CLINICAL RESEARCH

e-ISSN 1643-3750
© Med Sci Monit, 2026; 32: e953236
DOI: 10.12659/MSM.953236

Received: 2026.02.26
Accepted: 2026.05.19
Available online: 2026.06.07
Published: 2026.XX.XX

Impact of an Influenza and Pneumococcal Vaccination Course on Enhancing Pharmacists' Knowledge

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ABCDEF 1 Michał Waszkiewicz
ACDEF 2 Jakub Świtalski
DEG 3,4 Piotr Dąbrowski
ADEF 1 Artur Niedzielski
ABDEF 1,5 Anna Augustynowicz

1 School of Public Health, Centre of Postgraduate Medical Education of Warsaw, Warsaw, Poland
2 Department of Ethics and Medical Law, Center for the Humanities and Social Sciences in Medicine, Medical University of Warsaw, Warsaw, Poland
3 Department of Neurosurgery, Faculty of Medicine, Lazarski University, Warsaw, Poland
4 Department of Neurosurgery, Independent Public Specialist Western Hospital John Paul II in Grodzisk Mazowiecki, Grodzisk Mazowiecki, Poland
5 VIZJA University, Warsaw, Poland

Corresponding Author: Jakub Świtalski, Department of Ethics and Medical Law, Center for the Humanities and Social Sciences in Medicine, Medical University of Warsaw, Litewska 14a St, Warsaw 00-581, Poland, Phone: +48 225720702, e-mail: jakub.switalski@wum.edu.pl

Financial support: None declared
Conflict of interest: None declared

Background: In Poland, pharmacists have recently been authorized to administer vaccinations to adult patients in pharmacies, including influenza and pneumococcal vaccines. To obtain certification, pharmacists must complete a specialized qualification course organized by the Centre of Postgraduate Medical Education in Warsaw (CPME). This study aimed to evaluate changes in pharmacists' knowledge following completion of a qualification course on administering influenza and pneumococcal vaccinations.

Material/Methods: This pre-post study was conducted online between February 2024 and July 2025. Participation was limited to pharmacists eligible to enroll in the CPME course. Knowledge was assessed using an original 20-item single-choice test (1 point per correct answer) covering influenza and pneumococcal epidemiology, eligibility criteria, and the legal and financial aspects of vaccination. Analyses examined both the overall score and changes in responses to individual questions.

Results: The study included only participants who completed both the pre-test and post-test, constituting the matched analytic cohort (n = 327). The course significantly improved knowledge relative to the pre-training assessment ($t_{(326)} = 28.02$; $P < 0.001$; d = 1.55). The effect was substantial, with a mean increase of 4.7 points across the entire test ($M_{diff} = -4.67$; 95% confidence interval, -4.99 to -4.34). Respondents improved their scores by approximately 23% of the maximum possible score.

Conclusions: Completion of the qualification course on influenza and pneumococcal vaccination significantly improved pharmacists' knowledge. Longitudinal studies are needed to assess knowledge retention and determine the impact of expanded pharmacy-based vaccination services on public health outcomes in Poland.

Keywords: influenza, human • knowledge • pharmacists • *Streptococcus pneumoniae* • vaccines

Full-text PDF: https://www.medscimonit.com/abstract/index/idArt/953236

3009 2 — 24

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Introduction

Vaccinations—among the most effective public health interventions—play a crucial role in reducing the burden of infectious diseases, including influenza and pneumococcal infections [1-3]. Despite the availability of effective vaccines for these diseases, vaccination rates remain low in many countries. This issue also applies to Poland, where vaccination coverage remains suboptimal, even among at-risk populations [4-6].

One strategy to increase vaccination rates is allowing pharmacists to administer vaccines in pharmacies. In Poland, qualification as a pharmacist requires completion of pharmacy studies, obtaining a Master of Pharmacy degree, and completing at least 6 months of professional practice in a pharmacy. Under Polish law, pharmacists have both the right and the obligation to pursue continuous professional development, which may be achieved through postgraduate education (specialization training, qualification courses, or postgraduate studies) or other forms of professional development [7]. To administer vaccinations, Polish pharmacists must complete a qualification course organized by the Centre of Postgraduate Medical Education in Warsaw (CPME) [8,9]. Each vaccination must be preceded by an assessment to identify potential contraindications, and the course is designed to prepare participants to conduct these assessments [10].

Studies from around the world have shown that allowing pharmacists to administer vaccinations increases vaccination rates [11-14]. This effect may be attributed to improved accessibility and availability of vaccines, as well as more effective implementation of vaccination programs, particularly in regions with limited access to healthcare services. Therefore, Poland's decision to expand pharmacists' vaccination responsibilities is supported by existing evidence and established guidelines [15]. A key factor influencing the effectiveness of this approach is pharmacists' knowledge of vaccines and their preparedness to administer vaccines appropriately. To provide effective vaccination services, pharmacists must be willing and confident to offer vaccinations, which may depend on their knowledge of current recommendations, epidemiology, and medical contraindications. They should also be familiar with vaccination financing, relevant legislation, and medical record-keeping requirements [16-18].

This study aimed to assess changes in pharmacists' knowledge after completing a qualification course on patient eligibility for and administration of influenza and pneumococcal vaccinations.

Material and Methods

Ethics Statement

The study was conducted in accordance with the principles of the Declaration of Helsinki and approved by the Bioethics Committee of the CPME (19/2025). Prior to participation, eligible individuals were provided with detailed information regarding the study objectives and methodology. Participants received written information stating that completion of the questionnaire constituted consent to the use of anonymized data for research purposes. Participation required respondents to provide consent by answering "yes" to the question: "Do you consent to participate in the study?"

Qualification Course for Pharmacists

The course on vaccination and qualification examinations to identify contraindications to influenza and pneumococcal vaccination was organized by the CPME. The program comprised at least 16 didactic hours, including a minimum of 8 hours of theoretical instruction and 8 hours of practical training. Individuals authorized to conduct the theoretical and practical sessions included physicians, nurses, midwives, paramedics, laboratory diagnosticians holding a coronavirus disease 2019 (COVID-19) vaccination course certificate, pharmacists holding a COVID-19 vaccination course certificate, and pharmacists with a vaccination qualification course certificate covering COVID-19 and other recommended immunizations. The theoretical component was delivered through the CPME e-learning platform; it included pre-recorded lectures and written educational materials. Topics covered encompassed the epidemiology of influenza and pneumococcal infections, the electronic vaccination registration system, vaccination financing policies, adult vaccination recommendations, eligibility assessment, legal regulations governing vaccination services, pre-vaccination interviews, intramuscular injection techniques, and management of anaphylactic shock. The practical component was conducted at universities throughout Poland and included refresher training in first aid, management of life-threatening emergencies, vaccine preparation, and administration of intramuscular injections using manikins.

The course was exclusively intended for pharmacists holding a Master of Pharmacy degree and a license to practice. An additional requirement was at least 12 months of professional experience as a pharmacist.

The course was launched at different times for different groups of pharmacists and thus was delivered in multiple cohorts rather than continuously. To date, 82 editions of the program have been conducted, involving a total of 1147 pharmacists.

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Research Tool

An author-developed knowledge test was created based on the content of the pharmacist qualification course and current pharmaceutical care standards. The test consisted of 20 single-choice questions. Each correct answer was awarded 1 point, resulting in a maximum possible score of 20 points. The test covered the epidemiology of influenza and pneumococcal infections, vaccination eligibility criteria, legal aspects of vaccination, and vaccination financing.

The test questions were reviewed by a panel of immunization experts with experience in scientific research, including 2 pharmacists, 1 physician, 1 nurse, and 1 public health specialist. Minor linguistic revisions were suggested and incorporated into the final version. This expert-reviewed version was used throughout the study. Content validity was confirmed by the expert panel. However, a formal pilot study with statistical evaluation of psychometric properties was not conducted, which may represent a limitation of the study. Additionally, a group of 17 pharmacists completed the questionnaire and provided feedback before the main study. They raised no substantive concerns and suggested only minor editorial revisions, which were subsequently incorporated into the final version of the test. The complete set of questions is presented in **Table 1**.

Participants and Data Collection

The study was conducted between February 2024 and July 2025. Pharmacists enrolled in the theoretical component of the qualification course described above were eligible to participate.

At the beginning of the course, a link to the pre-test, administered through Microsoft Forms, was posted on the e-learning platform. Participants were informed about the study objectives and the anonymous nature of data collection. The pre-test was completed at the start of the course, before participants had received any course-related instruction. A link to the post-test was provided at the end of the course; it could be accessed only after participants had completed the required educational materials. The pre-test and post-test contained the same questions presented in the same order. Participants did not receive feedback on the correctness of their responses after completing the pre-test.

To link pre-test and post-test responses, participants were instructed to create a personal code consisting of at least 5 arbitrary characters and enter it in both forms. They were also asked to provide their age and gender to help distinguish individuals in the event of duplicate codes. All questionnaire items required a response, resulting in no missing data. Based on the collected information, pre-test and post-test responses could be matched at the individual level. To ensure a reliable comparison, only participants who completed both the pre-test and the post-test were included in the analysis; those who completed only 1 assessment were excluded. The dataset was screened for duplicate entries using the personal code in combination with age and gender, and any duplicate records were removed.

Statistical Analysis

Questionnaire responses were analyzed using McNemar's test to assess differences in paired dichotomous responses (no adjustment for multiple testing was applied). The purpose of this analysis was to determine whether the proportion of correct answers to vaccination-related knowledge questions significantly increased after completion of the educational program. Differences in total pre-test and post-test scores were assessed using a paired-samples Student's t-test. The difference score was calculated as the pre-test score minus the post-test score; accordingly, negative values indicated improved performance after training. Total knowledge scores ranged from 0 to 20 points. Before conducting the analysis, the assumption of normality concerning the distribution of difference scores was evaluated using skewness and kurtosis statistics, as well as visual inspection of Q-Q plots and box plots.

Effect size was calculated using Cohen's d for dependent samples, defined as the mean difference divided by the standard deviation of the difference scores. The following thresholds were used to interpret effect size: small ($d = 0.2$), medium ($d = 0.5$), large ($d = 0.8$), and very large ($d = 1.3$) [19].

Participant responses were compiled in a Microsoft Excel database, and all statistical analyses were performed using IBM SPSS Statistics version 29. Statistical significance was set at $\alpha = 0.05$.

Results

Sample

A total of 657 individuals completed the pre-test, whereas 428 completed the post-test. To enable a reliable comparison of results, participants were required to complete both assessments. Some participants completed only the pre-test, whereas others completed only the post-test. All submitted data and participant codes were reviewed. In total, 312 individuals completed only the pre-test, and 93 completed only the post-test. Additionally, 18 pre-test responses and 8 post-test responses were excluded because the same code, gender, and age were reported more than once, indicating duplicate records. The high proportion of participants who completed only 1 assessment reflects the voluntary nature of the study,

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Table 1. Pharmacists' knowledge test: Questions and answer options.

	Item	Answer options (correct answer in bold)
1	Who is eligible for compulsory (free) vaccination against invasive *Streptococcus pneumoniae* infections under the Preventive Vaccination Program for individuals at increased risk due to clinical or epidemiological factors?	a) Persons under 3 years of age with specific clinical or epidemiological indications who have not been vaccinated against pneumococcal disease b) Persons under 18 years of age with specific clinical or epidemiological indications who have not been vaccinated against pneumococcal disease **c) Persons under 19 years of age with specific clinical or epidemiological indications who have not been vaccinated against pneumococcal disease** d) Persons over 65 years of age
2	A pharmacist:	**a) Is authorized to administer adrenaline in the event of anaphylactic shock because it poses an immediate threat to the patient's life** b) Is authorized to administer any medicinal product in the event of an immediate threat to the patient's life c) Is not authorized to administer adrenaline to a patient d) Is not authorized to administer any medicinal product to a patient
3	Who is eligible for free influenza or pneumococcal vaccination in a single-dose regimen administered in a pharmacy by a qualified pharmacist?	a) All individuals, regardless of age b) Persons over 18 years of age c) Persons over 50 years of age **d) Persons over 65 years of age**
4	Which vaccinations can be administered in a pharmacy?	a) COVID-19 and influenza vaccines **b) Influenza, pneumococcal, and COVID-19 vaccines** c) Pneumococcal and influenza vaccines d) COVID-19 vaccines only
5	How long is vaccination eligibility valid?	a) 2 hours b) 12 hours **c) 24 hours** d) 36 hours
6	How many *Streptococcus pneumoniae* serotypes have been identified to date?	a) Approx. 30 b) Approx. 50 **c) Approx. 100** d) Approx. 120
7	Which serotypes are most commonly associated with invasive pneumococcal disease (IPD) in Poland?	a) 1, 2, 23B b) 4, 29, 34 **c) 3, 19A, 14** d) 9, 14, 31
8	Invasive pneumococcal disease (IPD) includes which of the following conditions?	**a) Meningitis, septicemia/sepsis, and bacteremic pneumonia** b) Otitis and meningitis c) Pneumonia only d) Meningitis and otitis
9	In Poland, the 20-valent pneumococcal conjugate vaccine (PCV20) is currently approved for individuals:	a) Over 2 years of age b) Over 10 years of age c) Over 13 years of age **d) Over 18 years of age**
10	Which legal act authorizes the administration of influenza and pneumococcal vaccinations in pharmacies?	**a) The Act of 6 September 2001 on Pharmaceutical Law (Journal of Laws 2022, item 2301, as amended)** b) The Act of 27 August 2004 on Health Care Services Financed from Public Funds (Journal of Laws 2022, item 2561, as amended) c) The Act of 12 May 2011 on Reimbursement of Medicines, Food for Special Nutritional Purposes, and Medical Devices (Journal of Laws 2023, item 826, as amended) d) None of the above

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Table 1 continued. Pharmacists' knowledge test: Questions and answer options.

	Item	Answer options (correct answer in bold)
11	Within what temperature range should influenza and pneumococcal vaccines be stored?	a) -2 °C to +8 °C b) +2 °C to +6 °C **c) +2 °C to +8 °C** d) +8 °C to +25 °C
12	In adults, vaccine injections should be administered:	a) In the shoulder muscle of the non-dominant arm b) In the anterolateral thigh area (if muscle mass in the shoulder area is insufficient) c) In either upper limb, regardless of dominance **d) Both a and b are correct**
13	After vaccine administration, the patient should be observed for:	a) Approx. 5 minutes **b) Approx. 15 minutes** c) Approx. 30 minutes d) No observation is required after vaccination
14	Which types of influenza viruses cause seasonal epidemics in humans?	a) A and D b) B and C **c) A and B** d) C and D
15	Influenza B viruses are divided into the following lineages:	a) H1N1 and H3N2 b) H2N2 and pdm09 **c) Victoria and Yamagata** d) Dozens of various lineages
16	During which months is influenza vaccination recommended for individuals requiring only 1 vaccine dose?	**a) September or October** b) August, September, or October c) August or September d) November or December
17	Vaccination of individuals in close contact with a person who is vulnerable to disease but cannot be vaccinated due to medical contraindications or age restrictions is known as:	a) Group strategy b) Clan strategy **c) Cocoon strategy** d) Family strategy
18	The highest percentage of influenza cases occurs in:	a) Children aged 0-3 years b) Adults aged 55-64 years c) Adults over 65 years of age **d) Distribution varies depending on influenza season**
19	Individuals at highest risk of influenza include:	**a) Children under 2 years of age and people with asthma** b) Children under 10 years of age and adults over 45 years of age c) Adults over 45 years of age and people with asthma d) Children under 10 years of age and pregnant women
20	Pneumococcal and influenza vaccination in adults is:	a) Mandatory b) Mandatory for specific professional groups c) Mandatory during public health emergencies **d) Recommended**

which was offered as an additional component of the pharmacist qualification course. Ultimately, 327 individuals who completed both the pre-test and post-test were included in the analysis. The sample comprised 287 women and 40 men, ranging in age from 25 to 61 years (mean [M] = 35.69; standard deviation [SD] = 8.57).

Nearly half of the respondents (n = 152; 46.5%) had worked in a pharmacy for 11 years or more. The second-largest group consisted of pharmacists with 1 to 2 years of professional experience (n = 92; 28.1%). This was followed by those with 3 to 5 years of experience (n = 48; 14.7%) and those with 6 to 10 years of experience (n = 35; 10.7%).

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Table 2. Pre- and post-course changes in responses to individual questions among pharmacists participating in a course on eligibility assessment and administration of influenza and pneumococcal vaccinations.

Item	Pre-test incorrect → Post-test correct (improvement)	Pre-test correct → Post-test incorrect (deterioration)	*P*
1	140 (95.2%)	7 (4.8%)	< 0.001
2	68 (84.0%)	13 (16.0%)	< 0.001
3	68 (74.7%)	23 (25.3%)	< 0.001
4	53 (98.1%)	1 (1.9%)	< 0.001
5	82 (98.8%)	1 (1.2%)	< 0.001
6	168 (94.9%)	9 (5.1%)	< 0.001
7	127 (92.0%)	11 (8.0%)	< 0.001
8	24 (54.5%)	20 (45.5%)	0.651
9	108 (85.0%)	19 (15.0%)	< 0.001
10	88 (83.0%)	18 (17.0%)	< 0.001
11	27 (75.0%)	9 (25.0%)	0.005
12	69 (75.0%)	23 (25.0%)	< 0.001
13	76 (100.0%)	0 (0.0%)	< 0.001
14	8 (100.0%)	0 (0.0%)	0.008
15	210 (100.0%)	0 (0.0%)	< 0.001
16	118 (91.5%)	11 (8.5%)	< 0.001
17	167 (99.4%)	1 (0.6%)	< 0.001
18	66 (65.3%)	35 (34.7%)	0.003
19	90 (76.9%)	27 (23.1%)	< 0.001
20	6 (40.0%)	9 (60.0%)	0.607

Note: Percentages are based on discordant pairs only.

Results of Individual Questions

McNemar's test was applied separately to each of the 20 dichotomous items using matched pre-test and post-test responses. *P*-values reported in **Table 2** correspond to these item-level analyses. Comparison of responses before and after completion of the pharmacist qualification course showed improvements in the vast majority of questions (Questions 1-7, 9-13, and 15-19). For these items, the predominant pattern was a shift from incorrect responses in the pre-test to correct responses in the post-test. Several questions demonstrated particularly large improvements, indicating strong acquisition of the course content. Question 14 also showed a significant change; however, the response distribution suggested a ceiling effect after training, limiting the potential for further improvement. No significant differences were observed for Questions 8 and 20, which likely reflects the high level of knowledge already demonstrated in the pre-test. Although Questions 11 and 18 showed statistically significant improvements, the magnitude of change was smaller than that observed for most other items. Detailed results are presented in **Table 2**.

Overall Result

Before conducting the main analysis, the normality of the distribution of difference scores was assessed using skewness (Sk = 0.01) and kurtosis (K = -0.44) statistics, as well as visual inspection of Q-Q plots and box plots. The results indicated no substantial deviations from normality and no evidence of outliers in the dataset. Analysis of total test scores revealed a statistically significant increase in knowledge following the training ($t_{(326)} = 28.02$; $P < 0.001$; d = 1.55). The mean pre-test score was 11.97 (SD = 2.72), whereas the mean post-test score was 16.64 (SD = 1.97). The mean difference between measurements

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

was -4.67 (SD = 3.01), with a 95% confidence interval ranging from -4.99 to -4.34. In practical terms, participants improved their scores by an average of approximately 4.7 points on the 20-point scale, corresponding to an increase of around 23% of the maximum possible score.

Discussion

In Poland, despite growing interest in pharmacists' involvement in vaccination programs, the effectiveness of qualification courses in improving pharmacists' knowledge and practical competencies related to influenza and pneumococcal vaccination has not been adequately assessed. Evaluating the impact of such training is important from both scientific and practical perspectives. The findings may inform the development of educational curricula, pharmacy practice models, and health policies aimed at increasing vaccination coverage. In this study, we examined changes in pharmacists' knowledge after completion of a qualification course on the eligibility assessment and administration of influenza and pneumococcal vaccines. The results demonstrated that participation in the course significantly improved pharmacists' knowledge in this area. Improvements were observed across both epidemiological topics and practical aspects of vaccine administration.

It is also important to note that pharmacists' baseline knowledge of vaccination was moderate and, in our view, insufficient for the effective provision of vaccination services in pharmacies. Numerous studies worldwide have identified gaps in pharmacists' vaccination-related knowledge [20]. These deficiencies include understanding of vaccine composition, as well as the safety, efficacy, and appropriateness of recommending influenza and pneumococcal vaccines to specific patient populations [21,22]. Our findings support the implementation of dedicated qualification courses for pharmacists. Such training can enhance knowledge and may increase pharmacists' willingness and confidence to offer vaccinations in pharmacy settings. Practical experience with recommending and administering vaccines is likely to further reinforce this knowledge [23]. Our findings also highlight the need for broader discussion regarding pharmacists' education, particularly the extent to which vaccination-related competencies should be incorporated into undergraduate pharmacy curricula. At present, the implementation of dedicated educational courses appears to be an essential component of preparing pharmacists in Poland to provide vaccination services in community pharmacies.

The next stage, which warrants further investigation, is to evaluate the impact of acquired knowledge on pharmacists' willingness to provide vaccinations and on vaccination rates in Polish pharmacies. The underlying assumption is that allowing pharmacists to administer vaccines will increase vaccination coverage for certain diseases included in the recommended vaccination schedule. A comprehensive assessment of the effectiveness of this initiative will require several years of observation. However, evidence from other countries suggests that pharmacist-administered vaccination services can substantially increase vaccination uptake [13]. In this context, the organizational aspects of implementing vaccination services in pharmacies remain critical. The system in Poland has been active for some time, and many pharmacies appear to have successfully addressed the associated logistical challenges. These pharmacies provide dedicated clinical spaces for vaccination and assign specific pharmacists to vaccination duties during work shifts. Additionally, some pharmacies operate appointment-based vaccination services. Nevertheless, this area needs further investigation among pharmacists working in pharmacies that provide vaccinations. Preliminary findings from Polish studies indicate high levels of patient satisfaction with pharmacy-based vaccination services [24].

A major strength of this study is its relevance to the optimization of postgraduate pharmaceutical education. Although the observed increase in knowledge after completion of the qualification course may be expected, detailed analysis of the collected data enabled identification of knowledge gaps that existed before participants undertook the specialized training. These findings provide valuable insights and can serve as a starting point for discussions on potential modifications to undergraduate pharmacy curricula aimed at better preparing students for the demands of contemporary pharmacy practice. Furthermore, the study provides empirical evidence supporting the effectiveness of the educational model adopted by the CPME. Despite its relatively short duration and limited number of instructional hours, the specialized course produced a statistically significant improvement in participants' knowledge. This finding is particularly relevant for healthcare-planning-focused policymakers because it supports the value of investing in short, intensive continuing professional development programs. The results may also inform future revisions of the course curriculum. By identifying topics associated with the lowest pre-course scores, educational content can be refined and targeted more effectively, potentially enhancing learning outcomes in future course editions. Finally, given the pioneering nature of this analysis in the Polish context, the present study helps address an important gap in the national scientific literature and may serve as a reference point for future research evaluating professional competencies among healthcare professionals.

Our study has several limitations that should be acknowledged. First, the observed effects may reflect only short-term knowledge gains, influenced in part by participants' ability to recall information during the post-test. Future studies should assess long-term knowledge retention, for example 1 to 2 years after

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

completion of the qualification course. Such research could help determine whether refresher training is needed to maintain competency over time. Second, the study design did not enable objective assessment of how knowledge is applied in practice. Although pharmacists' theoretical knowledge substantially improved, the pre-post design cannot determine whether participants effectively translated this knowledge into clinical practice, such as managing adverse vaccination reactions (eg, anaphylactic shock). Third, the final results may have been affected by participant attrition between the pre-test and post-test. A substantial proportion of participants who completed the pre-test did not complete the post-test, which may have introduced bias into the final sample. Fourth, identical test items were presented in the same order in both assessments. Consequently, the observed improvement reflects performance on a repeated test administered after a period of time and cannot be attributed solely to learning; test familiarity and other factors may also have influenced the results. Fifth, the study design allowed participants to complete the test without time restrictions and to navigate freely between questions. Furthermore, there was no restriction on the interval between reviewing the course materials and completing the post-test. The only constraint was the availability period of the course for a given cohort of pharmacists, which was determined independently of the study and typically lasted approximately 1 month. Sixth, selection bias may have been present. The study included only pharmacists who voluntarily enrolled in the educational course. These individuals may have been more motivated and more interested in incorporating vaccination services into their professional practice than the broader pharmacist population, potentially contributing to greater knowledge acquisition. Finally, the test instrument did not undergo formal psychometric validation. Nevertheless, the development process, including expert review and pilot testing, helped ensure that the instrument was relevant to pharmaceutical practice and reduced the risk of drawing erroneous conclusions.

Conclusions

Completion of the qualification course on the eligibility assessment and administration of influenza and pneumococcal vaccines was associated with improved knowledge of these vaccines and the related diseases among participants who completed both the pre-test and post-test. However, these findings reflect only changes in test scores within the matched study cohort and should not be interpreted as definitive evidence of sustained learning among all enrolled pharmacists. This limitation is due to factors including participant attrition, the selected study sample, and the lack of assessment of practical competencies. Further research is needed to evaluate long-term knowledge retention and to determine the extent to which pharmacist-administered vaccination services in community pharmacies have influenced vaccination uptake among patients in Poland.

References:

1. Rémy V, Zöllner Y, Heckmann U. Vaccination: The cornerstone of an efficient healthcare system. J Mark Access Health Policy. 2015;3:27041
2. Carrillo-Santisteve P, Ciancio BC, et al. The importance of influenza prevention for public health. Hum Vaccin Immunother. 2012;8(1):89-95
3. Oligbu G, Fry NK, Ladhani SN. The pneumococcus and its critical role in public health. Methods Mol Biol. 2019;1968:205-13
4. Kopciuch D, Hoffmann K, Kus K, et al. Analysis of attitudes and practices towards the influenza vaccine in high-risk adults in Poland. Vaccines (Basel). 2024;12(3):341
5. Sobierajski T, Rzymski P, Wanke-Rytt M. The influence of recommendation of medical and non-medical authorities on the decision to vaccinate against influenza from a social vaccinology perspective: Cross-sectional, representative study of Polish society. Vaccines (Basel). 2023;11(5):994
6. Rykowska D, Kuchar E. Influenza prevention among hospital employees in Poland: A narrative review. Med Pr. 2025;76(5):397-406
7. Act of 10 December 2020 on the Profession of a Pharmacist (Journal of Laws of 2025, item 608). Available from: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20250000608/O/D20250608.pdf [in Polish]
8. Regulation of the Minister of Health of 18 August 2022 on Qualification Courses for Pharmacists (Journal of Laws of 2025, item 563). Available from: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20250000563/O/D20250563.pdf [in Polish]
9. Order No. 155/2023/DGL of the President of the National Health Fund of 31 October 2023 on the Terms and Conditions for Concluding and Implementing Contracts for the Administration of Recommended Vaccinations in Pharmacies. Available from: https://baw.nfz.gov.pl/NFZ/document/2046/Zarzadzenie-155_2023_DGL [in Polish]
10. Act of 5 December 2008 on the Prevention and Control of Infections and Infectious Diseases in Humans (Journal of Laws, 2024, item 924). Available from: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20240000924/U/D20240924Lj.pdf [in Polish]
11. Amare SN, Yee KC, Leung M, et al. Impact of pharmacist-led interventions on COVID-19, herpes zoster, influenza, pneumococcal, and respiratory syncytial virus vaccines uptake in people aged 60 years and older: Systematic review and meta-analysis. Res Social Adm Pharm. 2025;21(11):857-71
12. Rahim MHA, Dom SHM, Hamzah MSR, et al. Impact of pharmacist interventions on immunisation uptake: A systematic review and meta-analysis. J Pharm Policy Pract. 2023;17(1):2285955
13. Isenor JE, Edwards NT, Alia TA, et al. Impact of pharmacists as immunizers on vaccination rates: A systematic review and meta-analysis. Vaccine. 2016;34(47):5708-23
14. Baroy J, Chung D, Frisch R, et al. The impact of pharmacist immunization programs on adult immunization rates: A systematic review and meta-analysis. J Am Pharm Assoc (2003). 2016;56(4):418-26
15. Isenor JE, Bowles SK. Opportunities for pharmacists to recommend and administer routine vaccines. Can Pharm J (Ott). 2019;152(6):401-5
16. Au AL, Chia DM, Ong PS. Vaccination knowledge, attitudes, perceptions, and educational needs of pharmacists in Singapore: A cross-sectional study. Vaccines (Basel). 2024;12(11):1219
17. Edwards N, Gorman Corsten E, Kiberd M, et al. Pharmacists as immunizers: A survey of community pharmacists' willingness to administer adult immunizations. Int J Clin Pharm. 2015;37(2):292-95
18. Della Polla G, Napolitano F, Pelullo CP, et al. Investigating knowledge, attitudes, and practices regarding vaccinations of community pharmacists in Italy. Hum Vaccin Immunother. 2020;16(10):2422-28

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

19. Sullivan GM, Feinn R. Using effect size—Or why the P value is not enough. J Grad Med Educ. 2012;4(3):279-82
20. Waszkiewicz M, Wnuk K, Świtalski J, Augustynowicz A. Knowledge, attitudes, and beliefs of pharmacists regarding vaccinations against influenza and pneumococci: A systematic review. Hum Vaccin Immunother. 2025;21(1):2489889
21. Ozdemir N, Kara E, Bayraktar-Ekincioglu A, et al. Knowledge, attitudes, and practices regarding vaccination among community pharmacists. Prim Health Care Res Dev. 2022;23:e38
22. Toledo D, Soldevila N, Guayta-Escolies R, et al. Knowledge of and attitudes to influenza vaccination among community pharmacists in Catalonia (Spain). 2013-2014 season: A cross-sectional study. Int J Environ Res Public Health. 2017;14(7):756
23. Frankart LM, Patterson JA, Crawford AN, et al. Retention of students' knowledge of immunizations following a one-day or a five-week course. Curr Pharm Teach Learn. 2022;14(9):1104-8
24. Merks P, Kowalczuk A, Wong A, et al. Patient satisfaction with pharmacist-administered COVID-19 vaccines in Poland: A survey study in the vaccination centres context. BMC Health Serv Res. 2022;22(1):1339

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]