

## A Systematic Review on Health Interventions Used in Enhancing Vaccination Uptake

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### Abstract

**Background:** Vaccine-preventable diseases (VPD) are common causes of morbidity and mortality reported worldwide among children under five years old. However, routine coverage rates for recommended vaccines in many countries are still below the national targets.

**Objective:** To systematically collate and synthesize evidence on public health interventions and strategies used in increasing the childhood vaccination uptake.

**Design:** A systematic literature search was conducted using studies that published in last 10 years. The present study was conducted using electronic search resources (PubMed/MEDLINE, Google scholar and Science Direct) and manually searched of references for evidence present in published studies. The inclusion criteria set was public health intervention studies with aimed to increase vaccine uptake of recommended childhood vaccinations. Two independent authors reviewed studies found for agreement on the quality of studies before it be selected as evidence data. The disagreement was resolved through discussion and the third author was added when necessary for consensus. The quality of study methodology was graded using the Effective Public Health Practice Project qualitative assessment tool for quantitative study.

**Results:** There were 17 of 21 studies were synthesized in the final discussion. Current study found that 76% of the public health interventions studies, used strategies by targeting the parents or guardians while 12% of the interventions targeting the health care workers and the rest is targeting the community. Interventions used in the studies were mobile-based messages (41%), face-to-face parent/community-based (29%), health care service delivery (18%) and internet/the web-based (12%).

**Conclusion:** Improving vaccine uptake using latest technology communication like mobile-based messages or the internet-based for educational intervention should be consider for immediate action in facing vaccination hesitancy. However, these methods are needed further assessment for cost effective. Any strategies used should tailor to target population's need, socio-cultural background, reasons for hesitancy, and the specific organization goals.

**Keywords:** Intervention; Vaccine uptake; Childhood

### Introduction

The communicable disease leads to high morbidity and mortality in children globally. According to WHO (World Health Organisation), it is estimated that communicable diseases such as tetanus, diphtheria, measles and pertussis (which are the vaccine preventable diseases) have cause two to three million deaths each year [1]. In the other hand, the vaccination that leads to immunisation has been proven to be one of the most effective modalities in preventing, eliminating and controlling life-threatening communicable diseases. Vaccine is typically administered to stimulate the children own immune system which hence giving the child immunisation or resistance towards the respective infectious disease. The vaccination programme, since its implementation, is also known to be the most cost-effective health investments. Strategies have been made and outlined for it to be

accessible, even to the vulnerable and the most hard-to-reach population [2]. With clearly defined target groups and outreach activities, it can be delivered effectively without requiring drastic lifestyle changes. Hence, it is easily adaptable and feasible to implement.

Over the past few years, the global vaccination coverage has reported as remained steady. Vaccination coverage was defined as the proportion of children who received the recommended vaccination. In 2015, estimated 116 million (86%) infants globally received three doses of diphtheria-tetanus-pertussis (DTP3) vaccine [2]. This protects them from the infectious diseases which are known to cause serious morbidity and could lead to fatality. From the same year, it is noted that 90% coverage of DTP3 vaccination has been reached by 126 countries. By the end of 2015, 191 countries have been introduced with Haemophilus influenzae type b (Hib) vaccination with an estimation total three doses coverage of 64% across the region. The vast difference

was noted between regions; the America's coverage was estimated to be 90%, the Western Pacific had an estimated coverage of 25% while South East Asia regions had 56% coverage [2]. The Hepatitis B vaccination program for infants had been introduced in 185 countries by the end of 2015 [2]. It is estimated that the global coverage for three doses of hepatitis B vaccine was 83% [2]. In conjunction to that, 96 countries have introduced one dose of hepatitis B vaccine to newborns within the first 24 h of life [2]. However, the global coverage from this introduction is a mere 39% [2]. It is reported that around 85% of children have received one dose of measles vaccination before two years old in 2015 and 160 countries had included a second dose as part of their routine immunisation [2]. Together with measles vaccination were mumps and rubella vaccination which all three were given simultaneously in a shot (MMR vaccine). Other vaccine-preventable diseases coverage like Human papillomavirus (HPV), Polio, Pneumococcal disease and Tetanus had a total worldwide coverage ranging 37% up to 86% [2].

In the Malaysian setting, immunisation programme has been implemented as far as 50 years back with the introduction of DPT vaccine [3]. This was followed by BCG vaccination programme in 1961 and in 1972 the OPV vaccination was implemented. In 1984, the measles vaccination was added and joining in the vaccination schedule was the rubella and hepatitis B vaccination in 1988 and 1989 respectively [3]. Hib vaccination was later introduced in the Malaysia's childhood vaccination program in year 2006 [4] and the latest would be the HPV vaccination which has been administered to 13 years old girls since year 2010 for the prevention of the rising prevalence of cervical cancer. By the end of 2013, Malaysia childhood vaccine coverage for the BCG vaccination was 98%, DPT-Hib was 96%, Polio vaccination coverage for the third dose was 96%, MMR vaccination coverage for toddlers between one to two years old was 95% and Hepatitis B third dose vaccination coverage was 96% [5]. The newly implemented HPV vaccination coverage was 94% before a girl reaches 14 years old [5]. Ministry of Health Malaysia Vaccination Program was delivered in various strategies to save lives and protection against life-threatening diseases. Among the strategies used were the implementation of child integrated services, child home-based book, family doctor concept, home visit for defaulter tracing, appointment visit reminder which aimed to improve coverage. These involved the public-private partnerships to ensure good monitoring.

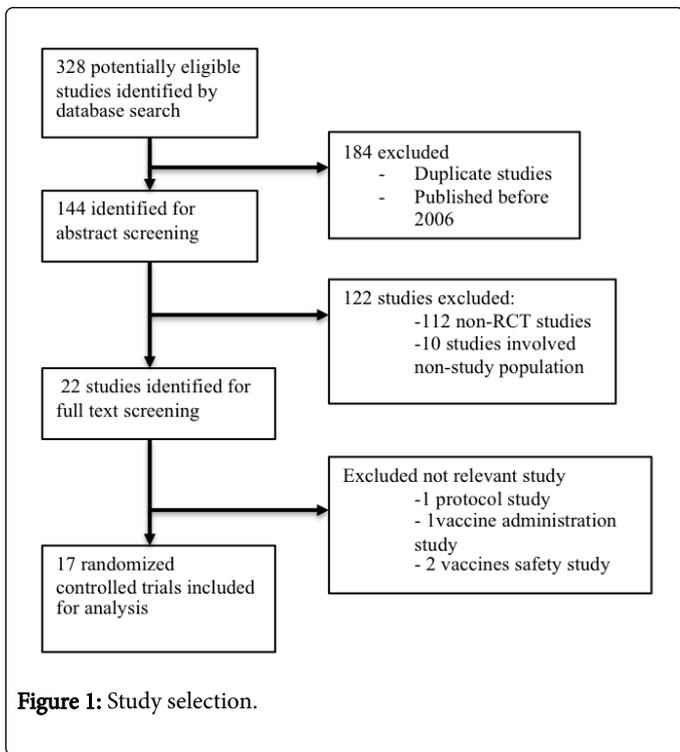
A study by Lim et al. [6] showed that the immunisation refusal rate was 8 per 10,000 children per year and the immunisation defaulter rate was 30 per 10,000 children per year. Various reasons for vaccine refusal explored in that study [6] were believed in alternative treatment and considered homeopathy rather than conventional immunisation due to perceived fewer care providers and long waiting time at the clinic, social media and family influence, and religious or personal beliefs. One third of the total studied sample in that study [6] reflected on unsure of vaccines effectiveness and doubted the vaccine(s) contents. Few of them [6] did highlight on inadequacy of health information obtained from healthcare providers. Having a big number of family varies in children age was noted [6] prone to miss a higher number of vaccines especially the MMR, the third dose of Hep B and third dose of DTaP/IPV/Hib. A known side effect of vaccine was reported as a reason for parental refusal of child vaccination [7]. Some parents changed their minds about delaying or refusing a vaccine was due to doubtful information or an assurance from health care providers was also reported [7]. Recently, social media debut on the anti-vaccine

movement and it has created a threat to public health. Vaccine safety and its benefits should be well explain to parent for them to make right decision. However, poor parental knowledge, present of barriers and misbeliefs towards childhood immunisation were reported in few of local studies [8-12]. Scares local published study in Malaysia reported prevalence of childhood vaccination refusal. However, it has been highlighted in internet-based social-media [13], that many vaccine refusal have constructed their opinions which may influenced parent towards vaccine refusal as some have inappropriate knowledge on immunization [6,8-12]. Studies on the intervention of childhood vaccination uptake shall be carried out as vaccine refusal has become an alarming health issue in Malaysia. Therefore, the goal of this review is to summarise available literature on the effective evidence-based interventions or strategies in increasing childhood vaccination uptake and to identify possible recommendations or strategies that could be implemented in Malaysia.

## Methods

A systematic literature search was conducted to examine published studies on public health interventions that increased vaccination uptake for children under 5 years old. Two independent researchers searched through PubMed/MEDLINE, Google scholar and Science Direct databases using keywords: "caregiver", "healthcare worker", "children", "infant" "not immune-compromised or immune deficiency or low immunity". For exploration on the intervention, the keywords used were "intervention", "promotion", "enhancing", "improve" and "randomized control trial". The keywords to indicate study population such as "developed", "industrialized", "developing", "countries" and "region" were used for comparison. For outcome, the keyword used was "vaccination", "uptake" and "coverage". Boolean operator "OR" was applied in combining search keywords for study population, intervention, comparison, and outcomes, where "AND" was applied in the title and abstract search combining study population, intervention, comparison and outcome. The abstracts identified were screened by a pair of independent reviewers who then discussed to gain consensus on the number of full articles review based on the inclusion criteria. The disagreement was resolved with the presence of a third researcher. Full articles were reviewed by a pair of researchers independently. For this review, only randomized controlled trials, quasi-randomized control trials, pre- and post-intervention studies where the selected intervention can increase vaccination uptake among children under age of five were selected. Studies that involved immune-compromised children, vaccine safety and vaccine efficacy trial were excluded. The outcome of the studies was the increase vaccine uptake or vaccination coverage. Data was extracted using Google form. The variables in the Google form were the year of study, study objective, study design and participation, intervention, outcome and quality of the study methodology. Duplicate study and study which was conducted before 2006 were excluded from the study result.

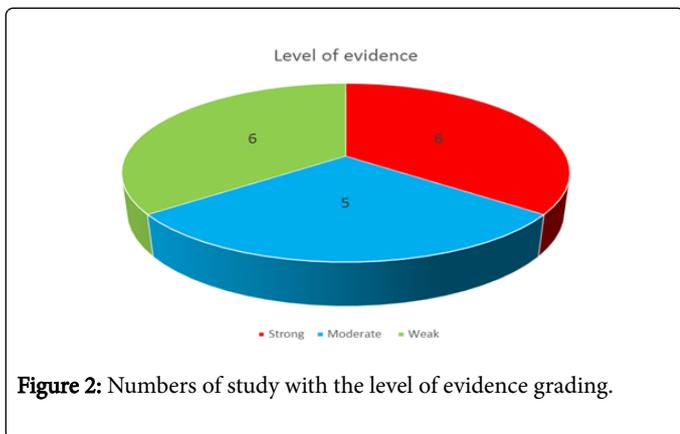
Final studies result and data were reviewed by two independent researchers. The disagreement was resolved through discussion and consensus with the third researcher. The quality of study methodology was graded using qualitative assessment tool for quantitative study by Effective Public Health Practice Project (EPHPP) [14]. The flow process of review was shown in Figure 1.



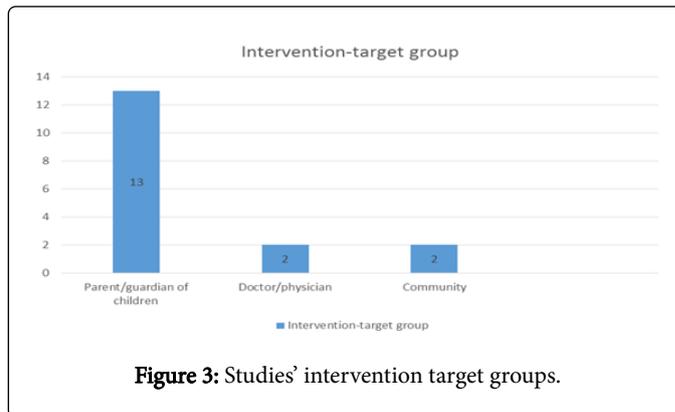
Hand search of unpublished document or reports was not conducted. The use of childhood vaccination policy or enforcement to increase vaccination uptake was not the focus of this review as present review solely focused on ways to improve vaccination as an intervention that can be administered in short time but has shown potential to be implemented in Malaysia.

## Result

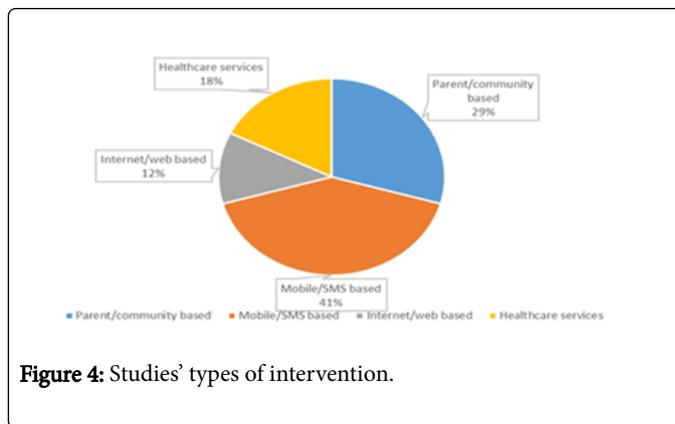
A total of 17 finalized eligible study papers were reviewed and summarized into a table form which consists of title, publication year, author, study design, sample size, intervention target group, intervention specifics, outcome findings and the grade of reviewed evidence (Appendix 1). The studies were analysed and graded for their level of evidence. Six studies were graded to have a strong level of evidence, five studies graded to have a moderate level of evidence, while another six were grouped as weak evidence (Figure 2).



There were three intervention target groups; which were the parents, doctors or physicians, and the community. Thirteen of the studies reported intervention on parents or guardians of children, two studies targeted doctors or physicians and another two studies were targeted community (Figure 3). The majority of the studies were focussed on parents as they were the main persons in laid out the decision-making for their children.



The types of intervention done in the studies to promote vaccine uptake in the society were further grouped into parent or community-based, the internet or web-based, mobile-based and healthcare services. Figure 4 showed that majority of studies were mobile-based (41%), and parent or community-based (29%); while the rest were healthcare-based and internet or web-based (18% and 12% respectively).



## Studies with parent or community-based type of intervention

Referring to Appendix 1, the parent or community-based type of intervention studies were the highest number with a strong level of evidence (Figure 5). The interventions listed were 1) video and written educational intervention that showed a significant finding in increasing knowledge and attitude towards vaccination in vaccine-refusal parents; 2) intervention involving community volunteers which significantly improved child vaccination status; 3) focus group discussion in the community involving teachers and village leaders which significantly increased in child immunisation status ie. Measles vaccination rates; 4) Parent meeting; provision of information, group discussion and coaching exercise which significantly lead to higher child immunisation coverage. No study with parent or community-based type of intervention shows moderate level of evidence. One study has a weak level of evidence which was the study with

intervention involving home visits by volunteers and community mobilisation events involving activities, theatre and discussion groups; which significantly improved general knowledge about vaccination in the intervention group.

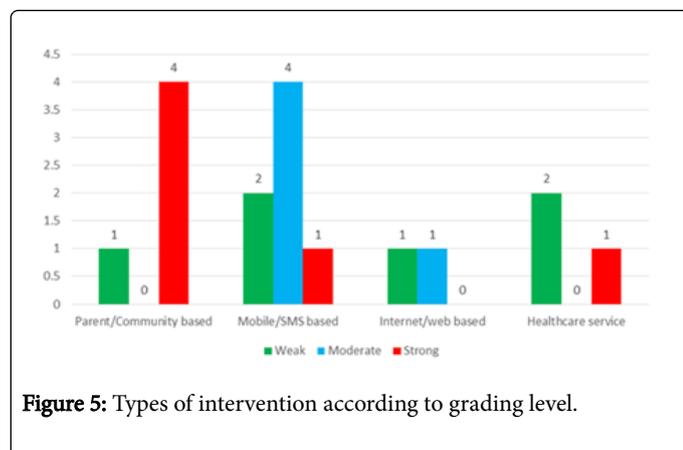


Figure 5: Types of intervention according to grading level.

### Studies with mobile or SMS based type of intervention

Appendix 1 showed that only one study with mobile-based type of intervention had strong level of evidence; which was the educational plus interactive text message reminders on vaccination which lead to increase in child vaccination status. Four studies were using this type of intervention had a moderate level of evidence. The interventions in this group were using short message reminder (SMS) which showed significantly increased immunization coverage at 6 weeks and earlier vaccination in intervention group. However, sending SMS reminder one week before dose resulted in non-statistically significant. Two studies using intervention on text message immunization reminders have a weak level of evidence. One study found significantly more parents who received both Hib reminders attended a recall session compared with parents who only received a mailed reminder and a greater numbers of intervention children received immunizations as scheduled.

### Studies with internet or web based type of intervention

No study with internet or web-based type of intervention has a strong level of evidence. One study using internet or web-based intervention had a moderate level of evidence. That study intervention used educational web pages that were individually tailored to address specific vaccine concerns. It had shown positive vaccination intentions and greater magnitude of change in vaccination intention. One study had a weak level of evidence; which was the study using web-based decision aid. The study used a modified version of the Australian MMR decision aid and was found decisional conflict significantly decreased at post-intervention (Appendix 1).

### Studies with healthcare service intervention

A study found related to healthcare service intervention and had strong level of evidence. It focussed on the physician-targeted communication intervention. Finding of that study showed that the intervention did not reduce maternal vaccine hesitancy or improve physician self-efficacy as fewer physicians in the intervention group reported high confidence in talking about risks, providing information, and answering difficult parent questions. No study with healthcare service intervention has a moderate level of evidence. Two studies in

healthcare intervention scored weak level of evidence. Apparently, both used similar intervention that was the 4 Pillars Immunization Toolkit (Pillar 1: convenient services, Pillar 2: notification on the importance of immunization, Pillar 3: enhanced office system to facilitate immunization and Pillar 4: motivation) [15]. One of these studies showed an increase of influenza vaccine uptake during active intervention and significantly increased in influenza vaccination uptake from pre- to post-intervention for all children (Appendix 1).

### Discussion

Present review of published public health intervention studies on strategies to improve childhood vaccination uptake has reveals the important of technology usage in its health promotion. The result of present review was grouped into health services delivery, the parent and the community through educational intervention. The health service delivery covered the human resources training and supervision, monitoring and evaluation of existing programs that enhancing knowledge transfer through appropriate communication and campaigns. Based on present review analysis, among the most effective intervention were the parent and the community-based intervention. Four studies targeting on educating parents or community have a strong evidence rating. The least effective interventions were internet/web-based educational intervention.

### Population and parents based educational intervention

Face to face communication with parents either individual or in the focus group discussion aimed to educate on their children routine childhood immunization was noted the best approach to improve vaccination uptake. Changing knowledge, attitude, belief, behaviour, and self-efficacy towards making positive decision to vaccinate children has been shown in studies using population and parents based educational intervention [16-19]. Social marketing was described as the process that applies traditional marketing principles and techniques to influence target audience behaviours that benefit society as well as the individual [20]. The healthcare provider can used the social marketing concepts in promoting vaccination uptake either using direct communication to parents or indirectly using the community volunteers, video or informative leaflet. The concept was based on several health behaviour theories, social psychology, marketing science, and communication research. The social marketing has been applied to increase the adolescent HPV vaccination [21] and it had shown that this method had modest impacts on uptake of the HPV vaccine. An effective delivery of information to parents in order to help them make right decision must use multi-dimensional approach like social marketing technique. To enhance the delivery, a good monitoring, reminder systems and feedback-assessment mechanism should be generated has been seen in earlier study to improve vaccination uptake [22,23]. However, variation in the delivery approach on promoting and enhancing knowledge for decision making should be tailored to local population need assessment. It may not suitable for adult vaccination such as a study evaluating an enhanced prenatal and postnatal home visitation programme among 530 low-income women versus regular community care who found no difference in vaccination uptake among them [24]. Therefore, the review has shown that to increase child vaccination uptake is suitable to used population and parents based educational intervention.

## Healthcare services delivery and provider-oriented interventions

Healthcare provider-based intervention has shown an important approach in present review. Earlier review [25] had highlighted the needs to have provider training, development of guidelines, and tools for immunization district managers or computerized provider reminders. Strengthening service delivery system intervention should practice as routine agenda for monitoring and it had shown an improvement in access to the services [26,27]. According to Lin et al. [15], using the immunization toolkit strategies increased the vaccination uptake. The strategies used to improve access to vaccination through convenient express vaccination services, creating opportunities to inform parents about vaccine recommendations, modifying office systems to remind providers, allowing non-physician staff to vaccinate without a specific written order, and encouraging the efforts of office personnel to promote vaccination [15]. However, in some conditions, targeting the healthcare providers alone was not shown effectiveness [28,29].

## Short Message Services (SMS) based interventions

Smartphone and short message reminder (SMS) were used recently as a technique to improve vaccination uptake. Varies results on its effectiveness were reported in studies using these methods of intervention to increase immunization coverage [30-32]. Availability of own smartphone and willingness to provide phone number to receive such reminders, high rate of mobile service loss would be the challenges to face if this technique is considered. A back up with secondary contact information like land-line telephone number, e-mail address and work number should be suggested if this technique is chosen.

## Internet-based educational intervention

Earlier review on interventions to improve adolescent [33] showed consistent findings of its no significant association and it was not recommended as the only approach to cater vaccine hesitancy. However, a study conducted in the US reported that parents conforming to the nationally recommended vaccination schedule were more likely to rank internet as the most important source in their networks as compared with non-conformer parents [34]. Current review related to childhood vaccination uptake using internet found similar findings [35-38].

In Malaysia context, one of obstacle faced was anti vaccination group who disseminate their arguments in their websites. On such sites, misinformation was pervasive. In implementing internet based educational intervention, information through web-based instrument must tailor and suit the target populations. Interact between healthcare providers and parent or community on uncertain information on childhood vaccine safety and benefits through social media, messaging tools or direct communication face to face may increase their awareness, understanding and promote vaccine uptake.

## Conclusion and Recommendation

Present review outlines the evidence-based of the published public health interventions effectiveness in the last 10 years that applied to increase childhood vaccination uptake. Among the most reported significant effective intervention to tackle parents with vaccine refusal was parents based educational intervention. This method will be the

best approach for Malaysia whereby it can be implemented using present strategies like integrated child health clinic visit and family doctor concept approach. However, this approach requires time, manpower, good communication and appropriate negotiation skill to improve parental knowledge, attitude and practice. Establishing a good rapport, understanding of parental background socio-cultural beliefs and practice were recommended by most studies selected in present studies. Ability to examine balanced information with face to face communication and provision of appropriate guidance for good decision making, will strengthened the effort towards positive childhood vaccine uptake. The healthcare providers need to be equipped with adequate knowledge, skills and confident in handling parent who refused childhood vaccination. In overall, single approach may not sufficient to see a significant increase in childhood vaccine uptake. It is also very important to have a written policy on child vaccination as one of public health intervention which no study ever reported its effectiveness. Formulating policy or child act on vaccination for enforcement will take longer time to derive and incurring many agencies such as education, social welfare and women and family ministries.

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