The impact of computer-generated messages on childhood immunization coverage
Dini E F, Linkins R W, Sigafos J

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Three types of computer-generated reminder/recall messages used each time vaccine becomes due, and sent to the families of children aged 60 to 90 days who had received the first dose of diphtheria-tetanus-pertussis (DTP) or poliovirus (PV) vaccines. The aim of the intervention programmes was to assess the sustained impact of computer-generated messages on immunisation coverage during the first two years of life. Households in the intervention programmes were set to receive either telephone messages followed by letters, telephone messages alone, or letters alone. Households in the intervention groups received up to five computer-generated telephone messages and/or up to four letters each time their children became due for immunisation. The content of phone messages (and letters) was very simple. No attempt was made to educate parents during these contacts. Messages reminded parents that their child was due for immunisation, and that immunisations were very important because they prevented children from contracting diseases that make many children very sick every year. They asked parents to either keep an existing appointment or make an appointment if one had not already been made. For each scheduled contact as many as nine attempts were made until the message was delivered. To maximise the likelihood of reaching a parent, all attempted contacts were made during weekday evening hours between 6.00 p.m. and 9.00 p.m. and on Saturdays from noon to 8.00 p.m. Families of children in the telephone and letters intervention programme who did not respond to any of the five telephone contacts were mailed a computer generated written reminder 1 week after the date of the fifth contact. A second computer-generated letter was sent 1 week after the first mailing if the target children remained unimmunised. Families of children in the letters only intervention programme received up to four computer-generated letters, the first sent 2 days after a child's scheduled immunisation was missed. If the child remained unimmunised, a second, third, and fourth letter was sent one week after each earlier written reminder. Families in the telephone and letters, and the telephone only intervention programmes were contacted before the scheduled immunisations. Telephone calls were associated with no additional expense. Whilst families in the letters only programme were contacted after the scheduled immunisations were missed (since it was associated with extra costs and did not require contacting many families (about 50%) that normally return for immunisations even without interventions). Immunisation messages were delivered in Spanish and English according to the household's specified language.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
Children aged 60 to 90 days who had received the first dose of DTP or PV vaccines, and who had telephone numbers listed in the pre-existing computerised health department database.

Setting
Primary care setting. The economic analysis was carried out in Denver, Colorado, USA.
Dates to which data relate
Effectiveness and resource use data corresponded to the period between 1993 and 1996. The price year was not explicitly specified.

Source of effectiveness data
The evidence for the final outcomes was based on a single study.

Link between effectiveness and cost data
Costing was performed on the same patient sample as that used in the effectiveness analysis. It was not reported whether costing was conducted prospectively or retrospectively.

Study sample
No power calculation appears to have been used to determine the sample size. It was reported that the study had a target sample of 1,200. A total of 1,227 children were originally enrolled in the study and their households were randomised into four groups to receive: telephone messages followed by letters (group A); telephone messages alone (group B); letters only (group C); no notification (group D). The number of households in each study group was not reported. From the cost analysis data, it appears that the number of households in group A was 308.

Study design
This was a randomised controlled trial, carried out in a tri-county health jurisdiction within the Denver metropolitan area with a total of 4 public health clinics, each with similar demographic characteristics and size. The duration of the follow-up was reported to be 22 months. The loss to follow-up (those who moved from the health jurisdiction or who had identified another provider for immunisation services, calculated by the abstractor from the difference in numbers given in randomisation analysis and receipt analysis) was 38 in the phone and letters group, 28 in the telephone only group, 33 in the letters only group, and 27 in the control group. Immunisations were scheduled according to the current Advisory Committee on Immunization Practices (ACIP) recommendations for DTP, oral PV (OPV), and mumps-measles-rubella (MMR), but not for Haemophilus influenzae type b (Hib) or hepatitis B. The four study clinics all had computerised databases that were linked to the main office, from which all the interventions were conducted.

Analysis of effectiveness
The principle used in the analysis of effectiveness was both intention to treat (randomisation analysis) and treatment completers only (receipt analysis). The primary outcome measure was series completion at 24 months of age. Secondary outcome measures were up-to-date coverage rates at selected ages based on ACIP recommendations. Parental acceptance of repeated reminders were evaluated using a 10% systematic sample (selection of every tenth family) of children whose households received successful telephone calls at 4 weeks after successful calls had been made. The study groups were comparable with regard to gender, number of children in the household, and whether children were insured by Medicaid. However, significant ethnic and language differences were noted between groups. Stratified analyses were conducted to assess the independent effect of each intervention on immunisation rates. Within each stratum of all potentially confounding variables, immunisation rates and rate ratios (RR) were compared between the intervention and non-intervention groups. Demographic characteristics of 126 children who had reached 24 months of age but who were identified as having moved or gone elsewhere for immunisation during the study period were similar to the 735 children who did not change their residence or provider.

Effectiveness results
Children whose families were randomised to receive any of the interventions were 21% more likely to have completed the immunisation series by 24 months of age than were children randomised into the control group (49.2% versus 40.9%; RR (rate ratio) = 0.21; 95% CI: 1.01 - 1.44). While not statistically significant, children in Group A were 23% more likely to complete their immunisation series by 24 months of age than those in the control group (50.2% versus 40.9%; RR=1.23; 95% CI: 1.00 - 1.52). No significant differences were detected among the intervention groups. In
terms of secondary outcome, differences were significant at 15 and 19 months, but only for children in group A compared to the control group. Subgroup analysis (including white, African American, Hispanic, other ethnicity, and non-white children as well as children from English- and Spanish-speaking households) revealed that up-to-date immunisation were generally higher in the intervention groups compared with similar children in the control group for each subgroup analysed. Most parents (86%) gave a positive response about the telephone contact, regardless of the age of their children or the number of prior telephone contacts they had received.

Clinical conclusions
This study suggests that vaccine coverage of pre-school children can be increased by the repeated use of automated parent notifications during the first 2 years of the child’s life, extending earlier findings that computer-generated telephone reminder and recall messages are an effective strategy to improve pediatric immunisation visits.

Measure of benefits used in the economic analysis
No summary benefit measure was identified in the economic analysis, and only separate clinical outcomes were reported.

Direct costs
Start-up costs were reported to have been discounted. Quantities were not reported separately from the costs. Cost items were reported separately. The cost analysis covered the start-up costs (including autodialling equipment, software modification to clinical database, dedicated line installation) and operating costs (including phone-line charges, clerical costs, postage). The perspective adopted in the cost analysis was not explicitly specified. Marginal cost analysis was performed. The price year was not specified.

Indirect Costs
Indirect costs were not considered.

Currency
US dollars ($).

Sensitivity analysis
A sensitivity analysis was not carried out.

Estimated benefits used in the economic analysis
The reader is referred to the effectiveness results reported above.

Cost results
The discount rate used for the start-up costs was not reported. The total cost was $4,738 for subjects enrolled in group A, $4,300 for group B, and $2,254 for group C. The corresponding values in terms of cost per year were $1,672, $1,518, and $796. In terms of intention to treat analysis, the cost per additional child in group A completing the immunisation series by 18 months of age was $132; by 24 months, it was $226. However, after discounting for start-up costs the cost for each additional child completing the series was $46 by 18 months and $79 by 24 months of age.

Synthesis of costs and benefits
A cost and benefits synthesis was not conducted.
Authors' conclusions
Computer-generated contacts, either by phone or by mail (or both combined), used each time vaccines become due, are efficacious in increasing immunisation coverage of children under 2 years of age.

CRD COMMENTARY - Selection of comparators
The choice of no notification as the comparator allowed the active value of the intervention programmes to be evaluated.

Validity of estimate of measure of benefit
The effectiveness results are likely to be internally valid given the randomised nature of the study design, and the intention to treat analysis carried out. However, although the sample was large, it appears that no power calculations were performed to justify the sample size adopted in the study. The effects of all potential confounding variables on the effectiveness results were investigated. The study sample appears to have been representative of the study population. However, it was speculated that the effectiveness of the intervention might have been even higher had children who began their immunisation series late been included in the cohort, because previous work suggests that telephone messages may be most effective in children who are late for their immunisations.

Validity of estimate of costs
Some limitations of the cost analysis were that quantities were not reported separately from the costs, adequate details of cost estimation were not given, the price year, discount rate, and perspective adopted in the cost analysis were not reported and no statistical analyses were performed on resource use components and cost data. It also appears that the costs associated with a lower immunisation rate in the control group (possible cases of diseases due to immunisations missed) were not incorporated into the cost analysis. The effects of different types of contacts on indirect costs were not addressed. The cost results may not be generalisable outside the study setting.

Other issues
The authors’ conclusion appears to be justified given the uncertainties in the data. The issue of generalisability to other countries was partially addressed by noting that the generalisability of the study may have been affected by the radical shift of health delivery in recent years from the public to the private sector. Clients remaining in the public sector now may have different characteristics from patients enrolled in this study 6 years previously. The issue of the representativeness of the study sample of the study population was, to some extent, addressed by noting the possible effects of including children who are late for their immunisations and the effects of the public/private health delivery divide.

Implications of the study
Additional studies will be needed further to define the effectiveness and cost-effectiveness of computer-generated messages and to determine the optimal number and sequence of telephone and mailed messages. Automated parent reminder/recall messages can lead to increases in vaccine coverage. However, additional strategies and interventions will be needed to reach the US health objective of 90% immunisation.

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Bibliographic details