



MySQL Database Server: Deploying Software Application to Enhance Visibility and Accountability

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Author's contribution

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

This study explored the design and development of customized enterprise web-based application management systems, which introduced a better approach on how to promote Insecticide Treated Nets (ITNs) supply chain management visibility, accountability, integration of inventory, real time location tracking and monitoring. The literature reveals that the pool of Web-based supply chain management apps and use represents the degree of responsiveness to institutional pressures, the effect of top management perception and support, and the role of organizational characteristics in the choice to adopt Web-based software application. A software development life cycle method was adopted combining a logistics management system with Web Services technology using waterfall approach. The result of this study provides an important information, for ITNs company to consider the implementation of Web-based application over the existing excel platform which will improve several ITNs processes across the supply chain such as better-quality supply chain transparency, reduction of costs related to labor, greater inventory visibility and management of transport channels as well as improvements in client's service experience. The study recommends that the company (ITNs) should invest in IT hardware infrastructures (internet, computers, and

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software), create a better awareness and develop a comprehensive training for staff across all the state on how to use the web base application in addition to increasing the number of employees who are specifically assigned to become company administrators in order to provide faster and user-friendly services.

Keywords: Insecticide Treated Nets (ITN); Malaria; MySQL data base server; software application.

1. INTRODUCTION

According to Aikpon et al. [1], Malaria is extremely common in Sub-Saharan Africa, particularly Nigeria. According to Adeneye [2], six nations in sub-Saharan Africa accounted for more than half of all malaria cases globally in 2018. These included Uganda (5%), the Democratic Republic of the Congo (12%), Nigeria (25%), Cote d'Ivoire, Mozambique and Niger (4% each) WHO (2018). It is a parasitic disease caused by Plasmodium bacteria which is caused by four different types of Plasmodia and according to several research, it is transmitted when an infected female anopheles' mosquito bites an uninfected individual, and its endemic nature can be ascribed to environmental circumstances that are suitable for mosquito breeding, Walter & John, (2022).

Despite being a preventable and treatable disease, malaria continues to be a significant public health issue. Dawaki et al. [3] Malaria, being the most serious public health problem in Nigeria is estimated to cause 216 million cases and 445,000 deaths worldwide each year Scates [4]. This disease has disproportionately afflicted children under the age of five and pregnant women. Malaria has significant health consequences, but there is evidence that it also has significant economic consequences for both individuals and entire economies. Since 2000, additional finances and resources have been deployed towards broad malaria control and elimination. As a result, existing successful anti-malaria initiatives, including insecticide-treated nets (ITNs), have been rapidly scaled up. In Sub-Saharan Africa, this has resulted in historic highs of vector control coverage WHO (2022).

ITNs are the most commonly utilized malaria control tool in Africa, serving as the primary vector control technique in practically every malaria-endemic country. They reduce malaria-related morbidity and mortality by acting as a direct barrier to mosquito bites and offering community-wide protection through mosquito killing, resulting in lower vector density and average longevity Dawaki et al. [3].

According to WHO, (2022) nearly two billion ITNs have been distributed worldwide since over two decades, through mass distribution campaigns method which has been said to be the most common method of distribution. It occurs every three years and seek to deliver one ITN for every two persons in malaria-affected households. The ITNs delivery, which encompasses arrival at the port of entry, transportation to and from warehouses in the State through LGA stores to final points of distribution (PDs) stores, has become a policy in the World Health Organization including the African's region and, there is need for real-time tracking of ITN's quantity by improving the visibility at every location and thereby increase accountability. In addition to tracking warehousing and other activities at different levels, such as zones or LGAs, left over ITNs after distribution to beneficiaries is also monitored. However, achieving widespread distribution and accountability of insecticide-treated nets (ITNs) for malaria control which involves logistics and supply chain management is one of the major difficulties facing many Sub-Saharan African countries as they are still far from meeting the African heads of state's aim of ITN coverage. Till date there has not been any use of software for the management of the logistics of ITN from the port of entry down to the PDs structured along local content to improve malaria control. The old way of paper tracking and the use of excel sheet (logistics report and reconciliation template, LRRT) has its attendant challenge or limitation as it does not offer real time tracking. The logistics system of the distribution still depends on the cumbersome paper work and telephoning in the era that is dynamically evolving technologically innovative means or method and more efficient way of doing business. This old way is inefficient and no longer acceptable; hence this work is intended to improve malaria management through real time data capturing thereby saving time, preventing diversion or loses, and reducing cost along the supply chain from port of entry all through to the last mile points of distribution to the beneficiaries, thereby increasing efficiency and effectiveness. For instance, during the ongoing 2022 distributions, timeline was shifted

because ITNs were not delivered as scheduled in-country, and in certain state a container load of ITNs arrived at the end of positioning to the local government. In addition, several bales were opened and pieces of nets were taken for verification by regulatory and security agents along the pipeline which reduced the final quantity of nets available for distribution. Oftentimes, there are gaps between quantity procured and delivered which would never be known until when all containers arrived the state negatively affecting quantity of ITNs available and reducing the number of vulnerable populations that could secure protection through it. Under the current process, total losses of ITNs within the state is known only at the end of distribution after all paper tracking tools are compiled and analyzed when the negative effect/impact can no longer be mitigated.

The use of software will help to bridge this gap, by creating opportunity of linking the enterprise systems of both manufacturers and regulatory and security agents together, making information available to authorities and decision makers which would help to mitigate some or all of these challenges.

2. AN OVERVIEW OF MALARIA IN NIGERIA: EMERGING MALARIA PREVENTION AND CONTROL METHODS

Sub-Saharan Africa, particularly Nigeria, has a high prevalence of malaria Ajegena and Oti [5]. The Plasmodium genus of microorganisms is what causes malaria, which is a contagious illness. Malaria has been linked to four primary Plasmodium species Asuquo [6]. According to the World Health Organization's (WHO) 2018 global malaria report, there were an estimated 228 million cases and 435000 fatalities worldwide WHO [7]. According to estimates, 93 percent of malaria cases reported globally in 2018—a little rise from the 92 percent reported in 2017—were found in the regions of Africa and India WHO (2018). In Seventeen African nations and India, about 80% of all malaria fatalities worldwide in 2017 occurred Asuquo [6]. With an estimated 85% of these deaths occurring in 20 nations within these same regions in 2018 [7], the situation appears to have become worse. Nearly half of all malaria deaths worldwide occurred in six of these nations, with Nigeria accounting for 24% WHO (2018). Malaria is widespread in Nigeria and is still the biggest public health issue. It affects children under the

age of five and pregnant women the most, yet it is preventive, treated, and curable. With over 51 million cases and 207,000 reported fatalities per year (almost 30% of the total malaria burden in Africa), Nigeria has the highest malaria burden in the world, and 97 percent of the population (or roughly 173 million people) is at risk of infection Dawaki et al. [3]. Additionally, malaria is the cause of 60% of outpatient hospital visits and contributed to 30% of child deaths and 11% of maternal deaths, particularly among children under the age of five (Federal Ministry of Health, 2012). The prevalence of malaria in Nigeria has been shown in several research Dawaki et al. [3]. The fact that malaria is an endemic disease that persists is related to the climate, which is perfect for mosquito breeding [3] (Federal Ministry of Health, 2012). The World Health Assembly set a target of decreasing malaria infections and fatalities by 75% in 2005 as a crucial Millennium Development Goal (WHO, 2018). As a result, during the past ten years, there has been a sharp resurgence in interest in research and improvements in diagnostic techniques, medications, and vaccines, as well as the creation of malaria control strategies [8]. The National Malaria Policy was introduced in February 2015 by the Federal Government of Nigeria in an effort to ensure that malaria is eradicated at all levels of government in the nation due to the disease's impact on maternal and child health conditions nationwide. The policy was designed to address fundamental concerns with malaria prevention, diagnosis, and treatment; communication and social mobilization; and laws regulating antimalarial commodities in the framework of a malaria-free Nigeria Federal Ministry of Health (2015).

Ivermectin's effectiveness against malaria parasites and vectors is one such development. According to research cited by (Olukosi et al., 2019), ivermectin that remains in the human bloodstream after the recommended oral dose has the ability to kill both malaria vectors and parasites. Critical research on the effectiveness of ivermectin against various parasite illnesses is urgently needed. Through widespread medication administration, ivermectin has been utilized to nearly eradicate onchocerciasis throughout the continent. Malaria may be controlled with the use of vaccines. Approximately 20 vaccine candidates are at various stages of development. The most advanced of these, RTS, is now going through clinical testing with S/AO1. In young children, it has been demonstrated to offer some protection

against *Plasmodium falciparum* [2]. Another cutting-edge tactic that has to be strengthened in terms of sensitivity is a urine malaria test kit (Federal Ministry of Health, National Malaria Elimination Programme, 2013). When this is widely accessible, it will be possible to test for malaria at home or on oneself [2]. Although sterile insect techniques are nothing new, they have recently received increasing attention due to their potential for controlling malaria vectors. The introduction of transgenic, sterilized mosquitoes has made some recent, encouraging strides [2]. These and other continually developing control strategies can help to reduce, get rid of, and completely eradicate malaria in the area. However, ITN remains till date, the cheapest method of control and it covers all ages of the population. Thus, increasing visibility and accountability will greatly safe cost and increase malaria control.

Theoretical Framework

The two main theoretical foundations for this study are the technology adoption model (TAM) and institutional theory.

3. MYSQL DATABASE SERVER (RELATIONAL DATABASE MANAGEMENT SYSTEM-RDBMS)

MySQL is the relational database management system used for this application. MySQL is a relational database program that is used to enter/insert, edit/update, delete, alter and analyze lists of data. The advantages of MYSQL includes

- i. **Duplicate data is minimized:** the software has the capability to prevent duplicate data entry which is not the case in the use of excel sheet hence improving data quality.
- ii. **Information is more accurate:** information on the software is more accurate because it detects errors and outliers at the point of inputting data.
- iii. **Data entry is faster and easier:** data entry is done on the go and there are no disruptions of formulae that could warrant corrections and delays; and users are given access to the field that is relevant/applicable to him.
- iv. **Information can be viewed and sorted in multiple ways.**
- v. **Information is more secure:** access is granted before users can use the apps and each user can access specific field

- vi. **Information can be shared among several users;** users with permission from the admin can share and view information
- vii. **Information retrieval is faster and easier for decision making:** at the click of buttons information can be analyzed and retrieved for use
- viii. **Best and the most widely used database:** the database is widely used and acceptable
- ix. **MySQL is open-source database management system**
- x. **Available and affordable by all**

4. PLANNING STAGE

This is a web-based application using a structured database. The backend structure of the web was built using the PHP programming language with the CodeIgniter framework. The CodeIgniter framework is used because the development method refers to the Model-View-Controller concept, and modularized, that is, the task is to do frontend programming, database design and backend programming. Hence, we can write and configure the application without having to interfere with the functionality of each class function. Also, many ready-made modules can be directly implemented into the system so that the development process will be very efficient and solid.

5. ANALYSIS STAGE

Observations are made in the field related to the operational pattern of the business (supply chain and logistics) and also the problems that often occur, especially related to interactions between administrators, distributors, transporters and beneficiaries. The problem that often occurs is the problem of tracking goods and reporting. The process of monitoring the location of goods is still conventional. Every two hours, the administrator makes a telephone call or chat with the transporter to receive the report. After that, the administrator communicates to national, state and local government service official whenever there is a supervisor who wants to check the distribution position. Hence, using a web-based application system, the administrators will get notifications within a particular time to report their position. Besides, the reporting will provide notifications for affiliates to monitor. In addition, affiliates can even pay service fees through payment gateways available via third parties.

6. DESIGN STAGE

Several types of drafting were carried out. Starting from mapping requirements, features and schemes to use the application. Next is the designing of the logical flow. The design of backend and frontend modules was based on

Model-View-Controller and the database and User Interface design. There is a series of design processes that can be understood as follows. The figure below displayed the use case diagram model to describe the roles of actors in the application.

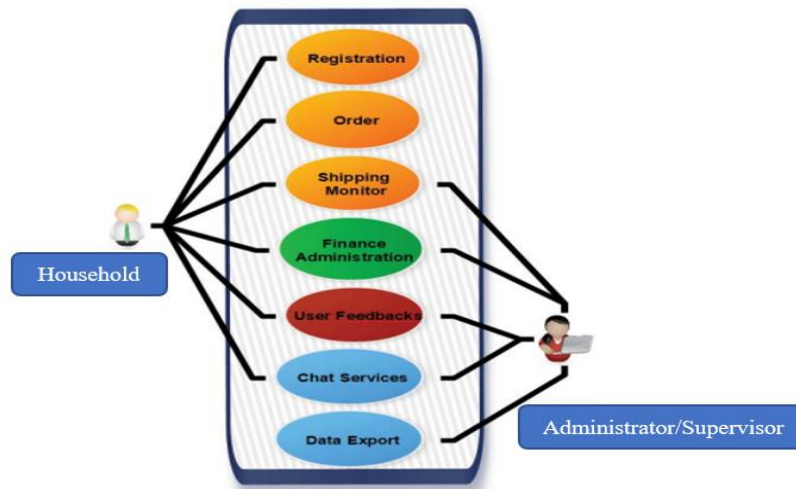


Fig. 1. The use case diagram for the actors

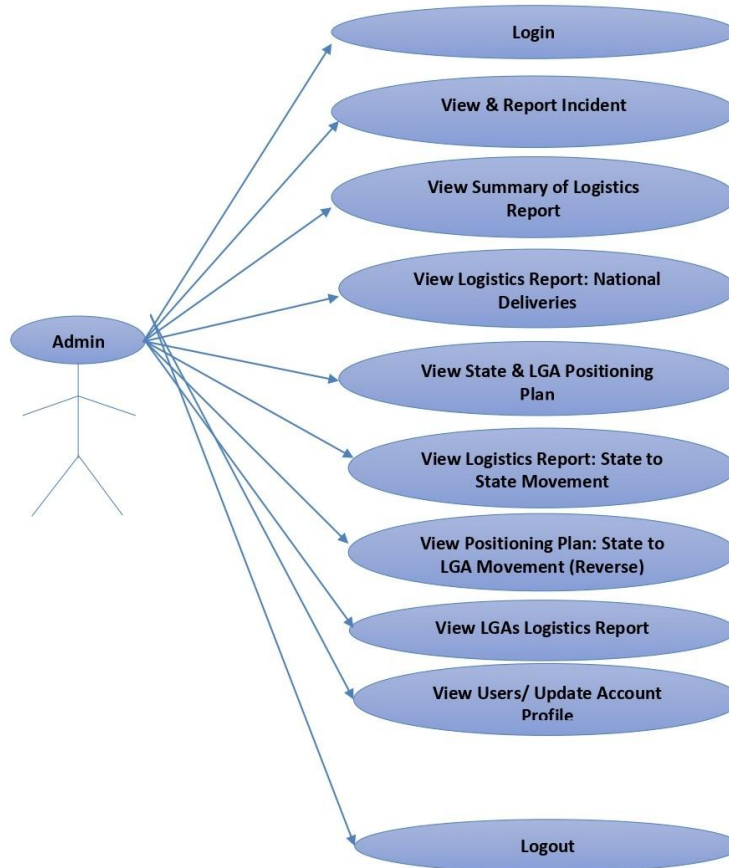


Fig. 2. Use case diagram for system admin

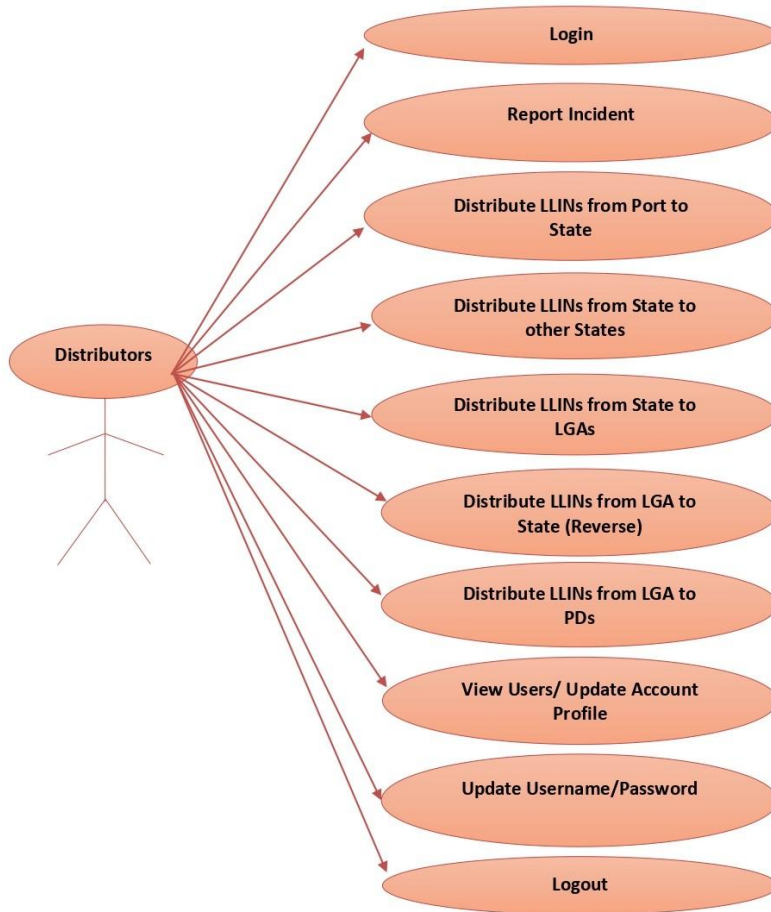


Fig. 3. Use case diagram for distributor/ supplier

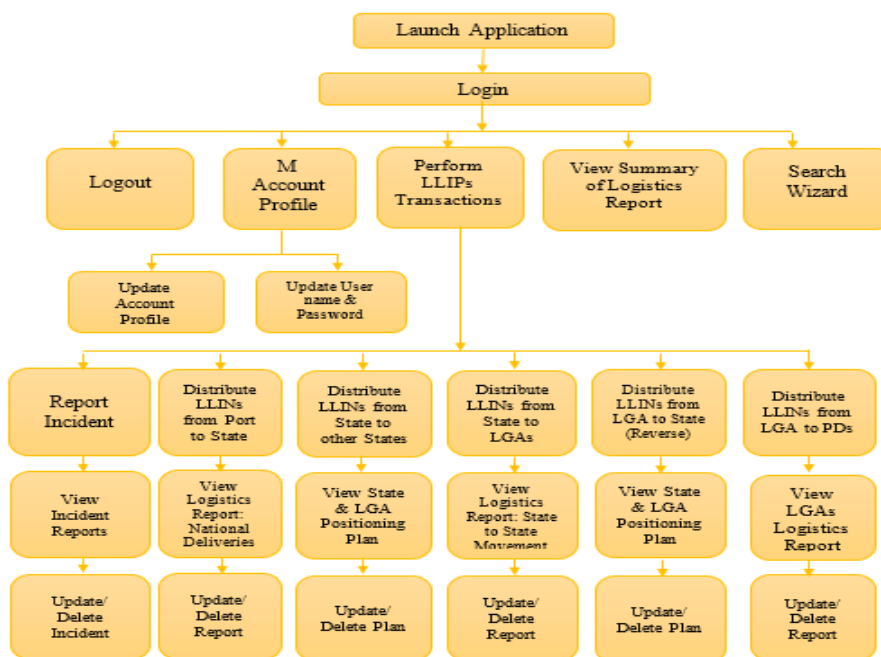


Fig. 4. Sequence diagram for the software application

7. IMPLEMENTATION STAGE

The design diagrams based on the requirements for the software are implemented to develop a web-based application. The application is expected to run on desktop web browsers and mobile devices such as mobile phones and tablets. All the concept and scenario on excel spreadsheet and the system design are executed. Furthermore, to make the web operates properly, the application is installed using cloud hosting with a minimum CPU core of 2 cores and 2GB of memory. The database uses MySQL and the patching system from CodeIgniter and also third-party applications. The most challenging process in this implementation is when we have to realize change management. Staff and personnel that distributes ITNs to household beneficiary who are accustomed to inputting data from their location to the current journal must be accustomed to inputting data through web applications and generate report instantly.

8. TESTING STAGE

The web-based application was tested against the requirements of the software application. This was carried out in a bid to ascertain if the web application meets the requirements of the software application. The requirements of any software system are divided into two: the functional requirements and non-functional requirements. To test the functionality of the software application, a usability test (evaluation) is carried out.

9. USABILITY TEST

According to Aniobi and Alu (2016) the usability of any product (website, mobile apps, desktop applications etc.) refers to the overall satisfaction users derive from using such product. A system that has high level of usability ought to possess the following qualities: "efficiency, learnability, interactivity and satisfaction". To carry out the usability evaluation, a demo application link was used to gather the experience and opinion of staff and selected users about the application. The staff and selected users were asked to use the web application as the design was to exact usability information from them.

10. IMPLICATIONS OF FINDINGS

Supply chain management is a technology-prone activity. The outcome of this study provides an

important information, ITNs company can consider the implementation of Web base application over the existing excel platform. Implementing the web base application, it is possible for technology to improve several processes across the supply chain such as improved supply chain transparency, safety and efficiency, as well as the reduction of costs related to labor, Improved environmental sustainability (more efficient resource planning), greater inventory visibility and management of transport channels as well as improvements in client's service experience and operational efficiency in processes. The improvement of these indicators has as consequence a gain in competitiveness allowing the companies to respond to the household beneficiary needs in a differentiated way increasing by this way the household beneficiary satisfaction. In addition, this application will change the ITN company cost model and call existing business models into question by enabling new platform-based business models and increasing efficiency. Also, there may well be new approaches to dynamic pricing that take capacity utilization more fully into account and gain control over important business aspect such as resource planning. Thus, investments in technology often yield handsome returns on investment (ROI), suggesting continued efforts of significant magnitude.

11. RECOMMENDATION(S)

This study recommends the need for ITNs company to embrace digital culture, given that, the project combined a supply chain management system with Web Services technology, explored the design and development of customized ITN Web base supply chain management application with good cross-platform, comprehensive integration flexibility, quick and efficient, scalable, and introduced a better approach on how to promote ITN supply chain management visibility, integration of inventory, real time location tracking and monitoring. It is also, recommended that the company (ITNs) should invest in IT hardware infrastructures (internet, computers, and software), create a better awareness and develop a comprehensive training for staff across all the state on how to use the web base application. In addition, increasing the number of employees who are specifically assigned to become company administrators in order to provide faster and user-friendly services. Apply reports, statistical data, and precise company

supply chain activities to develop decision-making systems.

12. SUGGESTIONS FOR FURTHER STUDIES

The companies can employ real-time GPS (Global Positioning System) technology in the future to assist in monitoring the flow and running of vehicles/trucks across the states, and local government areas to follow a predetermined path, which will help to enhance the developed system.

13. CONCLUSION

The project combined a logistics management system with Web Services technology, explored the design and development of customized enterprise management systems, and introduced a better approach on how to promote ITN supply chain management visibility, integration of inventory, real time location tracking and monitoring. With the web apps that have been developed in this project, it is envisioned that it would be able to respond to and assist the company with client transactions, beginning with the order process, monitoring, and delivery. House beneficiary and client data collecting, driver scheduling, and vehicle allocation for distribution tasks will all be simplified for the organization. Also, this is intended to aid in the resolution of issues that arise, particularly in the transaction and administrative areas. So that the company's business operations function smoothly, decision-making is improved, and the value provided to clients is increased.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Aikpon R, Affoukou C, Hounkpatin B, Eclou D, Cyaka Y, Egwu E, et al. Digital Insecticide-treated nets (ITNs) mass

2. distribution campaign in the particular context of Covid-19 pandemic in Benin: lessons learned and challenges; 2020. DOI: 10.21203/rs.3.rs-61810/v1
2. Adeneye AK, Olukosi YA, Brai BIC, Oparaugo CT, Agomo CO, et al. Knowledge, perception and practices of malaria prevention and treatment in communities of Lagos and Niger states, Nigeria. An Epidemiol Public Health. 2020; 3(1):1034.
3. Dawaki S, Al-Mekhlafi HM, Ithoi I, Ibrahim J, Atroosh WM, Abdulsalam AM, et al. Is Nigeria winning the battle against malaria? Prevalence, risk factors and KAP assessment among Hausa communities in Kano State. Malar J. 2016;15(1):351. DOI: 10.1186/s12936-016-1394-3, PMID 27392040.
4. Scates SS, Finn TP, Wisniewski J, Dadi D, Mandike R, Khamis M, et al. Costs of insecticide-treated bed net distribution systems in sub-Saharan Africa. Malar J. 2020;19(1):105. DOI: 10.1186/s12936-020-03164-1, PMID 32131834.
5. Ajegena BK, Oti VB. The challenges of using insecticides treated nets (ITNs) in curbing malaria in Nigeria: A 2000-2018 systematic review. J Infect Dis Epidemiol. 2020;6:140. DOI: 10.23937/2474-3658/1510140
6. Asuquo EF, Edet OB, Sampson-Akpan PE, Duke E, Nsemo AD, Ajah CI. Utilization of insecticides-treated nets among pregnant women and mothers with under five children in Ikot Omin Community, Calabar, Nigeria. Glob J Pure Appl Sci. 2017; 23(1):167-75. DOI: 10.4314/gjpas.v23i1.17
7. WHO. World Health Organization. World malaria report. Geneva: World Health Organization; 2019.
8. National Population Commission (NPC) [Nigeria] and ICF. Nigeria demographic and health survey 2018. Abuja, Nigeria, and Rockville, MD: NPC and IMB Community Foundation; 2019.

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