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User Acceptability of Electronic Vaccine Registry Created using Simple Mobile Phone Technology in Nyandarua County, Kenya

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Abstract

Vaccination is one of the most important and effective public health interventions against vaccine-preventable diseases. Developed countries have successfully reduced mortality and morbidity due to vaccine-preventable diseases through improving vaccine coverage. This is not the case among low-income countries as vaccine coverages continue to soar below the global target of 90% coverage. Among the reasons reported for the low coverage are poor documentation and poor target setting, which could be attributed to the limited use of electronic vaccine registries. An electronic vaccine registry was created using Unstructured Supplementary Service Data (USSD) technology and registered births, vaccines administered, and sent short message reminders to mothers about their clinic dates. The registry was deployed in Nyandarua County, Kenya, between June 2018 to March 2019. We conducted a study to establish the acceptability and usability of the system to receive user feedback and explore possibilities of large-scale roll-out. All those interviewed (59) were able to log into the system during their first attempt. The majority (94.8%) reported that it was easy to manoeuvre the menu and move from one menu to the other System downtime was a rare phenomenon, and more than half (63%) reported that if it occurred, it happened at most once or twice per week. The majority of the respondents, 55 (98%), reported that the system was able to record the vaccines administered as envisioned. The cost to run the platform was quite manageable and slightly lower than internet-based systems. The system was user-friendly and can be replicated elsewhere.

Keywords: *Vaccination, Registry, Immunization, Coverage.*

Introduction

Vaccination remains the best and most effective high-impact public health intervention against the spread and control of disease, reduction of mortality, and prevention against disability [1]. Vaccination also led to increased economic productivity and net economic gains by saving billions of dollars in illness costs globally [1]. These gains have largely been achieved in the western world (Europe and USA), where vaccination coverage is above 90%. However, many low- and middle-income countries, especially in Sub-Saharan Africa, are yet to achieve a vaccination coverage of 80% for the fully immunized child [1]. On average, one in 5 children in Africa is unvaccinated [2].

The World Health Organization 2016 estimated that approximately 85% of the world's infants were vaccinated against Diphtheria, Tetanus, and Pertussis (DPT), Hepatitis B, Measles, and Polio, thereby preventing approximately 2-3 million deaths, although an additional 1.5 million deaths could be averted if vaccination coverage improves

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[3]. Three years later, in 2019, the coverage had dropped slightly to 81.6% as did global coverage of the first-dose measles-containing vaccine, MCV1 to 83·6% [4]. However, the vaccination coverages varied by country, with Kenya being estimated at 89% for DTP3 and 75% for Measles Containing Vaccine 1(MCV1) [5].

One important reason that could explain this stagnation is the quality of data that is used to estimate vaccine coverage [6]. The other reported reasons include inconsistency of denominators used to estimate coverage, poor availability of guidelines (e.g., for late reporting), incorrect estimations of vaccine wastage, and lack of feedback on immunization performance that are all attributed to existing information systems, including vaccine registries [7]. To solve this, there is need to improve documentation and how vaccination-related data is captured. Electronic vaccine registries consequently fit in to help address this problem [8, 9]. The challenge with this, though is that due to financial and technological challenges, it has not been possible to create electronic vaccination registries in many countries and especially in Africa [10]. The electronic vaccine registries routinely created are web-based and require comprehensive information communication and technology equipment like laptops, tablets/smartphones and internet accessibility to use [11].

To mitigate this challenge, we created an electronic vaccine registry using a simple mobile phone technology, Unstructured Supplementary Service Data (USSD) - Chanjotrack, that is simpler, cost-effective, and can be easily scaled up in many other geographical regions. Electronic vaccine registries are known to be an essential component of the information infrastructure and allow for the assessment of the impact of changes in health care on the population holistically [12].

The main objective of the study was to establish the acceptability and usability of the electronic vaccine registry created using simple mobile phone technology to receive user feedback and explore possibilities of large-scale roll-out.

Specifically, the objectives of the study were:

1. To assess user acceptability.
2. To establish if the electronic vaccine registry created was able to perform intended functionalities.
3. To establish the cost-effectiveness of using an electronic vaccine registry.

Materials and Methods

Study Design

The study was a cross-sectional study.

Study Site

The study was conducted in Ndaragwa subcounty in Nyandarua County which is in Central Kenya. This is the same site where the electronic vaccine registry created using the USSD platform was piloted.

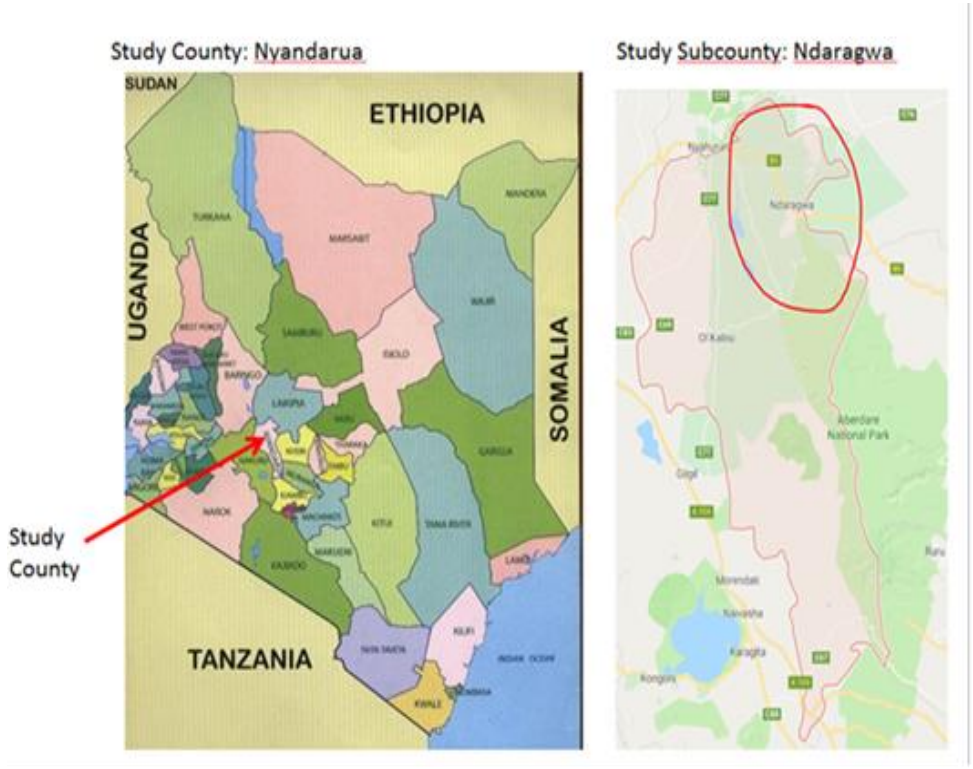

Figure 1. Map of Kenya showing the Study Site in Nyandarua County, Ndaragwa

Study Population (Inclusion and Exclusion Criteria)

The study population included all health workers who were involved in capturing vaccination-related data and transmitting it to the created system. For home deliveries, public health technicians were used to capturing the data, while in health facilities, nurses and data clerks captured the data.

Sample Size Calculation

This being a cross-sectional survey, and given the limited number of health facilities enrolled to the study, all health workers who were involved with the electronic vaccine registry were recruited. In total, a sample size of 59 health workers was adapted.

Data Collection

We conducted a survey through the administration of a structured questionnaire. The data was captured in paper form and later entered into a digital database.

Data Analysis

The data from this study underwent manual data cleaning on the filled questionnaires before entry into the computer. Data analysis was done using SPSS software (version 19). The data has been presented in graphs.

Societal and Scientific relevance

Electronic vaccination registries are responsible for improving performance in vaccination coverage. Use of cheaper and easier to use, and accessible technology would create even more benefits to the vaccination programming. This study has explored the acceptability and suitability of a new and innovative technology that helps create a simpler and less expensive electronic vaccine registry and made appropriate recommendations to policymakers to help inform practice.

Ethical Considerations

The ethical clearance was granted by Africa Medical Research Foundation (AMREF) Ethics

and Review Committee (Approval P454/2018). Nyandarua county health department granted permission to conduct the study in the study health facilities. Informed consent was given by the respondents after explaining the purpose and importance of the study. Confidentiality was maintained throughout the study by ensuring that respondents' names or identifications did not appear in the questionnaires and that the data collected and captured was stored in a safe password-protected database. The respondents' right to correct information was ensured at all times and their participation in the study was voluntary, and they were free to withdraw at any point in the study if they so wished.

Results and Discussion

User Acceptability

We interviewed 59 health workers from 18 health facilities who were registered to use the electronic vaccine registry to determine its acceptability and their satisfaction in using the system. All those interviewed (59) were able to log into the system during their first attempt. The majority also reported that it was easy to manoeuvre the menu and move from one menu to the other (94.8%).

Most of the users (73%) found the system to be reliable and functioning well most of the time.

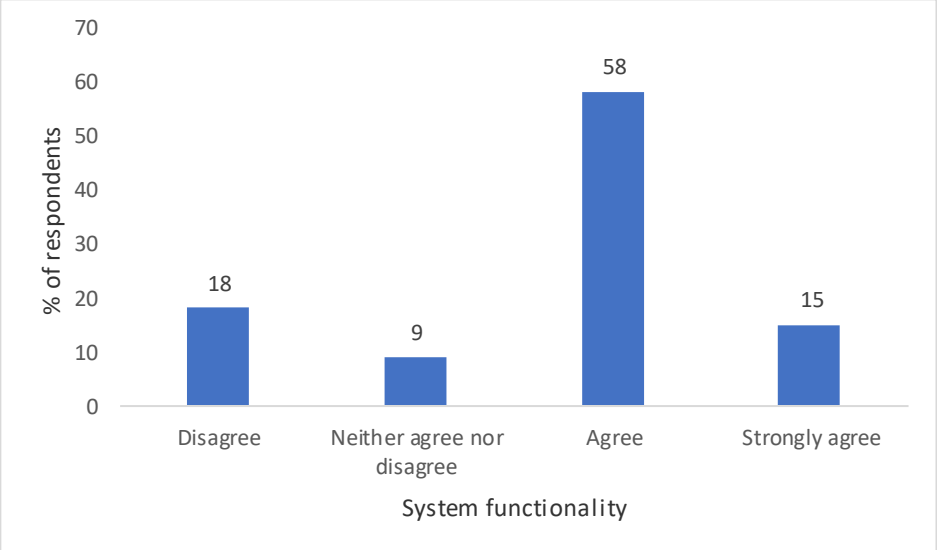

Figure 2. Respondents' Feedback on whether the System was Functioning well most of the Time

Regarding the frequency of system downtime, more than half (63%) reported that system downtime was a rare phenomenon and if it occurred, it happened at most once or twice per week. A further (52)94.1% affirmed that the system is user-friendly. More than three-quarters of the respondents asserted that they would recommend the system to other colleagues who were not already using the system.

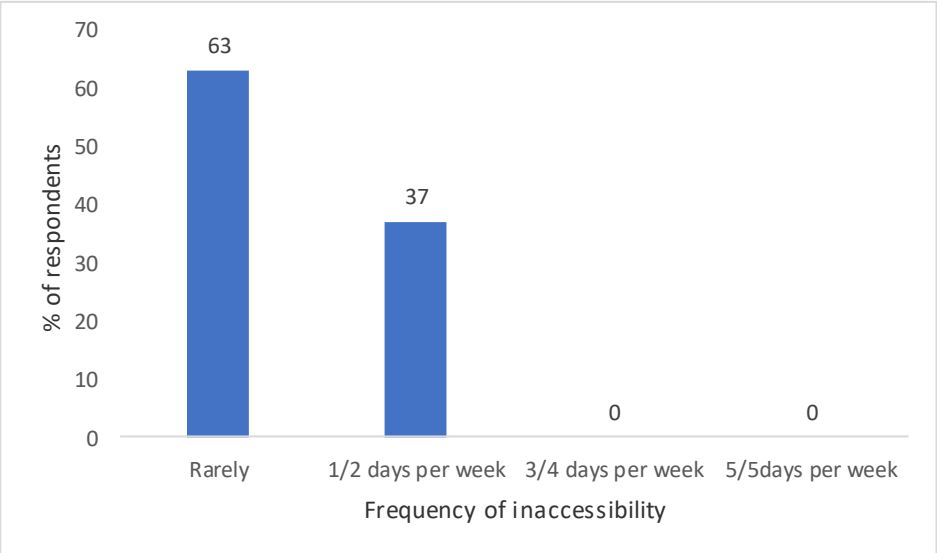

Figure 3. Frequency of System Downtime

Ability to Perform Intended Functions

The majority of the respondents, 55 (98%), reported that the system was able to record the vaccines administered as envisioned; at six weeks, ten weeks, fourteen weeks, six months, nine months, and eighteen months.

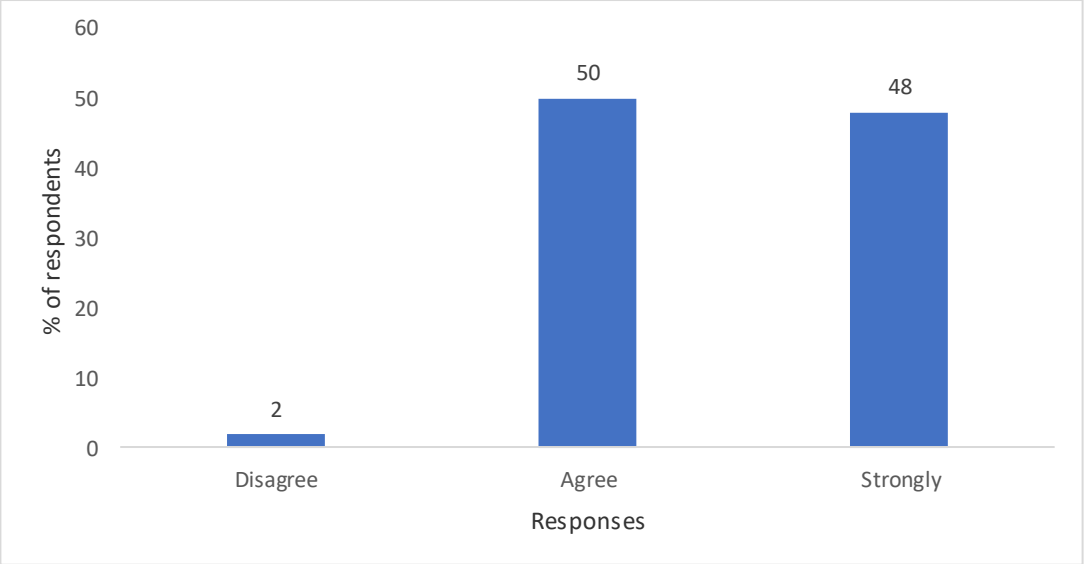

Figure 4. Proportion of Respondents reporting that the System was Able to Record Vaccines as Envisioned

We also assessed the capability of the system to record births. The majority of the respondents, 41 (75.9%), reported that it took less than four minutes to enter one birth record. The timing of four minutes was reported by the majority of the respondents, 53 (91.5%) as acceptable. The majority of the respondents also reported that the system is able to capture deaths into the register, 42 (79.2%), as well as transfer details of children who have moved out of the catchment area of a given health facility 53 (98.2%).

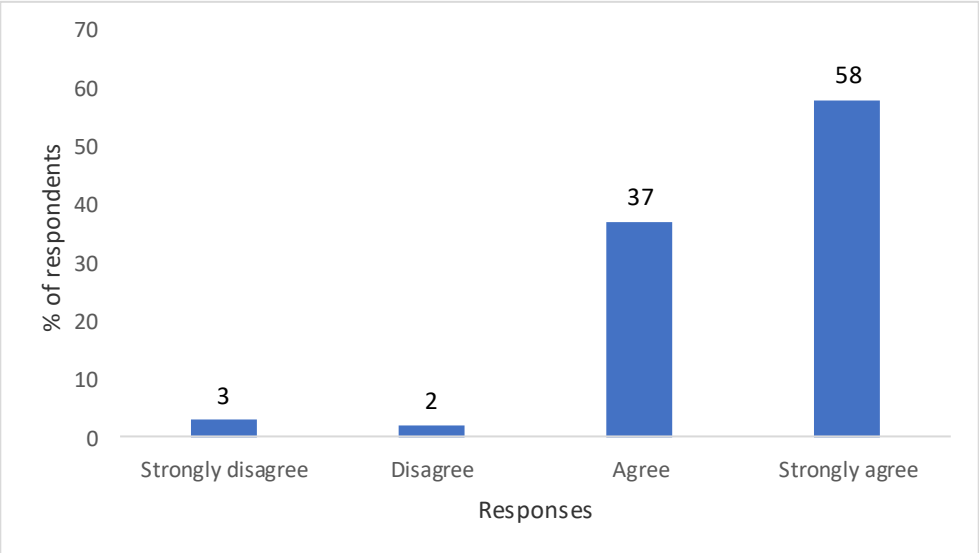

Figure 5. Participants Responses on the Easiness of using the USSD System to Record Births into the Register

Cost Effectiveness

In terms of cost, the system charged $ 0.015 per user per session. The expected cost of the 2,700 births registered in the system was $729 per year - 2700*18 system interactions (6 visits * 3 interactions/visit) @ $0.015. Per session. This translated into $3.40 per health facility per month. On average, the cost per health facility per month ranged between $2 - $4. The short message (SMS) reminders sent to mothers were charged at $ 0.0080 per SMS. The mobile phones used for the system were procured at $45 per piece.

Discussion

The system was created using simple mobile technology. USSD (Chanjotrack) reported very high acceptability and usability from the system users. The system was able to address the majority of the challenges that are common with routine vaccine registries especially paper-based registries-including loss of data due to poor documentation, user-friendliness as it was very easy to manoeuvre through the various menu when recording births and deaths, and it was also easy to set up given the system could be used on any mobile phone including analogue phones, its ability to provide real-time data, send automated reminders and track vaccination defaulters. Although different from the routine electronic vaccine registries created using other technologies, the finding on high acceptability for electronic registries is similar to the findings of a study conducted in similar settings in western Kenya that also reported very high acceptability, especially for workflow among electronic vaccine registry users (health care workers) [13]. Another study conducted in Pakistan on an electronic vaccine registry created on an android platform also reported high acceptability mainly due to related benefits, including its ability to monitor vaccination volume, track children with incomplete vaccinations, develop outreach visit plans and correct existing micro plans [14]. Additionally, another related study conducted in Pakistan also listed the benefits conferred by the Chanjotrack as some of the drivers for user acceptability for an electronic vaccine registry [15]. The acceptability for the use of Chanjotrack can also be attributed to users' awareness of other existing health electronic registries and health information systems since majority of the respondents were already conversant with District Health Information Systems 2 (DHIS 2) and the national Health Information Management System (HMIS). Also, the perceived benefits versus risks of

using the system could have contributed to the acceptability. This is supported by the findings of a study conducted to establish the acceptability of a personally controlled health record in a community-based setting [16].

On its ability to perform the intended functions, the respondents unanimously reported the success of the Chanjotrack. The respondents reported that births and deaths were well captured, automated short message reminders were sent, vaccination defaulter lists were generated, and a vaccination permanent register was generated. Given the difficulty experienced in generating of these reports and products, it is understandable why the respondents' affirmations were high. A study conducted among low-income countries to assess the performance of electronic vaccine registries describes some of the benefits brought about by the ability of the systems to perform their functions, including offering numerous opportunities to increase the timeliness, accuracy, and particularity of performance measures [17] which is similar to what the Chanjotrack system offered. Another function that has been exhibited by the Chanjotrack system that is similar to other electronic vaccine registries is that of ensuring access to big vaccines data and helping generate meaningful insights to drive actions and data-driven decisions [18].

The cost of running the system was much lower compared to the cost of running a routine web-based electronic vaccine registry, which would include procurement of computers, internet bundles, and training for personnel. To run the Chanjotrack, all that was required was a simple mobile phone (including analogue mobile phones), a mobile telephone network, and network charges. In terms of network charges, the web-based platform is 1.5 times more expensive compared to the Chanjotrack (the web-based platform would charge $5 per month while for the Chanjotrack, $ 3.40 was required for airtime)- as the system uses low-cost phones, we saved more than 60% on the cost of phones and about 30-40% on the system monthly charges compared if we had used smartphones that require data bundles. Although the costs incurred were lower relative to the web-based platform, it was higher than anticipated because of the numerous trials by users during piloting, and also because the phones procured were smartphones (more expensive than the analogue phones, which could have equally done the job). Elsewhere, web-based electronic vaccine registries have been reported to cost much more than it costed to establish the Chanjotrack system. To establish the Boston Immunization Information System it costed more than $345,556 annually [19].

Another study conducted to determine the annual cost per child to operate immunization registries in the United States of America reported an average cost of $3.91 per child per year [20]. In Tanzania, although the introduction of electronic vaccine registries reduced the resource cost (US$10,236) [21], the cost ranged from $3.30 and $3.81 per child per year [10]. The cost to set up the Tanzanian system was lower than the cost in Boston but still higher than the costs incurred in establishing the Chanjotrack system.

Equations

None.

Conclusion

The Chanjotrack system is user-friendly and was able to meet the needs of the users given the unique functionalities it had. The cost of setting it up was also very affordable given the limited initial investment needed to set up and can therefore be replicated in other resource limited settings. We recommend that the USSD technology be considered to develop electronic vaccine registries to help cut operational cost and to also make electronic vaccine registries accessible in areas where hitherto it couldn't because of the huge investment needed to set up the web-based platforms.

Acknowledgements

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Conflict of Interest

The authors declare no conflict of interest.

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