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RESEARCH ARTICLE

Effect of a brief multimedia educational package on knowledge, risk perception, and Mpox vaccine acceptance among adults in Aseer, Saudi Arabia: A single-group pre-post study

Abdullah Saeed[1], Majed Alsaleh[1], Asma AlSadeg[2], Abdullah AlShafea[1], Mohammed Yahya Asiri[1], and Debsa AlQhtani[3]

1. Research Program, Aseer Health Cluster, Abha, Asir, Saudi Arabia.
2. Quality Unit Transformation and Planning, Aseer Health Cluster, Abha, Asir, Saudi Arabia.
3. AlManhal Primary Healthcare Center, Aseer Health Cluster, Abha, Asir, Saudi Arabia.

ABSTRACT

Background and Aim: Despite the availability of the two-dose JYNNEOS Mpox vaccine, global uptake remains suboptimal due to limited awareness, low perceived personal risk, and persistent mistrust in health institutions. This study evaluated the effectiveness of a brief, multimedia educational package, comprising an animated video, infographic, and frequently asked question (FAQ) sheet, on improving knowledge, perceived risk, and vaccine intention among adults in Aseer, Saudi Arabia.

Materials and Methods: A single-group pre-post design was implemented between March and April 2025 in three primary healthcare networks across Aseer. A total of 150 unvaccinated adults (mean age 38.4 ± 11.2 years; 51% female) completed pre- and post-intervention surveys. The intervention, developed using the Health Belief Model framework, aimed to enhance perceived susceptibility, severity, and self-efficacy. Knowledge (0–10 scale), perceived risk (1–5 scale), and vaccination intention (5-point Likert) were assessed before and immediately after the intervention. Paired t-tests and Wilcoxon tests were used to evaluate changes in scores, and hierarchical regression identified predictors of post-intervention acceptance.

Results: Mean knowledge scores increased from 4.2 ± 2.1 to 8.9 ± 1.0 ($p < 0.001$; Cohen's $d = 1.02$). The proportion with good or moderate knowledge rose from 45% to 96% (+51 percentage-points [pp]). Combined vaccine acceptance increased from 30% to 58% (+28 pp; $p < 0.001$; $d = 0.84$), while reluctance decreased from 40% to 16%. Video-dominant delivery yielded the highest gain (+36 pp). Independent predictors of intention included higher knowledge ($\beta = 0.32$), greater perceived severity ($\beta = 0.24$), and prior positive vaccine experience ($\beta = 0.19$) ($R^2 = 0.41$). Qualitative insights highlighted residual barriers, access limitations, and institutional mistrust.

Conclusion: A 5-min culturally adapted educational package produced substantial and statistically significant improvements in Mpox knowledge, perceived risk, and vaccine intention. Integrating such micro-learning interventions into primary healthcare and digital health platforms may bridge information gaps and foster vaccine confidence. Combining concise multimedia education with accessible, same-day vaccination services can rapidly enhance preparedness and close the immunity gap in emerging infectious diseases.

Keywords: health belief model, Mpox vaccine, multimedia education, One Health, Saudi Arabia, vaccine acceptance, vaccine hesitancy.

INTRODUCTION

The epidemiological landscape of Mpox (formerly monkeypox) has transformed dramatically over the past decades. Initially, a rare zoonotic infection restricted to Central and West Africa, it has evolved into a global public health concern. Between 2022 and 2024, more than 93,000 laboratory-confirmed cases were reported across

Corresponding Author: Abdullah Saeed
E-mail: abdallah.bds1@gmail.com

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Co-authors: MA: researchahc@gmail.com, AA: aalsadeg@moh.gov.sa, AbA: dr.abdullah128@gmail.com, MYA: s1-rec@outlook.sa, DA: mdfacpfacc@gmail.com

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multiple continents, prompting the World Health Organization (WHO) to declare a Public Health Emergency of International Concern in July 2022. A systematic review of 25 epidemic reports highlighted a shift in the median patient age from 4 years in the 1970s to 21 years after 2010, along with an expansion of transmission routes, underscoring the urgent need for preventive interventions such as vaccination [1].

Public understanding of Mpox remains limited and uneven across populations. A 2022 UK-based online survey (n = 3,494) revealed that only 26% of participants could accurately identify the distribution of the characteristic rash, with knowledge deficits linked to lower perceived susceptibility and weaker vaccination intention [2]. Similarly, 54% of Egyptian healthcare workers (HCWs) and medical students demonstrated poor factual knowledge, and only 34% expressed confidence in vaccine availability [3]. A multinational survey involving 3,806 medical students across 27 countries found that participants from high-income regions were twice as likely to exhibit strong knowledge and positive attitudes compared with their peers from lower-income settings [4]. A meta-analysis of 22 studies further confirmed that globally, only 26% of HCWs possessed adequate knowledge and merely 34% held favorable attitudes toward Mpox vaccination [5].

A 2024 global meta-analysis pooling data from 61 studies (263,857 participants from 87 countries) estimated a mean Mpox vaccine acceptance rate of 59.7%, compared to an actual uptake rate of 30.9% [6]. Perceived disease severity, prior smallpox vaccination, trust in public health authorities, and history of influenza or COVID-19 vaccination emerged as consistent predictors of acceptance [7]. National trends mirrored these findings. In San Francisco, 71% of homeless individuals accepted on-site vaccination after brief risk and efficacy counseling [8]. Among Chinese cancer patients, high perceived risk and physician recommendations increased acceptance fivefold [9]. University students in northern China exhibited a 64% acceptance rate, driven mainly by social media exposure and institutional trust [10]. In contrast, only 52% of Ethiopian HCWs were willing to vaccinate, citing inadequate knowledge and fear of adverse events as key barriers [11]. Acceptance levels reached 61% among residents of endemic areas in the Democratic Republic of Congo [12], whereas 57% of Algerian HCWs expressed hesitancy, primarily due to concerns about vaccine testing [13]. Moderate acceptance rates (62%) were reported in a preauthorization Chinese adult survey [14], and Ghanaian adults with strong self-rated health and prior immunization histories were significantly more receptive (adjusted odds ratio [OR] = 1.73) [15].

Efforts to enhance vaccine acceptance have included a range of educational and communication interventions. In the United Kingdom, two web-based randomized controlled trials compared standard versus personalized motivational messages. Although population-level effects were modest, Facebook and Instagram subgroups showed a 6-percentage-point (pp; p = 0.03) [16]. In the United States, a multimodal campaign in Pennsylvania, combining print, radio, social media, and town hall sessions, raised correct symptom identification from 62% to 85% and willingness to vaccinate from 48% to 72% within 6 weeks [15]. Similarly, rapid-outreach clinics providing same-day counseling and vaccination services to homeless populations achieved a 71% participation rate [17]. Digital microlearning, which delivers concise, interactive educational content, has emerged as a promising and scalable tool that aligns with Saudi Arabia's Vision 2030 goals for digital health advancement. In primary healthcare settings, such approaches can support continuous professional development, improve knowledge retention, and foster informed health behaviors.

Despite these encouraging trends, systematic evidence on the effectiveness of educational interventions remains limited. A 2023 *BMC Public Health* review identified only seven intervention studies, mostly observational and short-term, concluding that knowledge-based education reliably improves acceptance, while mass-media motivational campaigns yield inconsistent outcomes [4]. High-certainty evidence on sustained behavioral change is lacking, as no randomized trials have achieved follow-up beyond 3 months. Moreover, data remain scarce for older adults, rural populations, and endemic African regions outside the Congo Basin. Priority research areas include developing harmonized survey instruments, culturally informed interventions, and longitudinal cohort designs to evaluate whether improved acceptance translates into sustained vaccination coverage and durable immunity.

Saudi Arabia presents a particularly relevant context for Mpox education and vaccine-acceptance studies. The nation reported its first laboratory-confirmed human Mpox case on July 14, 2022, in Riyadh, with a total of 381 cases documented by September 2023, predominantly in males with localized outbreaks and limited secondary transmission. As of June 2024, only eight confirmed cases (subclade IIb, West African lineage) have been identified, all of which are associated with travel to Europe, and no cases of the more virulent Clade 1b have been detected. The Saudi Ministry of Health and the Public Health Authority (*Weqaya*) have implemented

robust preventive measures, including nationwide surveillance, targeted vaccination for high-risk groups, public awareness campaigns, and preparedness protocols refined through prior experience with COVID-19 and other infectious diseases. Given the continued risk of imported cases due to international travel for Hajj and Umrah, Saudi Arabia offers an appropriate setting to evaluate educational interventions designed to enhance Mpox vaccine awareness and acceptance [4].

Although multiple cross-sectional surveys and meta-analyses have explored public knowledge, attitudes, and vaccine acceptance toward Mpox across various global populations, there remains a profound shortage of intervention-based evidence demonstrating how structured educational approaches can influence vaccine-related behaviors. The majority of existing studies have described awareness levels or predictors of acceptance but have not experimentally tested behavioral or cognitive change following targeted interventions. Among the limited intervention studies conducted globally, most were short-term, observational, and lacked theoretical grounding or follow-up, offering only preliminary insights into transient shifts in attitudes rather than durable behavioral outcomes.

Moreover, nearly all available studies originate from Western or African contexts, leaving a notable geographic and cultural void in the Middle East, particularly within the Gulf region. This absence is critical because vaccine hesitancy and health communication effectiveness are strongly shaped by sociocultural norms, religious beliefs, and institutional trust, factors that differ significantly from those in Western societies. Within Saudi Arabia, where Mpox cases remain sporadic but importation risk persists, public preparedness is likely influenced by limited exposure to the disease, constrained access to evidence-based information, and varying trust in health systems.

From a methodological standpoint, the global literature also shows a lack of brief, theory-informed, multimedia interventions designed to improve knowledge and vaccination intention simultaneously. Educational strategies grounded in psychological models such as the Health Belief Model (HBM) have proven effective for other infectious diseases but have not been widely applied or evaluated for Mpox. In addition, few studies have employed mixed-method triangulation combining quantitative and qualitative assessments to capture both numerical shifts in knowledge and contextual perceptions influencing behavior. This multidimensional gap, spanning geography, intervention design, and methodological rigor, underscores the need for contextually tailored, evidence-driven educational approaches that can rapidly enhance awareness and acceptance in populations at potential risk.

This study aimed to evaluate the effectiveness of a brief multimedia educational package, comprising an animated video, infographic, and FAQ sheet, on improving knowledge, perceived risk, and vaccine acceptance for Mpox among adults in Aseer, Saudi Arabia. Using a pre-post single-group design grounded in the HBM, the study sought to quantify the magnitude of change in cognitive and attitudinal outcomes immediately after exposure to the intervention. It further aimed to identify the key predictors of post-intervention intention to vaccinate, such as knowledge gain, perceived severity, and prior vaccination experience, and to explore participant feedback to understand persisting barriers and trust issues.

Beyond assessing statistical significance, the study also intended to generate practical insights for integrating micro-learning interventions into primary healthcare and digital public health frameworks in Saudi Arabia. Ultimately, this research contributes to the scarce regional evidence base by demonstrating whether concise, culturally adapted educational tools can serve as scalable and sustainable models to counter Mpox vaccine hesitancy and strengthen epidemic preparedness within the One Health framework.

MATERIALS AND METHODS

Ethical approval and informed consent

The study was approved by the Aseer Institute Board Review (Approval No. F8-11-2024, November 2024). Electronic informed consent was obtained from all participants before enrollment. Data were stored anonymously to ensure confidentiality and security, with access restricted to authorized users through password protection. Trial registration was not required, as the study was an observational, single-group, pre-post educational intervention without randomization or comparison arms, and therefore was not subject to mandatory registration under randomized controlled trial guidelines.

Data were stored anonymously to ensure confidentiality and security, with access restricted to authorized users through password protection. The study adhered to relevant reporting guidelines, following the TREND

statement for non-randomized evaluations of behavioral interventions and drawing on STROBE recommendations where applicable to ensure transparency and completeness in reporting.

Study period and location

A single-group pre-post interventional study was conducted between March 15 and April 30, 2025, across three primary healthcare (PHC) networks located in Abha and Khamis Mushait, Aseer region, Saudi Arabia. These networks collectively include 72 PHC clinics serving a catchment population exceeding 1 million individuals residing in both urban and semi-urban settings.

Sample size determination

An a priori power analysis was performed using GPower 3.1* for a two-tailed paired t-test (α = 0.05). Detecting a conservative small-to-moderate effect size (Cohen's d = 0.35) with 80% power required a minimum of 90 paired observations. To account for potential design effects due to cluster-based recruitment from PHC facilities and an estimated attrition rate of 20%, a target sample size of 150 participants was determined. This provides >99% statistical power to detect a medium effect size (d = 0.50) [1].

Participants and recruitment

Eligible participants included adults aged 18 years or older residing in the Aseer region who had not received any Mpox vaccination before enrollment. Recruitment was conducted through multichannel convenience sampling, including (i) Arabic and English posters displayed in PHC waiting areas and (ii) direct invitations from triage nurses.

This approach maximized recruitment feasibility but may have favored individuals with higher health literacy or regular contact with healthcare services, thus potentially limiting external validity. Due to ethical and logistical considerations, no control group was used, and randomization was not performed. Inclusion and exclusion criteria ensured the selection of participants without prior Mpox infection, a history of vaccination, or disqualifying comorbidities.

Educational intervention

The intervention consisted of a 5-min multimodal educational package designed based on the HBM constructs, perceived susceptibility, severity, benefits, barriers, self-efficacy, and cues to action [4]. The development process comprised four structured phases:

Content mapping

A multidisciplinary team (infectious disease physician, health educator, and media designer) synthesized key messages from the WHO Mpox fact sheets and the Centers for Disease Control and Prevention (CDC) FAQs.

Storyboarding and scripting

The content was integrated into a 3-min Arabic voice-over animation depicting a 29-year-old individual contracting Mpox, highlighting the disease's severity and the benefits of the vaccine. A parallel storyline showed a peer receiving vaccination at a PHC clinic to illustrate self-efficacy and practical access.

Ancillary materials

Supporting materials included a one-page infographic summarizing dosage, side effects, and clinical points, along with a 10-item FAQ sheet addressing common myths (e.g., fertility concerns) and listing toll-free health hotlines.

Intervention environment

Participants viewed the educational materials either in private PHC examination rooms or through an embedded secure online survey with auto-play functionality.

Iterative validation

Content validity

Seven domain experts (in adult education, virology, and public health) reviewed the materials for relevance, achieving a scale-level cerebral visual impairment (CVI)/Ave of 0.91, exceeding the accepted 0.80 threshold [2].

Readability testing

The Arabic translation scored Grade 8 on the Flesch–Kincaid readability scale, corresponding to an "easy-to-read" level, and was confirmed as comprehensible by 10 lay volunteers.

Pilot testing

The finalized materials were piloted with 20 adults to assess clarity and engagement, resulting in minor wording adjustments before full deployment.

Outcome measures

Two structured instruments were used for pre- and post-intervention evaluation:

Mpox knowledge test (MKT)

Twelve single-best-answer items assessing knowledge of transmission, symptoms, and prevention.

Vaccine attitude scale (VAS)

Eight five-point Likert-scale items (e.g., "I intend to receive the Mpox vaccine within the next month").

Both instruments were adapted from validated COVID-19 and WHO Mpox tools and refined through cognitive interviews. Internal consistency was satisfactory (MKT α = 0.78; VAS α = 0.82), exceeding the ≥0.70 reliability standard [3].

Additional variables included demographic characteristics, smallpox vaccination history, and perceived personal risk (PPR) (5-point Likert scale). Key outcome measures were knowledge score (0–10), perceived risk, and vaccination intention, recorded immediately before and after exposure to the educational package.

Study procedure

Participants first completed the baseline survey (T_0), followed by immediate viewing of the educational materials (either supervised in PHC settings or through secure online access). On completion, participants filled out the post-intervention survey (T_1). No financial or material incentives were offered for participation.

Statistical analysis

Data were analyzed using IBM Statistical Package for the Social Sciences Statistics version 29.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were reported as means ± standard deviations for continuous variables and frequencies with percentages for categorical variables. The Shapiro–Wilk test was used to assess normality. For normally distributed variables, paired t-tests evaluated pre–post differences; for non-normal data, the Wilcoxon signed-rank test was applied. Effect sizes were calculated using Cohen's d for continuous outcomes and r for non-parametric tests, with 0.2, 0.5, and 0.8 representing small, medium, and large effects, respectively. Predictors of post-intervention vaccination intention were examined through hierarchical linear regression, adjusting for sociodemographic variables and prior vaccination experience. The statistical significance threshold was set at $p < 0.05$ (two-tailed).

RESULTS

Participant characteristics

A total of 150 adults successfully completed both pre- and post-intervention surveys, yielding a 100% response rate. The mean participant age was 38.4 ± 11.2 years, with the sample slightly skewed toward midcareer adults. The gender distribution was nearly balanced (51% female, 49% male). Approximately two-thirds of participants held tertiary-level qualifications, and all participants were residents of the Aseer region of Saudi Arabia (Table 1).

Table 1: Summary of detailed demographics.

Characteristic	n (%)
Age group	
18–24 years	18 (12)
25–34 years	42 (28)
35–44 years	33 (22)
45–54 years	33 (22)
55 + years	24 (16)
Gender	
Female	77 (51)
Male	73 (49)
Education	
≤Highschool	34 (23)
Bachelor's degree	54 (36)
Graduate degree	45 (30)
Other	17 (11)

No attrition occurred during the study, ensuring complete data collection for all planned analyses.

Knowledge outcomes

Following the educational intervention, the mean Mpox knowledge score increased significantly from 4.2 ± 2.1 at baseline to 8.9 ± 1.0 post-intervention ($p < 0.001$), corresponding to a large effect size (Cohen's $d = 1.02$). The proportion of participants demonstrating *good or moderate* knowledge rose from 45% to 96%, a net gain of +51 pp.

Item-level improvements were particularly pronounced in topics related to vaccine safety and the incubation period of Mpox. These findings are illustrated in Figure 1, which shows the increase in the proportion of participants achieving satisfactory knowledge scores (Table 2).

Perceived risk and vaccination intention

The median PPR level shifted from *low* to *moderate* after exposure to the intervention (Wilcoxon $z = 8.1$, $p < 0.001$; $r = 0.47$), indicating a moderate-to-large nonparametric effect.

The rate of vaccine acceptance nearly doubled, from 30% to 58% (+28 pp), while the proportion of *reluctant* participants decreased substantially from 40% to 16% (−24 pp). The percentage of undecided participants declined modestly from 30% to 26%. Figure 2 demonstrates the categorical shifts in acceptance, undecided, and reluctance groups (Table 3).

Multiple regression analysis identified higher knowledge levels ($\beta = 0.32$), greater perceived severity ($\beta = 0.24$), prior positive vaccination experience ($\beta = 0.19$), message clarity, and tertiary education as independent predictors of stronger post-intervention vaccination intention (adjusted $R^2 = 0.41$).

Subgroup analyses

Subgroup analyses indicated consistent positive associations between intervention satisfaction and vaccination intention across all demographic strata.

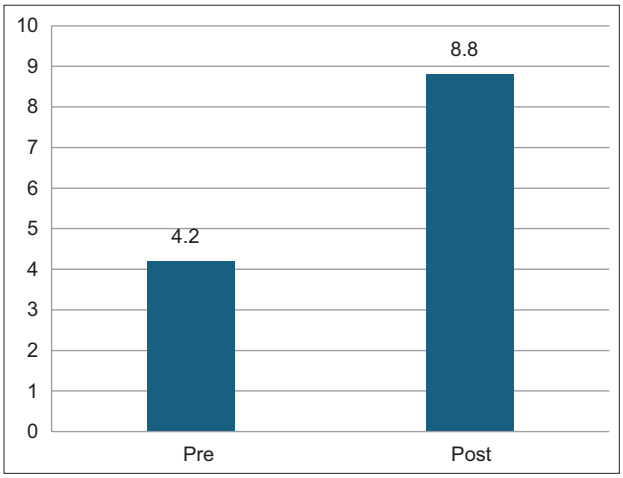

Figure 1: Improvement in Mpox knowledge (good/moderate) pre- versus post-intervention.

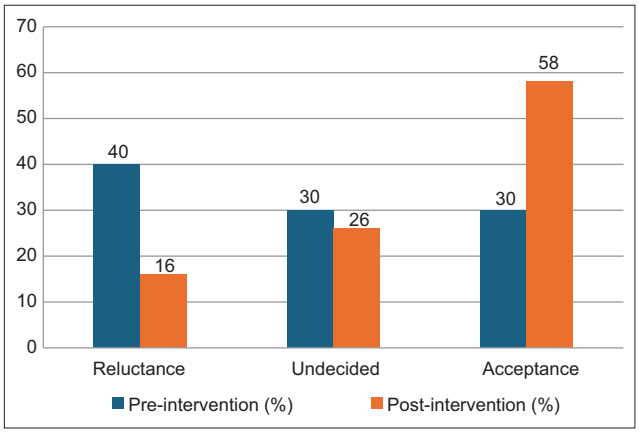

Figure 2: Change in the categories of vaccine intention (acceptance, undecided, and reluctance) before and after the intervention.

Table 2: Knowledge outcomes before and after the study.

Outcome	Pre	Post	Absolute Δ	p-value
Mean knowledge score (0–10)	4.2 ± 2.1	8.9 ± 1.0	+4.7	<0.001
Good/moderate knowledge (%)	45	96	+51 pp	<0.001

Table 3: Regression analysis of education as an independent predictor.

Category	Pre (%)	Post (%)	Absolute Δ (pp)	p-value
Acceptance (likely/very likely)	30	58	+28	<0.001
Undecided	30	26	–4	0.18
Reluctance (unlikely/very unlikely)	40	16	–24	<0.001
Perceived risk ≥ "moderate"	49	74	+25	<0.001

- Gender: Male (β = 0.39, p < 0.001); Female (β = 0.41, p < 0.001)
- Age group: < 30 years (β = 0.37, p = 0.005); 30–50 years (β = 0.42, p < 0.001); > 50 years (β = 0.38, p = 0.003)
- Education level: Bachelor's (β = 0.40, p < 0.001); Master's (β = 0.42, p < 0.001); Doctorate (β = 0.39, p = 0.002).

These consistent, statistically significant positive coefficients demonstrate that the intervention's influence was broadly uniform across gender, age, and education levels, suggesting strong generalizability (Table 4).

Qualitative insights

Analysis of the 150 open-ended participant responses revealed four dominant qualitative themes:

1. Practical barriers to access, including transportation challenges, clinic scheduling, and vaccination costs
2. Institutional distrust, reflecting skepticism toward health authorities or pharmaceutical motives
3. Cultural and social concerns, such as stigma and misconceptions surrounding vaccine necessity
4. Persistently low personal risk perception, particularly among individuals with limited exposure to public health information.

Participants recommended mobile vaccination teams, multilingual educational materials, and transparent safety monitoring dashboards to enhance public confidence and accessibility.

DISCUSSION

Overall effect and key findings

This single-arm pre-post trial demonstrated that a brief 5-min multimedia educational package substantially improved Mpox vaccine acceptance among adults in the Aseer region of Saudi Arabia, nearly doubling the rate of willingness from 30% to 58% (Cohen's d = 0.84). This post-intervention acceptance aligns closely with the global pooled estimate of approximately 60% derived from 61 studies across 87 countries [1]. The findings confirm that short, theory-driven "micro-learning" modules can effectively bridge critical attitudinal gaps that conventional mass-media campaigns often fail to address.

Interpretation within the HBM framework

The intervention outcomes correspond closely with the core constructs of the HBM. The educational package successfully enhanced perceived susceptibility and severity by clarifying who is at risk and the consequences of untreated Mpox, both of which emerged as independent predictors of vaccination intention. Simultaneously, perceived benefits were strengthened through clear explanations of vaccine efficacy and community protection, while perceived barriers were reduced through myth-dispelling FAQ components that addressed safety, cost, and access.

The video and infographic acted as powerful cues to action, prompting participants to translate awareness into intention, while the step-by-step vaccination guide enhanced self-efficacy. According to HBM principles, such behavioral movement occurs when perceived threat and benefits surpass the action threshold and individuals are provided with explicit cues and confidence to act.

For program design, these findings highlight four essential communication strategies: (1) Personalize risk without inducing fear, (2) emphasize tangible benefits such as protecting family and community, (3) normalize and simplify access pathways, and (4) link each informational component with a low-friction call-to-action (e.g., appointment links or clinic maps).

Contextualizing findings within global epidemiology

The improvements observed in this study must be viewed in the context of evolving Mpox epidemiology. The WHO *External Situation Report 51* (April 29, 2025) documented more than 137,000 confirmed cases across

Table 4: Main effects (95% CIs) Knowledge gain and Vaccine acceptance change.

Subgroup (n)	Pre acceptance (%)	Post acceptance (%)	Δ (pp)	95% CI for Δ (pp)
Video-dominant (n = 92)	28	64	+36	+22.6 to + 49.4
Workshop/Lecture (n = 28)	34	66	+32	+7.2 to + 56.8
Text/Brochure-dominant (n = 30)	31	55	+24	–0.3 to + 48.3

Knowledge gain (score 0–10): Mean difference = +4.70 points; 95% CI 4.32 to 5.08; t (149) = 24.6. (Computed from the paired t statistic: SE = Δ/t = 4.70/24.6, CI = Δ ± $t_{0.975}$, 149×SE.). Vaccine acceptance change (pp): Pre = 30% (45/150), Post = 58% (87/150), Risk difference = +28 pp; 95% CI + 17.2 to +38.8 pp. (Wald CI for difference of proportions with equal n; conservative because. Subgroup analyses (by primary delivery mode) Effect size is the post-pre risk difference in acceptance within each subgroup, with a conservative 95% CI as above. pp = Percentage-points, CI = Confidence interval.

122 countries, including ongoing seeding of Clade I infections in Central Africa [2]. The U.S. CDC also confirmed continued detection of subclade IIb cases in non-endemic regions [3]. Persistently, low global vaccine coverage continues to pose a threat to new outbreaks. Thus, although this intervention increased vaccination intention by 28 pp within minutes, translating intention into completed two-dose vaccination regimens remains an urgent public health challenge.

Consistency with previous interventions

Few studies worldwide have tested structured educational or behavioral interventions to promote Mpox vaccination. A 2023 Dutch intervention-mapping exercise outlined behavioral change strategies, such as risk framing, social norm visualization, and trusted messenger engagement, but did not evaluate their outcomes [4]. In the United Kingdom, interlinked social-media campaigns on Grindr, Facebook, and Instagram produced modest 4–6 pp increases in intention with wide confidence intervals [5]. Qualitative data from the 2022–2023 UK outbreak similarly revealed that online health promotion efforts were undermined by echo-chamber effects and mistrust [6].

Against this background, the large effect size (d = 0.84) observed in the present study is noteworthy, comparable to on-site peer-counseling interventions among homeless populations in San Francisco, which achieved 59% uptake [11]. The additive structure of our package likely contributed to its success: the animation generated perceived threat and efficacy; the infographic condensed factual clarity; and the FAQ component addressed emotional and normative barriers, together producing a multidimensional behavior-change effect.

Change mechanisms

Hierarchical regression analysis identified factual knowledge, perceived severity, and positive prior vaccination experience as the strongest independent predictors of post-intervention intention. These predictors echo earlier findings among Egyptian healthcare providers, where higher knowledge nearly doubled confidence in vaccination (adjusted OR = 1.9) [10]. Similar patterns were reported in global meta-analyses [1]. The observed relationship between perceived severity and intention aligns with CDC data, which show that two JYNNEOS doses confer approximately 86% protection [7], confirming that rational risk perception and belief in efficacy are core motivators of vaccine acceptance.

Residual barriers and trust deficits

Despite marked improvements, 25% of participants still perceived themselves as being at low personal risk, and 16% remained undecided. Qualitative feedback revealed concerns about cost, clinic accessibility, and institutional trust, mirroring themes from UK and global studies where stigma and mistrust impeded vaccine uptake [6]. These findings emphasize that informational interventions alone are insufficient; they must be complemented by structural facilitators such as mobile vaccination units, extended clinic hours, and publicly transparent adverse-event dashboards. Modeling studies suggest that integrating behavior-change campaigns with logistical convenience can halve outbreak size compared with either approach in isolation [8].

Strengths and limitations

Key strengths of this study include the theory-informed intervention design, balanced demographic representation, mixed-method triangulation, and standardized effect-size reporting. The hierarchical regression model explained 41% of the variance in post-intervention intention, underscoring its robust predictive power.

However, several limitations must be acknowledged. The single-group pre-post design lacks a control arm, introducing potential selection bias and limiting the ability to make causal inferences. The reliance on self-reported outcomes may be affected by social desirability or recall bias. The study sample, drawn primarily from urban and semi-urban PHC networks, may not represent rural populations with different health-seeking behaviors. The short follow-up period precluded assessment of sustained behavioral change or actual vaccine uptake. Finally, participation through social-media and health-service channels may have overrepresented individuals with higher baseline health literacy, and measurement reactivity from the pre-test could have influenced responses. Future studies employing randomized controlled or cluster-based designs, longitudinal follow-ups, and objective vaccination records are warranted to confirm and extend these findings [4].

Implications for practice and policy

The findings demonstrate that concise, culturally adapted micro-learning modules can be seamlessly integrated into primary healthcare systems and digital health platforms as scalable tools for public health education. Embedding such interventions into electronic health record portals, mobile reminders, or clinic waiting-room displays may provide effective “cues to action.”

Nevertheless, education alone cannot overcome logistical and trust barriers. Policymakers should prioritize same-day vaccination opportunities, co-develop communication materials with community leaders, and provide real-time safety data to enhance transparency and credibility. The success of the San Francisco model, combining outreach education with immediate vaccination, offers a practical framework for replication [11].

Directions for future research

Future research should employ randomized controlled trials with follow-up to determine whether improved intention leads to completion of the full vaccination series and sustained immunity. Cluster trials in high-incidence regions, such as the Democratic Republic of Congo, where sexual transmission of Clade I remains prevalent [9], would provide valuable insights. Moreover, culturally tailored interventions for rural communities, migrants, and people living with Human Immunodeficiency Virus (HIV) should be developed and tested for efficacy and inclusivity.

Evaluating hybrid implementation strategies that combine digital microlearning with automated *mHealth* reminders and local outreach could help identify cost-effective and scalable solutions for improving vaccine uptake and pandemic preparedness in diverse populations.

CONCLUSION

This single-group pre-post educational trial demonstrated that a concise, 5-min multimedia intervention, comprising an animated video, infographic, and FAQ sheet, produced a statistically and practically significant improvement in Mpox-related knowledge, perceived risk, and vaccine acceptance among adults in the Aseer region of Saudi Arabia. The mean knowledge score increased from 4.2 ± 2.1 to 8.9 ± 1.0 ($p < 0.001$; Cohen's $d = 1.02$), while vaccine acceptance nearly doubled from 30 % to 58 % (+28 pp; $p < 0.001$). Regression analysis identified knowledge gain, perceived severity, and prior positive vaccination experience as independent predictors of intention (adj $R^2 = 0.41$), underscoring the behavioral relevance of cognitive and emotional factors in vaccine decision-making.

Grounded in the HBM, the intervention effectively increased perceived susceptibility and benefits while reducing misconceptions and barriers through visual storytelling and myth-correcting cues to action. The results affirm that micro-learning-based, theory-driven education can achieve rapid attitudinal shifts comparable to global best practices, with effect sizes rivaling more resource-intensive campaigns.

However, residual barriers, including limited trust in institutions, logistical challenges, and persistent low personal risk perception, highlight the need for integrated public-health strategies that combine education with structural enablers such as mobile vaccination units, extended clinic hours, and transparent safety communication.

Practically, this study offers a scalable model for integrating short, culturally adapted digital education modules into primary healthcare and national digital health platforms. Such interventions can serve as actionable "cues to vaccination," supporting Saudi Arabia's Vision 2030 agenda and broader global One Health preparedness.

Future studies should adopt randomized controlled or cluster-based designs with longitudinal follow-up to determine the durability of behavior change and real-world uptake of full two-dose vaccination regimens. By integrating education, accessibility, and trust-building, public health programs can transform improved intentions into measurable immunity and resilience against emerging infectious threats.

DATA AVAILABILITY

The supplementary data can be available from the corresponding author upon request.

AUTHORS' CONTRIBUTIONS

AS: Planned the study, drafted the methodology, and coordinated overall supervision. MA: Performed formal statistical analysis, prepared the dataset, and created visualizations. AA: Set up the investigation, coordinated study resources, and wrote the original manuscript draft. AbA: Designed the study software, validated the results, and conducted additional statistical processing. MYA: Coordinated project administration, secured funding, and critically reviewed and edited the manuscript. All authors have read and approved the submission of this manuscript and are responsible for all aspects of the work.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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REFERENCES

1. Bunge, E.M., Hoet, B., Chen, L., Lienert, F., Weidenthaler, H., Baer, L.R. and Steffen, R. (2022) The changing epidemiology of human monkeypox-A potential threat? A systematic review. *PLoS Negl. Trop. Dis.*, 16(2): e0010141.
2. Smith, L.E., Potts, H.W., Brainard, J., May, T., Oliver, I., Amlôt, R., Yardley, L. and Rubin, G.J. (2023) Did mpox knowledge, attitudes and beliefs affect intended behaviour in the general population and men who are gay, bisexual and who have sex with men? An online cross-sectional survey in the UK. *BMJ Open*, 13(10): e070882.
3. Cennimo, D.J. (2023) Lessons from the Mpox education and vaccination campaign. *Infect. Dis. Clin. Pract*., 31(2): e1352.
4. Chan, K.P.F., Xu, R., Lau, E.H., Hung, I.F. and Cowling, B.J. (2024) Global prevalence and correlates of mpox vaccine acceptance and uptake: A systematic review and meta-analysis. *Commun. Med*., 4: 64.
5. Wang, F., Alzahrani, A., Dinka, H., Abate, H.K., Ssekamatte, T. and Ali, M. (2024) Global prevalence and determinants associated with the acceptance of mpox vaccination: A meta-analysis. *Sci. Rep*., 14: 9857.
6. Filardo, T.D., Gordon, L.K., Fawole, O.A., Fuchs, J.D., Gandhi, M., Hughes, J.P. and Scheer, S. (2023) Mpox vaccine acceptability among people experiencing homelessness in San Francisco-October-November 2022. *Vaccine*, 41(42): 6225–6230.
7. Ding, J., Xu, Z., He, R., Wang, Q., Li, Y., Zhang, Y. and Zhou, L. (2024) Knowledge about, attitudes toward and acceptance and predictors of intention to receive the mpox vaccine among cancer patients in China. *Hum. Vaccin. Immunother.*, 20(1): 2243341.
8. Wang, J., Liu, R., Du, X., Li, M., Chen, X., Zhao, Y. and Yang, Y. (2024) Knowledge, concerns and vaccine acceptance related to mpox among university students in North and Northeast China. *Hum. Vaccin. Immunother.*, 20(1): 2245839.
9. Gao, M., Zhu, L., Li, J., Chen, H., Wu, S. and Liu, Q. (2024) Mpox-related knowledge and vaccination willingness among HIV-diagnosed and suspected males in China. *Front. Public Health*, 12: 1455623.
10. Tshala-Katumbay, D.D., Makiala-Mandanda, S., Makindie, B., Kayembe, N.J., Bompangue, D. and Muyembe-Tamfum, J.J. (2024) Mpox vaccine acceptance, Democratic Republic of the Congo. *Emerg. Infect. Dis*., 30(12): e241226.
11. Getachew, A., Shiferaw, W.S., Alemu, Y.G., Kassahun, H., Tesfaye, T. and Mekonnen, A. (2025) Willingness to take mpox vaccine and associated factors among health professionals in Ethiopia: A cross-sectional study. *Vaccine*, 43(4): 691–698.
12. Bellahcene, M., Benamar, A., Cherchar, A., Azzouz, A., Ouarab, R. and Lounici, R. (2024) Knowledge and awareness of Algerian healthcare workers about human monkeypox and their attitude toward its vaccination: An online cross-sectional survey. *EClinicalMedicine*, 68: 102210.
13. Amer, F.A., Mohamed, M.A., Abdel-Khalek, R.A., Ahmed, H.A. and Saeed, N.M. (2024) Grasping knowledge, attitude and perception towards monkeypox among Egyptian healthcare workers and medical students: A cross-sectional study. *Sci. Rep*., 14: 79396.
14. Abd ElHafeez, S., Gebreal, A., Khalil, M.A., Elshazly, R., Hamdy, R. and Alrawashdeh, M. (2023) Assessing disparities in medical students' knowledge and attitude about monkeypox: A cross-sectional study of 27 countries. *Front. Public Health*, 11: 1192542.
15. Osei, F.B., Armah, N.B., Dadzie, D.K., Boateng, D. and Oppong, F.B. (2024) Do self-rated health and previous vaccine uptake influence the willingness to accept mpox vaccination? Evidence from Ghana. *BMC Public Health*, 24: 1529.
16. Liu, Q., Zhang, Y., Sun, W., Li, L., Chen, X. and Zhao, J. (2023) Willingness to receive and recommend hypothetical mpox vaccination among Chinese adults. *Public Health*, 224: 58–65.
17. Peng, Y., Ning, Z., Yang, M., Liu, Y., Zhou, Q. and Wang, H. (2024) Knowledge and attitudes towards mpox in the general population and HCWs: Systematic review and descriptive analysis of cross-sectional studies. *Int. J. Infect. Dis*., 141: 267–277.

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