




RESEARCH ARTICLE



Community pharmacists' knowledge, beliefs, and perceived barriers toward vaccination services at community pharmacies: A cross-sectional study from Saudi Arabia

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ABSTRACT

Community pharmacists were recently authorized to provide vaccination services in Saudi Arabia. However, the implementation is still limited. Consequently, this study aimed to assess the knowledge, beliefs, and views of community pharmacists in the Qassim region regarding vaccines and vaccination services and to identify the barriers to providing such services. A total of 170 community pharmacists participated in the study (response rate = 73.91%). The mean overall knowledge of vaccines and vaccination was 10.25 ± 1.35 out of a maximum score of 14. The majority stated that vaccines are rigorously tested for their safety (92.94%), go through a stringent approval process to ensure their quality and efficacy (93.53%), and vaccines play a key role in preventing and controlling infectious disease outbreaks (97.06%). However, only 48.82% were aware that community pharmacists are legally authorized to provide adult vaccination services. Few participants were also aware of the dosing of the varicella vaccine (14.12%) and indications of the herpes zoster vaccine (21.18%). The overall mean score on beliefs/views was 31.91 ± 5.53 out of a maximum of 40, indicating positive beliefs/views regarding vaccination services. The study identified many barriers to implementing vaccination services. These included lack of support staff and technicians in community pharmacies (79.41%), lack of requirements and equipment to provide the service (74.11%), the service will add extra workload (72.94%), and lack of formal certification in pharmacy-based immunization delivery (66.48%). Consequently, a holistic strategy is required to improve pharmacists' clinical knowledge of vaccines and to address the barriers to the implementation of vaccination services at community pharmacies.

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Introduction

Vaccination is one of the most effective health interventions globally to prevent morbidity and mortality caused by life-threatening infectious diseases and emerging pathogens.^{1–5} In addition, vaccines are a cost-effective strategy for the prevention and control of outbreaks of infectious diseases.^{6–8} Currently, there are licensed vaccines providing effective protection against over 20 life-threatening diseases.^{9,10} Besides that, vaccines can play a major role in combating antimicrobial resistance (AMR) within healthcare systems by preventing infectious diseases. As a result, decrease the use of antibiotics for secondary infections as well as their irrational use in viral infections which are now reduced with vaccines. As a result, reverse the emergence and spread of AMR.^{11–14}

Despite the availability, safety, effectiveness and benefits of vaccines, vaccination rates, and service uptake remain suboptimal globally, leading to global initiatives including those by the World Health Organization (WHO) to enhance vaccination rates.^{15,16} This is important as the under-utilization of vaccines has recently been associated with outbreaks of

vaccine-preventable diseases (VPDs) including measles and pertussis in developed countries.^{17–20} There have also been concerns with the uptake of vaccines in developing countries including those for polio.^{21,22} In Saudi Arabia, studies showed low uptake of seasonal influenza vaccine (SIV),^{23–27} herpes zoster vaccine,²⁸ and pneumococcal vaccine, including among high-risk groups of patients.²⁹ Poor uptake of vaccines generally is not helped by poor knowledge of vaccines and a lack of awareness among patients and the general population regarding available vaccines.^{30–34}

Consequently, to prevent or minimize the incidence and prevalence of VPDs, a high and continued level of vaccination coverage among the population is required.^{35,36} Key barriers contributing to low uptake of vaccines include, as mentioned, lack of awareness, vaccine hesitancy generally, and inconvenient access to vaccination services, with vaccine hesitancy exacerbated by the considerable hesitancy seen toward the COVID-19 vaccines across countries.^{37–39} Studies from Saudi Arabia also reported a considerable rate of prevalence of COVID-19 vaccine hesitancy^{40–43} and a corresponding low

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uptake of COVID-19 vaccine booster doses.⁴⁴ This is a concern with lockdown and other measures severely impacting vaccination rates generally, appreciably increasing future morbidity and mortality.^{45–48} Community pharmacists globally played a leading role during the recent COVID-19 pandemic with respect to providing reliable information on preventative strategies as well as offering COVID-19 vaccination services.^{49–51} They could also play a key role with providing information regarding new disease outbreaks across countries including monkeypox.⁵² Overall, community pharmacies have the ability to play key future roles across countries advocating, promoting, and providing vaccination services as they are uniquely positioned in communities to address health needs including vaccinations.^{53–56} Furthermore, community pharmacists are trusted sources of health information, one of the most easily accessible healthcare professionals, and often the first healthcare professional that patients visit for their illnesses.^{37,57–61}

In Saudi Arabia, in 2019, community pharmacists were authorized to provide vaccination services for adults, including administration of vaccines, after additional and appropriate training, i.e., certification or completion of a pharmacy-based immunization delivery program. Vaccines included those to protect against hepatitis, herpes zoster (shingles), tetanus, meningococcal disease, pneumococcal disease, *Haemophilus influenzae*, human papillomavirus, seasonal influenza, diphtheria, and pertussis.^{62,63} Having said this, the implementation of vaccination services in community pharmacies is still very limited in Saudi Arabia despite the initial successful experience of contributing toward the administration of the COVID-19 vaccines as part of the national vaccination program during the pandemic.^{52,64} Evidence from other countries indicates the key role of community pharmacies in providing vaccination services and increasing vaccine update among the population.^{65–72} This includes their contributions to life-course vaccinations and crucial roles, such as vaccine advocacy, addressing vaccine hesitancy, and the delivery of vaccine services.⁷³ However, there can be concerns with their vaccination-related knowledge.^{74–76}

A recent study from Saudi Arabia showed that many community pharmacists had inadequate clinical knowledge of vaccines and vaccination services in terms of their indications, contraindications, and use during pregnancy.⁷⁶ This is a concern as another recent study showed that the general public in Saudi Arabia needed community pharmacies to provide vaccination services to enable wider and more convenient access to vaccines and immunization, with community pharmacists in Saudi Arabia willing to provide such services.^{77,78} Consequently, this study aimed to assess community pharmacists' knowledge of vaccines and vaccination services, including their benefits, efficacy, safety, and cost-effectiveness, and their roles in preventing infectious diseases. Second, the study sought to assess pharmacists' knowledge on the regulations related to vaccination services and adult vaccination schedules in Saudi Arabia. Lastly, the study also assessed pharmacists' beliefs and views regarding vaccines, and perceived barriers regarding the provision of vaccination services in the community pharmacy setting. This is important given the appreciable growth in community pharmacists in recent years in Saudi Arabia. This includes those of Saudi

origin and female pharmacists to help improve the care of patients by joining the community pharmacy sector.⁷⁹ However, there have been concerns with the current curricula in Saudi Arabian pharmacy colleges regarding infectious diseases⁸⁰ and training on administration of vaccines.⁸¹ Consequently, the current study should provide valuable data to health policy makers and training institutions relating to the knowledge and perspectives of community pharmacists regarding vaccines and vaccination programs. In addition, provide future guidance to enhance the role of community pharmacists in public health, especially providing immunization services, to better serve the public.

Methods

Study design, setting, and population

This was a cross-sectional, questionnaire-based survey. The target population was community pharmacists practicing in the Qassim region of Saudi Arabia at the time of the study. The Qassim region is located in the central region of Saudi Arabia and consists of Buraidah city and 13 governorates, with a total population of 1.34 million in 2022.⁸² The study included community pharmacies from several areas from the Qassim region including Buraidah city and eight governorates, namely Unaizah, Al-Rass, Al-Badaya, Riyadh Al-Khabra, Al-Nabhaniyah, Al-Methnab, Al-Bekayriyah, and Uglat Asugour.

Sampling method, sample size, and sample size calculations

The sample size calculation for this study was performed using the Raosoft sample size calculator.⁸³ Based on an estimated 498 community pharmacies in the Qassim region according to the 2023 Statistical Yearbook of the Saudi Ministry of Health,⁸⁴ with a 5% margin of error, 95% confidence level, and 50% level of variance, the sample size was estimated to be 218 pharmacies. The sample size was increased to 230 to compensate for possible non-responders. When there was more than one pharmacist in the pharmacy, only one was invited to participate in the study to avoid duplicate responses from the same community pharmacy, as the questionnaire had some items/statements specific to the pharmacy. Convenience sampling was used to select the community pharmacies for this study, based on the geographical convenience to the data collectors. However, as mentioned earlier, the study covered a wide geographical area in the Qassim region, including Buraidah city and eight governorates, to minimize selection bias.

Development of the questionnaire

The questionnaire for the survey was developed based on a comprehensive literature review of previous studies that addressed vaccines and vaccination services in community pharmacies.^{54–56,78,85–90} In addition, the development of the questionnaire was informed by up-to-date information, and publications about vaccines and vaccination services from health authorities and other organizations. These included factsheets about vaccines from the American Academy of

Allergy, Asthma & Immunology (AAAAI),⁹¹ WHO,⁹² and US Centers for Disease Control and Prevention (CDC).⁹³ In addition, publications from the Saudi Ministry of Health, including the National Immunization Schedule for adults⁹⁴ and requirements and procedures for providing pharmaceutical care services in community pharmacies in Saudi Arabia.⁶²

To ensure the face and content validity of the questionnaire, the initial draft was reviewed by three academics with expertise in the topic. Following feedback, pre-testing was conducted among five community pharmacists to ensure suitability, clarity, and simplicity of the questionnaire. All feedback and comments were taken into consideration to finalize the questionnaire, including minor language modifications to ensure clear understanding of all questionnaire items and statements. Moreover, two additional statements were suggested to be included. One is related to storage and handling of vaccines in pharmacies and the other related to adverse events following immunization. The final questionnaire comprised four parts including 37 items and statements. The first part comprised five items related to participants' demographic data and characteristics including their sex, age, qualification, and experience. The second part comprised 14 statements to assess the level of general knowledge of vaccines and vaccination in terms of their benefits, efficacy, safety, cost-effectiveness, and their role in preventing infectious diseases. In addition, this part included statements to address pharmacists' knowledge with the current regulations and adult immunization schedule in Saudi Arabia. The response options for the knowledge domain were "yes," "no", and "I do not know." The correct answer was allocated one point, while an incorrect answer or "I do not know" was allocated zero points. Accordingly, the maximum attainable knowledge score was 14. The third part comprised eight statements to assess participants' beliefs and views regarding providing vaccination services at community pharmacies. A five-point Likert scale ranging from strongly disagree (1) to strongly agree (5) was used, similar to other studies.^{75,88,95-97} To assess the overall beliefs and views regarding vaccination services in community pharmacies, the total belief and view score was calculated with attainable scores ranging from 8 (strong disagreement with all statements) to 40 (strong agreement with all statements). The fourth part comprised 10 statements to assess perceived barriers to providing vaccination services at community pharmacies again using a five-point Likert scale (strongly agree, agree, neutral, disagree, and strongly disagree). For the comparison between participants' responses to each barrier, the responses were scored from 1 (strongly disagree) to 5 (strongly agree). Consequently, the score of each barrier ranged from 1 to 5. In addition, to summarize and present the results for the perceived barriers, strongly agree, and agree were combined as one category, and strongly disagree and disagree were also combined, while neutral responses remained as a neutral category.

Design of the final questionnaire and data collection

The final paper-based version of the questionnaire was converted into a web-based version, using an online survey platform (i.e., SurveyMonkey).⁹⁸ After that, an electronic

link and a bar-code were created for access to the web-based survey. Prior to implementation of the web-based survey, it was pre-tested by the research team to ensure that it is accessible across different operating systems, browsers, and devices, and to ensure there are no issues with the layout of the web-based survey and other factors including font size and spacing.^{99,100} In addition, the survey platform was configured to alert the participant to incomplete responses or missed items. Consequently, only complete responses could be submitted via the link. This was done to avoid the issue of incomplete responses or missing data.¹⁰¹

Data collection took place between February and March 2024 and was conducted by five final-year Doctor of Pharmacy (PharmD) students, who were provided with orientation and training on data collection procedures prior to initiation of the survey. The data collectors made field visits to community pharmacies, provided pharmacists with a brief overview of the study and an invitation letter to participate in the study. The invitation letter included an overview of the study, its objectives, and instructions on how to directly access the web-based survey by using either the bar-code or the link provided in the letter. The invitation letter also stated that participation in the survey was strictly voluntary, that all responses will remain anonymous and that responses would be reported as aggregated data. In addition, they were asked to complete the survey and submit their responses at a time convenient for them to help maximize uptake. Finally, pharmacists were informed that accessing the survey and responding online is considered as consent to participate in the study.

Data management and analysis

The data were downloaded from the electronic platform as an Excel file. Then, the data were coded and entered into IBM SPSS statistics for Windows, version 20.0 for statistical analyses. Descriptive statistics were used to summarize the data, namely frequencies and percentages for categorical variables and mean with standard deviation (SD) for continuous variables. Inferential statistics, including independent-samples t-test and one-way ANOVA, were used to examine associations and differences among study variables. When the ANOVA test was statistically significant, the Tukey HSD *Post-hoc* test was performed to identify which group or groups differed. A *p*-value of <0.05 was used as a cutoff point for statistical significance.

Ethics statement

The study was carried out in accordance with the Declaration of Helsinki. Participation in the study was entirely voluntary. The questionnaire included a consent statement that by completing the questionnaire, consent is provided to participate in the study. The study was approved by Regional Research Ethics Committee, Qassim region, Saudi Arabia (Approval No. 10566-45-607).

Results

Response rate

The data collectors visited 230 community pharmacies and invited one pharmacist from each pharmacy to participate in the study. Out of these, 4 declined to participate in the study, and 226 were given the survey and invited to complete it at their own convenience. Out of these, 170 electronic responses were received, yielding a response rate of 73.91%.

Demographic and characteristic data of participants

In this study, 93.53% ($n = 159$) were male participants, with most participants ($n = 147$; 86.47%) holding only the entry-to-the profession degree in Saudi Arabia, i.e., BPharm or PharmD, while 13.53% ($n = 23$) had a postgraduate qualification. Most participants were in the age group of 23–30 years ($n = 74$; 43.53%), followed by the age group of 31–40 years ($n = 73$; 42.94%). In terms of experience as a community pharmacist in Saudi Arabia, 73 (42.94%) and 43 (25.29%) had 1–5 years and 6–10 years of experience, respectively. Most of the pharmacies were run by 1–2 pharmacists ($n = 120$; 70.59%), followed by 3–4 pharmacists ($n = 44$; 25.88%). The results are summarized in Table 1.

General knowledge of vaccines and vaccination

The overall knowledge score (mean \pm SD) of the participants was 10.25 ± 1.35 out of the maximum attainable score of 14. Consequently, the overall percentage of correct answers for the knowledge statements was 73.21%.

In terms of the knowledge of roles of vaccines in preventing and controlling infectious diseases, safety, effectiveness, and benefits of vaccines, the vast majority of participants stated that the health benefits of vaccines greatly outweigh the risks ($n = 153$; 90.00%), vaccines are rigorously tested for their safety before approval ($n = 158$; 92.94%), and vaccines go through a stringent process to ensure their quality and efficacy before

approval by drug regulatory authorities ($n = 159$; 93.53%). Similarly, the majority of participants indicated that vaccines play a key role in preventing and controlling infectious disease outbreaks ($n = 165$; 97.06%), and immunization is a cost-effective public health intervention for the prevention of diseases ($n = 152$; 89.41%). Approximately, three quarters of participants reported that serious adverse events associated with vaccines are rare ($n = 126$, 74.12%). The majority of the participants ($n = 163$; 95.88%) were aware that vaccines require proper storage and handling to maintain potency.

In terms of knowledge of the regulations in Saudi Arabia, only 83 (48.82%) participants were aware that community pharmacists are legally permitted to provide vaccination services to adults after completion of the required training. Moreover, only 65 (38.24%) participants were aware that community pharmacists are not yet authorized to provide vaccination services to children in Saudi Arabia. In terms of clinical knowledge of the national immunization schedule, including indications and the dosing schedules, less than one quarter of participants were aware of the dosing of the varicella vaccine ($n = 24$; 14.12%) and specific indication for the herpes zoster vaccine ($n = 36$; 21.18%) according to the national adult immunization schedule in Saudi Arabia. The results are presented in Table 2.

Beliefs and views towards providing vaccination services at community pharmacies

The overall beliefs and views mean score for all participants was 31.91 ± 5.53 out of the maximum score of 40. Two-thirds of participants ($n = 116$; 68.23%) indicated (agreed/strongly agreed) that pharmacies are easily accessible and convenient avenues to provide vaccination services. The majority of participants believed that vaccination services through community pharmacies will increase the overall vaccination coverage rate in the community ($n = 136$; 80.00%), will allow pharmacists to contribute further to public health and the promotion of vaccines ($n = 143$; 84.12%) and that the administration of vaccines could be easily learned with additional training ($n = 147$; 86.47%). In addition, a separate area for the service is available or can easily be made available within the pharmacy premises to deliver the service ($n = 115$; 67.65%). The majority of participants ($n = 136$; 80.00%) also believed that based on their undergraduate studies, pharmacists have adequate background knowledge in immunology and therapeutics related to vaccines that would facilitate the implementation of the service. The results are presented in Table 3.

Perceived barriers to providing vaccination services at community pharmacies

As shown in Figure 1 and Supplementary Table S1, the participants in this study indicated that many barriers currently exist to providing vaccination services at community pharmacies in Saudi Arabia. In terms of operational and logistic barriers, participants reported a lack of support staff and technicians in community pharmacies to help with implementing vaccination services (79.41%). There was also a current lack of requirements and equipment to

Table 1. Demographic and characteristic data of participants.

Variable	N (%)
Sex	
Male	159 (93.53)
Female	11 (6.47)
Age (years)	
23–30	74 (43.53)
31–40	73 (42.94)
41–50	18 (10.59)
>50	5 (2.94)
Highest qualification achieved	
BPharm	88 (51.76)
PharmD	59 (34.71)
Postgraduate degree (higher diploma, residency, master's or above)	23 (13.53)
Experience as a community pharmacist in Saudi Arabia (years)	
<1	18 (10.59)
1–5	73 (42.94)
6–10	43 (25.29)
>10	36 (21.18)
Number of pharmacists employed in the pharmacy	
1–2	120 (70.59)
3–4	44 (25.88)
≥ 5	6 (3.53)

Table 2. General knowledge of vaccines and vaccination services ($n = 170$).

No.	Statement	Yes	No	I do not know
1	The health benefits of vaccines greatly outweigh the risks	153 (90.00)	12 (7.06)	5 (2.94)
2	Vaccines are rigorously tested for their safety before being approved by drug regulatory authorities	158 (92.94)	9 (5.29)	3 (1.76)
3	Serious adverse events associated with vaccines are rare	126 (74.12)	31 (18.24)	13 (7.65)
4	Vaccines play a key role in preventing and controlling infectious disease outbreaks	165 (97.06)	3 (1.76)	2 (1.18)
5	Immunization is a cost-effective public health intervention for the prevention of diseases	152 (89.41)	11 (6.47)	7 (4.12)
6	Vaccines go through a stringent process to ensure their quality and efficacy before approval by drug regulatory authorities	159 (93.53)	4 (2.35)	7 (4.12)
7	Local adverse reactions (e.g., pain, swelling, and redness at the injection site) and minor adverse effects (e.g. mild fever) could occur within a few hours of the injection but are usually mild and self-limited	161 (94.71)	6 (3.53)	3 (1.76)
8	Severe allergic reactions associated with vaccines (e.g., anaphylaxis) are life-threatening but are rare	147 (86.47)	16 (9.41)	7 (4.12)
9	Serious complications of vaccine-preventable diseases can be avoided through immunization	151 (88.82)	9 (5.29)	10 (5.88)
10	Proper vaccine storage and handling are essential to maintain vaccine potency and provide adequate immune response and disease protection	163 (95.88)	4 (2.35)	3 (1.76)
11	Community pharmacists are permitted to provide vaccination services to adults in Saudi Arabia after completion of the training required for this service	83 (48.82)	53 (31.18)	34 (20.00)
12	Community pharmacists are permitted to provide vaccination services to children in Saudi Arabia after completion of the training required for this service	71 (41.76)	65 (38.24)	34 (20.00)
13	According to the national adult immunization schedule, if no evidence of immunity, the varicella vaccine is administered in 3 doses (0, 1 month, and 6 months)	87 (51.18)	24 (14.12)	59 (34.71)
14	According to the national adult immunization schedule, the herpes zoster vaccine is recommended for adults aged 18 years or older	85 (50.00)	36 (21.18)	49 (28.82)

Bold text indicates correct answers. Due to rounding, percentages may not add up to 100%.

Table 3. Beliefs and views toward providing vaccination services at community pharmacies ($n = 170$).

No.	Statement	Strongly agree	Agree	Neutral	disagree	Strongly disagree
1	Community pharmacies are easily accessible and convenient avenues to provide vaccination services	50 (29.41)	66 (38.82)	29 (17.06)	21 (12.35)	4 (2.35)
2	Vaccination services through community pharmacies will increase the overall coverage rate of vaccination in the community	70 (41.18)	66 (38.82)	24 (14.12)	9 (5.29)	1 (0.59)
3	Vaccination services will allow pharmacists to contribute to public health and promotion of vaccines (e.g., influenza, travel-related vaccines)	62 (36.47)	81 (47.65)	16 (9.41)	8 (4.71)	3 (1.76)
4	Administration of vaccines is a technical skill that can be easily learned by additional training	62 (36.47)	85 (50.00)	15 (8.82)	5 (2.94)	3 (1.76)
5	A separate room/space is available or can be easily made in the current pharmacy building to deliver the service	45 (26.47)	70 (41.18)	27 (15.88)	20 (11.76)	8 (4.71)
6	Patients trust in community pharmacists could facilitate the introduction of vaccination services	55 (32.35)	74 (43.53)	26 (15.29)	10 (5.88)	5 (2.94)
7	The service will address the patients' needs and demands for immunization services from their pharmacies	44 (25.88)	91 (53.53)	21 (12.35)	12 (7.06)	2 (1.18)
8	Community pharmacists have background in immunology and therapeutics related to vaccines	44 (25.88)	92 (54.12)	27 (15.88)	6 (3.53)	1 (0.59)

provide vaccination services (74.11%), concerns that the service will add extra workload to community pharmacists (72.94%), issues related to vaccine storage, handling, and temperature monitoring in community pharmacies (68.82%), and community pharmacists currently lacking the time to provide vaccination services (60.59%). In terms of barriers related to practical skills, certification, and clinical management, the participants reported a lack of prior practical training on injection techniques (67.06%), lack of formal certification in pharmacy-based immunization delivery (66.48%), inadequate knowledge of the management of adverse reactions after vaccination (58.24%), inadequate clinical knowledge of vaccines, their precautions and contraindications (56.47%), and lack of up-to-date certification for basic life support (55.88%).

Association between participants' characteristics, their level of knowledge, beliefs and views, and perceived barriers regarding vaccines and vaccination services

As shown in Table 4, there were no statistically significant differences between participants' characteristics and their level of general knowledge of vaccines and vaccination services, neither their beliefs and views regarding vaccines and vaccination services.

However, as shown in Table 5, there were statistically significant differences between participants' characteristics and some of the perceived barriers to providing vaccination services at community pharmacies. In particular, there was a statistically significant association between the number of pharmacists employed in the pharmacy and their response to the barrier that vaccination services will add extra workload to

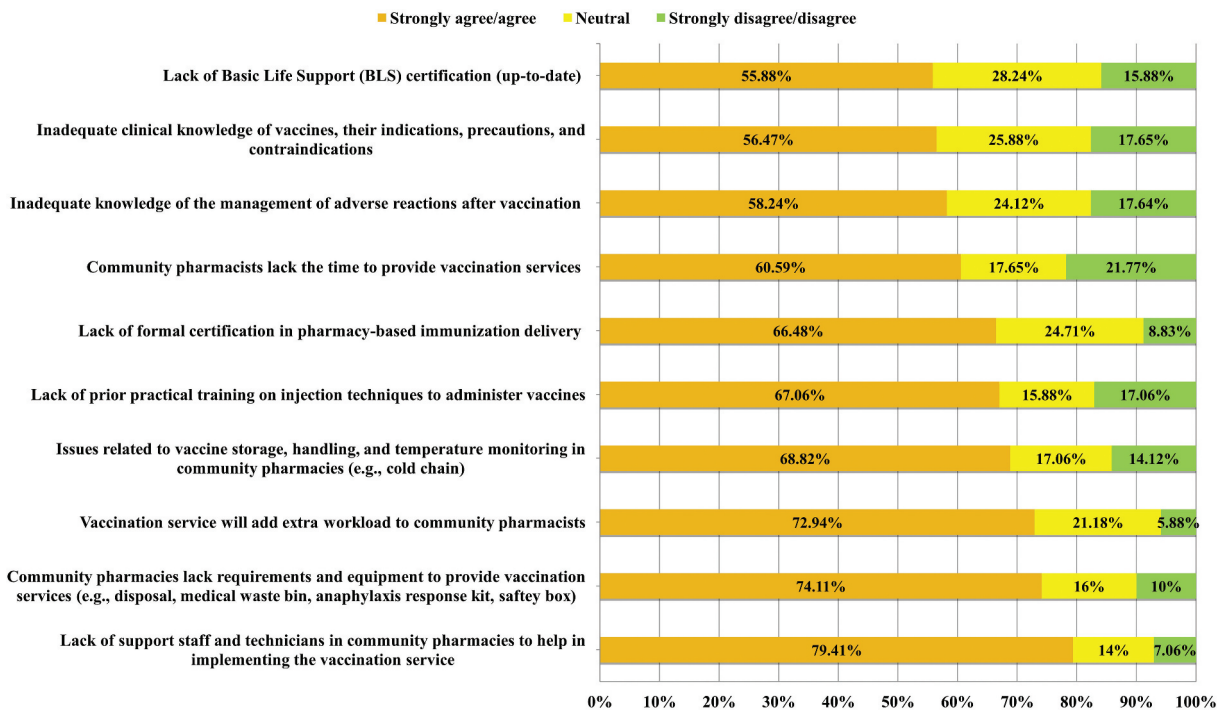


Figure 1. Barriers to providing vaccination services at community pharmacies.

Table 4. Association between participants' characteristics, and their level of knowledge and beliefs and views regarding vaccines and vaccination services.

Variable	Knowledge score (Mean ± SD)	<i>p</i> value*	Beliefs and views score (Mean ± SD)	<i>p</i> value*
Overall score	10.25 ± 1.35	-	31.91 ± 5.53	-
Sex				
Male	10.25 ± 1.35	.960	31.70 ± 5.58	.071
Female	10.27 ± 1.42		34.82 ± 3.92	
Age (years)				
23-30	10.19 ± 1.47	.283	32.32 ± 5.13	.764
31-40	10.26 ± 1.27		31.49 ± 5.79	
41-50	10.17 ± 1.10		32.22 ± 6.11	
>50	11.40 ± 1.52		30.60 ± 6.35	
Highest qualification achieved				
BPharm	10.16 ± 1.31	.602	31.30 ± 5.82	.196
PharmD	10.39 ± 1.43		32.95 ± 5.31	
Postgraduate degree [#]	10.26 ± 1.36		31.57 ± 4.68	
Experience as a community pharmacist in Saudi Arabia (years)				
<1	10.28 ± 1.99	.856	32.67 ± 4.69	.202
1-5	10.34 ± 1.23		32.75 ± 5.44	
6-10	10.12 ± 1.33		30.70 ± 5.13	
>10	10.22 ± 1.29		31.25 ± 6.35	
Number of pharmacists employed in pharmacy				
1-2	10.29 ± 1.27	.379	31.84 ± 5.49	.562
3-4	10.25 ± 1.60		32.36 ± 5.55	
≥5	9.50 ± 1.05		29.83 ± 6.59	

*Independent samples t-test or one-way ANOVA; [#]Higher diploma, residency, master's or above.

community pharmacists ($p = .043$). The post-hoc test showed that pharmacists who employ 3–4 pharmacists in their community pharmacy recorded a statistically significant higher level of agreement (4.27 ± 0.79) compared to pharmacies with only 1–2 pharmacists (3.89 ± 0.90) ($p = .036$). However, there was no statistically significant difference between pharmacies that employ ≥ 5 pharmacists (3.83 ± 0.75) and pharmacies with 1–2 pharmacists ($p = .986$) or 3–4 pharmacists ($p = .475$).

Furthermore, there was a statistically significant association between the number of pharmacists employed in the pharmacy and their response to the barrier that community pharmacies lack requirements and equipment to provide vaccination services such as disposal, medical waste bin, anaphylaxis response kit, and a safety box ($p = .006$). The post-hoc test showed that pharmacies which employ 1–2 pharmacists recorded a statistically significant higher level of agreement (4.03 ± 0.86) compared to pharmacies

Table 5. Association between participants' characteristics and identified barriers to providing vaccination services at community pharmacies.

Variable	Mean (standard deviation)* score for barriers (B**) and p-values***																				
	B1	P	B2	P	B3	P	B4	P	B5	P	B6	P	B7	P	B8	P	B9	P	B10	P	
Sex																					
Male	3.61 (1.08)	.647	4.01 (.87)	.309	3.58 (.98)	.119	3.74 (.87)	.331	3.64 (1.03)	.160	3.59 (.98)	.106	3.92 (.93)	.975	3.57 (1.02)	.729	3.72 (1.00)	.797	3.97 (.84)	.425	
Female	3.45 (1.13)		3.73 (1.01)		3.09 (1.22)		4.00 (.77)		4.09 (0.94)		3.09 (1.14)		3.91 (1.22)		3.45 (1.13)		3.64 (1.03)		4.18 (.60)		
Age in years																					
23–30	3.73 (1.02)	.051	4.04 (.83)	.387	3.61 (1.03)	.207	3.73 (.85)	.709	3.65 (1.01)	.989	3.66 (.98)	.530	3.96 (.97)	.728	3.59 (1.01)	.556	3.76 (.99)	.637	4.04 (.87)	.554	
31–40	3.53 (1.12)		3.97 (.91)		3.40 (1.04)		3.75 (.91)		3.68 (1.04)		3.44 (.99)		3.86 (.95)		3.47 (1.06)		3.64 (1.05)		3.92 (.85)		
41–50	3.11 (1.13)		3.72 (.89)		3.78 (.73)		3.72 (.89)		3.67 (1.08)		3.67 (.97)		4.06 (.87)		3.83 (.92)		3.67 (.97)		3.94 (.64)		
>50	4.40 (.55)		4.40 (.89)		4.00 (.71)		4.20 (.45)		3.80 (1.10)		3.40 (1.34)		3.60 (1.14)		3.40 (1.34)		4.20 (.45)		4.40 (.55)		
Highest qualification																					
BPharm	3.63 (1.06)	.952	3.97 (.92)	.885	3.69 (.95)	.088	3.81 (.91)	.602	3.70 (1.03)	.749	3.60 (1.05)	.613	4.03 (.90)	.231	3.64 (1.04)	.142	3.82 (.94)	.057	3.95 (.77)	.854	
PharmD	3.58 (1.12)		4.03 (.85)		3.32 (1.11)		3.66 (.91)		3.68 (1.04)		3.46 (.97)		3.76 (1.02)		3.36 (1.06)		3.46 (1.10)		4.02 (.88)		
Postgraduate degree#	3.57 (1.12)		3.96 (.82)		3.57 (.84)		3.78 (.60)		3.52 (.99)		3.65 (.83)		3.87 (0.92)		3.78 (.80)		3.96 (.82)		4.04 (.93)		
Experience as a community pharmacist in Saudi Arabia (years)																					
<1	3.50 (.86)	.920	3.83 (.92)	.513	3.50 (1.10)	.258	3.78 (0.88)	.849	3.39 (1.20)	.598	3.61 (1.20)	.394	4.06 (.54)	.724	3.33 (1.03)	.652	3.67 (.97)	.612	3.94 (.94)	.657	
1–5	3.63 (1.12)		4.05 (.83)		3.62 (1.02)		3.78 (.84)		3.77 (.94)		3.68 (.86)		3.89 (1.05)		3.64 (.98)		3.75 (1.01)		4.05 (.88)		
6–10	3.53 (1.14)		3.86 (.89)		3.30 (.89)		3.65 (.87)		3.70 (.96)		3.51 (1.01)		3.86 (.91)		3.58 (1.03)		3.81 (.85)		3.86 (.80)		
>10	3.67 (1.70)		4.08 (.94)		3.72 (1.03)		3.81 (.95)		3.58 (1.18)		3.33 (1.10)		3.97 (.97)		3.47 (1.13)		3.53 (1.19)		4.03 (.70)		
Number of pharmacists employed in the pharmacy																					
1–2	3.48 (1.08)	.053	3.89 (.90)	.043	3.55 (1.01)	.075	3.74 (.87)	.395	3.68 (1.05)	.455	3.64 (.99)	.241	4.03 (.86)	.006	3.62 (1.02)	.515	3.74 (.95)	.833	3.98 (.80)	.866	
3–4	3.86 (1.07)		4.27 (.79)		3.66 (.99)		3.84 (.86)		3.73 (.99)		3.36 (.99)		3.75 (1.12)		3.41 (1.04)		3.64 (1.14)		4.02 (.88)		
≥5	4.17 (.75)		3.83 (.75)		2.67 (.52)		3.33 (.82)		3.17 (.75)		3.33 (1.03)		3.00 (.63)		3.50 (1.05)		3.67 (1.03)		3.83 (1.17)		

*Responses to barriers ranged from 1 (strong disagreement) to 5 (strong agreement). **B1: Community pharmacists lack the time to provide vaccination services. B2: Vaccination service will add extra workload to community pharmacists. B3: Lack of Basic Life Support (BLS) certification (up-to-date). B4: Lack of formal certification in pharmacy-based immunization delivery. B5: Lack of prior practical training on injection techniques to administer vaccines. B6: Inadequate clinical knowledge of vaccines, their indications, precautions, and contraindications. B7: Community pharmacies lack requirements and equipment to provide vaccination services (e.g., disposal, medical waste bin, anaphylaxis response kit, safety box). B8: Inadequate knowledge of the management of adverse reactions after vaccination. B9: Issues related to vaccine storage, handling, and temperature monitoring in community pharmacies (e.g., Cold chain). B10: Lack of support staff and technicians in community pharmacies to help in implementing the vaccination service. ***Independent-samples t-test or one-way ANOVA; #Higher diploma, residency, master's or above. Bold text indicates statistically significant at p value < 0.05.

with ≥ 5 pharmacists (3.00 ± 0.63) ($p = .025$). However, there were no statistically significant differences between pharmacies with 3–4 pharmacists (3.75 ± 1.12) and pharmacies with 1–2 pharmacists ($p = .218$) or pharmacies with ≥ 5 pharmacists ($p = .157$).

Discussion

Our findings showed that overall community pharmacists in Saudi Arabia had good knowledge regarding many aspects related to vaccines and vaccination. Pharmacists were aware of the role of vaccines in preventing and controlling infectious diseases, and had good scientific knowledge of vaccines in terms of their safety, effectiveness, and health benefits as well as the drug regulatory approval process of vaccines before marketing. This is similar to the findings of studies from other countries including Canada,¹⁰² Malaysia,⁵⁵ Ethiopia,⁸⁸ and Lebanon⁵⁶ and could be explained by the fact that pharmacists during their university training are taught the principles and sciences related to immunology, immunization, drug, and vaccine development process.⁸⁰ However, in this study, we noted low scores on the knowledge of the regulations related to providing vaccines in pharmacies in Saudi Arabia. Despite that community pharmacists were authorized in 2019 to offer this service, less than half of participants were aware that community pharmacists with the required training are legally permitted to provide adult vaccination services. This could be potentially explained by a number of factors. First, at the time of the study, vaccination services were implemented in only a few community pharmacies in Saudi Arabia. Secondly, currently in Saudi Arabia most pharmacists in community pharmacies are trained and graduated abroad; consequently, they might be unaware of all the local laws and regulations regarding the full scope of community pharmacists.^{79,103} However, the situation may be changing with more graduates from Saudi Colleges of Pharmacy recently joining the community pharmacy workforce.^{79,104}

In this study, we noted that participants had poor clinical knowledge of vaccines in terms of their indications and dosing schedules. Most participants were not aware of the dosing of the varicella vaccine and the specific indications for the herpes zoster vaccine according to the national adult immunization schedule in Saudi Arabia. Gaps in the clinical knowledge of community pharmacists have been reported in other studies including Saudi Arabia.^{74–76} A recent study from Saudi Arabia that focused on the knowledge of community pharmacists regarding vaccines especially their indications, contraindications, and vaccines used during pregnancy and lactation, also found significant gaps with poor knowledge on these clinical aspects among 54% of participants.⁷⁶ Another study from Turkey reported that 29.9% of community pharmacists lacked knowledge of vaccination during pregnancy.⁷⁴ This is concerning and should be addressed, especially considering that 56.47% in our study population indicated that inadequate clinical knowledge of vaccines, their precautions, and contraindications, is a barrier to implementing vaccination services. Furthermore, as previously stated, until recently, nearly all community pharmacists in Saudi Arabia were expatriate; consequently, may have variable knowledge regarding

immunization and vaccines from their pharmacy education.⁷⁹ It is essential for pharmacists to counsel patients and advocate for the use of vaccines in the community, utilizing the best available evidence. Consequently, it is important to ensure community pharmacists have up-to-date evidence-based knowledge about the clinical use, indications, and contraindications of vaccines. This could be done via continuing professional development (CPD) programs and other development initiatives. This is particularly important as most community pharmacists are trained abroad and came from different healthcare systems and educational backgrounds as mentioned earlier. In addition, ensuring the curriculum in Saudi Colleges of Pharmacy adequately covers all key aspects regarding vaccines and vaccinations with more Saudi-trained pharmacists joining the community pharmacy workforce.^{79,104}

Overall, the participants had positive beliefs and views regarding future implementation of vaccination services in community pharmacies in Saudi Arabia. Participants reported that pharmacies are easily accessible and convenient avenues to provide vaccination services. Alongside this, vaccination through community pharmacies will increase the overall uptake of vaccines in the community and allow community pharmacists to contribute to public health and promotion of vaccines, especially given concerns with key issues including AMR in Saudi Arabia.^{105,106} This is similar to findings from previous studies in which accessibility of pharmacies was highlighted as an enabler and the contribution to increasing vaccination coverage.^{81,107–109} In addition, participants believed the service will address patients' needs and demands for immunization services from their pharmacies. These findings are encouraging and could facilitate implementation of vaccination services among community pharmacists in Saudi Arabia. We are aware that similar findings have been reported in countries in which community pharmacists are realizing their vital role in advancing public health through vaccination services to prevent infectious diseases and serve their community with access to vaccines.^{55–56,108–111} Consequently, community pharmacists in Saudi Arabia could contribute to life-course vaccination and support the vaccination of adults and high-risk groups to achieve high vaccination coverage rates in the country. This is particularly important as recent studies in Saudi Arabia have shown low coverage of several vaccines, including the seasonal influenza vaccine,^{23–26} the pneumococcal vaccine,²⁹ and the herpes zoster vaccine.²⁸ For instance, a study showed that only 27.4% of participants in the Al-Jouf region of Saudi Arabia have the seasonal influenza vaccine annually.²⁴ A nationwide study in Saudi Arabia also reported low uptake of the seasonal influenza vaccine at only 31.5%.²⁵ A third study reported that only 19.31% of the patients were covered by the seasonal influenza vaccine in association with COVID-19.²⁶ Among patients with diabetes, only 3.2% received the pneumococcal vaccine.²⁹ A study investigating the herpes zoster vaccine uptake among individuals aged ≥ 50 years in Saudi Arabia also reported a low uptake rate of only 7.7%.²⁸ Consequently, efforts and strategies are required to increase life-course vaccinations, including education, advocacy, and awareness campaigns through community pharmacies, as they are uniquely positioned to promote and administer vaccines.⁷³

However, many barriers to the implementation of vaccination services in community pharmacies were identified in our study. Several operational and logistic barriers and issues related to capacity to deliver vaccination services were reported. These included a lack of support staff and technicians in community pharmacies, pharmacists' lack of time, additional workload as a result of rendering vaccination services, and lack of requirements and equipment to provide vaccination services. These issues have been reported in studies from other countries, and need to be addressed going forward.^{81,86,87,90,107,112} Other barriers were related to practical skills, certification, and clinical management including the lack of training on immunization and injection techniques, lack of formal certification in pharmacy-based immunization delivery, and issues related to the management of adverse events following immunization. In fact, physical capability in terms of education and professional training including formal certificate programs is widely reported as one of the key influencing factors in the provision of vaccines by pharmacists across countries, which again needs to be addressed going forward starting in Saudi Colleges of Pharmacy as well as with CPD activities.^{18,76,107,113,114}

Overall, we believe the findings from this study had several implications on practice, policy, and education of community pharmacists in Saudi Arabia going forward. Several enablers and facilitators could help in establishing the service. These include pharmacists already authorized to provide the service, pharmacists' knowledge, positive beliefs and views toward the service, and availability of physical space, i.e., a room or separate area in the pharmacy, to deliver the service in most pharmacies. However, to establish the vaccination services in community pharmacies in Saudi Arabia, a multi-faceted approach is required. This includes addressing the human resources capacity, i.e., insufficient pharmacists and lack of pharmacy technicians, to deliver the service. This is evident by our study findings and other published studies.^{79,115–117} Increasing the human resources will help to address the other barriers including time and workload that were reported by the study participants. Moreover, pharmacists' capability should be addressed by formal certification programs to enable pharmacists to provide a safe and effective service orchestrated by Colleges of Pharmacy in Saudi Arabia. In addition, it is essential to address the pharmacy logistics, procedures, requirements, and equipment to provide a vaccination service. Similarly, colleges of Pharmacy in Saudi Arabia should ensure current curricula adequately cover the relevant theoretical and clinical aspects of vaccination, including the practical skills, i.e., knowledge and practical skills including, injection techniques given concerns.^{76,80,81} This is important especially with a recent study indicated a lack of training on the administration of vaccines among some Colleges of Pharmacy in Saudi Arabia.⁸¹ Consequently, it is necessary to have adequate coverage of this topic and area of practice to ensure future pharmacy graduates are adequately prepared to practice and contribute to the expanding roles of pharmacists in Saudi Arabia, in line with the recent developments in the profession and expanded scope of practice to meet the needs of the patients and health-care system. This is particularly important as the recent evidence published by the International Pharmaceutical

Federation (FIP) in 2023 shows the importance of community pharmacists' contributions to life-course vaccinations.⁷³ Community pharmacists play crucial roles, including vaccine advocacy, building vaccine confidence, addressing vaccine hesitancy, and the delivery of vaccine services, including prescribing and administration, in many countries,⁷³ and we need to build on this. We will continue to monitor the situation.

We are aware that the study had several limitations. First, the study only included community pharmacists from the Qassim region. However, the laws and regulations governing community pharmacy sector are the same across the country as they are national level and not at the regional level leading to similar practices. In addition, we employed convenience sampling. This though was inevitable due to logistical barriers. However, as mentioned in the methods section, we included pharmacies from a wide geographical area, including the city of the region and eight governorates to minimize any potential selection bias. Moreover, with the survey being administered over a web-based platform, a selection bias toward web access could be a limitation. However, we believe this had a minimal impact as 99% of the Saudi population were using the internet at the time of the study according to the Saudi Internet report of 2023.¹¹⁸ Similar to other study designs using surveys, social desirability could be a limitation. However, the responses were anonymous, consequently reducing any potential impact of this issue. As this was a voluntary survey, other limitations might be self-selection bias, and those who responded might differ from those who did not. However, given the high response rate and given our robust methodology including the comprehensive questionnaire and in-person field visits, we believe the study findings are valuable and provide useful guidance and insights to inform the future training of pharmacists in Saudi Arabia as well as develop vaccination services at community pharmacies.

Conclusion

Most of the community pharmacists in Saudi Arabia had good knowledge on many aspects of vaccines including their roles in preventing and controlling infectious diseases, safety, effectiveness, health benefits, and the rigorous regulatory approval process of vaccines before being marketed. However, some gaps in the clinical knowledge of vaccines were identified, as well as gaps in knowledge of the regulations related to provision of vaccination services by community pharmacists in Saudi Arabia. The majority of participants had positive beliefs and views toward providing vaccination services at community pharmacies. Many barriers were also identified hindering the implementation of vaccination services in community pharmacies in Saudi Arabia. These included operational and logistic barriers and those related to professional certification and training to deliver the service. Consequently, a holistic strategy is required to address these barriers to facilitate the implementation of vaccination services among community pharmacies in Saudi Arabia in the future. As a result, enable community pharmacists to contribute to public health via promoting and delivering vaccination services.

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Data availability statement

Additional data are available on reasonable request from the corresponding author.

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