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Towards Efficient Vaccine Immunization and Uptake for Nursing Mothers in South Western Nigeria Using Low-Cost Radio Frequency Identification (RFID) Based System

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ABSTRACT

Infant mortality rate has been a major public health issue not only in sub-Saharan Africa, almost half of all infants' deaths prior to age of five years worldwide occurs and have been reported in Democratic Republic of Congo, India, Pakistan, China and Nigeria. The attitudes of nursing mother to immunization uptakes has been a persistent problem in our communities' very few communities are doing well while in some other areas they are not. Therefore, for sound health of the children there is need for timely vaccination of the children as at when due, so as to keep the children healthy, build-up their immune system against any foreign attacks that may emerge or outbreak. Thus, non-compliance to vaccine preventable Disease (VPD) among the children aging between 1-5 years in our society is considerably high compared with the developed country. It is therefore, unacceptable that very significant number of children still die before their fifth birthday, mostly from preventable causes and treatable diseases, even though the knowledge and technologies for life- saving interventions are available. The study seek to investigate some factors and underlying mechanisms hindering compliance to immunization uptakes, and we would be applying engineering value analysis (VA) process using an existing product to construct and fabricates an RFID System that can be used to alert the nursing mothers the appropriate time to access health clinic for immunization and medication for their infant child in a bid to reduce infant's mortality rates in our societies.

Keywords: Infant Mortality, RFID, Vaccination, Uptake, Immunization, Preventable Disease, Technology

1. INTRODUCTION

Infant mortality has been a major problem in developing nations particularly in the sub-Saharan African. The problem has been linked to factors such as inadequate health facilities, lack of financial capacity, and lack of access to appropriate medical care. Some of the common causes of infant mortality in Nigeria include dehydration, infection, congenital malfunction, pneumonia, measles, diarrhea, and malaria attributed to falling vaccination rates and increasing prevalence of delayed or off-schedule administration of immunizations in sub-saharan African nations.

This has made many infants susceptible to the spread of eliminated vaccine preventable diseases (VPDs) (Atkinson et al., 2016). However, vaccination of infants is critical to protect infants against prone to VPDs. Healthcare systems are a very important part of the economy of any country and for the public health. Healthcare sectors are gradually getting involved in embracing new technologies to provide a better quality of care given to patients (Abugabah et al., 2020).The world is also reducing under-five mortality faster than at it were during the past two decades. Despite these gains, child survival remains an urgent concern (Vakili et al., 2015).

There is urgent need to lessen challenges of noncompliance of infants immunization uptakes and to reduce the child mortality in our societies among infants, thence the development of a low cost RFID based system for supporting vaccine immunization and uptake is a very paramount instrument that can be used among the nursing mothers and child to inform the nursing mothers why vaccinations became an important factor for the well-being and the health of child, importantly making the nursing mother to be more responsible for child's need and the procedure of how medication can be administered to the children, clinic attendant and time fixed for appointments on immunization of their child. Studied has shown that Children are at greater risk of dying before age five if they are born in rural areas, poor households, or to a mother denied basic education (Vakili et al., 2015).

Onamade (2018) revealed that failure other challenges failure to adopt the internationally agreed standards or best practices relating to immunization and injection safety contributed immensely to mortality rate in developing countries. Other reasons why nursing mothers miss clinic and immunization appointments are many nursing mothers are pre-occupied with making ends meet and sometimes forget the very important activity of vaccinating their infants against deadly diseases, some are ignorance of it (Balogun et al., 2012).The need for identification has become necessary for management infants and nursing mother due to outbreak of VPDs (Ruhil et al., 2013).To be able to identified the specific vaccine taken and the time this vaccine were taken by the child. RF Identification helps in providing a precise information about the infants and the nursing mother to allow for necessary vaccines and medication to be provided in case of any disease outbreak. Using RFID enables one to have knowledge about some relevant information about the child for example date of birth, last vaccination taken by the child, how was the vaccine and the drug were administered to the children and so on based on the information in the database.

Child mortality rates are falling globally as a result of advances in vaccine production, but more progress is still expected. The UNICEF, 2019 data showed that there has been a gradual decrease in the rate of child mortality between 1990s to date. The annual rate of reduction among the under-five mortality rate has increased from 2.0 percent in 1990 to 3.8 percent in 2018 (UNICEF, 2019). Many countries have shown considerable progress in tackling child mortality and have managed to reduce under-five mortality rate by 40 percent or more over the past 20 years (UNICEF, 2019). In contrast, little progress has been made in Nigeria and other sub-Saharan African countries. Data from the Nigeria Demographic Health Survey (NDHS, 2018), showed that the under-five mortality rate in Nigeria is 132 per 1,000 live-births, the painful implication of this is that 1 in 8 Nigerian children never reach the age of 5 (UNICEF, 2019). World health organization (WHO, 2020) report on immunization revealed that most deaths among infants in developing countries and in Nigeria are vaccine-preventable(Olusanya, 2005). These diseases are Diphtheria, Haemophilus, influenza, serotype b infection, hepatitis B, measles, meningitis, mumps, pertussis, poliomyelitis, rubella, tetanus, tuberculosis, and yellow fever.

Nigeria has a precarious problem of infant mortality complicated by vaccinating and ranked the world's third-largest birth rate within a culturally and socioeconomically diverse demography(McGavin et al., 2018). Therefore, it is imperative to decipher a technologically viable alternative that can serve as an antidote to this needless and unwarranted deaths. This study examined how RFID based system can be used to support vaccine immunization and uptake of nursing mother on regular vaccination of infants against outbreak of diseases.

This can be achieved by probing into various factors; cultural, infrastructural and environmental variable that mitigate against vaccination of infants, nursing mothers and health caregivers and how RFID can be integrated with the cellular telephones and used to enhance health care delivery and services in various hospitals among identified population. We proposed the use of a real-time low-cost RFID based system using location-aware request-response model to ensure compliance to vaccination schedules and adequate coverage of mapped-out geographical location for effective and efficient uptake and distribution of vaccines for infants. This is intended to improve vaccine uptake in pregnant women and children.

The proposed RFID technology would be a small portable device given to mothers upon a visit to health centers on health-related care. We will design in a multifunction mode with:

a) An in-built periodic alarm
b) Ability to send periodic SMS/alerts to the infant mothers' through phone.
c) A sensor Tags which senses the activities in (a) and (b)
d) Readers that are dynamic and reside in the test location.
e) RFID Middleware: consisting an Electronic Patient Records System (EPRS) and Database /SMS Server System.
f) Mobile Wireless Network with Voice capability.

This technology would help infant mothers captured and registered in the database and help them to respond timely to routine immunization. Our approach will educate parents, (especially mothers), about the importance of immunization and vaccination. This research would be carried out from sampled population in kwara state, Nigeria in a bid to properly collect real-life data and show the workability of the proof the concept.

1.1 Etiology of Infant's Mortality in Our Communities

Women are at risk for delivering a low birth weight baby, the same mothers whose children are at risk for later child-hood morbidity(Brooks-Gunn et al., 1988).Some of the identified causes of infants mortality are discussed below.

1.2.1 Congenital Disease

This account for almost a third of all infant deaths(McCormick & Wise, 1993).Therefore, reviews show that congenital malformations account for an increased proportion of infant deaths in both developed and developing countries. Infant mortality attribute-able to congenital anomalies is higher in developing nations, whereas the proportion of infant deaths is greater in developed countries (Rosano et al., 2000).

1.2.2 Prematurity

Prematurity is another causes of infant mortality related conditions which accounted for 37.5% of all deaths, ranking far above the 17.4% for congenital anomalies and 12.9% for sudden infant death syndrome(Dollfus et al., 1990).

1.2.3 Malaria

Study show that malaria associated with low birth weight in pregnancy is estimated to result in 100 000 infant deaths in Africa each year(Desai et al., 2007).Malaria is a threat to health, has remained undeterred in developing countries (Nevill, 1990). It contributes to one out of every 10 infant deaths(DEFO, 1995). Malaria is an acute and chronic disease caused by intracellular protozoa of the genus Plasmodium which are transmitted by the bite of female Anopheles mosquitoes. Approximately 2.6 billion people are at risk worldwide resulting in at least 100 million clinical cases(Nevill, 1990).

1.2.4 Diarrheal

Diarrheal diseases are one of the leading causes of childhood morbidity and mortality in developing countries. An estimated 1,000 million episodes occur each year in children under 5 years of age(Carlos & Saniel, 1990). However, comprehensive advances in living standards remain a long term prospect in most developing countries due to scarcity of resources. Results of many programmes aimed at reducing diarrheal diseases by provision of safe drinking water and adequate sanitation have often been unsatisfactory(Gupta et al., 1998). Diarrhea accounted for the second biggest killer of children in Nigeria with estimation of about 16% of child's death every year. Precisely an estimated figure 151,700 children die in Nigeria every year from diarrhea disease.

1.2.5 Pneumonia

Pneumonia constitutes a major proportion of the global burden of childhood mortality and morbidity being responsible for about 20% of childhood deaths, majority of which occur in developing nations. Yearly, almost half of the 1.9 million deaths due to acute respiratory tract infections in children under 5 years of age occur in Africa(Zar & Madhi, 2006).

1.2.6 Measles

Study shows that measles is a highly communicable disease which has an effect on child survival, particularly in developing countries(Clements et al., 1992). Measles incidence is increasing among children aged over 2 years(Cutts et al., 1991). Thus in the age group 0 to 11 months, measles mortality was higher among secondary cases than index cases, and the proportion of secondary cases was significantly higher for this age group than for older children(Abugabah et al., 2020).

1.3 Comparism Between White & Black Infant

When compare white infants mortality rate with black, study indicated that there was higher proportion of nonwhite infants death related to infectious diseases. More so for black infants, the mortality rate related to infectious diseases was found to be twice that of white infants(Jason & Jarvis, 1987).Jason and Jarvis (1987)Study show that infectious diseases contributed to 12.5% of all infant deaths and to almost 400,000 years of potential life was lost due to infant deaths(Jason & Jarvis, 1987). Therefore, infectious diseases contributed to 9% of deaths of low birth weight infants and to more than 18% of all deaths in the post neonatal period(Jason & Jarvis, 1987).

1.4 Prevention of Infant's Mortality

The prevention of preterm deliveries among disadvantaged populations remains elusive, suggesting the need for different approaches to women's health needs(McCormick & Wise, 1993). However, an attempt to decrease post neonatal mortality received marked attention with the recommendations for specific positioning to prevent sudden infant death syndrome and heightened attention to increased immunization completion rates(McCormick & Wise, 1993).Some of the preventive measures were discussed below.

1.4.1 Vaccination

Some childhood diseases can be prevented by taken vaccine includes but limited to measles, polio, diphtheria, tetanus, pertussis, pneumonia due to Haemophilius influenzae type B and Streptococcus pneumoniae and diarrhea due to rotavirus, vaccines are available and can protect children from illness and death. Asides using vaccine we are recommending the use of RFID to alert the nursing mother on appropriate time to visit nearest health medical clinic to access medication for their infant.

1.4.2 Immunization

Immunization remains the most effective methods for primary prevention and major contribution to reduction in post-natal mortality and morbidity(McCormick & Wise, 1993).

Early childhood Intervention Program

This serve as a service to support children who might not been able to survive the neo-natal period and as an intervention to reduce factors associated with post natal mortality(McCormick & Wise, 1993)

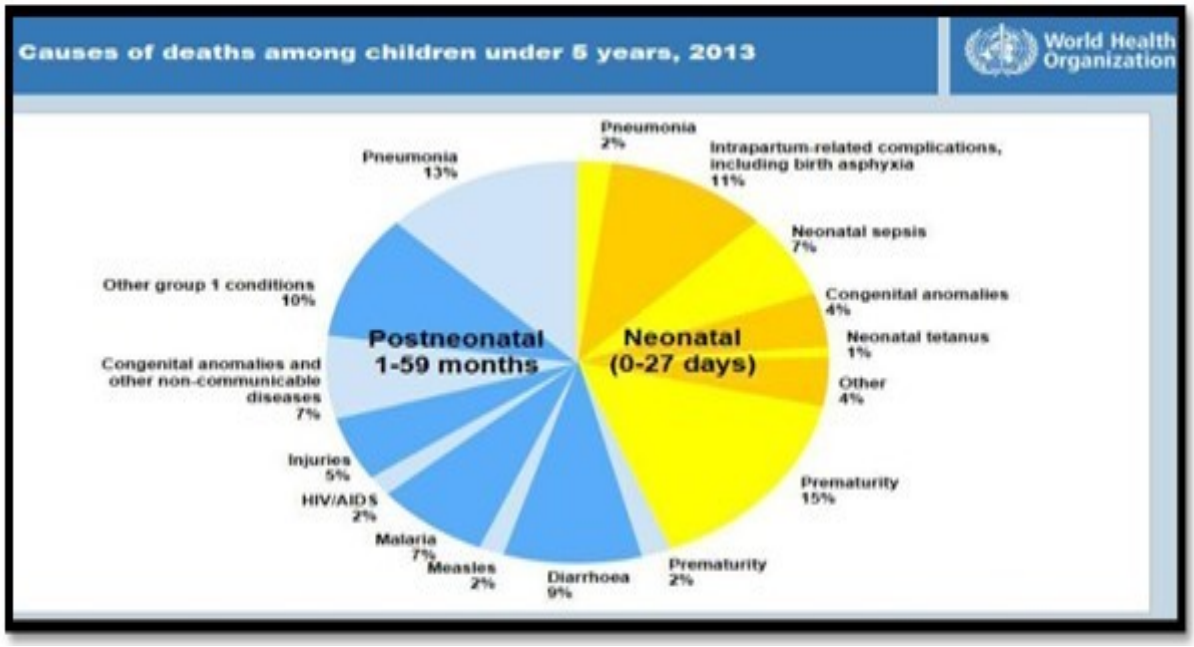


Fig.1: Causes Of Deaths Among Children Under 5 Years
Adapted From Vakili Et Al., 2015)

1.4.3 Family Planning

Family planning has helped to reduce the number of unplanned pregnancies also leading to decrease in low birth rate deliveries. Interventions that have been carried out includes decision making skills, peer counselling, community media, health education and School services(Brooks-Gunn et al., 1988) .

1.4.4 Access to Prenatal Care

It is one of most effective primary prevention for infant mortality as a pregnant woman would be informed to learn the do's and don'ts during pregnancy. Study show that inadequate prenatal care is extensively a risk factor for infant mortality(Brooks-Gunn et al., 1988)

1.5 Problem Statement

The inefficient management of infants, in need of medical assistance, and poor living condition has been one of the major challenge for infant's mortality rate in our society .Sub-Saharan Africa, still have very high rates of under-five mortality rate and these children are more than 15 times more likely to die before the age of five than children in developed regions(Vakili et al., 2015). The leading causes of death in under-five children are mostly attributed to preterm birth complications, pneumonia, birth asphyxia, diarrhea and malaria.

Most deaths among children aged one to five years are due to diseases that can be prevented, but that can also be easily treated at home or in health facilities. Development Goal 4 (MDG 4) calls for reduction in the under-five mortality rate by two-thirds between 1990 and 2015(Vakili et al., 2015). Accurate and routine vaccination is a perennial problem in Nigeria. According to the study conducted by McGavin et al. (2018) on the nature of immunization coverage among 5759 children within one year of age revealed that 25.5% of the children were fully vaccinated, 47.9% were under or irregularly vaccinated, and 26.6% had not received any vaccinations. This problem is exacerbated by myriad challenges of culture, illiteracy, unavailability of health care centers in rural areas, and poverty(Bolu-Steve et al., 2020). It is therefore unacceptable that very significant number of children still die before their fifth birthday, mostly from preventable causes and treatable diseases, even though the knowledge and technologies for life- saving interventions are available(Mesike & Mojekwu, 2012).This research seek to construct RFID system that capable of alerting nursing mother on periodic time to access immunization for their infant child.

Although research has shown that non-compliance with vaccination in most countries is caused by financial reasons (Harris Interactive, 2001), in resource-poor environments such as Nigeria, a preliminary interrogation of nursing mothers on non-compliance to vaccination regimen for infants revealed that lack of information, monitoring, lack of knowledge of medications, confusion with medication and forgetfulness are major factors responsible for non-compliance. Oku et al. (2017) revealed myriads of problem affecting vaccination communication and awareness in Nigeria, these included funding constraints, poor attitude of health workers and vaccination teams, inadequate infrastructure and equipment and weak political will, and health human resource factors.

In an attempt to solve these problems, they proffered political-will and organized communication committee to effect workable vaccination communication. However, while these factors are admissible, their study failed to consider the use of emerging technology to effect the inadequacy of communication problems in vaccination. Our project will fill up the research gap in vaccination communication and find a means to reduce these inequities across countries and saving more children's lives by ending preventable child deaths.

1.6 Research Questions

1) What are the major challenges responsible facing immunization uptake of infants among nursing mothers in our communities?
2) What are the current methods and measures being used among public health workers to ensure nursing mothers compliance?
3) What level of acceptance of technology tools and devices introduced to nursing mothers?

1.7 Aim

To develop a RFID based application that can be used to alert nursing mother on their appointment time for vaccination of infant in our communities. The aim of this study was to design and develop a reliable RFID system for effective management of immunization of infant's children by the nursing mother. This is to simplify a cumbersome and risk procedure currently in operation in our health clinics.

1.8 Objectives

The objective of our research is to develop a prototype device that can serve as a prompt for infant and maternal patients for vaccine and schedule visit compliance. To achieve this aim, the following specific objectives will be pursued:

i. Investigate the level of vaccination compliance in Offa, Kwara State.
ii. Develop a technological artifact using appropriate tool that can support immunization and uptakes.
iii. Test the developed artefact for relevance and efficiency at solving the problem.

2. RELATED LITERATURE

Some information's on the sources of child deaths is crucial to guide human efforts to improve child survival(Black et al., 2010).A child's risk of dying is highest in the neonatal period, the first 28 days of life(Vakili et al., 2015).Yaya et al. (2017) stressed on the menace of infant mortality to public health system amongst families in Nigeria. McGavin et al. (2018) study on the nature of immunization coverage among 5759 children within one year of age revealed that 25.5% of the children were fully vaccinated, 47.9% were under or irregularly vaccinated, and 26.6% had not received any vaccinations. Atkinson et al. (2016)the study revealed that the use of mobile app was a well-received technological solution, but there was a divergent view on the accessibility and application of the technology. Studies such as Gatuha and Jiang (2015) proposed prototypes using mobile technologies and an open source data collection frameworks to test the feasibility of improving the vaccination data collection in Afghanistan and Kenya.

Records has it that infants deaths prior to age of five years worldwide occurs in Democratic Republic of Congo, India, Pakistan, China and Nigeria(Bolu-Steve et al., 2020).When particularized to Nigeria infant mortality has been a major issue associated to some factors such as funding, accessibility to good medical care and inadequate health faculties in our communities and some of the major causes of infant mortality rate are diarrhea, pneumonia, measles, congenital malfunction and malaria. In 2008,findings indicated that 8·795 million deaths in children under 5 years worldwide infectious diseases caused 68% (5·970 million), with the largest percentages due to pneumonia (18%, 1·575 million, uncertainty range 1·046 million–1·874 million), diarrhoea (15%, 1·336 million, 0·822 million–2·004 million),and malaria (8%, 0·732 million, 0·601 million–0·851 million). 41% (3·575 million) of deaths occurred in neonates, and the most important single causes were preterm birth complications (12%, 1·033 million(Black et al., 2010).

Black et al. (2010) child mortality can be lessen by two-thirds, only if the high numbers of deaths are addressed by maternal, newborn, and child health interventions. According to (Olusanya, 2005) about half of the 10.8 million child deaths in year 2000 worldwide occurred in India, Nigeria, China, Pakistan, Democratic Republic of Congo, and Ethiopia although these countries were not necessarily the worst by infant mortality rate ranking. Findings also revealed that age, education, and mothers' monthly income working mothers' cultural beliefs significantly predicted f infant mortality(Bolu-Steve et al., 2020).Culture is another factor hindering the infant immunization in Sub-Sahara Africa as many individuals belief in orthodox medication for the infant medication rather than seeking for modern medication for the children. However, this vary from by geographical location, tribes, ethnicity, level of education, gender, age, income, marital status to give better understanding on how this cultural belief works. Inequity in health delivery system within and between one nations to another was found to be the major hurdle against achieving the goal of vaccine.

The rate of infant mortality in Nigeria is not only high but also failed to improve relative to other countries(Bolu-Steve et al., 2020; Oku et al., 2017).Ramazani et al. (2022) the maternal mortality rate was estimated at 620 deaths per 100,000 live births, of which 46% of maternal deaths were related to a parturients' delayed decision in seeking healthcare on time (first delay) and adopted an epidemiological study that employs retro-spective data to estimate the maternal mortality rate. One of the challenges facing the nursing mother also include concerns regarding vaccine safety, challenges the understanding of complex immunization schedules, logistical issues related to attending appointments and beliefs that VPDs are rare and the fear of immune system overload have been documented and erroneously believed by the nursing mothers(Atkinson et al., 2016). World health organization (WHO, 2020) report on immunization revealed that most death among infants in developing countries and in Nigeria are vaccine preventable technological interventions the inability of government in addressing these issues to enable nursing mother adherence to on-time vaccination of their children has been major issues confronting infants mortality rate (Atkinson et al., 2016) .RFID is known to is a technology that not been fully deployed in the health sectors in alerting the nursing mother for purpose of immunization of their infants (Abugabah et al., 2020). Many countries have shown considerable progress in tackling child mortality, however, little progress has been made by countries, especially in Nigeria and other sub-Saharan Africa countries, this study will address how this technology can be used and deployed to the nursing mothers for prompt immunization of their children.

2.1 Radio Frequency Identification (RFID)

Radio-frequency identification (RFID) technology can be used to track patients by generating a unique ID and allows Patient information to be retrieved from the database using this ID (Omar et al., 2016).Radio frequency identification (RFID) is technology for automatic identification that allows the transmission of a unique serial number wirelessly(Uddin et al., 2009). A typical RFID system includes transponders (tags) and interrogators (readers).The tags are attached to nursing mother, and readers communicate with the tags in their transmission ranges via radio signals(Xiao et al., 2007).RFID technology play a critical role in identifying articles and serving the growing need to combat counterfeiting and fraud. Thus, the use of RFID tags may cause privacy violation of people holding an RFID tag. Abugabah et al. (2020) RFID technology has the ability to track and relates with individual patients and almost any of the medical devices, IT equipment, deployed in health clinics all over the world.

According to Abugabah et al. (2020) who investigate the benefits and obstacles to implement RFID technology in the healthcare sector and further highlighted the most possible methods or technologies that can adopted to improve and overcome the limitations of implementation of RFID. The concern and demerit of using RFID is the information leakage of a tag, traceability of the person and impersonation of a tag. One of the major challenge is to find a way to protect the leakage of information(Lee et al., 2005). As Information is collected and transmitted, security issues will become vital for such a fully connected environment security issues became inevitable to guide low-cost devices such as RFID tags to prevent tag cloning, and for data authentication to prevent transmission of data forgery(O'Neill & Robshaw, 2010).

Scharfeld (2001) RFID systems provide an automatic means to inexpensively, accurately, and flexibly capture information. In combination with the Internet, which allows immediate accessibility and delivery of information, passive RFID systems will allow for increased productivities and efficiencies in every segment of the global supply chain. Therefore its widespread adoption depends on its improvements in terms of performance range, speed, integrity, and compatibility particularly, reduction in cost of purchasing power. RFID technology is better than barcode in many ways, and may totally replace barcode in the future if certain technologies can be achieved such as low cost and protection of personal privacy(Xiao et al., 2007).

Configuration of RFID system

RFID consists of three basic component such as transponder (tag), interrogator (reader) and antenna. In a typical communication sequence, RFID system performs a number of functionalities between reader and tag. RFID reader emits a continuous RF carrier sine wave. When a tag enters the RF field of the reader, the tag receives energy from the field. Further, when receiving sufficient energy, it begins to modulate the carrier signal to the data storage on the tag. The modulating carrier signal is resonated from the tag to the reader. The reader detects the modulating signal from the tag, and decodes signal in order to retrieve the data from the tag. However, the information relays to the host computer where more data will be stored and finally will be displayed to the user. RFID is basically based on wireless communication making use of radio waves, which is a part of the electromagnetic spectrum.

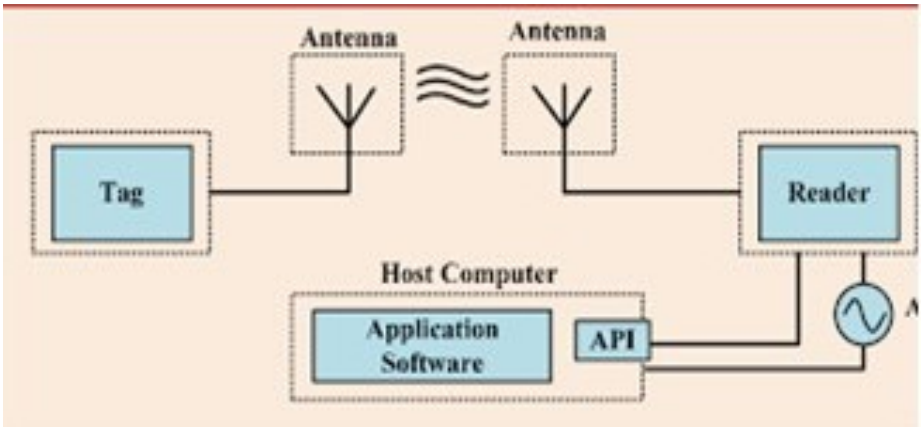


Fig.2 Block diagram of Configuration of RFID System. Adapted from(Uddin et al., 2009)

3. RESEARCH DIRECTION

This section discusses the research approach and design, construction, sampling techniques and procedure, research instrument and sources of data. It also explains modes of operation for RFID based system and the method used in collection of data and how the data collected were used in analyzing the findings.

3.1 Scope

The study was conducted intended to carry-out its field work in ten selected clinic centers but due to limited resource and time constraint, we have chosen to select six clinic centers from Offa Kwara state for our field work and data collection. These includes Olalomi Hospital (OLAH), Muslim Hospital, Offa (MHO), Afolabi Hospital (AFH), PHCC, Offa (PHCC), Specialist Hospital (SPECH) and Olanipekun Hospital clinic, Offa (OLAN). The Clinics were selected based on the fact that the locations were accessible, strategically located and can be easily located.

3.2 Ethical Considerations

All the stages of the research work will be made to comply with ethical considerations as found in its research ethics policy of institutional review board (IRB). Appendix A. The Ethical considerations include a commitment that the research reports shall be treated confidentially and the privacy of individual respondents shall be protected. All efforts shall be made to uphold to this promise at all times. An assurance was given to all respondents that under no circumstances would their names be mentioned or revealed in the course of writing the research report and the information given would not be used for any other purpose except for academic reasons. Respondents were again assured that the information supplied will not be given to any third party without their consent. Any company clinic who has assisted in given useful information to the success of this report shall be given a copy of the final report of the research work. Lastly all references to published text books, Journals, website shall be rightly acknowledged to avoid any breach of intellectual property rights.

3.3 Confidentiality

Confidentiality of the participants was not compromised at any stage of data gathering for the study so that the data collected would be valid, reliable and have integrity.

3.4 Informed consent & Concept form

In order to carry out the study, formal permission was requested and granted by the selected community health institutions used for the field work, before the participants fills the questionnaires, they are first given concept form to filled and signed before completing the form (Appendix B) willingly.

3.5 Research Approach

The research study adopted the descriptive survey research design with the view of sourcing information from respondents and will adopt the concept of a multidisciplinary and collaborative research and positivism as philosophical paradigm. The choice of this approach is considered appropriate and suitable for this kind of study because the researcher will not manipulate any of the variables being measured. The characteristics will be described as they occur. This will help the researcher to analyze, interpret and report the information collected based on the conditions and circumstances that exist and enable the researcher to draw a conclusion based on the information collected.

3.6 Research Design

The quantitative research approach were used to collect data taken cognizant of cultural, amenities and environmental factors that exist as enabling factors to vaccination with the support of RFID technology used for vaccination uptake. Then, a quantitative was used to examine the effect of using RFID technology as a barometer to determine the level of performances in compliance to immunization clinic appointments by the nursing mothers. To achieve the objective, a quantitative research method was employed in the research work (Onamade, 2018).Quantitative approach was found suitable for the study under investigation because the same group of respondents, who initially participated in the pre-test, were again used for the post-test exercise.

3.7 Database Design

A database (dB) is a collection of logically related data, which have organized in such a way that fulfills organizational requirements. We use a freely available relational database management system (RDBMS). The infants ID, Temperature, Date and Time are recorded and later on we can use this ID to retrieve all the above data of the patient. This will make tracking of the patient much easier to illustrate. To add a new patient to the system, first, we need to log in as admin or a username that has access to make new account, and an option will appear under his/her name, it called "add new patient"**.** This study combines both action research and design science methods. The action research paradigm involve the clients or the target population in finding solutions to the problem, the design science method would use the data collected in order to prototype and coming up with the artefacts intended to solve the problem of infant and maternal vaccine uptake. Quantitative data would be collected using questionnaire from a sampled population of the target health clinics in each of health clinic selected for the study. The data would be analyzed using SPSS and the analyzed data would be better visualized by using a conventional charts and diagrams.

3.8 Modes of Operation for the RFID Based System Construction

We implement a smart RFID for management, monitoring and alerting nursing mother based on the information provided in the database system.

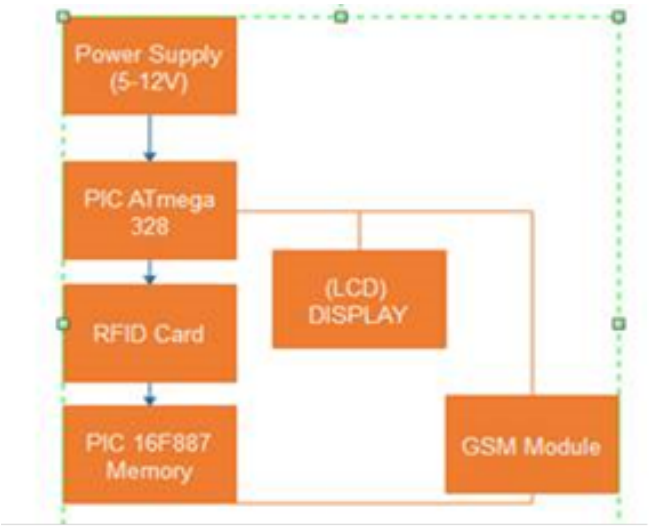


Fig 3: Block Diagram for Design & Construction of RFID Based System

The system intends to create unique identification numbers with tags for each nursing mothers which will identify her in the health information system. The ID will link her information to records of the infant's vital, will be signed and saved in a database for further analysis and historical consultation for immunization updates. The system will also provide real-time patient monitoring of vital signs during their stay in an emergency and critical care unit in a clinic. The RFID can provide a cost-effective means of increasing reliability, privacy and security in the management of healthcare records.

The design and construction of Low Cost RFID based System for supporting Vaccine Immunization and update is a mechanism whereby nursing mother will have her own RFID card for periodical information on the immunization of her infant child at the hospital or clinical centre. The device is use for checkup and also to provide the nursing mother with information on when to take her child for the next immunization period via Short Message Service (SMS).This process can be done when the nursing mother places her RFID card on the scanner and then scanned to pull out information from the device. However, the device will be unable to get activated and display information unless it is enable. To activate it, the nursing mother will need to register her details using Programmable IC (PIC ATmega 328) which enables the information to be stored with the aid of memory device (PIC 16f887) expected to be monitored, processed and then save the information into the memory module of the device. The device helps to support the nursing mother to know the last period she immunized her child and then update her when next she is expected to visit the clinic center for the next appointment day for immunization of her infant child.

3.9 Sample & Sampling Technique

The sample used for the study were majorly nursing mothers. A simple random sampling technique was used in selecting respondents from clinics selected for the study because in using random sampling, the likelihood of bias is reduced.

3.10 Sampling Criteria

Subjects included in the sample selected met the following criteria=

i) Literacy and knowledge about the ICT

ii) Usage of at least one GSM network and the nursing mother must have attained the age of 20 or above.

3.11 Target Population

The sample selected for study are the nursing mothers that are attending clinic for immunization of their infant children from offa in kwara states.

3.11.1 Sample Size

Tandem with Bruton (1975) cited in Olukoya and Olufemi C.(2011) in their work recommended a sample size of 10% for population of area under 50,000 and 1% for areas having ≥1,000,000 people. A sample size of 25 was uniformly considered as adequate and representative enough for each of the clinic center selected for study. Hence One hundred and fifty (150) questionnaires were distributed to all selected respondents from all the various targeted clinic centers of the study. Of these numbers, a total of (84) questionnaires were returned by the respondents representing 56%.

3.12 Sources of Data Collection

The primary source consisted of response from respondents via questionnaires, while as the secondary data were derived from website, journals, and those data which have already been collected and analyzed by someone else. This has helped the researchers in analyzing the results obtained through primary source.

3.13 Data Collection Instrument

A questionnaire was chosen as data collection instrument. A combination of closed-ended and very few open-ended questions were used for the questionnaires. The questionnaire was designed in such a way that the respondents could fill it without the presence of researcher. The questionnaires comprised 15 questions. The first-five questions, elicited a brief profile of respondents, while the remaining ten questionnaire sought the views of respondents on subject of the study.

3.14 Reasons for Using Questionnaires for the Study

Data collection was done using questionnaires for the following reasons:

i. To gather information from the respondents on the subject and to gather information relating to respondents behavior, attitudes and opinion and also allow the researcher to reach people who live in remote locations.
ii. ii) Questionnaires are relatively quick and easy to create, code and interpret most especially if closed-ended questionnaires are used and considered standardize because respondents answer same questions and this makes questionnaires to be reliable method of research.

3.15 Piloting the Questionnaires

Piloting was done to ensure that any amendments highlighted by the pilot are made to the questionnaires before issuing the final version to respondents. According to HN Shilubane (2009 cited in Polit & Hungler 1995:38), a pre-test refers to a trial administration of an instrument to identify flaws. When a questionnaire is used as a data gathering instrument, it is necessary to determine whether questions and directions are clear to subjects and whether they understand what is required from them. Consequently, before administering the questionnaires to respondents about three copies were printed and used as sample tests which were distributed to three respondents to be answered. Thus, All three questionnaires were returned and positive feedbacks were received from the six three respondents in respect of how the questionnaire was designed.

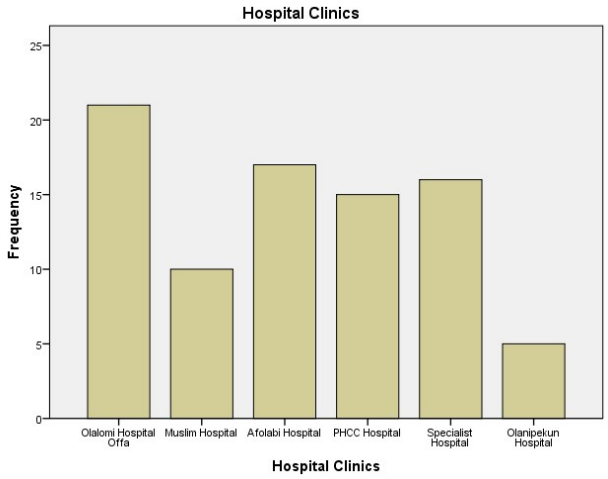
4. DATA COLLECTION PROCEDURE, PROCESSING & ANALYSIS

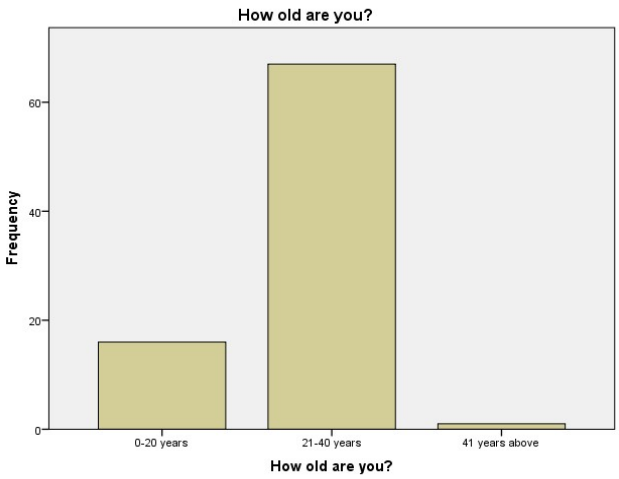
4.1 Data Collection Procedure

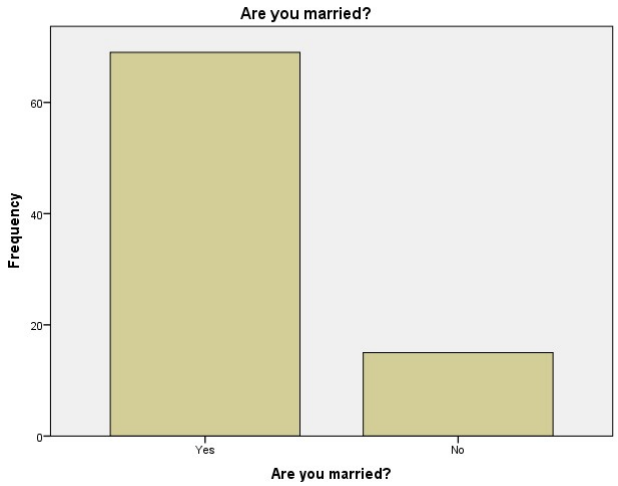
Questionnaires were taken to each of the selected clinic for onward distribution to selected respondents in their respective clinic for administering and thereafter data were collected. However, some respondents gave time to come for picking of the questionnaires, for instance some gave 2-4 weeks to come for picking of the questionnaires, while in some cases the respondents responded immediately and returned the questionnaire.

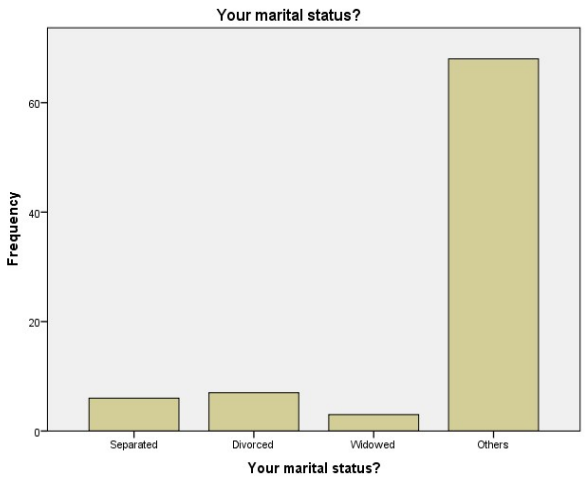
4.2 Data Processing

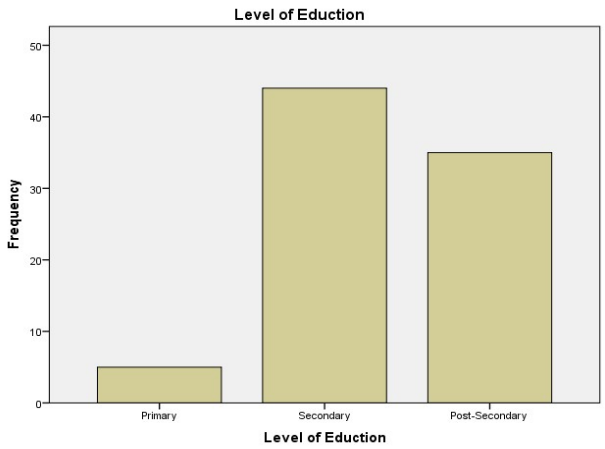
On collection of the questionnaires, each response was numbered and arranged in ascending order and then tabulated accordingly. The data collected were then cleaned and edited. Some of the wrongly answered questionnaires were corrected using various techniques of imputation. The cleaned data were input into the computer and then analyzed. The data was summarized and presented using the SPSS.

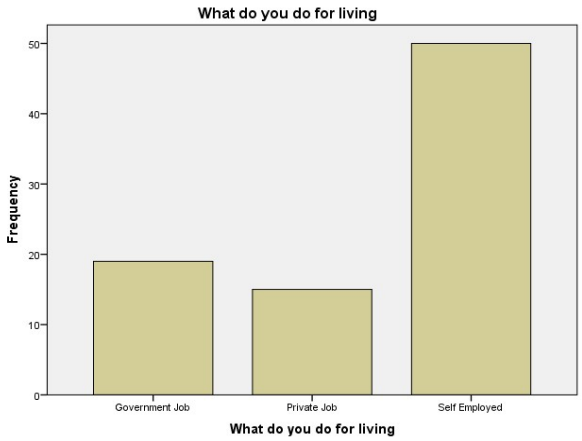

Hospital Clinics
Frequency
25
20
15
10
5
0
Olalomi Hospital Offa
Muslim Hospital
Afolabi Hospital
PHCC Hospital
Specialist Hospital
Olanipekun Hospital
Hospital Clinics

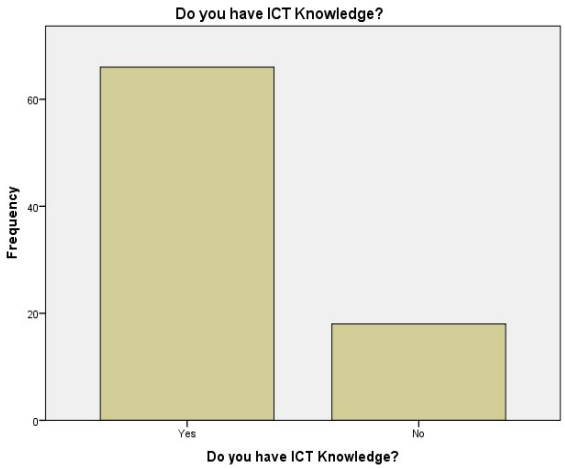

How old are you?
Frequency
60
40
20
0
0-20 years
21-40 years
41 years above
How old are you?

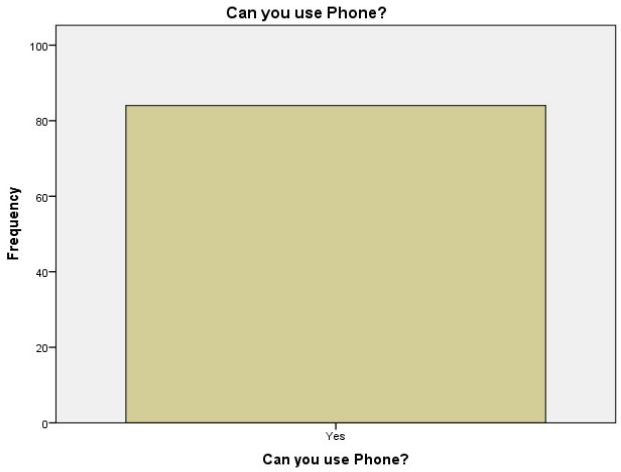

Are you married?
Frequency
60
40
20
0
Yes
No
Are you married?


Your marital status?
Frequency
60
40
20
0
Separated
Divorced
Widowed
Others
Your marital status?

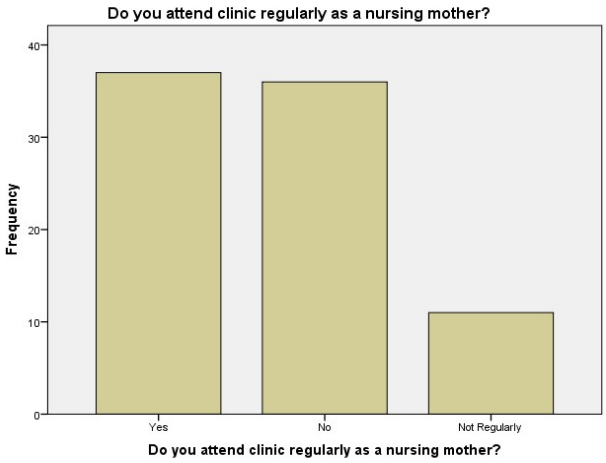

Level of Eduction
Frequency
50
40
30
20
10
0
Primary
Secondary
Post-Secondary
Level of Eduction

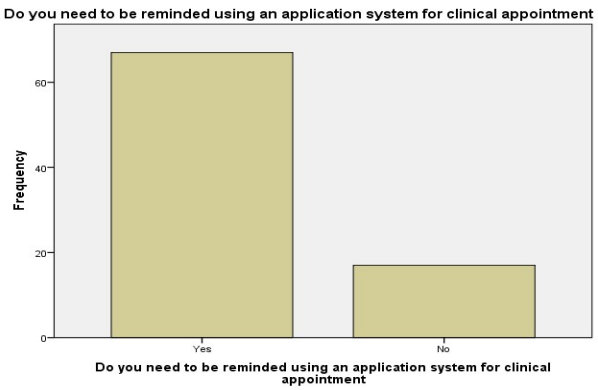

What do you do for living
Frequency
50
40
30
20
10
0
Government Job
Private Job
Self Employed
What do you do for living

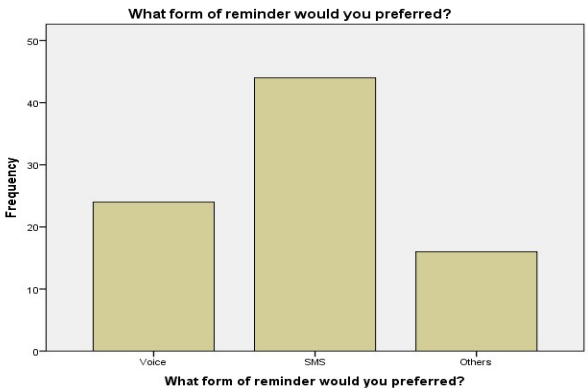

Do you have ICT Knowledge?
Frequency
60
40
20
0
Yes
No
Do you have ICT Knowledge?

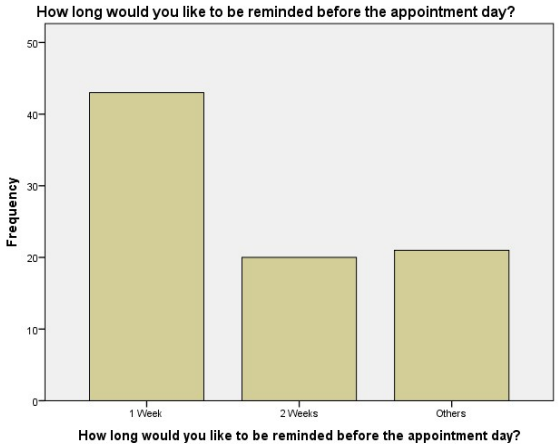

Can you use Phone?
Frequency
100
80
60
40
20
0
Yes
Can you use Phone?

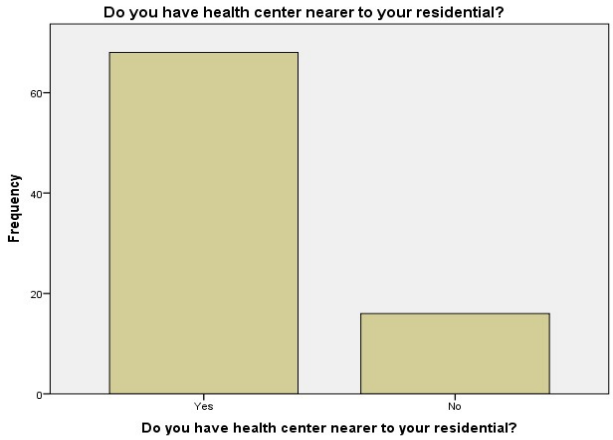
As a Nursing mother have you ever missed your clinical appointment?
Frequency
50
40
30
20
10
0
Yes
No
As a Nursing mother have you ever missed your clinical appointment?

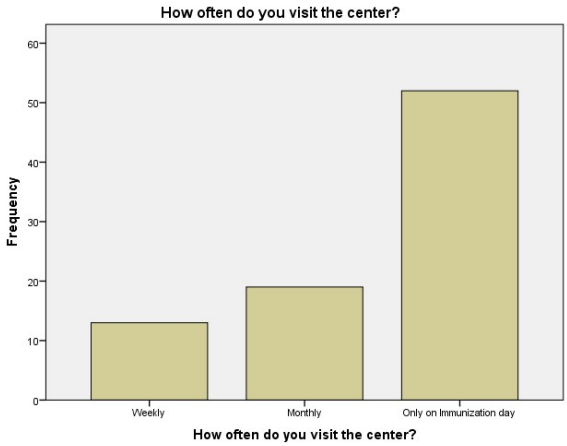

Do you attend clinic regularly as a nursing mother?
Frequency
40
30
20
10
0
Yes
No
Not Regularly
Do you attend clinic regularly as a nursing mother?


Do you need to be reminded using an application system for clinical appointment
Frequency
60
40
20
0
Yes
No
Do you need to be reminded using an application system for clinical appointment


What form of reminder would you preferred?
Frequency
50
40
30
20
10
0
Voice
SMS
Others
What form of reminder would you preferred?







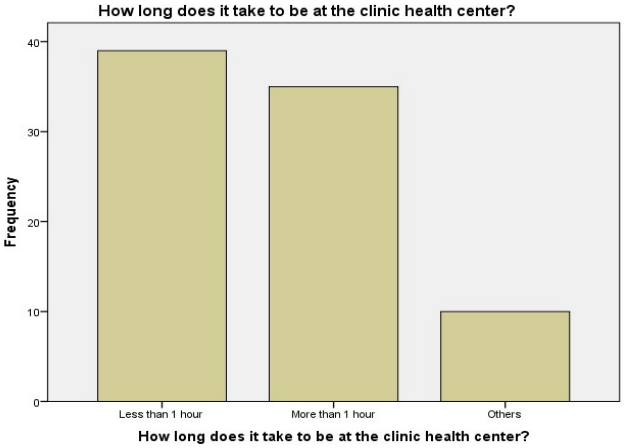


Table 1: An Unstructured Data Collected From Six Clinic Centers

S/No	Symbol	Meaning
1	OLAH	Olalomi Hospital Clinic Offa
2	MHO	Muslim Hospital Clinic,Offa
3	AFH	Afolabi Hospital Clinic,Offa
4	PHCC	
5	SPECH	Specialist Hospital,Offa
6	OLAN	Olanipekun Hospital Clinic
7	FRQ	Frequency
8	%	Percentage

OLAH		MHO		AFH		PHCC		SPECH		OLAN	
FRQ	%	FRQ	%	FRQ	%	FRQ	%	FRQ	%	FRQ	%
4	19	3	30	6	35	0	0	1	6	2	40
17	81	7	70	11	65	15	100	14	88	3	60
0	0	0	0	0	0	0	0	1	6	0	0
21	100	**10**	100	**17**	100	**15**	100	**16**	**100**	5	100
14	67	8	80	15	88	14	93	13	81	5	100
7	33	2	20	2	12	1	7	3	19	0	0
21	100	10	100	17	100	15	100	16	100	5	100
0	0	0	0	4	24	0	0	2	13	0	0
6	29	0	0	1	6	0	0		0	0	0
1	5	0	0	2	12	0	0		0	0	0
14	67	10	100	10	59	15	100	14	88	5	100
21	100	10	100	17	100	15	100	16	100	5	100
3	14	1	10	1	6	0	0	0	0	0	0
10	48	7	70	6	35	13	87	6	38	2	40
8	38	2	20	10	59	2	13	10	63	3	60
21	100	10	100	17	100	15	100	16	100	5	100
4	19	1	10	8	47	1	7	3	19	2	40
4	19	2	20	2	12	4	27	2	13	1	20
13	62	7	70	7	41	10	67	11	69	2	40
21	100	10	100	17	100	15	100	16	100	5	100
17	81	7	70	15	88	8	53	15	94	4	80
4	19	3	30	2	12	7	47	1	6	1	20
21	100	10	100	17	100	15	100	16	100	5	100
21	100	10	100	17	100	15	100	16	100	5	100
0	0	0	0	0	0	0	0	0	0	0	0
21	100	10	100	17	100	15	100	16	100	5	100

13	62	6	60	14	82	0	0	2	13	2	40
8	38	4	40	3	18	15	100	14	88	3	60
21	100	10	100	17	100	15	100	16	100	5	100
17	81	0	0	1	6	0	0	16	100	3	60
3	14	7	70	10	59	15	100	0	0	1	20
1	5	3	30	6	35	0	0			1	20
21	100	10	100	17	100	15	100	16	100	5	100
18	86	9	90	16	94	15	100	5	31	4	80
3	14	1	10	1	6	0	0	11	69	1	20
21	100	10	100	17	100	15	100	16	100	5	100
10	48	5	50	5	29	2	13	1	6	1	20
10	48	5	50	11	65	11	73	3	19	4	80
1	5	0	0	1	6	2	13	12	75	0	0
21	100	10	100	17	100	15	100	16	100	5	100
6	29	3	30	8	47	13	87	9	56	4	80
7	33	2	20	6	35	2	13	2	13	1	20
8	38	5	50	3	18	0	0	5	31	0	0
21	100	10	100	17	100	15	100	16	100	5	100
14	67	6	60	14	82	15	100	15	94	4	80
7	33	4	40	3	18	0	0	1	6	1	20
21	100	10	100	17	100	15	100	16	100	5	100
5	24	2	20	4	24	0	0	0	0	2	40
6	29	2	20	4	24	0	0	7	44	0	0
10	48	6	60	9	53	15	100	9	56	3	60
21	100	10	100	17	100	15	100	16	100	5	100
9	43	3	30	8	47	7	47	8	50	4	80
10	48	6	60	7	41	5	33	6	38	1	20
2	10	1	10	2	12	3	20	2	13	0	0
21	100	10	100	17	100	15	100	16	100	5	100

4.3 Data Analysis

Descriptive and quantitative methods were used to analyze the data collected. The descriptive method used for this study includes frequency tables, percentages, means, mode and charts. All the data gathered were coded and then analyzed using SPSS.

Bill of Engineering Measurement & Evaluation (BEME) for the Construction

A	B	C	D	E	F
1		Personnel Costs/Allowances			
1.1		Principal Researcher		1	250,000.00
1.2		Co-Researcher		1	100,000.00
Sub-Total					**350,000.00**
	ITEM		Qty	Unit Price	Cost
2	Supplies/Consumables				
2.1	**Discrete Electronic components**				
	PIC Atmega 328		6	5,900.00	35,400.00
	PIC16F887		6	6,000.00	36,000.00
	LCD 16x4		4	5,300.00	21,200.00
	RFID Module		16	5,500.00	88,000.00
	Card		16	1,000.00	16,000.00
	Transistor(NPN/PNP)		20	340.00	6,800.00
	GSM Module		6	12,000.00	72,000.00
	Capacitor		10	400.00	4,000.00
	Resistor		20	100.00	2,000.00
	Regulator (7812)		12	9,500.00	114,000.00
	Regulator (7805)		12	9,500.00	114,000.00
	Crystal (600m2)		10	4,500.00	45,000.00
Casing			1	6,000.00	6,000.00
	Vero Board		5	1,000.00	5,000.00
	Breadboard		5	3,000.00	15,000.00
	Soldering Iron		2	6,500.00	13,000.00
	Soldering lead		2	1,500.00	3,000.00
	Pack of wire stripes		20	300.00	6,000.00
					602,400.00

5. CONCLUDING REMARKS

Several ways have been used and adopted by the health sector in Nigeria to make the nursing mothers adherence to appointment time for immunization of their child for instance, creating awareness using town-cryer, involving health workers to visit various houses, running radio jingle messages, sending text messages and putting calls to nursing mothers to remind them of their clinic and or immunization appointments. All these interventions are not without burdens because they are not basically targeted at rural dwellers and for the busy life style of most urban dwellers. Many rural areas in Nigeria do not have GSM network coverage and are predominantly illiterates who are having challenges with reading and replying text messages with understanding, who sometimes perceive text messages as scams. This work contributes towards identifying some of the challenges confronting nursing mothers for noncompliance with immunization appointment time. The design and construction of a low-cost RFID that can be used to improve on keeping to appointment date and time for immunization of infants by the nursing mothers and how low-cost RFID technology as a device can be used for reminding the nursing mothers the appointment date and time.

6. FUTURE WORKS

Post design and implementation we will report the test runs and feedbacks from users of the designed system while also reflecting on possible improvements and additional channels of application where the usage of the developed artefact can find usefulness. This study will contribute to the success of immunization coverage most especially in rural areas where immunization is taken for granted; it will also make contributions to the literature in the area of RFID as a device to reduce immunization noncompliance if replicated in developing countries. Future research will be a guide for e-Health application by software developers and the study can be used by government and nongovernmental organizations in health sectors to improve vaccination for decision making.

REFERENCES

1. Abugabah, A., Nizamuddin, N., & Abuqabbeh, A. (2020). A review of challenges and barriers implementing RFID technology in the Healthcare sector. Procedia Computer Science, 170, 1003-1010.
2. Atkinson, K. M., Westeinde, J., Ducharme, R., Wilson, S. E., Deeks, S. L., Crowcroft, N., Hawken, S., & Wilson, K. (2016). Can mobile technologies improve on-time vaccination? A study piloting maternal use of ImmunizeCA, a Pan-Canadian immunization app. Human vaccines & immunotherapeutics, 12(10), 2654-2661.
3. Balogun, M., Sekoni, A., Okafor, I., Odukoya, O., Ezeiru, S., Ogunnowo, B., & Campbell, P. (2012). Access to information technology and willingness to receive text message reminders for childhood immunisation among mothers attending a tertiary facility in Lagos, Nigeria. South African Journal of Child Health, 6(3), 76-80.
4. Black, R. E., Cousens, S., Johnson, H. L., Lawn, J. E., Rudan, I., Bassani, D. G., Jha, P., Campbell, H., Walker, C. F., & Cibulskis, R. (2010). Global, regional, and national causes of child mortality in 2008: a systematic analysis. The lancet, 375(9730), 1969-1987.
5. Bolu-Steve, F., Adegoke, A., & Kim-Ju, G. (2020). Cultural Beliefs and Infant Mortality in Nigeria. Education Research International, 2020.
6. Brooks-Gunn, J., McCormick, M. C., & Heagarty, M. C. (1988). Preventing infant mortality and morbidity: Developmental perspectives. American Journal of Orthopsychiatry, 58(2), 288-296.

7. Carlos, C. C., & Saniel, M. C. (1990). Etiology and epidemiology of diarrhea. Phillips J Microbio Infect Dis, 19, 51-53.
8. Clements, C. J., Strassburg, M., Cutts, F. T., & Torel, C. (1992). The epidemiology of measles. World health statistics quarterly. Rapport trimestriel de statistiques sanitaires mondiales, 45(2-3), 285-291.
9. Cutts, F. T., Henderson, R. H., Clements, C. J., Chen, R. T., & Patriarca, P. A. (1991). Principles of measles control. Bulletin of the World Health Organization, 69(1), 1.
10. DEFO, B. K. (1995). Epidemiology and control of infant and early childhood malaria: a competing risks analysis. International journal of epidemiology, 24(1), 204-217.
11. Desai, M., Ter Kuile, F. O., Nosten, F., McGready, R., Asamoa, K., Brabin, B., & Newman, R. D. (2007). Epidemiology and burden of malaria in pregnancy. The Lancet infectious diseases, 7(2), 93-104.
12. Dollfus, C., Patetta, M., Siegel, E., & Cross, A. W. (1990). Infant mortality: a practical approach to the analysis of the leading causes of death and risk factors. Pediatrics, 86(2), 176-183.
13. Gatuha, G., & Jiang, T. (2015). KenVACS: Improving vaccination of children through cellular network technology in developing countries. Interdisciplinary Journal of Information, Knowledge, and Management, 10, 37.
14. Gupta, P., Murali, M., & Seth, A. (1998). Epidemiology of diarrhea in urban slums. Indian pediatrics, 35, 147-150.
15. Jason, J. M., & Jarvis, W. R. (1987). Infectious diseases: preventable causes of infant mortality. Pediatrics, 80(3), 335-341.
16. Lee, S. M., Hwang, Y. J., Lee, D. H., & Lim, J. I. (2005). Efficient authentication for low-cost RFID systems. International Conference on Computational Science and Its Applications,
17. McCormick, M. C., & Wise, P. H. (1993). Infant mortality. Current Opinion in Pediatrics, 5(5), 552-557.
18. McGavin, Z. A., Wagner, A. L., Carlson, B. F., Power, L. E., Eboreime, E., & Boulton, M. L. (2018). Childhood full and under-vaccination in Nigeria, 2013. Vaccine, 36(48), 7294-7299.
19. Mesike, C. G., & Mojekwu, J. N. (2012). Environmental determinants of child mortality in Nigeria. Journal of Sustainable Development, 5(1), 65.
20. Nevill, C. (1990). Malaria in sub-Saharan Africa. Social Science & Medicine, 31(6), 667-669.
21. O'Neill, M., & Robshaw, M. J. (2010). Low-cost digital signature architecture suitable for radio frequency identification tags. IET Computers & Digital Techniques, 4(1), 14-26.
22. Oku, A., Oyo-Ita, A., Glenton, C., Fretheim, A., Eteng, G., Ames, H., Muloliwa, A., Kaufman, J., Hill, S., & Cliff, J. (2017). Factors affecting the implementation of childhood vaccination communication strategies in Nigeria: a qualitative study. BMC public health, 17(1), 1-12.
23. Olusanya, B. (2005). State of the world's children: life beyond survival. Archives of disease in childhood, 90(3), 317-318.
24. Omar, H. Q., Khoshnaw, A., & Monnet, W. (2016). Smart patient management, monitoring and tracking system using radio-frequency identification (RFID) technology. 2016 IEEE EMBS Conference on Biomedical Engineering and Sciences (IECBES),
25. Onamade, A. A. (2018). A Low Cost Cell Phone Based System for Monitoring and Evaluating Infants Vaccination Uptake among Nursing Mothers in South West Nigeria [PhD thesis, University of South Africa]. South Africa.
26. Ramazani, I. B.-E., Ntela, S.-D. M., Ahouah, M., Ishoso, D. K., & Monique, R.-T. (2022). Maternal mortality study in the Eastern Democratic Republic of the Congo. BMC Pregnancy and Childbirth, 22(1), 1-14.

27. Rosano, A., Botto, L. D., Botting, B., & Mastroiacovo, P. (2000). Infant mortality and congenital anomalies from 1950 to 1994: an international perspective. Journal of Epidemiology & Community Health, 54(9), 660-666.
28. Ruhil, A., Mohanty, T., Rao, S., Lathwal, S., & Subramanian, V. (2013). Radio-frequency identification: A cost effective tool to improve livestock sector. Indian Journal of Animal Sciences, 83(9), 871-879.
29. Scharfeld, T. A. (2001). An analysis of the fundamental constraints on low cost passive radio-frequency identification system design Massachusetts Institute of Technology].
30. Uddin, M., Ibrahimy, M., Reaz, M., & Nordin, A. (2009). Design and application of radio frequency identification systems. European Journal of Scientific Research, 33(3), 438-453.
31. Vakili, R., Emami Moghadam, Z., Khademi, G., Vakili, S., & Saeidi, M. (2015). Child mortality at different world regions: A comparison review. International Journal of Pediatrics, 3(4.2), 809-816.
32. Xiao, Y., Yu, S., Wu, K., Ni, Q., Janecek, C., & Nordstad, J. (2007). Radio frequency identification: technologies, applications, and research issues. Wireless Communications and Mobile Computing, 7(4), 457-472.
33. Yaya, S., Bishwajit, G., & Ekholuenetale, M. (2017). Factors associated with the utilization of institutional delivery services in Bangladesh. PloS one, 12(2), e0171573.
34. Zar, H. J., & Madhi, S. A. (2006). Childhood pneumonia-progress and challenges. South African Medical Journal, 96(9), 890-899.