

SYSTEMATIC REVIEW ON EFFECTIVENESS OF METHODS OF DELIVERY AND REMINDER OF HEALTH EDUCATION MODULE TO IMPROVE ADHERENCE ON CHILDHOOD IMMUNIZATION SCHEDULE

Mohammad Farhan R.^{2,3}, Muhammad Hanfiah Juni¹, Nor Afiah MZ^{1*}

²Department of Community Health, Faculty of Medicine, Universiti Putra Malaysia.

³Department of Community Medicine, Kulliyah of Medicine, International Islamic University Malaysia

**Corresponding author: AP Dr. Nor Afiah MZ, Department of Community Health, Faculty of Medicine, Universiti Putra Malaysia, norafiah@upm.edu.my*

<https://doi.org/10.32827/ijphcs.5.6.54>

ABSTRACT

Background: There are currently various methods of delivery that can improve adherence on under-five childhood immunization schedule. The methods differ significantly and there is the conventional method of providing a health education module, reminders and recalls to improve adherence and some other non-conventional methods to improve adherence. A systematic review was conducted on the effectiveness of methods of delivery and reminder of health education module to improve adherence on childhood immunization schedule.

Materials and Methods: The systematic review performed utilized searched on available electronic databases and bibliographies of studies and also previous reviews. The databases were broad search and began with the use of generic terms to identify search terms that were relevant. The PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) by Moher et al (2009) was used. Databases including PubMed, Science Direct, Medline and CINAHL were utilized for this systematic review.

Results: The studies in the review conducted was conducted in various countries with the United States of America (USA) contributing 7 studies, followed by the United Kingdom and Pakistan with 3 studies each and Kenya, Australia, New Zealand and India with 1 study respectively. The lowest number of respondents was 12 while the most was 9213 respondents. All studies were Randomized Control Trial's (RCT's) and 1 Quasi Experimental study.

Conclusion: The studies showed multiple factor and effective methods of delivery with reminders for health education. Utilizing technology showed to be one of the most effective methods.

Keywords: Effectiveness of methods of delivery, Health education module, Childhood immunization schedule.

1.0 Introduction

There are currently various methods of delivery that can improve adherence on under-five childhood immunization schedule. The methods differ significantly and there is the conventional method of providing a health education module, reminders and recalls to improve adherence and some other non-conventional methods to improve adherence. A systematic review was conducted on the effectiveness of methods of delivery and reminder of health education module to improve adherence on childhood immunization schedule.

2.0 Methods

The systematic review performed utilized searched on available electronic databases and bibliographies of studies and also previous reviews. The databases were broad search and began with the use of generic terms to identify search terms that were relevant. The PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) by Moher et al (2009) was used. Databases including PubMed, Science Direct, Medline and CINAHL were utilized for this systematic review.

Study titles were screened initially and analysis of the abstract was conducted to determine the relevance to this systematic review. Then the full text of the articles were obtained and only those studies that fulfilled the inclusion and exclusion criteria were then selected. The population of the studies were parents or guardians; the interventions were health education intervention programs and reminders; Comparisons were between group who received intervention and who did not receive the intervention and whereas the outcomes were those with a change in the adherence level of the study population. Studies being included in the systematic review were limited to only experimental studies either randomized control trial (RCT) or quasi experiments.

Search of the databases was done to include studies from 1995 to the present date. The studies included all published articles in citation indexed journals as well as peer reviewed journals. The MeSH (Medical Subject Heading) search terms used for the first level were “Methods of delivery and reminder of health education module” AND “Health education to improve adherence”. The second level then followed the primary search and keywords applied to be more specific to the searches was used including “Procedure” OR “Technique” OR “System” OR “Process” AND “Conveyance” AND “Recall” OR “Prompt” OR “Types”, AND “Compliance” OR “Improvement” AND “Education” OR “Campaigns” OR “Programs”.

The inclusion criteria for the systematic review applied were the articles needed to be in the English language, Full Text availability, and were conducted among parents or guardians. The exclusion criteria were duplication of studies or studies conducted among other groups besides parents or guardians. Duplicated publications were determined and excluded from this study and was done by comparing the author names, study names and their sample sizes. Information was extracted for the review from the articles obtained to cover the author name, year of publication and the country where the study was conducted. The study design was

then noted along with the sample size and results. Only those that published crude odds ratio, adjusted odd ratio and relative risk with a 95% confidence interval that does not include 1 or a p value less than 0.05 to have a significant factor method.

The researcher utilized the EPHPP (Effective Public Health Practice Project) quality assessment component and rating from Thomas et al (2004) where components of the study that included the selection bias, design, confounders, blinding, data collection methods and withdrawals or dropouts were assessed and placed into 3 groups wither weak, moderate or strong. For the purpose of this systematic review only studies that fall into the categories of strong were included as it needed to be an experimental study and those that were weak were discarded from the review process to maintain the quality of the literature being reviewed. The results were then placed in a logic framework after being synthesized but meta-analysis was not performed. The framework illustrates the various results obtained and classifies the types of methods or reminders of the individual studies. The bias was limited in the systematic review by ensuring that none of the studies were selected based on their origin, journal impact factor or selective reporting within the studies.

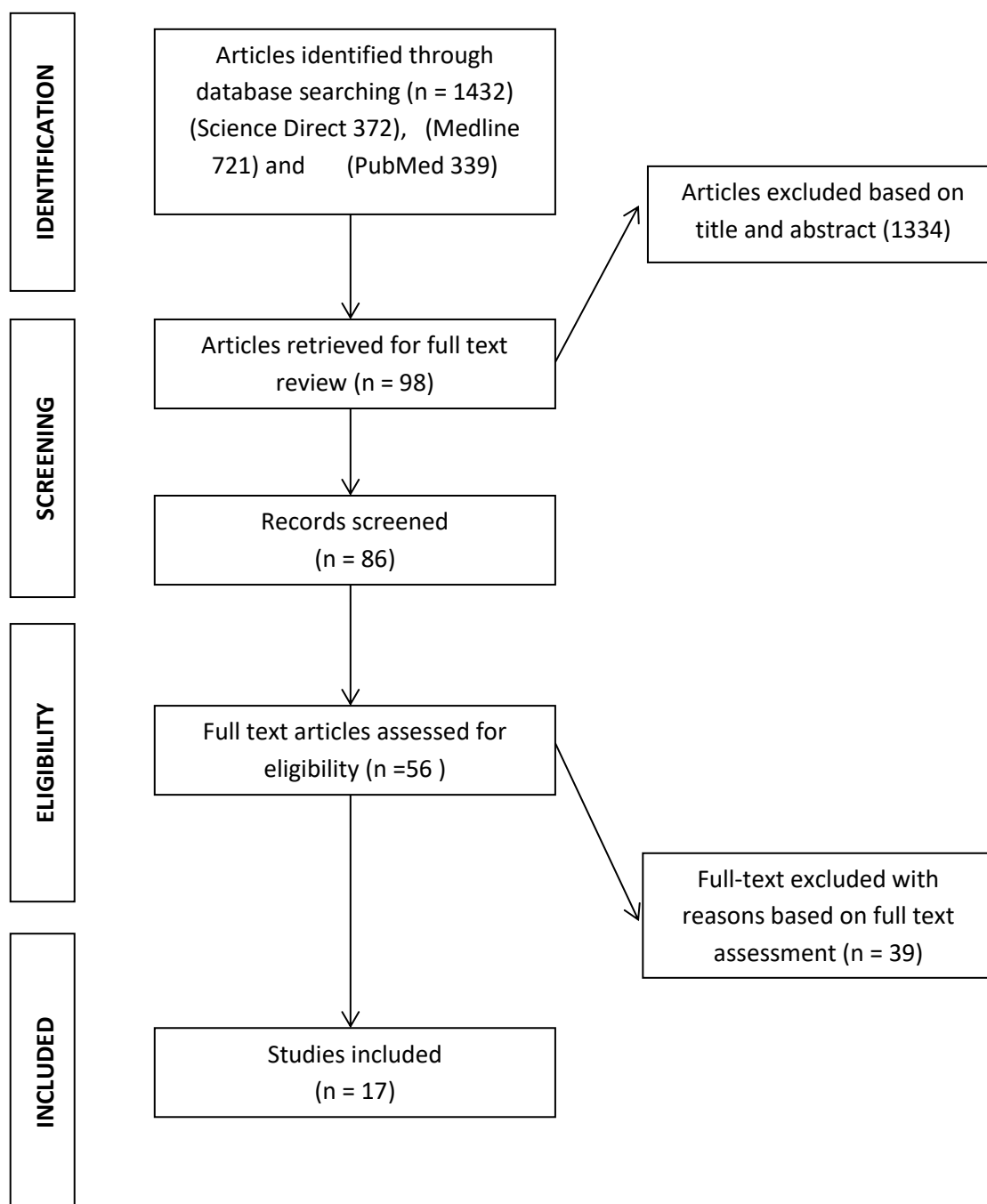


Figure 2.7: Flowchart of the systematic review process on Methods of Delivery and Reminder of Health Education Module to improve adherence.

(n) Refers to Number.

Over 1432 results were returned of which 56 were relevant to this study after examining the full text. The main researcher examined all the full text to ensure its relevance by moving on bibliographic references and undertaking key author and grey literature searches proved as an effective complimentary approach to the original review and were reverted to the original search. Where there were doubts the second researcher was consulted to ensure that no literature was discarded based on the main researchers opinion alone. This approach brought the total number of relevant full text result to 17. A major problem faced was the little quantitative evidence of local studies, which could be due to the limitations in availability of databases with wide scope. The Table 2.4 below is a summary of the reminder, recall and health education to improve adherence. The majority of the studies were randomized control trials.

Table 2.4: Summary of systematic review on methods of delivery and reminder of health education module to improve adherence (1995 – present).

Author/Location	Study Design	Intervention type	Population	Intervention	Outcomes Measured	Summary of Findings
Banerjee et al. (2010) (India)	RCT	Incentivised Immunization program	1640 children aged 1-3 years old from 134 villages.	34 villages were randomized to one of three groups: a once monthly reliable immunization camp (intervention A; 379 children from 30 villages); a once monthly reliable immunization camp with small incentives (raw lentils and metal plates for completed immunization; intervention B; 382 children from 30 villages), or control (no intervention, 860 children in 74 villages). Surveys were undertaken in randomly selected households at baseline and about 18 months after the interventions started (end point).	Complete immunization for intervention B versus control was aRR = 6.7, 95% CI 4.5 - 8.8 and for intervention B versus intervention A was aRR = 2.2, 95% CI 1.5 - 2.8. Children in areas neighboring intervention B villages were also more likely to be fully immunized than those from areas neighboring intervention A villages aRR = 1.9, 95% CI 1.1 - 2.8. The average cost per immunization was \$28 in intervention A and \$56 in intervention B.	Improve immunization for intervention B and More likely to be fully immunized for those in intervention B.
Brown et al. (1997) (UK)	RCT	Technology based (Web game)	59 participants aged 8 to 16.	Each participant received a Super Nintendo video game system at an initial clinic visit and was randomly assigned to receive either Packy & Marlon (treatment group, N = 31) or an entertainment video game containing no diabetes-related content (control group, N = 28). Participants were interviewed with questionnaire at baseline, three months, and six months.	There was improvement in the treatment group relative to the control group in terms of diabetes-related self-efficacy ($p = 0.07$), communication with parents about diabetes ($p = 0.025$), and self-care behaviors ($p = 0.003$), and a decrease in unscheduled urgent doctor visits ($p = 0.08$).	Improve of self-efficacy, improve communication with parents, improve self-care behavior and reduce in unplanned doctor visits.

Guendelman et al. (2002) (USA)	RCT	Technology based (Health Buddy)	Inner-city children aged 8 to 16 years	An asthma self-management and education program, the Health Buddy, designed to enable children to assess and monitor their asthma symptoms and quality of life and to transmit this information to health care providers through a secure Web site. Control group participants used an asthma diary.	After adjusting for covariates, the odds of having any limitation in activity during the 90-day trial were significantly ($P = 0.03$) lower for children randomized to the Health Buddy. The intervention group also was significantly ($P = 0.01$) less likely to report peak flow readings in the yellow or red zone or to make urgent calls to the hospital ($P = 0.05$). Self-care behaviors, which were important correlates of asthma outcomes, also improved far more for the intervention group.	Increase self-managements skills, reduce unnecessary calls to emergency department and improve of self-care behaviors.
Hawe et al. (1998) (Australia)	RCT	Educational postal reminder	Parents of children born 1987–1988.	A: HBM reminder card ($n = 124$) Control: Usual vaccination reminder card ($n = 135$) Intervention: Reminder cards worded in accordance to the HBM. (1) the severity of measles, (2) the susceptibility of children <2 years and (3) the risks of the disease outweigh those of the procedure.	Percentage of children vaccinated against measles/mumps in the 5 weeks following postal reminder. (AOR = 3.36, 95% CI 1.15 – 5.62)	A significantly greater proportion of children were immunised following receipt of the HBM card compared to the usual reminder card
Jacobson et al. (1999) (USA)	RCT	Health education leaflet	433 patients who presented for routine primary care, had vaccine indications	One-page, low-literacy (below fifth-grade level) educational handout encouraging patients to "ask your doctor about the pneumonia shot" vs a control group (1-page, low-literacy educational handout conveying information about nutrition)	Patients in the intervention group were 4 times more likely to have discussed the pneumococcal vaccine with their physicians than patients in the control group aRR = 3.97, 95% CI 2.71 - 5.83, and were more than 5 times as likely to have received the pneumococcal vaccine than the control group aRR = 5.28 95% CI 2.80-9.93.	A simple, low-literacy educational tool increased pneumococcal vaccination rates and patient-physician discussions about the vaccine in an elderly, low-literacy rates, indigent, minority

Lester et al. (2010) (Kenya)	RCT	SMS notification	538 patients who were to receive ART.	Patients were randomized (1:1) by simple randomization with a random number generating program to a mobile phone short message service (SMS) intervention or standard care. Patients in the intervention group received weekly SMS messages from a clinic nurse and were required to respond within 48 h.	Adherence to ART was reported in 168 of 273 patients receiving the SMS intervention compared with 132 of 265 in the control group aRR = 0.81, 95% CI 0.69 – 0.94. Suppressed viral loads were reported in 156 of 273 patients in the SMS group and 128 of 265 in the control group, (for virology failure aRR = 0.84, 95% CI 0.71 – 0.99). The number needed to treat (NNT) to achieve greater than 95% adherence was aRR = 9.3 95% CI 5.0 – 29.5, and the NNT to achieve viral load suppression was aRR = 11.0, 95% CI 5.8 – 227.3.	population. Patients who received SMS support had significantly improved ART adherence and rates of viral suppression compared with the control individuals. Mobile phones might be effective tools to improve patient outcome in resource- limited settings.
Mason and Donnelly 2000 (UK)	RCT	Postal reminder and information	Children living in a health authority born between November 1996 and April 1997 who had not received MMR by 21 months	A: Postal reminder + informational leaflet (n = 255) Control: Routine care. No reminder (n = 256) Intervention: Personal reminder letter sent to parents, GP and HV of child due for immunisation. Parents also sent the leaflet MMR: the facts.	MMR uptake between 21 and 24 months old. (OR = 2.4, 95% CI 1.4 – 5.5)	Personal reminder letters including an informational leaflet did increase MMR uptake compared to routine care
Matthew et al. (2002) (USA)	RCT	Individually Tailored Calendars	The study sample included babies aged birth to 1 year	Parents of babies aged birth to 1 year (n = 321) received individually tailored calendars promoting immunization from 2 urban public health centers. For	A higher proportion of intervention than of control babies were up to date at the end of a 9-month enrollment period (82% vs 65%, P < 0.001) and at age 24 months	Tailored immunization calendars can help increase child immunization rates.

			who visited the pediatrics department at 2 public health centers in St Louis during the project period.	each baby, an age- and sex-matched control was selected from the same center. Immunization status was tracked through age 24 months.	(66% vs 47%, $P < 0.001$). The younger the baby's age at enrollment in the program, the greater was the intervention effect.	
Owais et al. (2011) (Pakistan)	RCT	Pictorial messages	Three hundred and sixty-six mother-infant pairs, with infants aged ≤ 6 weeks, were enrolled and randomized into either the intervention or control arm between August - November 2008.	The intervention, administered by trained community health workers, consisted of three targeted pictorial messages regarding vaccines. The control group received general health promotion messages based on Pakistan's Lady Health Worker program curriculum. Assessment of DPT/Hepatitis B vaccine completion (3 doses) was conducted 4-months after enrollment.	Baseline characteristics were similar. At 4 months assessment, among 179 mother-infant pairs in the intervention group, 129 (72.1%) had received all 3 doses of DPT/Hepatitis B vaccine, whereas in the control group 92/178 (51.7%) had received all 3 doses. Multivariable analysis revealed a significant improvement of 39% ($aRR = 1.39$, 95% CI 1.06 -1 .81) in DPT-3/Hepatitis B completion rates in the intervention group.	A simple educational intervention designed for low-literate populations, improved DPT-3/Hepatitis B vaccine completion rates by 39%.
Papachrisanthou, Lorenz, & Loman (2016) (USA)	Quasi Exp.	Visually enhanced education (Pictures)	A sample size of 34 from the VEE site and 34 from the UC site achieved a power of 80% to detect a 20% difference in the proportion	VEE consisted of parents viewing 5 pictures of children with visible physical changes from vaccine- preventable diseases combined with verbal education. While parents were viewing the pictures, symptoms associated with the diseases, long-term disease effects, potential side effect of the vaccines, and vaccine	Statistically significant age-specific immunization adherence in the VEE group compared with the UC group at the 2 month visit $p=0.014$, 4 month $p=0.041$ and 6 month $p=0.042$	By utilizing the picture based to visually enhance the health education, they were able to increase the adherence level at all follow-ups.

			of patients with delayed immunization.	information sheets were discussed and questions answered by the PI. This lasted approximately 5-15 minutes, during the child's initial office visit (4-14 days old) and again during the 1-month office visit (21-41 days old) before being seen by the provider.		
Patrick et al. (2009) (USA)	RCT	Technology based utilizing SMS & MMS	65 total consented adults.	The study was a randomized controlled trial, with participants being exposed to one of the following two conditions, lasting 16 weeks: (1) receipt of monthly printed materials about weight control; (2) an intervention that included personalized SMS and MMS messages sent two to five times daily, printed materials, and brief monthly phone calls from a health counselor. The primary outcome was weight at the end of the intervention.	A total of 75 overweight men and women were randomized into one of the two groups, and 65 signed the consent form, completed the baseline questionnaire, and were included in the analysis. At the end of 4 months, the intervention group (n = 33) lost more weight than the comparison group (-1.97 kg difference, 95% CI -0.34 to -3.60 kg, $P = 0.02$) after adjusting for sex and age. Intervention participants' adjusted average weight loss was 2.88 kg (3.16%). At the end of the study, 22 of 24 (92%) intervention participants stated that they would recommend the intervention for weight control to friends and family.	Text messages might prove to be a productive channel of communication to promote behaviors that support weight loss in overweight adults.
Pop-Eleches et al. (2011) (USA)	RCT	SMS reminder	431 adult patients for ART.	Four hundred and thirty-one adult patients who had initiated ART within 3 months were enrolled and randomly assigned to a control group or one of the four intervention groups.	In intention-to-treat analysis, 53% of participants receiving weekly SMS reminders achieved adherence of at least 90% during the 48 weeks of the study, compared with 40% of participants in the control group	The SMS reminder is an important tool to achieve optimal treatment response in resource-limited settings.

				Participants in the intervention groups received SMS reminders that were either short or long and sent at a daily or weekly frequency. Adherence was measured using the medication event monitoring system. The primary outcome was whether adherence exceeded 90% during each 12-week period of analysis and the 48-week study period. The secondary outcome was whether there were treatment interruptions lasting at least 48 h.	($P=0.03$). Participants in groups receiving weekly reminders were also significantly less likely to experience treatment interruptions exceeding 48 h during the 48-week follow-up period than participants in the control group (81 vs. 90%, $P = 0.03$).	
Rodgers et al. (2005) (New Zealand)	RCT	Tech messaging intervention	1705 smokers who had intention to quit smoking	All participants received a free month of text messaging; starting for the intervention group on their quit day to assist with quitting, and starting for the control group at six months to encourage follow up.	More participants had quit at six weeks in the intervention compared to the control group: 239 (28%) v 109 (13%), relative risk 2.20 (95% confidence interval 1.79 to 2.70), $p < 0.0001$. This treatment effect was consistent across subgroups defined by age, sex, income level, or geographic location (p homogeneity > 0.2).	This programme offers potential for a new way to help young smokers to quit, being affordable, personalised, age appropriate, and not location dependent.
Siriwardena et al. (2002) (UK)	RCT	Educational outreach visit	Fifteen practices were random to intervention and 15 to the control group after stratifying for baseline	All intervention practices were offered and received an educational outreach visit to primary healthcare teams, in addition to audit and feedback directed at improving influenza and pneumococcal vaccination rates in high-risk groups. Control practices received audit	Primary outcomes were improvements in vaccination rates. The increases for influenza vaccination in intervention versus control practices were 18.1% versus 13.1% (OR = 1.06, 95% CI = 0.99 to 1.12).	Practices where primary care teams received an educational outreach visit demonstrated a significantly greater improvement in uptake.

			vaccination rate.	and feedback alone. All practices measured influenza and pneumococcal vaccination rates in high-risk groups.		
Stockwell et al. (2012) (USA)	RCT	Technology based text messaging intervention	Randomized controlled trial of 9213 children and adolescents aged 6 months to 18 years receiving care at 4 community-based clinics in the United States during the 2010-2011 influenza season.	Parents of children assigned to the intervention received up to 5 weekly immunization registry linked text messages providing educational information and instructions regarding Saturday clinics. Both the intervention and usual care groups received the usual care, an automated telephone reminder, and access to informational flyers posted at the study sites.	Receipt of an influenza vaccine dose recorded in the immunization registry via an electronic health record by March 31, 2011. Receipt was secondarily assessed at an earlier fall review date prior to typical widespread influenza activity. Higher proportion of children and adolescents in the intervention group (43.6%; n=1653) compared with the usual care group (39.9%; n=1509) had received influenza vaccine (difference, 3.7% [95% CI, 1.5%-5.9%]; relative rate ratio [RRR], 1.09 [95% CI, 1.04-1.15]; P=0.001). At the fall review date, 27.1% (n=1026) of the intervention group compared with 22.8% (n=864) of the usual care group had received influenza vaccine (difference, 4.3% [95% CI, 2.3%-6.3%]; RRR, 1.19 [95% CI, 1.10-1.28]; P=0.001).	Among children and adolescents in a low-income, urban population, a text messaging intervention compared with usual care was associated with an increased rate of influenza vaccination.
Usman et al. (2009) (Pakistan)	RCT	Immunisation card and centre-based education	1500 mother-child dyads attending 5 urban EPI centres	A: Redesigned card (n= 375) B: Centre-based education (n= 375) C: Redesigned card + centre-based education (n= 375) Control: Routine care (n= 375) Intervention: Parents were given	Complete uptake of 2nd and 3rd doses of DTP at the end of 90 day follow-up. (aRR = 1.7, 95% CI 1.5 - 2.0), center-based education group (61%) (aRR = 1.5, 95% CI 1.3 - 1.8) and combined intervention	Immunisation uptake was significantly improved in all intervention groups. Reminder cards and centre-based parental

				a redesigned reminder card detailing date and location of their appointment and instructed to place the card in a visible location and/or received a 3 min education session emphasising the importance of immunisation.	group (67%) (aRR = 1.7, 95% CI 1.4 - 2.0).	education significantly increased uptake
Usman et al. (2011) (Pakistan)	RCT	Immunisation card and centre-based education	1506 mother-child dyads attending 6 rural EPI centres	A: Redesigned card (n= 378) B: Centre-based education (n= 374) C: Redesigned card + centre-based education (n= 376) Control: Routine care (n= 378) Intervention: Parents were given a redesigned reminder card detailing date and location of their appointment and instructed to place the card in a visible location and/or received a 3 min education session emphasising the importance of immunisation at the EPI centre.	Complete uptake of 2nd and 3rd doses of DTP at the end of 90 day follow-up. (Adjusted risk ratio aRR = 3.0; 95% CI = 1.7 - 5.3), the centre-based education group (aRR = 3.3; 95% CI = 1.9 - 5.8) and the combined intervention group (aRR = 3.0; 95% CI = 1.7 - 5.4)	Immunisation uptake was significantly improved in all intervention groups. Reminder cards and centre-based parental education significantly increased uptake

3.0 Results

The studies in the review conducted was conducted in various countries with the United States of America (USA) contributing 7 studies, followed by the United Kingdom and Pakistan with 3 studies each and Kenya, Australia, New Zealand and India with 1 study respectively. The lowest number of respondents was 12 while the most was 9213 respondents. All studies were Randomized Control Trial's (RCT's) except for the study by Papachrisanthou, Lorenz, & Loman (2016), which was a Quasi Experimental study. The majority of respondents varied but most were parents or patients who were directly involved or held an interest in the intervention being conducted. The majority of the studies were conducted in developed and high-income countries as the penetration of multi platform use of health intervention through various instruments such as smartphones and Internet are much higher.

Incentive

Various methods for the delivery and reminder of health education has been explored and researched. There is no single golden or definitive method being full proof of achieving maximum improvement of results. This is because the various culture and settings of populations respond differently to different stimuli. Banerjee et al. (2010) conducted the research in India where 34 villages were randomized to one of three groups to determine if improvement on immunization can be achieved via incentives. The 3 groups were once monthly reliable immunization camp, a once monthly reliable immunization camp with small incentives or control with surveys undertaken in randomly selected households at baseline and about 18 months after the interventions started.

Conventional Intervention

Prior to the introduction of technology, most if not all types of intervention done in the conventional way utilized the used of paper or a hard copy print material. This is still available or being utilized in many countries of the world especially in the third world or some developing nations. Matthew et al. (2002) introduced individually tailored immunization cards to his clinical trial in the United States of America and it showed that it did increase the immunization rates in those who received the cards in comparison to those who did not. Usman et al. (2009) in Pakistan utilized this type of intervention by introducing a physical redesigned immunization card to his respondents that participated in the control trial. The study found that the immunisation uptake was significantly improved in all intervention groups and that the reminder cards and centre-based parental education significantly increased uptake of the vaccines. The problem encountered prior to the introduction of this intervention was that in Pakistan parents had a tendency to forget the immunization schedule dates and the reminder cards handed out were dull and not memorable. Usman et al. (2009) developed a redesigned card based on the existing immunization schedule reminder card to make it more attractive and visible. It was then placed in an area where it would be seen daily and this was the refrigerator. The improved rates to the immunization schedule was encouraging that it was followed up 2 years later Usman et al. (2011) with similarly positive results. Utilizing conventional intervention is cheaper and faster for a researcher and is still the choice of many researchers today.

Another method under the conventional intervention is an educational outreach program as shown by Siriwardena et al. (2002). Practices where primary care teams received an educational outreach visit demonstrated a significantly greater improvement in uptake in comparison to those who did not. This has been the practice for many health intervention programs and requires a lot of manpower and skilled workers to ensure that the program is successful. One of the more rudimentary type of conventional intervention was the leaflet as shown by Jacobson et al. (1999) where a simple, low-literacy educational tool increased pneumococcal vaccination rates and patient-physician discussions about the vaccine in an elderly, low-literacy rates, indigent, minority population. Those who received the leaflet were 4 times more likely to improve their understanding and enquire regarding the vaccine in comparison to the control group.

Owais et al. (2011) on the other hand introduced a simple educational intervention designed for low-literate populations, improved DPT-3/Hepatitis B vaccine completion rates by 39%. This intervention was a visually enhanced pictorial diagram targeted for that specific population. It showed that minimal but informative health interventions also had positive outcome. Similarly Papachrisanthou, Lorenz, & Loman (2016) utilized visually enhanced education. By utilizing the picture based to visually enhance the health education, they were able to increase the adherence level at all follow-ups in their intervention groups. Pictorial and images enhance the ability of respondents to commit to memory better than text only health education.

Conventional Reminder

Reminders have been identified in multiple studies to have an impact on the level of acceptance and also positive outcome into any health intervention. In the systematic review conducted there were conventional reminder methods identified and used by researchers. Hawe et al. (1998) found that a significantly greater proportion of children were immunised following receipt of the HBM card compared to the usual reminder card with those receiving it being 4 times more likely to complete. This study showed that health intervention should be accompanied by a reminder to ensure the full sustainability of the health intervention for improvement of positive outcome. Similarly in the study conducted in Australia by Mason and Donnelly (2000) where they used personal reminder letters including an informational leaflet and showed that it did increase MMR uptake compared to routine care to those who did not receive the personal reminder letters.

Technology Based Intervention

Through the progress of technology various researchers have attempted to utilize the use of technology base products for health intervention. The utilization of technology base mediums varies from simple text messaging to complex applications such as tailor-made apps or websites. The incorporation and fusion between health and technology is even more widespread with the exponential penetration of smartphones, laptops, computers and the Internet especially in developing countries. This has resulted in big leaps in healthcare and research.

Brown et al. (1997) utilized the use of a web game that resulted in the improvement of self-efficacy, improvement of communication with parents, improve self-care behavior and reduce in unplanned doctor visits in a group of respondents with diabetes. Through the incorporation of the technology based intervention the children respondents were more likely to remember messages imbedded in the game in comparison to those who received instructions directly from the health care worker. Guendelman et al. (2002) developed an asthma self-management and education program, the Health Buddy, designed to enable children to assess and monitor their asthma symptoms and quality of life and to transmit this information to health care providers through a secure Web site while the control group participants used an asthma diary. His results found that it increased self-managements skills, reduce unnecessary calls to emergency department and improve of self-care behaviors of the respondents.

Patrick et al. (2009) used a less complex method in addressing weight issues by utilizing text messaging and found that Text messages might prove to be a productive channel of communication to promote behaviors that support weight loss in overweight adults. Similarly Stockwell et al. (2012) used text based intervention and found among children and adolescents in a low-income, urban population, a text messaging intervention compared with usual care was associated with an increased rate of influenza vaccination. Rodger et al. (2005) in his study utilized the technology by incorporating the text messages to be sent at specific intervals to help smoking cessation and also smokers to quit. This proved to be successful as the intervention showed more positive results in smoking cessation in comparison to the control group. One of the main highlights of the study was the ability for the technology to be able to deliver messages almost instantaneously to the respondent. This ensured that a strict timetable and repetitive information feeding was possible. It is due to this repetitive and fast delivery that a higher successful health intervention or program can be conducted in comparison to the utilization of standard or conventional methods of delivery. Technology based health intervention are not only relatively cheaper that conventional methods, but it requires less manpower and easy duplication of information to be passed on. Technology based interventions also are more sustainable as most do not utilized the use of paper or any hard medium to transfer information. However even with multiple positive points, it requires the recipient to possess a medium to be able to access the information and may result in those of the marginalized or very low income earners not to be able to benefit from this type of health intervention.

Technology Based Reminder

As with conventional methods, technology based reminder are also on the rise and are seen as being a permanent replacement to conventional reminders. Where conventional reminders usually require a third party to be the logistic partner in the reminder process, more modern technology based reminder directly connects researcher to the recipient. This reduces lag time and also allows the researcher to be in complete control of the entire reminder process in comparison to the conventional method.

Lester et al. (2009) illustrated in the study done in Kenya where the Patients who received SMS support had significantly improved ART adherence and rates of viral suppression compared with the control individuals. The study showed that mobile phones might be effective tools to improve patient outcome in resource-limited settings and be utilized as a

reminder tool. Pop-Eleches et al. (2011) in the study utilized four hundred and thirty-one adult patients who had initiated ART within 3 months were enrolled and randomly assigned to a control group or one of the four intervention groups. Participants in the intervention groups received SMS reminders that were either short or long and sent at a daily or weekly frequency. Adherence was measured using the medication event monitoring system. The primary outcome was whether adherence exceeded 90% during each 12-week period of analysis and the 48-week study period. The secondary outcome was whether there were treatment interruptions lasting at least 48 hours. The study found 53% of participants receiving weekly SMS reminders achieved adherence of at least 90% during the 48 weeks of the study, compared with 40% of participants in the control group. Participants in groups receiving weekly reminders were also significantly less likely to experience treatment interruptions exceeding 48 hours during the 48-week follow-up period than participants in the control group. The SMS reminder is an important tool to achieve optimal treatment response in resource-limited settings.

4.0 Discussion

The study found that that in the group with the most improvement to immunization was those with incentives. This illustrated that in order to achieve a positive outcome to a health program, respondents needed to be incentivized in order to achieve compliance to the health intervention. This was similar to studies conducted by Tones & Green (2004) where it details that an incentive is often necessary for the achievement of a health promotion. In regards to this systematic review, incentive may not necessarily mean monetary or financial gain but a healthier lifestyle or improvement gain that may influence a respondent to better receive and accept a health intervention program.

The different conventional method shown in the review are those that have been implemented over decades and even in advancements in technology it still shows significant results to the delivery of health education. Conventional reminder requires more manpower and takes up a lot of time as it involves physical handling of the medium through various channels. Furthermore, the reminder may not reach its intended recipient as multiple factors including third party delivery that may disrupt the reminder process. This could lead to uncertainty and would require further follow up such as through a telephone call, which would result in double replication. However even with the many reasons of failures or the negative implications of utilizing conventional methods it is still widely used even until today.

There is however a shift being seen in the current trend of health promotion into adapting technology based methods for the delivery of health intervention. One simple method that is becoming more widespread is the utilization of the Short-Messaging-Service (SMS). The reason for this might be the text messaging is a short and direct information medium that highlights only important key points for the respondent to know in comparison with conventional methods where most information routinely start with information and other irrelevant or less important information. Utilizing technology based intervention and reminder would help create a more sustainable development in health promotion and research in Malaysia. It is also a future step that needs to be taken as the current practice of conventional

methods have shown stagnant results especially in the pursuit of adherence. Technology based health education may help bridge the gap and result in a positive outcome to the health intervention.

5.0 Conclusion

The main findings from the systematic review conducted identified two groups of interventions and reminder. They are categorically placed into traditional interventions and reminders and technology based interventions and reminders. Although there are placed into two categories, the main substance of the health education remains the same.

The difference between the two groups is its methods of delivery. While the conventional utilizes systems such as conventional media, pamphlets, posters, telephone calls for the dissemination of information, the technology-based studies utilized the more modern approach of social media, web-based applications and also websites. This represents a shift in the move of health promotion in incorporating new and current technologies to be consistent thus enabling health promotion to adapt to the new environment. However through this systematic review process, its well noted that the majority of these studies that utilized technology based health education were in more developed countries. Developing countries tended to utilize older and more conventional forms of communication in delivering the health education.

Acknowledgements

The authors acknowledge all the participating nurseries in the districts and the cooperation of all the managers and education providers. The Universiti Putra Malaysia (UPM) ethics committee approved the study [UPM/TNCPI/RMC/1.4.18.2(JKEUPM)] and all participants consented by filling up the consent form and declaration prior to the involvement in the study.

Authors' contributions

NAMZ gave insight on the study design as well as the critical revisions of the research. MFR made contributions to the writing of the manuscript, data collection and analysis. MHJ provided idea of the study design and the direction of the study process as well as the re-evaluation of the entire analysis.

References

Banerjee, A. V., Duflo, E., Glennerster, R., & Kothari, D. (2010). Improving immunisation coverage in rural India: clustered randomised controlled evaluation of immunisation campaigns with and without incentives. *Bmj*, 340, c2220.

- Brown, K. F., Shanley, R., Cowley, N. A., van Wijgerden, J., Toff, P., Falconer, M., ... & Sevdalis, N. (2011). Attitudinal and demographic predictors of measles, mumps and rubella (MMR) vaccine acceptance: Development and validation of an evidence-based measurement instrument. *Vaccine*, 29(8), 1700-1709.
- Guendelman, S., Meade, K., Benson, M., Chen, Y. Q., & Samuels, S. (2002). Improving asthma outcomes and self-management behaviors of inner-city children: a randomized trial of the Health Buddy interactive device and an asthma diary. *Archives of pediatrics & adolescent medicine*, 156(2), 114-120.
- Hawe, P., McKenzie, N., & Scurry, R. (1998). Randomised controlled trial of the use of a modified postal reminder card on the uptake of measles vaccination. *Archives of disease in childhood*, 79(2), 136-140.
- Jacobson, T. A., Thomas, D. M., Morton, F. J., Offutt, G., Shevlin, J., & Ray, S. (1999). Use of a low-literacy patient education tool to enhance pneumococcal vaccination rates: a randomized controlled trial. *JAMA*, 282(7), 646-650.
- Lester, R. T., Ritvo, P., Mills, E. J., Kariri, A., Karanja, S., Chung, M. H., ... & Marra, C. A. (2010). Effects of a mobile phone short message service on antiretroviral treatment adherence in Kenya (WelTel Kenya1): a randomised trial. *The Lancet*, 376(9755), 1838-1845.
- Mason, B., & Donnelly, P. (2000). Impact of a local newspaper campaign on the uptake of the measles mumps and rubella vaccine. *Journal of epidemiology and community health*, 54(6), 473.
- Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of internal medicine*, 151(4), 264-269.
- Owais, A., Hanif, B., Siddiqui, A. R., Agha, A., & Zaidi, A. K. (2011). Does improving maternal knowledge of vaccines impact infant immunization rates? A community-based randomized-controlled trial in Karachi, Pakistan. *BMC public health*, 11(1), 1.
- Papachrisanthou, M. M., Lorenz, R. A., & Loman, D. G. (2016). Increasing Immunization Adherence Among Infants of Low-income Parents: The Effects of Visually Enhanced Education. *The Journal for Nurse Practitioners*, 12(5), 304-310.
- Patrick, K., Raab, F., Adams, M., Dillon, L., Zabinski, M., Rock, C., ... & Norman, G. (2009). A text message-based intervention for weight loss: randomized controlled trial. *Journal of medical Internet research*, 11(1), e1.
- Pop-Eleches, C., Thirumurthy, H., Habyarimana, J. P., Zivin, J. G., Goldstein, M. P., De Walque, D., ... & Ngare, D. (2011). Mobile phone technologies improve adherence to antiretroviral treatment in a resource-limited setting: a randomized controlled trial of

text message reminders. *AIDS (London, England)*, 25(6), 825.

Rodgers, A., Corbett, T., Bramley, D., Riddell, T., Wills, M., Lin, R. B., & Jones, M. (2005). Do u smoke after txt? Results of a randomised trial of smoking cessation using mobile phone text messaging. *Tobacco control*, 14(4), 255-261.

Siriwardena, A. N., Rashid, A., Johnson, M. R., & Dewey, M. E. (2002). Cluster randomised controlled trial of an educational outreach visit to improve influenza and pneumococcal immunisation rates in primary care. *Br J Gen Pract*, 52(482), 735-740.

Stockwell, M. S., Kharbanda, E. O., Martinez, R. A., Vargas, C. Y., Vawdrey, D. K., & Camargo, S. (2012). Effect of a text messaging intervention on influenza vaccination in an urban, low-income pediatric and adolescent population: a randomized controlled trial. *Jama*, 307(16), 1702-1708.

Usman, H. R., Akhtar, S., Habib, F., & Jehan, I. (2009). Redesigned immunization card and center-based education to reduce childhood immunization dropouts in urban Pakistan: a randomized controlled trial. *Vaccine*, 27(3), 467-472.

Usman, H. R., Rahbar, M. H., Kristensen, S., Vermund, S. H., Kirby, R. S., Habib, F., & Chamot, E. (2011). Randomized controlled trial to improve childhood immunization adherence in rural Pakistan: redesigned immunization card and maternal education. *Tropical Medicine & International Health*, 16(3), 334-342.