Hospitals. A case study of Uniosun Teaching Hospital, Osogbo, Osun State, there were certain limitations and challenges which include:

- Time Constraint: Due to the nature of work in the hospital, the head of the health records management department is always hectic, and he does not keep up with an appointment. Also, the research supervisor is the Head of the Department; he is also very busy with official and academic activities. Personally, the researcher had sleepless nights to beat time.
- Financial Constraints: The researcher encountered financial challenges due to the high cost of transportation to the case study for data collection, Internet, and other miscellaneous expenses.
- Poor response: poor response by some health information management practitioners due to fear of computers taking over health information management practice, which they think can cause them to lose their jobs.
- Computer Infection: The computer system can be infected by a virus, leading to the loss of research materials.

CONCLUSION

The following conclusions were reached based on findings from this study. The design and implementation of an automated patient master name index system for a hospital will be a significant relief for health information managers and health information management practice as a whole. The automated Patient MNI system can effectively help in handling the Patient Master Name Index practice in Nigeria Teaching hospitals. Also, it will suffice as a tool for quick intervention for patients who have misplaced or lost their reference cards, thus enabling the health information managers' practice more accurately than before. Thus the overall effect of computer usage in health information management will be effective and practical and would take health information management to the next level.

RECOMMENDATIONS

The following recommendations are made from the findings of this study:

- The Health Information Management Department should provide more computers so that the automated patient master name index management system can extend beyond the General Out-Patient Department (GOPD).
- Health Information Managers should be sent on compulsory training for further development of health information management practice.
- Health Information Managers should be appropriately monitored and evaluated by the department head to see if they are using the newly adopted designed system.
- Health Information Managers should be educated on the maintenance culture of all systems and tools used in the facility.
- The health information management board should create awareness on eradicating paper-based systems in health information management practice and embrace modern digitalization of health information management practices.

GENERALIZABILITY OF THE RESEARCH FINDINGS

This research work was carried out in Uniosun Teaching Hospital, Osogbo, Osun State, and can be generalized to all Health Information Management Departments in other Teaching Hospitals in Nigeria and across the globe because the Patient Master Name Index shares similar characteristics within the Health Information Management profession.

RECOMMENDATIONS FOR FURTHER STUDIES

This study suffices as a basis for further research on the Design and Implementation of an Automated Patient Master Name Index Management System across the globe. Similar studies should be conducted in other federation states and other countries to improve the Patient Master Name Index system.

DEDICATION

This research work is dedicated to Almighty Allah; The Most Beneficial, The Most Merciful, The Lord of the worlds and all that exists in it for His infinite love and mercy on me constantly and His Compassion over my successful completion of this course of study in good health and intensive knowledge, All praises and adoration belong to The Provider, The Sustainer of the Universe.

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My tribute goes to my parents (May Almighty Allah forgive their sins, show them mercy and grant them Al-Jannatul Firdaws).

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