Asian Journal of Health Research
Journal Homepage: https://a-jhr.com
Published by Ikatan Dokter Indonesia Wilayah Jawa Timur

Original Research

Effectiveness of the SIMPOL Web-Based Educational Intervention for Village Midwives in Improving Polio Immunization Coverage: A Quasi-Experimental Study

Ita Susanti[1*], Erlia Rosita[1], Maharani Maharani[2]

[1] Diploma III Midwifery Study Program, STIKes Medika Seramoe Barat, Meulaboh, Aceh, Indonesia
[2] Department of Midwifery, Polytechnic of Health-Ministry of Health, Aceh, Indonesia

ARTICLE HISTORY
Received: 14 May 2026
Revised: 15 June 2026
Accepted: 18 July 2026

CORRESPONDING AUTHOR*
Ita Susanti
itasusanti1990@gmail.com
Diploma III Midwifery Study Program, STIKes Medika Seramoe Barat, Meulaboh, Aceh, Indonesia

KEYWORDS
Counseling; Media; Midwife; SIMPOL; Website

This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (https://creativecommons.org/licenses/by/4.0/)

ABSTRACT

Introduction: Polio is a disease caused by the enterovirus (poliovirus) that attacks the brain's nervous system, causing paralysis in children. Although Indonesia has been a polio-free country since 2014, vigilance against the re-emergence of polio virus cases must still be increased by increasing polio immunization coverage. The use of website-based SIMPOL (Polio Immunization Education) media is one of the best alternatives for village midwives in delivering counseling. This greatly assists the government's program in increasing polio immunization coverage. Website-based media has the ability to disseminate information quickly, practically, and easily accessed, making it easier for village midwives to deliver counseling. Thus, the website-based counseling process is believed to increase public awareness to immunize their children. The purpose of this study is to evaluate the effectiveness of the SIMPOL Web-Based Educational Intervention for Village Midwives in Improving Polio Immunization Coverage.

Material and Methods: This study employs a quasi-experimental design with a one-group pretest-posttest approach.

Results: The mean village-level complete polio immunization coverage increased from 31.05% at baseline to 70.82% following implementation of the SIMPOL web-based educational intervention. This represented a statistically significant increase of 39.78 percentage points (95% CI: 37.58–41.97; $t(23) = 37.44$, $p < 0.001$).

Conclusion: The SIMPOL web-based educational intervention was associated with a significant improvement in complete polio immunization coverage. Integrating SIMPOL into routine health education delivered by village midwives may strengthen polio immunization programs in primary healthcare settings.

Cite this as: Susanti I, Rosita E, Maharani M (2026) Effectiveness of the SIMPOL Web-Based Educational Intervention for Village Midwives in Improving Polio Immunization Coverage: A Quasi-Experimental Study. *Asian J Heal Res.* 5 (2): 146–155. doi: https://doi.org/10.55561/ajhr.v5i2.360

INTRODUCTION

Polio or poliomyelitis is a nervous system disease that can cause sufferers to experience permanent paralysis [1]. Polio is caused by a highly contagious viral infection, but this disease can be prevented by polio immunization [2,3]. Even though the World Health Organization (WHO) has declared Indonesia a polio-free country, vigilance against the emergence of polio cases must be increased [4,5]. With the discovery of cases of paralysis due to positive poliovirus type 2 VDVP in Pidie Regency, Aceh in November 2022 and in West Java in March 2023 [6]. The government will implement an additional polio immunization program simultaneously on April 3, 2023 [7]. as WHO stated that at least four million children must be immunized so that the spread of the disease can be stopped [8,9].

Although basic immunization coverage in Indonesia reached 95.4% in 2023, this figure has not yet met the Renstra target [6]. Cot Seumeureung Community Health Center is one of the health centers in West Aceh with the lowest annual polio immunization coverage in 2024; it will only reach 32.3%. Many people are still hesitant to immunize their children for various reasons, one of which is a lack of information about the importance of immunization [10–14].

Parents believe that immunizations cause their children to develop high fevers and are unaware of how to treat them. Furthermore, the legality of administering vaccines remains questionable. Information and education provided by village midwives have so far been delivered solely through lectures, which are considered ineffective and inefficient, as they miss out on important information. Therefore, in the 2030 Immunization Agenda, the WHO recommends the use of innovative methods, including digital tools, to support increased immunization coverage [9,15,16].

The use of information technology in the form of website-based media is an alternative for delivering effective and efficient counseling [17]. Presenting website-based information using a combination of several features that present interesting text, images and videos as well as the use of language that is easy for the community to understand will certainly make it easier for village midwives to provide counseling, because the website is a practical technological media, easy to access anytime and anywhere, and presents information according to the community's needs so that it is expected to be able to answer problems in the community [18–20]. This process will help increase parents' knowledge and awareness, thereby motivating them to give their children immunizations [21–24]. Thus, the SIMPOL (Polio Immunization Education) media, as a website-based outreach program, has successfully supported the government's program to increase polio immunization coverage.

The website-based SIMPOL media developed in this study was designed based on problems in the community, namely the presentation of material on a complete overview of basic immunization, polio immunization, post-immunization adverse events (KIPI), handling of children with fever after immunization, and fatwa of the Indonesian Ulema Council regarding the law on immunization in children. The presentation of information is designed according to the needs of the community with the design of several features that display material with a combination of text, images and interesting videos, as well as the use of language that is easily understood by the community, so that the website-based SIMPOL media can be used by village midwives in providing counseling to increase community knowledge regarding polio immunization and the coverage of polio immunization can be achieved according to the Renstra that has been set by the government.

To date, there has been no website-based outreach media specifically developed for polio immunization education. Village midwives have typically delivered polio immunization education through lectures, which are considered ineffective and inefficient because the community's limited resources make it difficult to absorb information without the aid of media that presents it in an engaging manner. Indirectly, SIMPOL Media can facilitate the delivery of polio immunization education for village midwives. Therefore, the website-based media developed in this study is an interactive educational medium believed to achieve the desired goals [25,26]. The SIMPOL media in this study focused solely on polio immunization, as polio immunization coverage is considered the lowest, necessitating increased public awareness to prevent the recurrence of polio cases among children. Therefore, this website-based SIMPOL media product will be recommended to the West Aceh District Health Office for implementation in all Community Health Centers.

The aim of this research is to evaluate the effectiveness of the SIMPOL Web-Based Educational Intervention for Village Midwives in Improving Polio Immunization Coverage.

MATERIAL AND METHODS

SIMPOL Web-Based Educational Intervention

The SIMPOL (Polio Immunization Education) web-based educational platform (Version 1.0) was developed as a digital health

education tool to support village midwives in delivering immunization counseling. The platform provides educational content on childhood immunization, with a particular focus on complete polio immunization, including information on the definition and benefits of immunization, the recommended schedule and administration of oral polio vaccine (OPV) and inactivated polio vaccine (IPV), adverse events following immunization (AEFI), management of post-immunization fever, and educational videos. The educational materials were developed based on national and international evidence-based references, including guidelines from the Indonesian Ministry of Health, the World Health Organization (WHO), the Indonesian Pediatric Society (IDAI), the Maternal and Child Health (MCH) Handbook, and the Indonesian Ulema Council (MUI) fatwa on immunization.

Before implementation, all 24 village midwives participated in a half-day orientation that included a website demonstration, discussion, and a simulation on using SIMPOL during immunization counseling. Following the training, the midwives implemented the intervention during routine Posyandu sessions, with each counseling session lasting approximately one hour and scheduled according to local service needs. The intervention targeted mothers of infants aged <1 year, with each midwife reaching approximately 13–43 mothers in their respective villages. SIMPOL was designed for use exclusively by village midwives during health education sessions, was accessible via laptop without login requirements, and was not intended for direct public access. Intervention fidelity was monitored by the research team using website analytics to verify platform utilization throughout the study period (Figure 1).

Study Design and Setting

This study employed a quasi-experimental design using a one-group pretest–posttest approach to evaluate the effectiveness of the SIMPOL (Polio Immunization Education System) web-based educational intervention in improving polio immunization coverage. The study was conducted from July to September 2025 in the working area of Cot Seumeureung Primary Health Center, Aceh, Indonesia. A total of 24 village midwives, each responsible for one of the 24 villages within the health center's catchment area, participated in the study. Before the intervention (pretest), a baseline assessment of polio immunization coverage was conducted for each village using secondary data from the Local Area Monitoring (Immunization) reports. Subsequently, all village midwives received orientation on using the SIMPOL web-based educational platform and implemented it as an educational tool to deliver polio immunization counseling to communities in their respective villages.

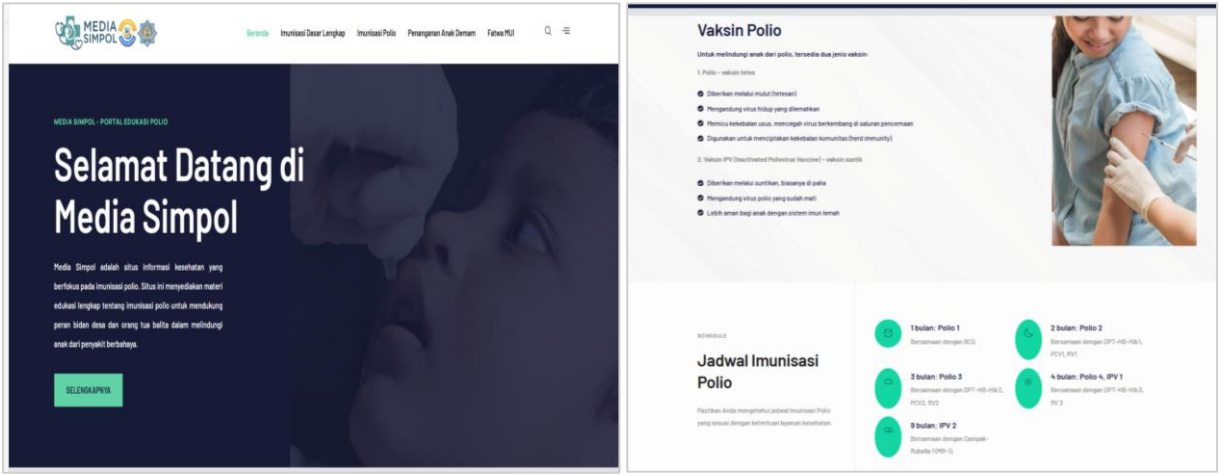


Figure 1. SIMPOL (Polio Immunization Education) web-based educational platform (Version 1.0).

Outcome Measurement and Data Sources

The primary outcome of this study was village-level complete polio immunization coverage, expressed as a percentage (%) for each village. Complete polio immunization was defined as the receipt of the recommended oral polio vaccine (OPV) and inactivated polio vaccine (IPV) according to the Indonesian National Immunization Program among infants aged <1 year. Coverage data were obtained from the routinely compiled Local Area Monitoring (Immunization) reports maintained by the Cot Seumeureung Primary Health Center. Under the Indonesian National Immunization Program reporting system, village-level immunization coverage is routinely calculated as the percentage of eligible infants aged <1 year who received complete OPV and IPV immunization relative to the total target infant population in each village.

The present study used the official village-level coverage percentages reported in the Immunization system for the baseline and post-intervention periods and did not recalculate coverage from individual immunization records. Procedures for updating the target population, including migration, immunizations received outside the study area, duplicate entries, incomplete records, and missing data, were managed in accordance with the Primary Health Center's standard recording and reporting procedures and the Indonesian National Immunization Program. Only complete village-level Immunization reports available for both the baseline and post-intervention periods were included in the analysis. Changes in immunization coverage were reported as percentage-point differences between the baseline and post-intervention assessments.

The Immunization reports are routinely validated by the Primary Health Center before submission to the District Health Office. Duplicate records and incomplete reports were excluded during routine verification. Infants vaccinated outside the study area were recorded in accordance with the official reporting procedures of the Indonesian National Immunization Program. No missing data were identified in the village-level coverage reports used in this study.

Intervention Implementation and Timeline

The orientation and training on the SIMPOL web-based educational platform for the 24 participating village midwives were conducted in May 2025. Following the training, baseline (pre-intervention) data on complete polio immunization coverage were collected from the PWS Immunization reports using coverage data for infants aged <1 year who had received the first dose of oral polio vaccine (OPV1). Beginning in June 2025, all village midwives implemented SIMPOL as a health education tool during routine Posyandu sessions in their respective villages. The intervention was monitored over a three-month period (July to September 2025), during which infants continued to receive subsequent doses of the oral polio vaccine (OPV2, OPV3, and OPV4) and the first dose of the inactivated polio vaccine (IPV1) according to the Indonesian National Immunization Program schedule. Post-intervention immunization coverage was assessed using cumulative village-level coverage data collected from July through September 2025.

Complete polio immunization coverage was calculated using the same cohort of eligible infants aged <1 year throughout the study period. Infants who received delayed vaccinations in the same reporting month were included in the cumulative monthly coverage, in accordance with the routine reporting procedures of the Indonesian National Immunization Program. All 24 villages within the Cot Seumeureung Primary Health Center catchment area met the eligibility criteria and were included in the analysis, with no village excluded, no loss to follow-up, and no missing data. The number of eligible infants ranged from 13 to 38 per village. Participating village midwives were required to be actively assigned to a village, hold at least a Diploma III in Midwifery, possess good communication skills, and participate throughout the study period. Intervention fidelity was monitored through the SIMPOL administrator dashboard by tracking website visitor activity to verify platform utilization, and no major implementation problems were identified during the intervention period.

Statistical Analysis

The unit of analysis comprised the 24 villages within the working area of Cot Seumeureung Primary Health Center. After the intervention (posttest), a post-intervention assessment of polio immunization coverage was conducted using the same secondary data source. Data on polio immunization coverage were extracted from the PWS Immunization reports and analyzed using IBM SPSS Statistics version 25. Data normality was assessed using the Shapiro–Wilk test on the paired differences (post-intervention minus baseline immunization coverage). Because the paired differences were normally distributed ($p > 0.05$), a paired samples t-test was used to compare complete polio immunization coverage before and after the intervention. The paired samples t-test was selected because the study employed a one-group pretest–posttest design in which the same villages were assessed at two time points, resulting in paired observations. A two-sided p-value of < 0.05 was considered statistically significant.

Ethical Approval

This study received ethical approval from the Research Ethics Committee of Institut Nalanda, Jakarta (Approval No. 009/LRPM/EC-IN/VII/2025) in July 2025, prior to data collection. Institutional permission to conduct the study and access routine immunization records was also obtained from the Head of Cot Seumeureung Primary Health Center. This study was funded by the Ministry of Education, Culture, Research, and Technology of Indonesia through the Beginner Lecturer Research Grant 2025 (Decree No. 0070/C3/AL.04/2025; Contract No. 138/LPPM/STIKes.MSB/MBO/VI/2025). The SIMPOL web-based educational platform is protected under Indonesian copyright registration (No. EC002025168477) and was developed exclusively for research and educational purposes. Although the platform requires periodic paid hosting and maintenance to remain operational, it was provided free of charge during the study, and the authors received no financial or commercial benefit from its use. The funding agency provided financial support for this study and had no role in the study design, data collection, data analysis, interpretation of the findings, or preparation of the manuscript.

RESULTS

As shown in Table 1, the mean complete polio immunization coverage increased from 31.05% (SD = 3.15) at baseline to 70.82% (SD = 4.53) following implementation of the SIMPOL intervention. Similarly, the median coverage increased from 31.50% (IQR: 30.85–33.30) to 70.75% (IQR: 68.48–73.73), suggesting an overall improvement in village-level immunization coverage after the intervention.

As shown in Table 2, the paired-samples t-test revealed a statistically significant increase in complete polio immunization coverage following the implementation of the SIMPOL web-based educational intervention. The mean increase in village-level immunization coverage was 39.78 percentage points (95% CI: 37.58–41.97). This improvement was statistically significant ($t(23) = 37.44$, $p < 0.001$), indicating that the SIMPOL intervention was associated with a substantial increase in complete polio immunization coverage across the study villages.

Table 1. Descriptive Analysis of Pretest and Posttest

Measurement Stage	n	Mean ± SD (%)	Median (IQR)
Pretest	24	31.05 ± 3.15	31.50 (30.85–33.30)
Posttest	24	70.82 ± 4.53	70.75 (68.48–73.73)

Source: Secondary Data (2025)

Table 2. Paired Samples t-test Analysis

Outcome	Mean Difference (%)	95% CI	t	df	p-value
Pretest – Posttest	39.78	37.58–41.97	37.44	23	<0.001

Source: Secondary Data (2025)

DISCUSSION

The present study found that complete polio immunization coverage was substantially higher following implementation of the SIMPOL web-based educational intervention than at baseline. Village-level coverage increased from a mean of 31.05% before implementation to 70.82% after implementation, with a mean increase of 39.78 percentage points. This difference was statistically significant (95% CI: 37.58–41.97; $t(23) = 37.44$, $p < 0.001$), indicating that higher immunization coverage was observed following implementation of the SIMPOL intervention in the participating villages.

The observed increase in immunization coverage following implementation of the SIMPOL intervention may be explained by several plausible mechanisms. As a web-based educational platform, SIMPOL provides village midwives with standardized immunization messages, visual educational materials, and video-based learning resources that support more consistent health education during routine Posyandu sessions [27]. The platform also enables repeated access to reliable immunization information, allowing midwives to respond more systematically to parents' questions and concerns regarding vaccine schedules, benefits, and potential adverse events following immunization. These features may have contributed to more consistent counseling and improved communication between healthcare providers and parents. Previous studies have reported that web-based educational media can enhance the quality and consistency of health communication by providing accessible, evidence-based information for both healthcare providers and the communities they serve [28].

These features are consistent with the design of the SIMPOL platform, which was developed to facilitate immunization counseling by village midwives. The website presents polio immunization information through an integrated combination of text, illustrations, educational videos, and user-friendly language, enabling health messages to be delivered clearly and consistently. Such an approach may help parents better understand the importance of complete polio immunization, recommended vaccination schedules, and the management of common concerns following immunization.

The potential advantages of the SIMPOL platform are consistent with findings from previous studies evaluating web-based health education. For example, a study [29] reported that a website-based educational program, combined with face-to-face sessions, was associated with improved adolescents' knowledge of vaccine-preventable diseases and higher vaccination coverage. The authors suggested that providing accessible, evidence-based information through digital media helped clarify disease severity, modes of transmission, vaccination schedules, and vaccine safety, while also reducing concerns about immunization. Although the target population and study outcomes differed from those of the present study, these findings support the potential role of web-based educational media in strengthening health communication and promoting vaccination-related behaviors.

Similar findings have also been reported in other studies evaluating digital health education interventions. For example, a randomized controlled trial [16] found that pregnant women who received an interactive, website-based educational intervention showed higher vaccine acceptance and better infant immunization compliance than those who received conventional lecture-based education. Although that study evaluated vaccine acceptance and immunization compliance rather than village-level immunization coverage, its findings suggest that digital educational platforms may strengthen parental confidence in vaccination and support recommended immunization practices. Together with the present findings, these studies indicate that web-based educational media have the potential to support immunization programs through different pathways, including improving knowledge, increasing vaccine acceptance, promoting adherence to immunization schedules, and facilitating health education delivered by healthcare providers.

Evidence from other populations also supports the potential value of web-based health education. A study by [30], reported that a website-based educational intervention was associated with higher HPV vaccination coverage among female college students. The authors suggested that the

intervention increased participants' awareness of HPV vaccination by providing accessible and reliable health information. Although the study focused on HPV vaccination among young adults, whereas the present study evaluated village-level polio immunization coverage among infants, the findings further suggest that web-based educational platforms may improve awareness and facilitate informed decision-making regarding vaccination in different populations.

Additional evidence suggests that web-based educational interventions may also positively influence attitudes toward vaccination. Previous studies reported that brief web-based educational programs improved public attitudes toward HPV vaccination and increased willingness to consider HPV vaccination for both girls and boys, particularly among fathers [31]. The authors suggested that concise, behaviorally informed online education helped address communication barriers and reduced confusion arising from inconsistent vaccine-related information. Although these studies evaluated attitudes and vaccination intentions rather than actual immunization coverage, they further support the potential role of digital educational platforms in strengthening public confidence and facilitating informed vaccination decisions across different population groups [32,33].

In addition to the characteristics of the intervention, several contextual factors may also have contributed to the higher immunization coverage observed following implementation of the SIMPOL intervention. These factors include the active involvement of village midwives in routine Posyandu activities, community trust in healthcare providers, vaccine availability, local acceptance of immunization, internet accessibility, and the capacity of primary healthcare services. Therefore, the observed findings should be interpreted within the local context of the Cot Seumeureung Primary Health Center rather than being attributed solely to the SIMPOL intervention.

This study has several strengths. It evaluated the implementation of a web-based educational intervention under routine primary healthcare conditions and included all 24 villages within the study area, with no missing data or loss to follow-up. In addition, the use of routinely validated village-level Immunization reports enhanced the completeness and consistency of the outcome data.

Overall, complete polio immunization coverage was substantially higher following implementation of the SIMPOL web-based educational intervention than at baseline. However, because this study employed a one-group pretest–posttest design without a comparison group, the observed improvement cannot be attributed solely to the intervention, and other contextual factors may also have influenced the findings. In addition, the SIMPOL platform requires regular updating of its educational content to ensure consistency with current recommendations and policies of the Indonesian Ministry of Health. Future multicenter studies with larger samples, longer follow-up periods, and appropriate comparison groups are needed to confirm these findings and evaluate the broader applicability of the SIMPOL intervention.

CONCLUSION

This study found a statistically significant increase in complete polio immunization coverage following implementation of the SIMPOL web-based educational intervention. These findings suggest that SIMPOL is a promising digital health education tool that may support routine health promotion activities conducted by village midwives in primary healthcare settings. However, because this study employed a one-group pretest–posttest design without a comparison group, further controlled studies are required to confirm its effectiveness and establish causal inference.

ACKNOWLEDMENTS

We would like to thank the Ministry of Higher Education, Science, and Technology for providing us with research grant funding, enabling us to complete this research. We also extend our gratitude to the LPPM STIKes Medika Seramoe Barat and the Cot Seumeureng Community Health Center for facilitating our research.

CONFLICT OF INTEREST

The authors declare no competing interests. Although the SIMPOL platform was developed by the research team and is protected by intellectual property rights, the authors have not received any commercial or financial benefit from its development or use.

REFERENCES

1. Losey L, Ogden E, Bisrat F, Solomon R, Newberry D, Coates E, et al. The CORE group polio project: An overview of its history and its contributions to the global polio eradication initiative. American Journal of Tropical Medicine and Hygiene. 2019;101(4):4–14. doi:10.4269/ajtmh.18-0916 PubMed PMID: 31760971.
2. Badizadegan K, Thompson KM. Characterization of environmental and clinical surveillance inputs to support prospective integrated modeling of the polio endgame. PLOS Global Public Health. 2025;5(2):1–21. doi:10.1371/journal.pgph.0004168
3. Kementerian Kesehatan Republik Indonesia. Profil Kesehatan. Jakarta; 2023.
4. Kalkowska DA, Thompson KM. Insights From Modeling Preventive Supplemental Immunization Activities as a Strategy to Eliminate Wild Poliovirus Transmission in Pakistan and Afghanistan. Risk Analysis. 2021;41(2):266–72. doi:10.1111/risa.13471 PubMed PMID: 32144841.
5. Kishore N, Krow-Lucal E, Diop OM, Jorba J, Avagnan T, Grabovac V, et al. Surveillance To Track Progress Toward Polio Eradication — Worldwide, 2022–2023. MMWR Morb Mortal Wkly Rep. 2024;73(13):278–85. doi:10.15585/mmwr.mm7313a1 PubMed PMID: 38573841.
6. Kementerian Kesehatan Republik Indonesia, World Health Organization, UNICEF, Polio Global Eridication Initaitive. Laporan Situasi Nomor 5 KLB Virus Polio Jenis cVDPV2 [Internet]. 2023. Available from: https://cdn.who.int/media/docs/default-source/searo/indonesia/polio/bahasa-5-sitrep_cvdpv-ino_who-unicef.pdf?sfvrsn=c11a7589_2
7. Adamu AA, Karamagi H, Wiysonge CS. Monitoring implementation in routine immunisation. The Lancet. 2024;404(10456):932–3. doi:10.1016/S0140-6736(24)01601-5 PubMed PMID: 39244268.
8. Grais RF. Safeguarding immunisation: a core function of WHO. The Lancet. 2025;405(10485):1140–1. doi:10.1016/S0140-6736(25)00577-X
9. World Health Organization. Immunization Agenda 2030: A global strategy to leave no one behind. Geneva: World Health Organization [Internet]. 2022;1–58. Available from: https://www.who.int/immunization/ia2030_Draft_One_English.pdf?ua=1
10. Lieu TA, Zikmund-Fisher BJ, Chou C, Ray GT, Wittenberg E. Parents' Perspectives on How to Improve the Childhood Vaccination Process. Clin Pediatr (Phila). 2017;56(3):238–46. doi:10.1177/0009922816649001 PubMed PMID: 27162178.
11. Mekonnen ZA, Gelaye KA, Were MC, Tilahun B. Mothers intention and preference to use mobile phone text message reminders for child vaccination in Northwest Ethiopia. BMJ Health Care Inform. 2021;28(1):1–9. doi:10.1136/bmjhci-2020-100193 PubMed PMID: 33608258.
12. Hmr A, Glenton C, Lewin S. Parent's and Informal Caregivers' Views and Experiences of Communication About Routine Childhood Vaccination: a synhesis of qualitative evidance (Qualitative Review). Cochrane Library: Database of Systematic Reviews. 2017. doi:10.1002/14651858.CD011787.pub2.www.cochranelibrary.com
13. Daley MF, Narwaney KJ, Shoup JA, Wagner NM, Glanz JM. Addressing Parents' Vaccine Concerns: A Randomized Trial of a Social Media Intervention. Am J Prev Med. 2018;55(1):44–54. doi:10.1016/j.amepre.2018.04.010 PubMed PMID: 29773490.
14. Larson HJ, Gakidou E, Murray CJL. The Vaccine-Hesitant Moment. New England

Journal of Medicine. 2022;387(1):58–65. doi:10.1056/nejmra2106441 PubMed PMID: 35767527.

15. Jo Ann Shoup, PhD, Komal J. Narwaney, PhD, Nicole M. Wagner M. Social Media Vaccine Websites: A Comparative Analysis of Public and Moderated Websites. Health Educ Behav. 2020;46(3):454–62. doi:10.1177/1090198118818253
16. Glanz JM, Wagner NM, Narwaney KJ, Kraus CR, Shoup JA, Xu S, et al. Web-based social media intervention to increase vaccine acceptance: A randomized controlled trial. Pediatrics. 2017;140(6). doi:10.1542/peds.2017-1117 PubMed PMID: 29109107.
17. Mahimbo A, Tiwari P, Abdi I, Seale H, Charania N, Heywood AE. Designing an online educational program to improve immunisation service delivery for migrants and refugees in Australia and New Zealand. Discover Health Systems. 2023;2(1). doi:10.1007/s44250-023-00043-9
18. Gesualdo F, Marino F, Mantero J, Spadoni A, Sambucini L, Quaglia G, et al. The use of web analytics combined with other data streams for tailoring online vaccine safety information at global level: The Vaccine Safety Net's web analytics project. Vaccine. 2020;38(41):6418–26. doi:10.1016/j.vaccine.2020.07.070 PubMed PMID: 32788137.
19. Youhasan P, Henning MA, Chen Y, Lyndon MP. Developing and evaluating an educational web-based tool for health professions education: the Flipped Classroom Navigator. BMC Med Educ. 2022;22(1):1–9. doi:10.1186/s12909-022-03647-6 PubMed PMID: 35915441.
20. De Sousa D, Fogel A, Azevedo J, Padrão P. The Effectiveness of Web-Based Interventions to Promote Health Behaviour Change in Adolescents: A Systematic Review. Nutrients. 2022;14(6):1–24. doi:10.3390/nu14061258 PubMed PMID: 35334915.
21. Choi J, Tamí-Maury I, Cuccaro P, Kim S, Markham C. Digital Health Interventions to Improve Adolescent HPV Vaccination: A Systematic Review. Vaccines (Basel). 2023;11(2). doi:10.3390/vaccines11020249
22. Matta P, El Mouallem R, Akel M, Hallit S, Fadous Khalife MC. Parents' knowledge, attitude and practice towards children's vaccination in Lebanon: Role of the parent-physician communication. BMC Public Health. 2020;20(1):1–9. doi:10.1186/s12889-020-09526-3 PubMed PMID: 32962689.
23. Gendler Y. Development and Appraisal of a Web-Based Decision Aid for HPV Vaccination for Young Adults and Parents of Children in Israel—A Quasi-Experimental Study. Vaccines (Basel). 2023;11(6). doi:10.3390/vaccines11061038
24. Zarekar M, Al-Shehabi H, Dörner R, Weishaar H, Lennemann T, El Bcheraoui C, et al. The impact of information and communication technology on immunisation and immunisation programmes in low-income and middle-income countries: a systematic review and meta-analysis. EBioMedicine. 2025;111:105520. doi:10.1016/j.ebiom.2024.105520
25. Willis E, Gundacker C, Harris M, Mameledzija M. Improving immunization and health literacy through a community-based approach enhanced by technology. Inf Serv Use. 2019;39(1–2):23–36. doi:10.3233/ISU-180027
26. MacDonald NE, Dubé E. Promoting immunization resiliency in the digital information age. Canada Communicable Disease Report. 2020;46(01):20–4. doi:10.14745/ccdr.v46i01a04
27. Pavia G, Branda F, Ciccozzi A, Romano C, Locci C, Azzena I, et al. Integrating Digital Health Solutions with Immunization Strategies: Improving Immunization Coverage and Monitoring in the Post-COVID-19 Era. Vaccines (Basel). 2024;12(8):1–14. doi:10.3390/vaccines12080847
28. Odone A, Gianfredi V, Sorbello S, Capraro M, Frascella B, Vigezzi G Pietro, et al. The use of digital technologies to support vaccination programmes in europe: State of the art and best practices from experts' interviews. Vaccines (Basel). 2021;9(10):1–17. doi:10.3390/vaccines9101126

29. Esposito S, Bianchini S, Tagliabue C, Umbrello G, Madini B, Di Pietro G, et al. Impact of a website based educational program for increasing vaccination coverage among adolescents. Hum Vaccin Immunother. 2018;14(4):961–8. doi:10.1080/21645515.2017.1359453 PubMed PMID: 28853975.
30. Zhang X, Chen H, Zhou J, Huang Q, Feng X yu, Li J. Impact of web-based health education on HPV vaccination uptake among college girl students in Western and Northern China: a follow-up study. BMC Womens Health. 2022 Dec 1;22(1). doi:10.1186/s12905-022-01625-0 PubMed PMID: 35197068.
31. Suzuki Y, Sukegawa A, Ueda Y, Sekine M, Enomoto T, Miyagi E. Effect of a brief web-based educational intervention on willingness to consider human papillomavirus vaccination for children in Japan: randomized controlled trial. J Med Internet Res. 2021 Sep 1;23(9). doi:10.2196/28355 PubMed PMID: 34569941.
32. Chandeying N, Thongseiratch T. Systematic review and meta-analysis comparing educational and reminder digital interventions for promoting HPV vaccination uptake. NPJ Digit Med. 2023 Dec 1;6(1). doi:10.1038/s41746-023-00912-w
33. de Brito KC, de Carvalho Ribeiro da Silva MF, Cardoso CW, Silva LK, Khouri R, de Albuquerque AE, et al. A randomized, controlled trial of a web-based tailored intervention to increase human papillomavirus vaccination among people living with HIV/AIDS. PLoS One. 2025 Mar 1;20(3 March). doi:10.1371/journal.pone.0319646 PubMed PMID: 40163452.