Effect of Mobile Phone Reminders and Recalls on Missed Immunisations among Infants in Two Health Facilities in Abakaliki, Nigeria

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Authors’ contributions

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

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ABSTRACT

Background: Missed immunisation (MI) may contribute to low immunisation coverage in diverse settings, especially developing countries. Receipt of vaccines at the recommended ages and intervals will ensure that children are adequately protected from target diseases at all times. Immunisation reminder and recall (RR) systems are cost-effective methods of improving adherence to recommended immunisation schedules. This study, therefore, determined the effect of immunisation reminders and recalls on reducing missed immunisations in Abakaliki.

Materials and Methods: This is a quasi-experimental study conducted among caregivers of infants in rural health facilities in Abakaliki. Mile-Four and St. Vincent hospitals located in Ebonyi and Izzi Local Government Areas (LGA) respectively in Ebonyi State were selected purposively. Mile-Four was assigned intervention group and St. Vincent as control group. The sample size was determined using the formula for comparing two proportions. Caregiver-child pair was recruited during the infants’ BCG or Pentavalent vaccines 1 immunisation visit and followed till the final scheduled immunisation visit for each child. Data was collected using a questionnaire, proforma and checklist. Statistical Package for Social Science (SPSS) version 22.0 was used for analysis. Ethical approval was obtained from the Research and Ethics Committee (REC) of the Federal Teaching Hospital Abakaliki (FETHA).
1. INTRODUCTION

Immunisation is a powerful and cost-effective public health intervention. It prevents debilitating childhood illnesses and disabilities and saves millions of lives yearly.

Access to communication is one of the important factors in the improvement of maternal and child health services [1]. Health care services that require repeated visits to the health facility due to timed scheduling of care are faced with the challenges of poor compliance and attrition. Clients receiving such care could and indeed have to be reminded by mobile phone calls which have great potential for improving compliance with or adherence to childhood immunisation schedules as the number of subscribers' increase [1].

Immunisation reminder and recall systems (RR) are cost-effective methods whereby infants who had come for vaccination but fail to continue or come for subsequent vaccinations are identified and contacted to come to the immunisation clinic or physician's office for its completion. It is cost-effective method of improving adherence to recommended immunisation schedules [2-5]. Reminder system tracks future immunisation appointments, whereas recall system tracks missed immunisation appointments and prompts clients to return to the clinic to receive the recommended or needed overdue immunisations [3]. A "reminder" is the postcard, letter, short message services [SMS] or telephone call reminding clients of immunisations before they are due. A "recall" is the postcard, letter, short message services or telephone call after clients missed an immunisation appointment or when an individual has fallen behind on scheduled immunisations prompting them to return to the clinic to receive the recommended immunisations [6].

Use of mobile phone technology to aid clients' compliance with and adherence to healthcare guidelines represents an advance in public health care delivery system, especially in developing countries. Different methods exist such as chart reminders, mail reminders, postcards, telephone calls, short message service (SMS), home visits, computerised immunisation alert systems, standing orders, expanding clinic hours, card file and clinical assessment software application (CASA). However, no one method suits all facilities. The appropriateness of a method is dependent upon personnel's capacity to utilise the selected method and fine-tune it to meet the specific needs of the practice and locale.

Abakaliki (study area) has a large number of rural dwellers with a low level of education, and this has been found to be one of the factors influencing immunisation uptake with decreasing expectations about the performance of primary health care system. Consequently, low immunisation coverage and high childhood immunisation drop-out rate are the attendant health problems [7]. Effective communication is therefore imperative for the delivery and receipt of adequate maternal and child health care services especially in such areas [1]. This study therefore determined the effect of immunisation reminders and recalls on reducing missed immunisations in Abakaliki.

2. MATERIALS AND METHODS

This is quasi-experimental study conducted among mothers/caregivers accessing childhood immunisation services at Mile-Four Hospital and...
Ethics Committee (REC) of the Federal Teaching Hospital Abakaliki (FETHA), Ebonyi State, Nigeria. Consent was obtained from the respondents.

3. RESULTS

Table 1 showed socio-demographic characteristic of the infants in both the intervention and control groups. High proportions of the infants were in the age group of 0-2 weeks, a difference that was not significant (p=0.31).

Fig. 1 showed the proportion of respondents who missed each vaccine in both groups. A greater proportion of respondents in the intervention group (8.3%) missed vaccination at the 6th and 10th weeks when compared with the 4.1% and 6.9% for the above mentioned weeks respectively in the control group. This difference in proportion was statistically significant (p=0.02). In the control group, a greater proportion (22.1%) missed vaccination than the intervention group (8.9%) at the 14th week, a difference in proportion that was also significant (p=0.04). Table 2 compared pre-intervention and post-intervention missed immunisations. Out of 82 infants who missed immunisations in pre-intervention phase, 28% missed immunisations post-intervention. Similarly, out of 69 infants who missed immunisations at the beginning of study, 30.4% missed immunisations at the end of study in the control group. The differences in their proportions in pre- and post-intervention phases and in the beginning and end of study in control groups were not statistically significant (p>0.05).

Table 3 showed within group comparison between sex of the infants and missed immunisation. More males (27.4%) than female (23.6%) infants missed immunisations in the intervention group when compared with control group. The difference in their proportion was not significant (p>0.05).

In Table 4, the proportion of respondents who missed immunisations pre- and post-interventions was compared with the control groups. Out of 406 infants studied during pre-intervention phase, 39.7% missed immunisations when compared with 25.5% who missed immunisations post-intervention. The difference in their proportions was statistically significant (p=0.02). In the control group, 48.4% of the infants missed immunisations at the beginning of the study when compared with 33.1% who
missed immunisation at the end of the study, a difference in their proportions was also statistically significant ($p=0.01$).

In Table 5: Relative to female caregivers, male caregivers are 6.2 times more likely to miss immunisation in the intervention group. The employed are 2.2 times more likely to miss immunisation than the unemployed even when not statistically significant. In Table 6, none of the factors was found as predictor of missed immunisation in the control group. However, male caregivers are 2.3 times more likely to miss immunisation than the female ones. Those at older age (≥30 years) are 1.2 times more likely to miss immunisation than those of younger age group.

### Table 1. Socio-demographic characteristics of infants in the study and control groups

| Variables                      | Intervention (n=145) Freq. (%) | Control (n=145) Freq. (%) | $\chi^2$ | p-value |
|--------------------------------|---------------------------------|---------------------------|---------|---------|
| **Sex**                        |                                 |                           |         |         |
| Male                           | 73 (50.3)                       | 72 (49.7)                 | 0.01    | 0.90    |
| Female                         | 72 (49.7)                       | 73 (50.3)                 |         |         |
| **Age group (weeks)**          |                                 |                           |         |         |
| 0-2                            | 103 (71.0)                      | 93 (64.2)                 | 3.43    | 0.31    |
| 3-5                            | 21 (14.5)                       | 26 (17.9)                 |         |         |
| 6-8                            | 21 (14.5)                       | 26 (17.9)                 |         |         |
| **Vaccines received at recruitment** |                              |                           |         |         |
| BCG, OPV0, HB0                 | 125 (86.2)                      | 121 (83.4)                | 0.42    | 0.51    |
| OPV1, PENTA1, PCV1             | 20 (13.8)                       | 24 (16.6)                 |         |         |

### Table 2. Within group comparison between pre-intervention and post-intervention missed immunisation

| Variables                        | Intervention group (n=145) | Control group (n=145) |
|----------------------------------|----------------------------|-----------------------|
| **Post-intervention missed immunisation** |                            |                       |
| **Yes**                          | **Freq. (%)**               | **No Freq. (%)**      | **Total** | **$\chi^2$ (p-value)** |
| Pre-intervention missed immunisation |                           |                       |           |                     |
| Yes (n=82)                       | 23 (28.0)                   | 59 (72.0)             | 82 (100)  | 0.63 (0.42)          |
| No (n=63)                        | 14 (22.2)                   | 49 (77.8)             | 63 (100)  |                     |

### Table 3. Within group comparison between Sex of infants and missed immunisation post-intervention

| Variables       | Intervention group (n=145) | Control group (n=145) |
|-----------------|----------------------------|-----------------------|
| **Missed immunisation** |                           |                       |
| **Yes**         | **Freq. (%)**              | **No Freq. (%)**      | **Total** | **$\chi^2$ (p-value)** |
| Sex of infants  |                           |                       |           |                     |
| Male            | 20 (27.4)                  | 53 (72.6)             | 73 (100)  | 0.27 (0.60)          |
| Female          | 17 (23.6)                  | 55 (76.4)             | 72 (100)  |                     |
Table 4. Effect of mobile phone reminders and recall on missed immunisation pre- and post-intervention

| Variables                          | Intervention group         | Control group         | (p-value)         | Beginning of study | End of study | (p-value) |
|-----------------------------------|----------------------------|-----------------------|-------------------|-------------------|--------------|-----------|
|                                   | Pre-intervention Freq. (%) | Post-intervention Freq. (%) |                     | Freq. (%)          | Freq. (%)    |           |
| Number who missed immunisations  | Yes 161 (39.7)             | 37 (25.5)             | 0.02*             | 136 (48.4)        | 48(33.1)     | 0.01*     |
|                                   | No 245 (60.3)              | 108 (74.5)            |                   | 145 (51.6)        | 97(66.9)     |           |
| Number who missed each vaccine    | OPV1 60 (14.8)             | 12 (8.3)              | <0.05*            | 22 (7.8)          | 6 (4.1)      | <0.01*    |
|                                   | Penta1 11(2.7)             | 12 (8.3)              | 0.09              | 5 (1.8)           | 6 (4.1)      | 0.07      |
|                                   | PCV1 26 (6.4)              | 12 (8.3)              | <0.03*            | 7 (2.5)           | 6 (4.1)      | 0.0       |
|                                   | OPV2 89 (21.9)             | 22 (15.2)             | 0.01*             | 57(20.1)          | 10(6.9)      | 0.06      |
|                                   | Penta2 80 (19.7)           | 22(15.2)              | 1.00              | 58(20.6)          | 10(6.9)      | 0.01*     |
|                                   | PCV2 99 (24.4)             | 22 (15.2)             | 0.04*             | 57(20.3)          | 10(6.9)      | 0.06      |
|                                   | OPV3 152 (37.4)            | 19 (13.1)             | 0.06              | 136(48.4)         | 32(22.1)     | 0.02*     |
|                                   | Penta3 146 (36.0)          | 19 (13.1)             | 0.05              | 135(48.0)         | 32(22.1)     | 0.02*     |
|                                   | PCV3 161(3.7)              | 19 (13.1)             | 0.08              | 136(48.4)         | 32(22.1)     | 0.02*     |

*Statistically significant. McNemar \( \chi^2 \) was used for this comparison

Fig. 1. Proportion of infants who missed each vaccine on each schedule post-intervention

- OPV1, Penta1 and PCV1
- OPV2, Penta2 and PCV2
- OPV3, Penta3 and PCV3

4. DISCUSSION

A comparable proportion of respondents in the intervention group (25.6%) and control group (33.1%) missed immunisations at the end of the study. A higher proportion of respondents in the intervention group missed the 6th and 10th week vaccines when compared with the control group, while a significant proportion in the control group (22.1%) missed the 14th week vaccines. No infant missed BCG, OPV0 and HB0 in both groups. The more infants miss immunisation among a given population, the more compromised the herd immunity of such population could be and are such prone to vaccine preventable diseases with attendant morbidity and mortality [11]. It is noteworthy that these vaccines are the ones
given at birth. Although this study however did not explore the place of birth of these infants, it is therefore likely that most of these infants were delivered in the facility (study area) or presented immediately for immunisation probably on the day they were born which made them stand the chance of being immunised with BCG, OPV0 and HB0 vaccines before discharge. The fewer proportion of respondents in the intervention group (9%) who missed the 14th week vaccines may be explained by the fact that as the caregivers kept receiving phone reminders and recalls they saw the need for timeliness and promptness in immunising their children, hence fewer number of missed immunisations.

Table 5. Predictors of missed immunisation in the intervention group

| Variables               | Missed immunisation Intervention group | AOR   | 95% CI of AOR | P-value |
|-------------------------|----------------------------------------|-------|--------------|---------|
| Sex                     |                                        |       |              |         |
| Female                  | 1                                      |       |              |         |
| Male                    | 6.20                                   | 1.28-15.89 | 0.05**    |
| Employment              |                                        |       |              |         |
| Unemployed              | 1                                      |       |              |         |
| Employed                | 2.15                                   | -0.89-4.54 | 0.09     |
| Forgot date             |                                        |       |              |         |
| No                      | 1                                      |       |              |         |
| Yes                     | 4.83                                   | -0.77-8.78 | 0.99     |
| Travelled               |                                        |       |              |         |
| No                      | 1                                      |       |              |         |
| Yes                     | 7.48                                   | -0.77-14.77 | 0.99    |
| Busy with work          |                                        |       |              |         |
| No                      | 1                                      |       |              |         |
| Yes                     | 1.04                                   | -0.78-2.56 | 1.00     |

**Predictor
AOR = Adjusted odd ratio
CI = Confidence interval

Table 6. Predictors of missed immunisation in the control group post-intervention

| Variables               | Missed immunisation control group | AOR | 95% CI of AOR | P-value |
|-------------------------|-----------------------------------|-----|---------------|---------|
| Sex                     |                                    |     |               |         |
| Female                  | 1                                  |     | -0.99-6.20    | 0.99    |
| Male                    | 2.32                               |     | -0.99-6.20    | 0.99    |
| Age group (years)       |                                    |     |               |         |
| <30                     | 1                                  |     |               |         |
| ≥30                     | 1.21                               | -0.58-2.55 | 0.66     |
| Marital status          |                                    |     |               |         |
| Not married             | 1                                  |     |               |         |
| Married                 | 1.23                               | -0.15-9.56 | 0.86     |
| Forgot appointment date |                                    |     |               |         |
| No                      | 1                                  |     |               |         |
| Yes                     | 4.22                               | -0.99-11.12 | 0.99    |
| Travelled               |                                    |     |               |         |
| No                      | 1                                  |     |               |         |
| Yes                     | 3.97                               | -0.78-9.56 | 1.00     |
| Difficult getting fare  |                                    |     |               |         |
| No                      | 1                                  |     |               |         |
| Yes                     | 3.97                               | -0.78-9.56 | 1.00     |
| Baby’s sickness         |                                    |     |               |         |
| No                      | 1                                  |     |               |         |
| Yes                     | 3.47                               | -0.99-8.3  | 0.99     |
There was a significant relationship between respondent’s age and marital status and missed immunisation in the control group and none in the intervention group.

In the study area, infants who visited on a day immunisation was not scheduled were asked to go back home without been vaccinated. Refusal to vaccinate on an unscheduled day may increase the mothers’ total cost of transportation as stated by some caregivers, thus dampening their enthusiasm to attend vaccination clinics with loss of confidence in the immunisation system [12]. Health care providers should spend more time to communicate to mothers/caregivers on immunisation schedules and have constant training on vaccine management. In Texas, USA the reminder messages were effective in reducing missed immunisation appointment compared with the control. The content of reminder messages was also suggested to be an important factor in the reduction of missed immunisation appointments [13].

In addition, opened vaccine vials when not completely used should be preserved in the immunisation stations by the use of Cold chain/refrigerator. This will enable the health workers to open a new vial of vaccine when there are few children in the immunisation clinic instead of sending them home unvaccinated. A recall system may be more effective among caregivers showing attitude as the incriminating factor for missed immunisations. The recall would then act as a motivator for those concerned.

The following independent factors influenced missed immunisation in the intervention group: gender, employment, while in the control group, gender, age group, marital status influenced missed immunisations.

5. CONCLUSION

Mobile phone reminders and recall has proven effective in reducing childhood missed immunisations and non-compliance in Abakaliki. Immunisation reminders and recall system is therefore recommended in immunisation clinics in developing countries especially in Nigeria for immunisation timeliness and completion.

CONSENT

Consent was obtained from the respondents.

ETHICAL ISSUE

Ethical approval for this study was obtained from the Research and Ethics Committee (REC) of the Federal Teaching Hospital Abakaliki (FETHA), Ebonyi State, Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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