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Transforming Pharmacovigilance Practice Through Education: A Sustained Intervention Study Among Hospital Pharmacists in Dubai

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Abstract

The objective of this investigation was to evaluate how a custom-designed educational intervention influenced knowledge, attitudes, practices, barriers, and facilitating factors related to pharmacovigilance (PV) among institutional pharmacists practicing in Dubai. Pharmacists across three hospital sites participated in an instructional intervention comprising a PowerPoint lecture and a practical, hands-on workshop focused on PV. Ongoing follow-up communications supplemented this via WhatsApp over the course of 6 months. To measure the module's efficacy, a structured questionnaire was administered at baseline and at 3 and 6 months following the intervention. Median (IQR) scores derived from individual Likert-type items were compared across various demographic variables employing Mann–Whitney and Kruskal-Wallis tests. Inter-variable correlations were assessed via Spearman's rank correlation and Pearson's R (interval-by-interval) tests. In contrast, the Wilcoxon signed-rank test was used to evaluate pre- versus post-intervention scores at the alpha = 0.05 significance level. Among the 60 enrolled participants, post-intervention assessments revealed that overall knowledge scores rose significantly from a baseline of 14 (12–15)/18 to 17 (16–18) at 3 months ($P < 0.001$), and reached 18 (17–18) at 6 months ($P < 0.001$). Similarly, attitude scores increased from 25 (23–26)/30 at baseline to 27 (26–29) at 3 months ($P < 0.001$), and further escalated to 28 (27–29) at 6 months ($P < 0.001$). Practice scores likewise demonstrated progress, shifting from 9 (7–11)/24 at baseline to 9.5 (8–11) at 3 months ($P < 0.001$), and to 10 (8–11) at 6 months ($P < 0.001$). Corresponding positive shifts were observed regarding the factors driving adverse drug reaction (ADR) reporting and the mitigation of existing barriers. The instructional program demonstrated a particularly notable effect on boosting knowledge levels among participants within the 20–29 and 30–39 age brackets, as substantiated by Spearman correlation analysis ($P = 0.001$ ($r = 0.854$) and $P = 0.003$ ($r = 0.468$), respectively). The outcomes of this research underscore the effectiveness of targeted educational interventions in improving pharmacovigilance-related knowledge, attitudes, and clinical practices among institutional pharmacists. While this initiative represents a pioneering effort in its context, the outcomes may have been confounded by external variables affecting the metric responses. With appropriate contextual modifications, this training framework could be adopted by healthcare organizations to augment pharmacovigilance operations within their respective clinical environments.

Keywords: Attitude, Education module, Hospital pharmacists, Knowledge, Pharmacovigilance, Practice

Introduction

Pharmacovigilance (PV) is a systematic, structured methodology for observing and detecting adverse drug reactions (ADRs) within specified clinical contexts [1]. The overarching goal of this discipline is to optimize the therapeutic outcomes of medical interventions [2]. The scope of pharmacovigilance encompasses an array of clinical activities, including the detection and reporting of ADRs, medication errors (MEs), counterfeit pharmaceutical products, instances of therapeutic failure,

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drug misuse or abuse, and drug–drug interactions [3]. Within the United States, ADRs are recognized as the fifth leading cause of mortality [4]. These adverse events have varying impacts across age groups, serving as significant drivers of morbidity and mortality in both institutional and ambulatory healthcare environments [5, 6]. Engaging the full spectrum of healthcare practitioners—including physicians, nursing staff, and pharmacists—constitutes an effective strategy for fostering a robust culture of safety and PV within the broader healthcare framework [7].

Healthcare professionals are fundamentally expected to possess comprehensive knowledge regarding pharmaceutical safety and institutional ADR reporting frameworks [8]. Provision of appropriate training can generate a positive impetus to elevate reporting frequencies, thereby enhancing the established safety profiles of medicinal products. Furthermore, professional perceptions play a critical role in determining the frequency with which healthcare workers report ADRs. Prior investigations have demonstrated that deficiencies in both awareness and clinical perception regarding ADRs can heavily depress reporting rates [9, 10]. The United Arab Emirates (UAE) participates in the World Health Organization (WHO) international pharmacovigilance program alongside approximately 178 other nations [11]. Initiated in the UAE in 2008, this program aims to aggregate all documentation on ADRs and medication errors to monitor pharmaceutical safety nationwide systematically [12].

One prior study indicated that, despite the rigorous efforts and sound structural frameworks established by the National Pharmacovigilance Center, distinct operational areas require refinement. The authors suggested that administrative personnel, allied healthcare practitioners, and pharmacists should undergo periodic, standardized, and tailored training initiatives that explicitly outline PV principles alongside standard operating procedures for ADR documentation [13]. Educational interventions have consistently demonstrated utility in bridging knowledge and clinical practice gaps among institutional pharmacists regarding ADR reporting [14, 15]. Global literature corroborates that delivering targeted instruction and training curricula focused on ADR reporting to clinical providers improves both the descriptive quality and the absolute frequency of safety reports [2, 4, 16-21]. Within these published accounts, such advancements are regularly ascribed to favorable transitions in professional knowledge and baseline attitudes toward PV tasks, particularly among pharmacy staff who lacked formal PV instruction during their undergraduate or postgraduate training.

While diverse methodologies exist for administering educational interventions to medical staff, in-person instructional delivery has emerged as the premier strategy for long-term knowledge retention and addressing individualized learning requirements [22]. Furthermore, this face-to-face modality is considered superior to alternative modalities such as virtual classrooms, mobile-based learning, or online modules [23]. Although specific training resources—such as the ‘WHO-ISoP Core Elements of a Comprehensive Modular Curriculum’ [24]—are openly accessible online, they generally communicate only foundational PV concepts. Conversely, other professional institutions provide fee-based curricula targeting PV, including the London School of Hygiene and Tropical Medicine (LSHTM) [25], the Drug Safety Research Unit (DSRU) [26], centers in Rabat and Accra, the [27], and the WHO [28].

The educational curriculum developed in the present research was structured around insights from a comprehensive nationwide survey [13] and a meticulous review of available PV courses and reference literature. The resulting module was tailored to cover all dimensions of PV operations and practical ADR reporting workflows in alignment with the regulatory mandates of the UAE Ministry of Health. This educational tool was specifically deployed to resolve discrepancies between baseline knowledge and real-world practice among hospital pharmacists regarding ADR reporting. Quantifying the precise impact of this instructional module provides valuable diagnostic feedback to refine the curriculum iteratively, thereby serving the needs of future investigators and academic educators. Consequently, the objective of this investigation was to systematically assess the influence of this PV training curriculum on pharmacists’ attitudes, knowledge base, and professional practices regarding PV.

Materials and Methods

Study design

This investigation utilized a pre–post interventional research design executed across two distinct phases: first,

the architectural formulation of the educational module and its subsequent delivery to hospital pharmacists; second, the longitudinal appraisal of the curriculum's impact on the participants' knowledge, attitudes, and practical applications of ADR reporting. A pre–post methodology was selected to facilitate direct inferential statistical comparisons within the identical sample population across multiple temporal intervals.

Phase 1: education module development

The primary investigator constructed the PV training framework using Miller's Pyramid of assessment as a guiding structural model **(Figure 1)** [29, 30], following the operational stages outlined in **Figure 1.** Miller's hierarchy was specifically selected to map the module's core learning objectives directly to measurable competencies in knowledge, attitudes, and clinical skills within the PV domain.

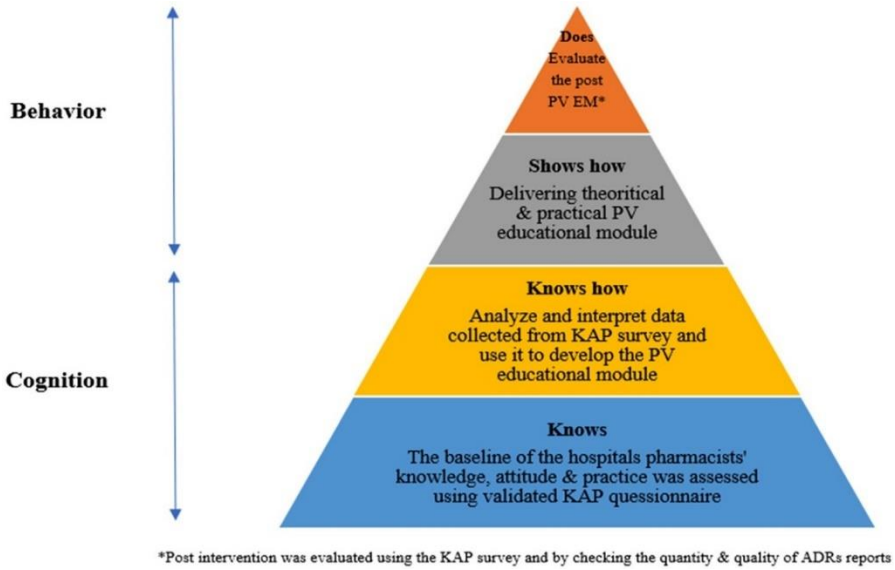


Figure 1. Developing the PV educational module based on Miller's Pyramid of Assessment method.

The module was structured for delivery to the participants across four distinct phases:

Stage 1: The theoretical session was composed of three parts focusing on the following:

- An introduction to pharmacology safety and pharmacovigilance (PV), encompassing historical contexts, definitions, significance, the operational boundaries of PV, methodologies, and the specific PV initiative within the UAE.
- Characterization of adverse drug reactions (ADRs), the necessity of reporting mechanisms, the determination of ADR causality, and the classification of ADR types.
- Obstacles encountered in reporting ADRs; factors influencing the occurrence of ADRs; instruments used in spontaneous reporting schemes; foundational criteria for reporting; the responsibilities of pharmacists within PV; and a summary.

Stage 2: The hands-on session focused on:

- Protocols for documenting ADRs and medication errors (ME).
- The official adverse event reporting documentation utilized in the UAE.
- The procedural manual for executing reports within the Ministry of Health (MOH) digital framework.

Stage 3: Distribution of educational materials

- The participating pharmacists were provided with a physical copy of the instructional module containing:
- The official ADR documentation form.
- The UAE MOH Guidelines in Good Vigilance Practice (GVP) For Marketing Authorisation Holders / Pharmaceutical Manufacturers in the UAE.

Stage 4: Reinforcement of the practice of ADRs reporting was done by

- Dispatching brief SMS reminders to pharmacists to encourage the reporting of all encountered ADRs, alongside instructions for navigating to the national ADR reporting platform and comprehensive contact information for the national PV headquarters.
- These text notifications were distributed weekly throughout 6 months following the initial educational program.

Validation of the educational module

Following the development of the educational program, content validation was executed. Three specialists were invited to review the material via an evaluation form, and their subsequent assessments were documented. These experts comprise a UK-based university professor, a clinical pharmacist practicing within a private medical institution, and an associate professor at a local university who concurrently practices in a public hospital. Each evaluator possesses extensive professional background in pharmacovigilance (PV) and adverse drug reaction (ADR) reporting.

Administration of education module

The educational intervention encompassed four distinct components, executed over a cumulative 6-month period. Each participating medical facility underwent this educational intervention independently.

The instructional workshop lasted 3–4 hours and used PowerPoint slides. Active learning exercises addressing the presented subjects were integrated throughout the presentation. The session concluded with a practical workshop on applying the Naranjo ADR probability scale and the WHO–UMC causality categories for ADR causality determination [31], along with instructions for accurately submitting ADR forms via the official Ministry of Health (MOH) online platform [32]. Educational resources were distributed to the cohort at the start of the session, and the evaluation tool was administered immediately preceding and following the intervention, adhering to the predefined research timeline.

Pilot testing of educational module

A preliminary pilot study was performed to evaluate the feasibility of the newly developed PV educational curriculum. A 4-hour instructional session was held in an auditorium at a private hospital in Dubai. The evaluation framework was organized into four primary phases: a baseline pre-intervention survey, delivery of the curriculum, follow-up reinforcement via WhatsApp messaging, and a final post-intervention survey alongside participant evaluations. Three clinical pharmacists took part in this pilot phase and provided signed informed consent. The pilot outcomes confirmed the operational viability of the primary study; however, minor refinements were implemented to condense the theoretical presentation, which included summarizing the introductory and historical contexts, retaining only a single illustrative case of market product withdrawal, and promoting collaborative peer activities among the pharmacists.

Follow-up messages to reinforce the intervention

Weekly electronic notifications were dispatched to the pharmacists to prompt sustained documentation of all encountered ADRs. Dedicated WhatsApp communication groups were established for each hospital, encompassing all professionals who participated in the training module. Throughout the 6-month study, the investigator sent these reminder updates every Monday. The communications provided full contact details for the national PV center, as well as hyperlinks to the ADR and medication error (ME) submission frameworks on the MOH portal.

Phase 2: assessment of the PV educational module

Study setting and subjects

The primary investigation was conducted in December 2022 across three distinct medical institutions in Dubai, including one public hospital dedicated to special needs pediatric care and two private tertiary care facilities. These three institutions are prominent entities across Dubai and the broader UAE, accommodating a substantial daily volume of patients.

The inclusion criteria mandated participation from all hospital pharmacists holding an active employment contract with the three designated facilities who formally agreed to participate by executing an informed consent document. Conversely, the exclusion criteria excluded pharmacists who were away from active duty due to medical leave or annual vacation, as well as those who declined to complete the survey instruments despite participating in the instructional workshop. An aggregate cohort of 60 pharmacists was recruited across the 3 medical sites.

Pre–post assessment of KAPBS scores

The efficacy of the instructional intervention was quantified by tracking shifts in knowledge, attitudes, practices, and perceived barriers regarding ADR documentation, as well as elements that promote reporting behaviors and participants' evaluations of the curriculum. The diagnostic survey comprised six distinct segments: Section 1 collected socio-demographic parameters; Section 2 measured baseline knowledge regarding PV and ADR documentation procedures via 9 short-answer items; Section 3 evaluated attitudinal perspectives using 6 Likert-scale items; Section 4 documented self-reported ADR reporting practices through 8 dichotomous (Yes/No) questions; Section 5 examined operational barriers hindering PV execution using 8 Likert-scale statements; and Section 6 explored motivating factors that could facilitate ADR reporting via 11 Likert-scale statements [13].

The maximum attainable scores for each respective index were knowledge (18), attitude (30), practice (24), barriers (40), and suggestions (55).

The educational module's efficacy was monitored at baseline and at 3 and 6 months post-intervention. The initial survey responses were gathered on the day of the workshop delivery during the first week of December 2022. The subsequent second and third follow-up datasets, using the same survey instrument, were compiled in March 2023 and June 2023, respectively.

Completed KAPBS and evaluation tools were processed to determine individual domain scores. Statistical analysis was performed utilizing IBM SPSS Version 28. Normality of the distribution was tested using the Shapiro–Wilk test, which revealed that the data departed significantly from normality (p-value < 0.001). Consequently, continuous variables were summarized using median and interquartile range (IQR), along with frequency counts and percentages, whereas categorical variables were analyzed descriptively. The threshold for statistical significance was established at a p-value of 0.05. Furthermore, potential interactions among pharmacists' knowledge, attitude, practice, and perceived barriers, and independent traits such as age, gender, and educational credentials were evaluated using Spearman's rank correlation and Pearson's R (Interval by Interval) tests. The Wilcoxon Signed Rank test was applied to assess longitudinal changes attributable to the educational module at the 3- and 6-month time points, with a fixed P-value of 0.05.

Participants' feedback on the module

Evaluations of the instructional curriculum were collected using a validated feedback tool. This evaluation form was divided into three components: the initial part assessed curriculum content using 5 Likert-scale items; the second part evaluated delivery methodologies using 5 Likert-scale statements; and the final section provided an open-ended section for qualitative remarks or recommendations. Median (IQR) values for each item were calculated from a scoring scale ranging from 1 to 5.

Results and Discussion

Characteristics of participating healthcare facilities

The research was conducted across three medical centers, representing two private institutions and a single government-run facility. The operational capacities of these major clinical sites, including total bed availability and associated medical infrastructures, are summarized in **Table 1**. Every staff pharmacist operating at these facilities was invited to participate in the educational program. Of the 70 total invitees, 60 enrolled and completed the evaluations, yielding an 85.7% participation rate. Non-attendance was primarily due to scheduling conflicts, with a minority of pharmacists being away on annual leave, assigned to overnight shifts, or facing conflicting duties.

Socio-demographic profiles of the enrolled hospital pharmacists

Table 1. Overview of clinical institutions included in the investigation.

Characteristic	Hospital 3	Hospital 2	Hospital 1
Geographical location	Dubai	Dubai	Dubai
Healthcare sector classification	Private tertiary care hospital	Private tertiary care hospital	Government-run pediatric hospital
Academic qualification of pharmacovigilance (PV) lead	Master's degree in Pharmacy	Master's degree in Pharmacy	Master's degree in Pharmacy
Professional experience of PV coordinator (years)	26	20	22

Bed capacity of affiliated hospital	220	350	200
Annual number of reported ADRs (previous year)	0	9	40
Total number of pharmacists employed	10	15	45
Number of pharmacists included in the study	8	10	42

The final sample comprised 60 pharmacists employed within 3 distinct hospitals across Dubai. The study cohort ranged in age from 20 to 60 years, comprising 32 (53.5%) female practitioners and 28 (46.7%) male practitioners, who collectively represented 28 diverse nationalities. Detailed baseline demographic metrics are compiled in **Table 2**.

Longitudinal assessment of PV and ADR comprehension and reporting competencies

Table 2. Baseline demographic characteristics of the participating pharmacist cohort (n = 60).

Demographic characteristics	Frequency (%)	Count
Gender		
Female	53.3	32
Male	46.7	28
Age distribution		
20–29 years	18.3	11
30–39 years	63.3	38
40–49 years	11.7	7
≥ 50 years	6.7	4
Educational qualification		
Pharmacy Diploma	5.0	3
Bachelor of Pharmacy	58.3	35
Doctor of Pharmacy (PharmD)	21.7	13
Master's in Pharmacy	15.0	9
PhD	5.0	3
Country of graduation		
United Arab Emirates	16.7	10
Other countries (total)	83.3	50
├ **Middle East (Saudi Arabia, Kuwait, Oman, Jordan, Syria, Lebanon, Iraq, Iran)**	13.3	8
├ **Asia (India, Pakistan, Philippines, Bangladesh)**	50.0	30
├ **Africa (Libya, Algeria, Egypt, Sudan, Somalia)**	16.7	10
├ **North & South America (USA, Canada)**	1.7	1
└ **Europe (UK, Cyprus)**	1.7	1
Current job position		
Pharmacy Technician	5.0	3
Pharmacist	50.0	30
Clinical Pharmacist	6.6	4
Pharmacist-in-Charge	5.0	3
Inpatient Pharmacist	15.0	9
Outpatient Pharmacist	16.7	10
Pharmacy Manager	1.7	1
Years of professional experience		
< 5 years	30.0	18
5–9 years	31.7	19
10–14 years	28.3	17
≥ 15 years	10.0	6

The longitudinal selections of the cohort across various items evaluating pharmacovigilance (PV) and adverse drug reaction (ADR) reporting knowledge, both before and after the educational session, are detailed in **Table 3**.

Regarding baseline familiarity, a large proportion of the sample provided accurate definitions of PV (n = 44, 73.3%) and ADRs (n = 50, 83.3%) during the pre-intervention phase. In contrast, only 15 (25%) pharmacists initially identified the specific clinical criteria that necessitate hospitalization for a patient due to an adverse event. However, understanding of this parameter increased substantially post-intervention, with accurate responses climbing to 42 (70%) at 3 months and 53 (83.3%) at 6 months. Additionally, only 18 (30%) respondents at baseline were aware that VigiBase is the WHO's official global online database for collecting ADR data. Before the educational workshop, 35 pharmacists (58.3%) demonstrated proficiency in applying the Naranjo algorithm for causality determination. The detailed response frequencies for each knowledge item across all evaluation periods are structured in **Table 3**.

Variations in perspectives toward ADRs and reporting mechanisms

Table 3. Assessment of pharmacists' comprehension of PV and ADR documentation before and after the educational program (n = 60).

Knowledge questions	Median (IQR) scores	After intervention (6M)	After intervention (3M)	Before intervention
	Incorrect n (%)	Correct n (%)	Incorrect n (%)	Correct n (%)
1. What best represents the definition of Pharmacovigilance (PV)?	0	60 (100)	16 (26.7)	44 (73.3)
2. Which option accurately describes an Adverse Drug Reaction (ADR)?	0	60 (100)	10 (16.7)	50 (83.3)
3. Hospital admission becomes necessary at the earliest onset of which condition?	18 (30)	42 (70)	45 (75)	15 (25)
4. A 70-year-old male receiving Amiodarone for cardiac arrhythmia develops heart block as an adverse effect. Which category of ADR does this represent?	22 (36.7)	38 (63.3)	34 (56.7)	26 (43.3)
5. A 15-year-old boy administered Benzylpenicillin for rheumatic heart disease prophylaxis develops anaphylaxis. What type of ADR is this?	17 (28.3)	43 (71.7)	34 (56.7)	26 (43.3)
6. A side effect is considered acute when it occurs:	0	60 (100)	29 (48.3)	31 (51.7)
7. The global center responsible for Adverse Drug Reaction (ADR) monitoring is located in:	0	60 (100)	36 (60)	24 (40)
8. Which instrument is most widely used for determining causality in Adverse Drug Reactions (ADRs)?	0	60 (100)	25 (41.7)	35 (58.3)
9. Which of the following represents the WHO online reporting database for Adverse Drug Reactions (ADRs)?	0	60 (100)	42 (70)	18 (30)

*Items 3, 6, and 7 are formulated around a clinical case scenario.

Table 4 outlines the sample's shifting attitudinal perspectives regarding the documentation of adverse events before and after the training intervention. Six months post-intervention, a prominent majority of participants (n = 50, 83.3%) strongly agreed that they should consistently dedicate sufficient professional time to review patient-specific ADRs with their department managers. Furthermore, 70% (n = 42) initially favored introducing institutional rewards for pharmacists who actively document ADRs. This perspective gained wider consensus following the training sessions, rising to 85% (n = 51) after 3 months and reaching 95% (n = 57) at the 6-month follow-up. As demonstrated in **Table 4**, which details responses to prompts such as "I believe that ADR reporting should be made mandatory for practicing pharmacists" and "It is important to report ADRs to answer the questions that may arise in my practice," the instructional intervention achieved a substantial and favorable shift in the participants' professional outlook.

Adverse reaction tracking behaviors prior to and following the intervention

Table 4. Comparative pre- and post-intervention perspectives regarding adverse event documentation among institutional pharmacists (n = 60).

Item	Strongly disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly agree n (%)	Median (IQR) PRE	Median (IQR) 3M	Median (IQR) 6M
A1	PRE: 1 (1.7), 3M: 1 (1.7), 6M: 1 (1.7)	PRE: 0, 3M: 0, 6M: 0	PRE: 7 (11.7), 3M: 0, 6M: 0	PRE: 28 (46.7), 3M: 18 (30), 6M: 9 (15)	PRE: 24 (40), 3M: 41 (68.3), 6M: 50 (83.3)	4 (4–5)	5 (4–5)	5 (5–5)
A2	PRE: 3 (5), 3M: 2 (3.3), 6M: 1 (1.7)	PRE: 6 (10), 3M: 1 (1.7), 6M: 0	PRE: 9 (15), 3M: 6 (10), 6M: 2 (3.3)	PRE: 21 (35), 3M: 12 (20), 6M: 14 (23.3)	PRE: 21 (35), 3M: 39 (65), 6M: 43 (71.7)	4 (3–5)	5 (4–5)	5 (4–5)
A3	PRE: 22 (36.7), 3M: 33 (55), 6M: 36 (60)	PRE: 16 (26.7), 3M: 21 (35), 6M: 22 (36.7)	PRE: 4 (6.7), 3M: 3 (5), 6M: 0	PRE: 14 (23.3), 3M: 2 (3.3), 6M: 0	PRE: 4 (6.7), 3M: 1 (1.7), 6M: 2 (3.3)	4 (2–5)	5 (4–5)	5 (4–5)
A4	PRE: 0, 3M: 0, 6M: 0	PRE: 0, 3M: 0, 6M: 0	PRE: 4 (6.7), 3M: 1 (1.7), 6M: 1 (1.7)	PRE: 30 (50), 3M: 18 (30), 6M: 15 (25)	PRE: 26 (43.3), 3M: 41 (68.3), 6M: 44 (73.3)	4 (4–5)	5 (4–5)	5 (4–5)
A5	PRE: 0, 3M: 0, 6M: 0	PRE: 0, 3M: 0, 6M: 0	PRE: 2 (3.3), 3M: 1 (1.7), 6M: 0	PRE: 34 (56.7), 3M: 26 (43.3), 6M: 23 (38.3)	PRE: 24 (40), 3M: 33 (55), 6M: 37 (61.7)	4 (4–5)	5 (4–5)	5 (4–5)
A6	PRE: 0, 3M: 0, 6M: 0	PRE: 0, 3M: 0, 6M: 0	PRE: 0, 3M: 0, 6M: 0	PRE: 33 (55), 3M: 23 (38.3), 6M: 19 (31.7)	PRE: 27 (45), 3M: 37 (61.7), 6M: 41 (68.3)	4 (4–5)	5 (4–5)	5 (4–5)

IQR, Interquartile range.

- A1: I am prepared to routinely allocate sufficient time to review patient adverse drug experiences with my direct supervisor.
- A2: Professional incentives should be established for pharmacy staff who file adverse reaction reports.
- A3: Direct adverse event reporting by patients should be restricted (This item was reverse-scored during data entry due to its negative wording).
- A4: Completing adverse event reports ought to be a compulsory requirement for licensed pharmacy practitioners.
- A5: Documenting adverse clinical events is crucial for resolving practical questions that emerge during my routine duties.
- A6: Submitting adverse experience reports is vital to demonstrate to patients that their clinical concerns are treated with high importance.

Before the educational program began, 34 (56.7%) pharmacists noticed ADRs in their clinical settings, but only 20 (33.3%) actually documented these events. Following 3 and 6 months of the educational initiative, the number of pharmacists tracking ADR incidents rose to 40 (66.7%) and 42 (70%), respectively. Post-intervention data showed that every single encountered ADR was successfully documented. Detailed pre- and post-intervention evaluations of hospital pharmacists' ADR logging habits are presented in **Table 5**.

Obstacles to Pharmacovigilance Integration and ADR Documentation Before and After the Educational Initiative

Table 5. Baseline and post-intervention assessments of ADR documentation behavior among clinical pharmacists (n = 60).

Item	Median (IQR) 6M	Median (IQR) 3M	Median (IQR) PRE	Yes n (%) 6M	Yes n (%) 3M	Yes n (%) PRE
1. Observed any Adverse Drug Reactions (ADRs) in the past year	2 (1–2)	2 (1–2)	2 (1–2)	42 (70)	40 (66.7)	34 (56.7)
2. Reported any Adverse Drug Reactions in the past year	2 (1–2)	2 (1–2)	1 (1–2)	42 (70)	40 (66.7)	20 (33.3)

5. Workplace provides information on ADR reporting procedures	2 (1–2)	2 (1–2)	2 (1–2)	37 (61.7)	37 (61.7)	37 (61.7)
6. Received training in ADR reporting at workplace	1 (1–1)	1 (1–1)	1 (1–1)	15 (25)	15 (25)	15 (25)
7. Workplace encourages ADR reporting	2 (2–2)	2 (2–2)	2 (2–2)	46 (76.7)	46 (76.7)	46 (76.7)
8. ADR reporting is mandatory at the workplace	1 (1–2)	1 (1–2)	1 (1–2)	30 (50)	30 (50)	30 (50)

Table 6 details the specific challenges hospital pharmacists face in implementing PV protocols and ADR logging before and after the training. After completing the course, almost all respondents (n = 55; 91.6%) either agreed or strongly agreed that tracking ADRs is a core duty of the pharmacy staff. Before training, 46 (76.7%) participants agreed or strongly agreed that a "Lack of awareness about the reporting process" was a major deterrent; however, this barrier was completely resolved by the educational module. Another prominent hurdle was a "Lack of awareness of the existence of a national ADR reporting system," which received 56.7% agreement and 18.3% strong agreement at baseline but was eliminated afterward. Overall, a downward shift in median barrier scores pointed to the successful removal of these logistical obstacles.

Incentives for Pharmacists to File ADR Reports and Adopt PV Protocol Before and After the Educational Initiative

Table 6. Baseline and post-intervention comparison of challenges faced during PV and ADR system setup (n = 60).

Statement	Strongly disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly agree n (%)	Median (IQR) PRE	Median (IQR) 3M	Median (IQR) 6M
1. ADR reporting is not part of a pharmacist's job	PRE: 16 (26.7), 3M: 29 (48.3), 6M: 29 (48.3)	PRE: 28 (46.7), 3M: 26 (43.3), 6M: 26 (43.3)	PRE: 5 (8.3), 3M: 3 (5), 6M: 3 (5)	PRE: 7 (11.7), 3M: 1 (1.7), 6M: 1 (1.7)	PRE: 4 (6.7), 3M: 1 (1.7), 6M: 1 (1.7)	2 (1–3)	2 (1–2)	2 (1–2)
2. Lack of awareness about reporting process	PRE: 2 (3.3), 3M: 15 (25), 6M: 15 (25)	PRE: 5 (8.3), 3M: 28 (46.7), 6M: 28 (46.7)	PRE: 7 (11.7), 3M: 10 (16.7), 6M: 10 (16.7)	PRE: 30 (50), 3M: 7 (11.7), 6M: 7 (11.7)	PRE: 16 (26.7), 3M: 0, 6M: 0	4 (4–5)	2 (1–3)	2 (1–3)
3. Serious ADRs are already detected before drug registration	PRE: 7 (11.7), 3M: 10 (16.7), 6M: 10 (16.7)	PRE: 13 (21.7), 3M: 33 (55), 6M: 33 (55)	PRE: 15 (25), 3M: 11 (18.3), 6M: 11 (18.3)	PRE: 20 (33.3), 3M: 4 (6.7), 6M: 4 (6.7)	PRE: 5 (8.3), 3M: 2 (3.3), 6M: 2 (3.3)	3 (2–4)	2 (2–3)	2 (2–3)
4. Fear of consequences after reporting (legal issues / reduced patient trust)	PRE: 0, 3M: 0, 6M: 0	PRE: 17 (28.3), 3M: 13 (21.7), 6M: 13 (21.7)	PRE: 12 (20), 3M: 8 (13.3), 6M: 8 (13.3)	PRE: 23 (38.3), 3M: 26 (43.3), 6M: 26 (43.3)	PRE: 8 (13.3), 3M: 13 (21.7), 6M: 13 (21.7)	4 (2–4)	4 (3–4)	4 (3–4)
5. Lack of awareness of national ADR reporting system	PRE: 0, 3M: 28 (46.7), 6M: 28 (46.7)	PRE: 5 (8.3), 3M: 32 (53.3), 6M: 32 (53.3)	PRE: 10 (16.7), 3M: 0, 6M: 0	PRE: 34 (56.7), 3M: 0, 6M: 0	PRE: 11 (18.3), 3M: 0, 6M: 0	4 (3.25–4)	2 (1–2)	2 (1–2)

6. Pharmacovigilance not included in pharmacy curriculum	PRE: 9 (15), 3M: 9 (15), 6M: 9 (15)	PRE: 23 (38.3), 3M: 23 (38.3), 6M: 23 (38.3)	PRE: 6 (10), 3M: 6 (10), 6M: 6 (10)	PRE: 13 (21.7), 3M: 13 (21.7), 6M: 13 (21.7)	PRE: 9 (15), 3M: 9 (15), 6M: 9 (15)	2 (2–4)	2 (2–4)	2 (2–4)
7. Lack of proper training on ADR reporting	PRE: 0, 3M: 0, 6M: 0	PRE: 4 (6.7), 3M: 13 (21.7), 6M: 13 (21.7)	PRE: 8 (13.3), 3M: 5 (8.3), 6M: 5 (8.3)	PRE: 37 (61.7), 3M: 31 (51.7), 6M: 31 (51.7)	PRE: 11 (18.3), 3M: 11 (18.3), 6M: 11 (18.3)	4 (4–4)	4 (3–4)	4 (3–4)
8. Difficulty in identifying whether an ADR has occurred	PRE: 0, 3M: 0, 6M: 0	PRE: 7 (11.7), 3M: 7 (11.7), 6M: 7 (11.7)	PRE: 11 (18.3), 3M: 7 (11.7), 6M: 7 (11.7)	PRE: 32 (53.3), 3M: 36 (60), 6M: 36 (60)	PRE: 10 (16.7), 3M: 10 (16.7), 6M: 10 (16.7)	4 (3–4)	4 (4–4)	4 (4–4)

Every participant (n = 60; 100%) strongly agreed at the 6-month evaluation mark that establishing an in-house ADR monitoring center at each medical facility, combined with ongoing professional training, would optimize PV performance. Before the program, 55 respondents (91.7%) agreed or strongly agreed that having institutional legal safeguards was crucial when reporting adverse drug events. Following the intervention, this agreement rate climbed to 58 (96.7%) at 3 months and 59 (98.3%) at 6 months. **Table 7** outlines additional strategies proposed by the investigators to motivate hospital pharmacists to log ADRs, along with participant reactions to these ideas across both phases of the study.

Average scores for knowledge, attitudes, behaviors, obstacles, recommendations, and overall metrics across the baseline and post-intervention phases

Table 7. Baseline and post-intervention views on motivational factors for ADR reporting and PV implementation among pharmacy professionals (n = 60).

Statement	Strongly disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly agree n (%)	Median (IQR) PRE	Median (IQR) 3M	Median (IQR) 6M
1. Incentives should be provided to pharmacists who report ADRs	PRE: 1 (1.7), 3M: 0, 6M: 0	PRE: 6 (10), 3M: 4 (6.7), 6M: 3 (5)	PRE: 11 (18.3), 3M: 7 (11.7), 6M: 4 (6.7)	PRE: 24 (40), 3M: 29 (48.3), 6M: 30 (50)	PRE: 18 (30), 3M: 20 (33.3), 6M: 23 (38.3)	4 (3–5)	4 (4–5)	4 (4–5)
2. Availability of ADR reporting centers in each hospital enhances pharmacovigilance	PRE: 0, 3M: 0, 6M: 0	PRE: 0, 3M: 0, 6M: 0	PRE: 4 (6.7), 3M: 0, 6M: 0	PRE: 33 (55), 3M: 31 (51.7), 6M: 24 (40)	PRE: 23 (38.3), 3M: 29 (48.3), 6M: 36 (60)	4 (4–5)	4 (4–5)	5 (4–5)
3. Patients should be allowed to report ADRs directly to the national PV centre	PRE: 0, 3M: 0, 6M: 0	PRE: 10 (16.7), 3M: 2 (3.3), 6M: 2 (3.3)	PRE: 14 (23.3), 3M: 4 (6.7), 6M: 3 (5)	PRE: 23 (38.3), 3M: 36 (60), 6M: 31 (51.7)	PRE: 13 (21.7), 3M: 18 (30), 6M: 24 (40)	4 (3–4)	4 (4–5)	4 (4–5)
4. Proper training encourages pharmacists to report ADRs	PRE: 0, 3M: 0, 6M: 0	PRE: 0, 3M: 0, 6M: 0	PRE: 3 (5), 3M: 1 (1.7), 6M: 1 (1.7)	PRE: 36 (60), 3M: 25 (41.7), 6M: 32 (53.3)	PRE: 21 (35), 3M: 34 (56.7), 6M: 27 (45)	4 (4–5)	5 (4–5)	4 (4–5)
5. Legal protection should be provided to pharmacists	PRE: 0, 3M: 0, 6M: 0	PRE: 0, 3M: 0, 6M: 0	PRE: 5 (8.3), 3M: 2 (3.3), 6M: 1 (1.7)	PRE: 33 (55), 3M: 29 (48.3), 6M: 36 (60)	PRE: 22 (36.7), 3M: 29 (48.3), 6M: 23 (38.3)	4 (4–5)	4 (4–5)	4 (4–5)

when ADRs occur due to dispensed medicines								
6. Continuous education and workshops for pharmacists are necessary	PRE: 0, 3M: 0, 6M: 0	PRE: 1 (1.7), 3M: 0, 6M: 0	PRE: 1 (1.7), 3M: 0, 6M: 0	PRE: 29 (48.3), 3M: 25 (41.7), 6M: 24 (40)	PRE: 29 (48.3), 3M: 35 (58.3), 6M: 36 (60)	4 (4–5)	5 (4–5)	5 (4–5)
7. All healthcare professionals should be encouraged to report ADRs	PRE: 0, 3M: 0, 6M: 0	PRE: 0, 3M: 0, 6M: 0	PRE: 2 (3.3), 3M: 0, 6M: 0	PRE: 30 (50), 3M: 29 (48.3), 6M: 28 (46.7)	PRE: 28 (46.7), 3M: 31 (51.7), 6M: 32 (53.3)	4 (4–5)	5 (4–5)	5 (4–5)
8. Ease of access to ADR reporting forms is important	PRE: 0, 3M: 0, 6M: 0	PRE: 0, 3M: 0, 6M: 0	PRE: 4 (6.7), 3M: 1 (1.7), 6M: 0	PRE: 34 (56.7), 3M: 31 (51.7), 6M: 29 (48.3)	PRE: 22 (36.7), 3M: 28 (46.7), 6M: 31 (51.7)	4 (4–5)	4 (4–5)	5 (4–5)
9. Use of information technology can facilitate ADR reporting in the country	PRE: 0, 3M: 0, 6M: 0	PRE: 0, 3M: 0, 6M: 0	PRE: 2 (3.3), 3M: 0, 6M: 0	PRE: 33 (55), 3M: 27 (45), 6M: 25 (41.7)	PRE: 25 (41.7), 3M: 33 (55), 6M: 35 (58.3)	4 (4–5)	5 (4–5)	5 (4–5)
10. Pharmacovigilance should be included in the pharmacy curriculum	PRE: 0, 3M: 0, 6M: 0	PRE: 0, 3M: 0, 6M: 0	PRE: 1 (1.7), 3M: 1 (1.7), 6M: 0	PRE: 34 (56.7), 3M: 30 (50), 6M: 28 (46.7)	PRE: 25 (41.7), 3M: 29 (48.3), 6M: 32 (53.3)	4 (4–5)	4 (4–5)	5 (4–5)
11. Difficulty in identifying whether an ADR has occurred	PRE: 0, 3M: 0, 6M: 0	PRE: 6 (10), 3M: 5 (8.3), 6M: 5 (8.3)	PRE: 14 (23.3), 3M: 10 (16.7), 6M: 8 (13.3)	PRE: 28 (46.7), 3M: 33 (55), 6M: 33 (55)	PRE: 12 (20), 3M: 12 (20), 6M: 14 (23.3)	4 (3–4)	4 (3.25–4)	4 (4–4)

The training curriculum achieved significant success across all measured metrics—including knowledge retention, personal attitudes, professional practice, perceived obstacles, and openness to incentives—among the pharmacists who attended all instruction blocks, as illustrated in **Table 8**. Professional knowledge demonstrated a significant upward trajectory following the training and subsequent follow-up assessments (P\text{-value} \le 0.001). The curriculum also positively reshaped participants' views of their role in tracking adverse events; at 3 and 6 months post-training, median (IQR) metrics rose from 25 (23–26) to 27 (26–29) and 28 (27–29), respectively. Post-program results verified a statistically significant drop in the complications preventing pharmacists from filing reports (P\text{-value} \le 0.001). Furthermore, participant perspectives on the specific elements that could incentivize tracking shifted significantly after the program (P\text{-value} \le 0.001).

Table 8. Comparison of median values for knowledge, attitudes, professional practice, barriers, suggestions, and cumulative metrics across study phases.

Domain	Time point	Median (IQR)	P-value comparisons
Knowledge	Pre-intervention	14 (12–15)	Pre vs 3M: <0.001
	Post-intervention (3M)	17 (16–18)	Pre vs 6M: <0.001
	Post-intervention (6M)	18 (17–18)	3M vs 6M: <0.001
Attitude	Pre-intervention	25 (23–26)	Pre vs 3M: <0.001
	Post-intervention (3M)	27 (26–29)	Pre vs 6M: <0.001
	Post-intervention (6M)	28 (27–29)	3M vs 6M: <0.001

Practice	Pre-intervention	9 (7–11)	Pre vs 3M: ≤0.001
	Post-intervention (3M)	9.5 (8–11)	Pre vs 6M: ≤0.001
	Post-intervention (6M)	10 (8–11)	3M vs 6M: 0.5
Barriers	Pre-intervention	26 (24–29)	Pre vs 3M: ≤0.001
	Post-intervention (3M)	21 (19.25–23)	Pre vs 6M: ≤0.001
	Post-intervention (6M)	21 (19.25–23)	3M vs 6M: 1.0
Perception of factors encouraging reporting	Pre-intervention	44.5 (42–50)	Pre vs 3M: ≤0.001
	Post-intervention (3M)	47.5 (44.25–52.75)	Pre vs 6M: ≤0.001
	Post-intervention (6M)	48 (46–52)	3M vs 6M: 0.2

*Evaluated via the Wilcoxon Signed-Rank method utilizing paired matches.

Looking closely at reporting behaviors, out of the 34 pharmacists who observed clinical ADRs in the year before the intervention, only 20 filed an official report. Following the program, every pharmacist who identified an ADR in their daily practice participated in the reporting process. At the 3-month follow-up, 40 pharmacists witnessed adverse reactions, and each individual documented them. Similarly, at 6 months, 42 pharmacists identified adverse reactions, and all of them compiled reports. Consequently, the intervention triggered a noticeable surge in the cumulative volume of submitted forms, which grew from 18 at baseline to 39 at 3 months, and reached 40 at the 6-month mark.

Interrelationships between hospital pharmacists' perspectives on PV and ADR reporting

The subsequent sections analyze various statistical associations between PV and ADR reporting and distinct demographic parameters—such as gender, age, and professional characteristics—both before and after the educational program. **Table 9** outlines the comprehensive correlation data for these designated parameters.

Table 9. Statistical associations between surveyed domains of hospital pharmacists regarding PV and ADR reporting.

Domain	Variable association	Category	P-value	Correlation coefficient (r)
Knowledge	Gender	Male	0.031*	0.408
		Female	0.001*	0.555
	Age	20–29	0.001*	0.854
		30–39	0.003*	0.468
	Qualification	Bachelor in Pharmacy	0.003*	0.481
	Years of experience	<5 years	0.001*	0.715
		5–9 years	0.004*	0.627
Attitude	Gender	Male	0.031*	0.408
		Female	0.001*	0.555
	Age	20–29	0.001*	0.854
		30–39	0.003*	0.468
	Qualification	Bachelor in Pharmacy	0.003*	0.481
	Years of experience	<5 years	0.001*	0.715
		5–9 years	0.004*	0.627
	Hospital type	Governmental hospital	0.003*	0.452
		Private teaching hospital	0.025*	0.697
Practice	Gender	Male	0.017*	0.448
	Age	30–39	0.010*	0.411
	Qualification	Master in Pharmacy	0.001*	0.909
	Years of experience	≥15 years	0.049*	0.814
	Hospital type	Governmental hospital	0.009*	0.398
Barriers	Gender	Male	0.000*	0.746
		Female	0.000*	0.714

	Age	30–39	0.000*	0.681
		40–49	0.003*	0.919
	Qualification	Bachelor in Pharmacy	0.000*	0.639
		Pharm D	0.001*	0.810
		Master in Pharmacy	0.003*	0.861
	Years of experience	5–9 years	0.000*	0.760
		10–14 years	0.002*	0.690
		≥15 years	0.015*	0.899
	Hospital type	Governmental hospital	0.000*	0.599
		Private non-teaching hospital	0.012*	0.822
		Private teaching hospital	0.008*	0.776
Suggestions	Gender	Male	0.000*	0.787
		Female	0.000*	0.852
	Age	20–29	0.001*	0.836
		30–39	0.000*	0.741
	Qualification	Bachelor of Pharmacy	0.000*	0.793
		Pharm D	0.023*	0.621
		Master in Pharmacy	0.003*	0.861
	Years of experience	<5 years	0.000*	0.843
		5–9 years	0.000*	0.745
		10–14 years	0.000*	0.795
		≥15 years	0.011*	0.912
	Hospital type	Governmental hospital	0.000*	0.815
		Private non-teaching hospital	0.000*	0.949
		Private teaching hospital	0.014*	0.743

*Statistically significant ($P < 0.05$).

The majority of these association analyses were conducted using Spearman's rank correlation, except for the gender and medical facility type variables, which were evaluated using Pearson's R (Interval by Interval) test.

Participant knowledge

Cross-tabulation assessing knowledge metrics between male and female cohorts demonstrated that the educational program generated significant improvements for both genders [Pearson's R interval-by-interval correlation: ($P = 0.031$, $r = 0.408$) for males and ($P = 0.001$, $r = 0.555$) for females]. This analysis indicated that the educational initiative exerted a more pronounced effect on knowledge scores among female practitioners than their male counterparts. Furthermore, Spearman correlation assessments revealed that the educational intervention significantly enhanced knowledge levels among participants within the 20–29 and 30–39 age cohorts [($P = 0.001$, $r = 0.854$) and ($P = 0.003$, $r = 0.468$), respectively].

According to Spearman's correlation, the training program produced a more pronounced improvement in practitioners' knowledge base among those with bachelor's degrees than among colleagues with PharmD or master's degrees ($P = 0.003$, $r = 0.481$). Pharmacists with fewer than 10 years of professional background experienced a greater knowledge gain from the course than those with a decade or more of service. Specifically, the knowledge metrics of practitioners with under 5 years of tenure escalated significantly post-intervention [Spearman correlation test: ($P = 0.001$, $r = 0.715$)]. Similarly, those with 5–9 years of practice experience showed a significant increase in knowledge following the course ($P = 0.004$, $r = 0.627$).

Participant attitude

The instructional curriculum significantly altered the viewpoints of both male and female pharmacists regarding ADR reporting. Pearson's R (Interval by Interval) analysis confirmed that the intervention modified female perspectives more substantially than those of males [($P = 0.001$, $r = 0.555$) vs. ($P = 0.031$, $r = 0.408$)]. Practitioners under 40 years of age exhibited more responsive attitudinal adjustments to the course than those older than 40. Pharmacists in the 20–29 age

bracket demonstrated a more substantial shift in their outlook toward ADR tracking than those in the 30–39 age group, as shown by Spearman correlation results [(P = 0.001, r = 0.854) and (P = 0.003, r = 0.468)]. Spearman rank-order testing also showed that the educational course led to a more robust attitudinal improvement among respondents with bachelor's degrees than among those with PharmD or master's qualifications (P = 0.003, r = 0.481).

The effects of the training were more apparent in cohorts with less than 10 years of experience; this was particularly evident among those with fewer than 5 years of tenure, whose attitudinal scores improved significantly post-intervention, as validated by the Spearman correlation test (P = 0.001, r = 0.715). Likewise, practitioners with 5–9 years of professional background exhibited a significant positive shift in outlook following the intervention (P = 0.004, r = 0.627). Furthermore, the data showed that, after the module, the attitudes of pharmacists working in public and private teaching institutions improved more than those of pharmacists working in private non-teaching settings. Pearson's R (Interval by Interval) testing revealed that practitioners in public hospitals developed a more receptive stance toward ADR reporting than colleagues in private teaching institutions [(P = 0.003, r = 0.452) and (P = 0.025, r = 0.697), respectively].

Practice of participants

Based on the Pearson's R (Interval by Interval) test (P = 0.017, r = 0.448), male pharmacists involved in this research demonstrated significantly better post-intervention ADR monitoring practices than their female colleagues. Following the completion of the instructional unit, the 30–39 age bracket accounted for a greater volume of logged ADRs than either the younger or older demographics, a trend validated by the Spearman correlation test (P = 0.01, r = 0.411). Educational background also played a role; professionals holding a master's degree logged a higher frequency of ADRs post-intervention than those with a Pharm D or a bachelor's degree [Spearman correlation test (P = 0.001, r = 0.909)]. Furthermore, professional longevity influenced outcomes, as the Spearman correlation test (P = 0.049, r = 0.814) revealed that clinicians with more than 15 years of experience filed ADR reports at a higher rate than those with shorter tenures. Finally, evaluating the institutional setting using Pearson's R (Interval by Interval) test indicated that post-intervention ADR reporting was significantly greater among pharmacists working in government hospitals than in private teaching or non-teaching facilities (P = 0.009, r = 0.398).

Assessment of participants' feedback on the educational module

The evaluation of the curriculum's substance and execution yielded highly favorable metrics **(Table 10).** The dataset was entirely free of negative commentary, with every enrolled pharmacist reporting satisfaction regarding the competencies and information acquired. Moreover, the cohort expressed interest in participating in subsequent follow-up initiatives to continuously refine their longitudinal ADR reporting proficiency.

Table 10. Participants' feedback on the pharmacovigilance educational module (n = 60).

Statement	Median (IQR) score
The session increased awareness of the pharmacovigilance concept	3 (2–3)
ADR reporting by pharmacists should be mandatory in the UAE	3 (3–3)
The session content was well organized and structured	3 (3–3)
The case studies presented during the session were informative	3 (3–3)
The session is likely to be useful for my current professional practice	3 (2–3)
The session was informative and engaging	3 (3–3)
The duration of the session was appropriate	3 (3–3)
I would welcome follow-up sessions with the same instructor	3 (3–3)
I would be interested in attending similar future sessions	3 (3–3)
The case studies used in the session were interesting	3 (3–3)

This inquiry represents the inaugural study within the UAE designed to evaluate how a custom-designed PV training intervention affects hospital pharmacists. The empirical evidence clearly indicates that the instructional program produced a favorable shift across all monitored parameters (knowledge, attitude, practice, barriers,

suggestions). It can therefore be reasoned that integrating hospital pharmacists more deeply into PV operations could bolster patient safety by facilitating ADR detection and driving the formulation of prophylactic protocols. Nevertheless, the pre–post experimental framework used here imposes a structural constraint on the generalizability of these insights. External confounding factors can introduce bias or contamination, potentially skewing the assessment of the primary outcomes. Additionally, because these metrics depend on self-reported improvements in KAP, the results could be vulnerable to social desirability bias (the Hawthorne effect) and the Dunning–Kruger effect.

The baseline assessments showed that most participating hospital pharmacists could accurately define both PV (73.3%) and ADRs (83.3%). This finding mirrors a 2021 survey of UAE-based community and hospital pharmacists, in which 88% of the sample demonstrated strong mastery of PV and ADR protocols [33]. Parallel trends have emerged in comparative literature from Jordan and Kuwait [20]. Conversely, alternative studies have highlighted a widespread unfamiliarity with PV terminology and low baseline knowledge scores among various cohorts of medical professionals [9, 34-36].

In the current investigation, comprehension of specific ADR categories and the International Center for Adverse Drug Reaction Monitoring's geographic location improved measurably following the intervention. This aligns with educational trials in Jordan that reported post-training gains in pharmacists' understanding of ADR types [16]. This precise clinical knowledge is vital, as it empowers practitioners to distinguish between diverse ADR classes and expedite reporting within the administrative windows set by regulatory authorities. Historically, a UAE study noted that only 28% of pharmacists and 13% of physicians were cognizant of the domestic ADR reporting framework [35]. In a similar vein, subsequent UAE research revealed that 81% of physicians and 83% of both community and hospital pharmacists did not know that a national monitoring center existed.

In comparison, 56%, 60%, and 72% across these respective roles lacked familiarity with the submission protocols [37]. Similar baseline deficits were documented in India, where an initial lack of familiarity with domestic and global ADR networks was reversed through an educational intervention, increasing correct response rates from 23.11% to 98.66% [2]. Data from Malaysia also indicated that over two-thirds of surveyed pharmacists were unaware of MADRAC—the central agency tasked with compiling adverse event data in Malaysia—before receiving targeted training, an indicator that improved significantly post-intervention [17]. Viewed broadly, the literature underscores that structured educational programs for pharmacy practitioners are highly effective vehicles for improving PV literacy. These metrics imply that improved comprehension can actively translate into functional practice. However, the enduring continuity of these practice changes over time was not tracked in this study, which constitutes a distinct limitation.

Even before the intervention, the hospital pharmacists in this cohort possessed a receptive attitude toward tracking ADRs. This baseline affinity persisted post-intervention, accompanied by stronger consensus on multiple individual indicators. This receptive outlook aligns with earlier data from the UAE, where two separate studies found that 82.7% and 93% of community pharmacists held positive perspectives [33, 38]. Corresponding patterns were identified in Jordan, where healthcare staff recognized the necessity and ethical obligation of ADR logging before a workshop, with their overall perception scores climbing significantly following the educational session [16]. Post-intervention, an overwhelming majority (83.3%) strongly supported allocating regular, dedicated time to discuss adverse events with management. A similarly enthusiastic response was observed following instructional interventions in India [2]. The post-intervention results here reveal a clear evolution in perspective, with strong consensus emerging that ADR reporting should be a mandatory, core responsibility of active pharmacy practice. This shift is highly consistent with data reported globally [17, 39]. A recurring theme across the literature is the direct, positive link connecting a practitioner's knowledge base to their professional attitude. Consequently, systematically elevating healthcare providers' attitudes and understanding of ADR mechanisms is expected to optimize the efficacy of broader adverse event surveillance networks.

The present study investigated the impact of an educational intervention on Adverse Drug Reaction (ADR) reporting practices at 3- and 6-month post-intervention intervals. Prior research conducted nationwide consistently indicated that healthcare professionals in the UAE exhibited inadequate ADR reporting behaviors [33, 35, 37, 38, 40-42]. Conversely, following this intervention, every detected ADR case was

submitted immediately, thereby increasing both the volume and completeness of the reports. Comparable improvements were documented in Nigeria, where lecture-centered training programs led to a modest increase in ADR submissions [42]. However, an earlier investigation in India demonstrated that although pharmacovigilance (PV) training enhanced knowledge and perceptions regarding ADR reporting, medical professionals still failed to implement actual reporting in practice [43]. Furthermore, German research found that PV-focused educational programs yielded only temporary improvements in practitioners' ADR reporting habits [44]. The extant literature underscores that knowledge and attitudes are modifiable elements directly linked to reporting actions [45, 46]. Consequently, the behavioral improvements observed in this study can be largely attributed to enhanced knowledge levels and attitudes.

Post-intervention assessments revealed that participants overcame several obstacles that had previously hindered the ADR reporting process. Before the training, 76.7% of respondents attributed underreporting to an unfamiliarity with the reporting protocol; however, this impediment was successfully resolved and eliminated after the intervention. Analogous challenges were reported in previous literature across diverse healthcare domains, where suboptimal reporting rates were tied to ambiguity regarding the execution of reporting workflows [33, 35, 38, 40-42]. An additional identified barrier was the lack of awareness of the national ADR reporting framework and the availability of the submission form online. This issue was entirely resolved post-intervention. This specific challenge aligned with findings from a previous study conducted within the country [33]. Similarly, research in Malaysia found that underreporting occurred because pharmacists were unaware of online submission avenues [17]. These observations substantiate earlier investigations suggesting that adopting digital reporting systems can optimize ADR data collection and foster greater community pharmacist involvement in PV operations [47, 48].

Agreement levels regarding the various strategies proposed in this study to strengthen PV initiatives expanded following the intervention. Afterward, all respondents agreed that establishing a dedicated ADR reporting hub within every hospital would optimize PV workflows. This perspective aligns with data gathered from investigations in India [49] and Saudi Arabia [50]. Implementing this measure could require allocating a dedicated budget for hospital-based PV operations, thereby driving higher ADR reporting rates. Insufficient financial support for advancing PV practices in low- and middle-income territories has previously restricted the proportion of healthcare staff competent in drug safety monitoring [51]. Another dimension that achieved a 100% consensus post-intervention was the perspective that providing pharmacists with ongoing professional development would reinforce PV practices. This mirrors evidence from multiple regional studies, where nurses, physicians, and pharmacists collectively concurred that PV operations could be improved through targeted workshops and seminars on reporting methodologies [33, 35, 41, 42, 52].International studies likewise verify that educational programs in PV motivate healthcare staff to report ADR events [4, 17, 21, 43, 53].

Additionally, after the intervention, a greater proportion of respondents agreed that offering incentives to participating pharmacists could boost PV involvement, a notion supported by earlier literature [54, 55]. Before the program, 91.7% of the cohort expressed a need for institutional legal protection when documenting ADRs. At the 3- and 6-month post-intervention follow-ups, this agreement rose to 96.6% and 98.3%, respectively. It is therefore recommended that governing bodies grant pharmacists legal indemnity when medications they dispense cause adverse reactions. Following the training, a substantial percentage of pharmacists advocated for integrating PV into the pharmacy syllabus. This corresponds to a study in Nepal, where medical students expressed a heightened desire to study PV and ADR reporting mechanisms after receiving educational modules [20]. A parallel Nepalese study also highlighted nursing students' interest in incorporating PV content into their academic curriculum after their training. Moreover, research from India indicated that, following an intervention, pharmacy students recommended embedding concepts related to the identification, prevention, and reporting of ADRs into their coursework [2]. This curricular adaptation aims to prepare future pharmacists to safely intervene and limit ADRs by actively communicating with prescribers and patients.

A notable statistical variance was observed in the impact of the educational module on knowledge, attitudes, practices, barriers, and recommendations related to ADR reporting, when analyzed with respect to independent variables such as gender, age, academic qualifications,

professional experience duration, and hospital setting. These outcomes diverge from prior literature indicating a lack of statistical association between ADR reporting behaviors and demographics like age, sex, graduation country, practice setting, and career longevity [17]. Conversely, other publications align with the current research, establishing that age, gender, and career duration do influence ADR reporting dynamics [56, 57]. The present investigation demonstrated that the educational framework was notably more effective at expanding knowledge and altering attitudes among female pharmacists than their male colleagues. While the precise mechanisms driving these variations remain unestablished, it is hypothesized that women may be more sensitive to ADR reporting or perceive it as an intrinsic, standard component of their professional duties.

Additionally, the intervention led to a pronounced improvement in the knowledge and attitudes of individuals under 40. Mirroring these trends, the educational module yielded significantly greater gains in knowledge and attitudes for participants holding a bachelor's degree relative to those with a Pharm D or master's degree. Pharmacists with less than 10 years of professional experience also demonstrated greater educational receptivity, in terms of knowledge and attitude enhancements, than those with 10 or more years of experience. This pattern may stem from younger practitioners being more open to novel training than individuals with advanced academic degrees and substantial career longevity. Furthermore, the data indicated that following the educational intervention, pharmacists practicing in public hospitals demonstrated a more favorable attitude toward ADR reporting than colleagues in private teaching institutions. This finding contrasts with research from Great Britain, which identified no meaningful disparities in ADR reporting inclinations across varying hospital models [57].

Strengths of the study

This research represents the initial effort to evaluate how an educational intervention alters hospital pharmacists' knowledge, attitudes, and ADR reporting behaviors in the UAE. Because the investigation was conducted among 60 pharmacists across three distinct hospital sites in Dubai, the dataset's trustworthiness is strengthened. Additionally, this project establishes a foundational benchmark for future educational frameworks for healthcare professionals.

Limitations of the study

Several limitations must be acknowledged in this investigation. First, the longitudinal monitoring of the pharmacists was limited to a 6-month window, restricting the evaluation of their ongoing practices to this timeframe. It remains possible that professional reporting behaviors waned after this surveillance period ended; consequently, subsequent investigations are required to determine the long-term durability of the educational outcomes. Furthermore, the pre-test/post-test design introduces potential confounding variables because there is no parallel control cohort. External environmental elements may have likewise shaped the observed outcome metrics. The restricted participant pool (n = 60) serves as another constraint. Moreover, 10 individuals who received invitations did not participate for various reasons, potentially introducing selection bias. Because the primary metrics relied on self-reported advancements in KAP, the data may be susceptible to both the Hawthorne effect and the Dunning-Kruger effect. Finally, variations in participants' attentiveness and absorption during the sessions could have affected the final measurements, further limiting the study.

Recommendations

It is recommended that comparable investigative designs be deployed among broader cohorts of healthcare practitioners to design cohesive frameworks for optimizing PV performance in the UAE. Additionally, longitudinal tracking is advised to monitor the sustained impact of the educational intervention on PV workflows. Alternative healthcare facilities could integrate this structural framework, adapting it as needed to optimize ADR reporting at the local level. A more nuanced appraisal of the curriculum could also be achieved through qualitative methods, capturing granular insights that quantitative metrics overlook

Conclusion

In conclusion, the data from this investigation illustrate that the structured educational curriculum successfully drives improvements in the knowledge, attitudes, and PV practices of the participating hospital pharmacists. Nevertheless, these constructive developments yield institutional value only if the outcomes remain stable over extended timelines, an objective that likely requires recurrent instructional refreshers. This project outlines a

structured methodology for designing PV and related educational interventions, while offering healthcare leaders guidance on evaluating curricula centered on patient safety. Ultimately, the educational framework designed for this study is highly adaptable, allowing domestic and global healthcare systems to tailor it to their unique institutional constraints. This investigation establishes a clear baseline for the future integration of patient safety education modules within academic environments.

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