An Educational Intervention to Improve Adverse Drug Reactions Reporting Among Healthcare Practitioners in Selected Pediatric Hospitals in Iraq

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Abstract

Background: Pharmacovigilance is getting a lot of attention lately because it plays a crucial role in managing effective medication use in clinical settings. The main goals of pharmacovigilance are to protect and enhance public health and reduce the harm caused by drugs by ensuring their justified use. This study aimed to create a pharmacovigilance education program, record adverse medication reactions, and assess the impact of the program on the knowledge, attitudes, and practices (KAP) of healthcare professionals in several Iraqi pediatric hospitals. **Method:** In a three-phase study, healthcare professionals were asked to complete a KAP questionnaire before and after the educational program. **Results:** The educational program significantly improved participants' knowledge about adverse drug reactions (ADRs) and pharmacovigilance (PV). Similar improvements were observed in attitudes and practices. **Conclusion:** Ongoing education programs are essential to assess their impact on achieving and maintaining the desired outcomes of the ADR reporting system and enhancing inter-professional practices.

Keywords: Adverse Drug Reaction reporting, educational program, healthcare practitioners, KAP questionnaire and Iraq.

Significance | The study is to design an intervention program to increase knowledge attitude and practice of healthcare practitioners towards pharmacovigilance.

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1. Introduction

The usage of drugs carries some level of risk. Benefits and hazards are kept in balance throughout the entire medication life cycle, including throughout pre-marketing development and testing and after a drug has been given patient use approval. Drug safety monitoring is still required throughout the post-marketing period, though. Off-label prescription is particularly common among pediatric patients (Allen et al. 2018, Cuzzolin et al. 2006, Choonara and Conroy 2002). Use of off-label medications appears to be linked to a high prevalence and diverse clinical presentation of adverse drug reactions (ADRs), even though the linkage is not yet obvious (Mason et al. 2012; Choonara and Conroy 2002). Lack of information regarding adverse effects to prescribed medications is another factor contributing to the underreporting of ADRs in paediatric patients (Dittrich et al. 2020). This shows even more clearly how important it is for pediatric patients to recognize, treat, and most importantly, prevent ADRs. Pharmacovigilance is the term used to describe the research and actions involved in the post-marketing period of adverse drug effects identification, assessment, understanding, and prevention.

Pharmacovigilance has gained a lot of attention recently since it is a crucial component in the control of efficient medication use systems in clinical practice (Abu Farha et al. 2018). Pharmacovigilance's primary objectives are to safeguard and advance public health and reduce the harm that can be caused by drugs by justifying its usage (van Hunsel et al. 2019). To promote optimal medication use, the pharmacovigilance system must

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include the spontaneous reporting of adverse drug reactions (WHO, 2010). However, studies have shown that adverse medication responses are not adequately documented, particularly in developing nations like Iraq, where only 10% of major adverse drug reactions were reported to authorities globally (Almandil 2016; Najafi 2018).

To guarantee drug safety, healthcare personnel are essential in identifying and reporting adverse drug reactions (Najafi 2018). All members of the healthcare team who could encounter adverse drug responses during their practice are accountable for reporting adverse drug reaction information, not just pharmacists (Alraie et al. 2016). Healthcare professionals, such as doctors, pharmacists, and nurses, are advised to report any suspected adverse drug reactions for recently approved drugs as well as any serious adverse drug reactions for previously approved drugs that resulted in life-threatening situations, extended hospital stays, suspected birth defects, patient disabilities, or patient deaths (Najafi 2018; Sahu et al. 2014).

The practice of pharmacovigilance was significantly impacted by the health care workers' knowledge of the discipline. If training is offered, there may be a positive incentive to boost reporting, which could have a favorable impact on the safety profile of medicines. Additionally, perception has a significant impact on how healthcare providers record adverse drug reactions. According to reports, establishing educational initiatives geared at healthcare personnel may increase the rate at which adverse drug reactions are recorded in adult (Alshakka et al. 2016; Le et al. 2020).

This study's objective was to construct a pharmacovigilance education program and record adverse medication reactions, then evaluate the program's effects on healthcare professionals' knowledge, attitudes, and practices (KAP) in a few Iraqi pediatric hospitals.

2. Materials and Methods

2.1. Study Design and Setting

A prospective three-phase interventional study.

Pre-Education Phase

Prior to intervention, all participating HCPs were requested to complete the KAP questionnaire as a baseline measure of their knowledge, attitudes, and level of practice regarding ADR reporting.

Intervention Phase

Numerous instruction sessions for all HCPs in various departments would receive a holistic intervention. It consisted of 10 to 20 participants and took place at weekly staff meetings to ensure the presence of the greatest number of HCPs. Each HCP participated in a total of three educational sessions, each lasting an hour. An introduction to the project's background, goal, methodology, and other practical considerations was provided to all HCPs. Additionally, they got a guide for reporting ADRs. A review of international studies on drug-related morbidity and mortality, hospital admissions due to ADRs, and the economic importance of ADRs is presented in the second section. It also provides information and education about ADR reporting, definitions, and classification of ADRs according to mechanisms and organ systems. It also describes the methods used in pharmacosurveillance and spontaneous reporting systems and explains that underreporting is the system's primary limitation. Finally, a survey is conducted. We also went through the Yellow Card's primary components and how to use it when you're dealing with a possible ADR. After the first educational block and over the following six months, participants were encouraged and permitted to report ADRs. The training courses were run under the direction of Hawler Medical University's College of Pharmacy.

Post-Education Phase

The HCPs were requested to complete the same KAP questionnaire after six months, which is a sufficient amount of time for practicing ADR reporting. The results of this phase's data collection were compared to those from the pre-education phase.

The data collection for this study was carried out between May 2022 and November 2022 at the Raparin Teaching Hospital for Children in Erbil, which was chosen as the study's study site because it is one of the largest pediatric referral hospitals in the Kurdistan region. The trial was open to all HCPs working in the hospital.

2.2. Study Population

The primary target for this study was healthcare professionals (Healthcare providers) in pediatric hospitals, including physicians, pharmacists, and nursing staff working in the Raparin Teaching Hospital for Children in Erbil City.

2.3. Survey Development

The study questionnaire was created and used from earlier research studies that assessed healthcare providers' pharmacovigilance knowledge, attitudes, and practices, with modifications made to meet the objectives of this study (Abu Farha et al. 2018; Abu Hammour et al. 2017; Gupta et al. 2015; Nisa et al. 2018). Two academics with extensive backgrounds in this field of study conducted a peer assessment of the questionnaire. The content validity of the questionnaire was evaluated for completeness and clarity.

It was created in English and given to HCPs in that language. 48 items total were included in the final questionnaire, which was divided into 5 sections: (1) Demographics (7 items), (2) Knowledge (11 items), (3) Attitudes (14 items), (4) Practices (5 items), and (5) Barriers to Reporting (11 items).

Questions that connected to knowledge and practice were created as multiple options. Five-choice Likert scale questions with an attitude component were devised. The total score was determined

by adding together all the points awarded for correct answers in the knowledge and practice sections, with a maximum score of 11 signifying the highest level of knowledge and a maximum score of 5 signifying the highest level of practice.

2.4. Validity and Reliability

By having the expert panel analyze the survey questions for relevance, clarity, and thoroughness in covering the knowledge, attitudes, and behaviors relevant to adverse drug reaction (ADR) reporting, the survey instrument's face and content validity were evaluated. To obtain input and improve the survey's clarity and readability, it was also pilot tested on 15 healthcare professionals.

The final version of the survey was evaluated for reliability after going through multiple revisions. Cronbach's alpha coefficients, which were calculated, were used to assess the reliability of the knowledge, attitude, practice, and obstacles domains. The corresponding values were 0.817, 0.803, 0.799, and 0.843.

2.5 Sample Size Determination

The sample size calculation was performed to detect a medium effect size ($d = 0.45$, $\eta^2 = 0.048$) difference in the knowledge of ADR reporting before and after an educational intervention, which was assumed to be a clinically meaningful difference based on the results of a previous study (Selvan et al. 2016).

Using a repeated measures ANOVA approach, accounting for three repeated groups (pharmacist, physician, nurse) and two-time points (pre/post-intervention), a correlation of 0.30 between repeated measures, 80% power, and a two-sided alpha of 0.05, the required sample size was calculated to be 57 participants in total (approximately 20 per group). The sample size was further increased by 25% to account for potential missing data and participant dropout. Additionally, we increased the target sample size by another 20% to ensure adequate power to account for between-group differences in the effect of the planned educational programs on KAP among different professions. Therefore, the sample size was finally estimated to be a minimum of 83 participants. Sample size calculations were performed using R software (Version 4.3.1, R Foundation for Statistical Computing, Vienna, Austria).

2.6. Data Analysis and Interpretation

Data was described as frequencies and percentages for categorical variables, while continuous variables were presented as mean ± standard deviation (SD). To evaluate changes in knowledge, attitude, and practice (KAP) before and after the educational intervention, McNemar's chi-squared tests were used for dichotomized individual items, while Wilcoxon signed-rank tests were applied for overall composite scores. Composite scores were computed by summing responses to items in each domain, with higher scores indicating better KAP.

Differences in composite scores between healthcare provider groups (nurses, physicians, pharmacists) were assessed using Kruskal-Wallis tests. Post-hoc pairwise comparisons between groups were conducted with Bonferroni adjustment for the calculated *p*-values.

Poisson regression models were constructed to assess predictors of self-reported adverse drug reaction (ADR) reporting rates. Univariate models were first built to examine the association between each predictor and outcome separately. Predictors significant at $p<0.05$ in univariate analyses were included in a multivariate Poisson model to identify independent predictors while controlling for confounders. Results were reported as incidence rate ratios (IRR) with 95% confidence intervals (CI).

All tests were two-sided and p-values <0.05 were considered statistically significant. Descriptive statistics, as well as hypothesis testing, were conducted using SPSS version 26.0 (IBM Corp, Armonk, NY), while regression analysis and data visualizations were adopted using R version 4.3.1 (R Foundation for Statistical Computing, Vienna, Austria).

2.7. Ethical Consideration.

Ethical clearance was obtained from the Ethical Review Committee of College of Pharmacy at Hawler Medical University. A participant's written informed consent was obtained after explaining the purpose and procedures of the study. In addition, all the responses were kept confidential.

3. Results and Discussion

3.1. Demographic Characteristics

Out of 95 candidate participants, a total of 90 participants completed the survey before and after the training program (Response rate 94.7%). The mean age of the participants was 33.3±8.5 years. Of the total, 60.0% were males, while 40.0% were females. In terms of professional distribution, nurses constituted the majority at 52.2%, followed by physicians at 26.7%, and pharmacists represented 21.1%.

Regarding the education level of participants, 46.7% had attained a bachelor's degree, 31.1% had a diploma, 7.8% had a master's degree, and 14.4% held a PhD. In the context of departmental distribution, the Pediatric Ward had the highest representation with 32.2%, followed by the Emergency Ward with 27.8%, the NICU with 23.3%, and the Hospital Pharmacy department with 16.7%. On average, participants reported seeing approximately 19.9±7.6 patients per day. The average yearly rate at which adverse drug reactions (ADRs) were reported by the participants was 5.5±2.4 (Table 1).

3.2. Knowledge

The educational training program significantly improved the participants' knowledge of several aspects of adverse drug

reactions (ADRs) and pharmacovigilance (PV) [**Table** 2]. Before training, 38.9% of participants understood the definition of an ADR, and this proportion increased significantly to 53.3% after training (p=0.026). Similarly, the proportion of participants who were aware of the types of ADRs to report grew from 27.8% pre-training to 48.9% post-training (p=0.002). The understanding of the term pharmacovigilance also demonstrated an enhancement, with those having a clear definition increasing from 34.4% before training to 53.3% after (p=0.003). Moreover, the purpose of pharmacovigilance was more widely grasped post-training, as the percentage of participants knowledgeable about this purpose increased from 20.0% before the program to 42.2% afterward (p<0.001). Knowledge about the location of the International ADR Center also witnessed a remarkable surge, with only 11.1% being aware before training, but this percentage rose to 34.4% after the program (p<0.001). Interestingly, while 86.7% of participants before the training were aware of the Iraqi National PV Program, this proportion dropped to 68.9% post-training, showing a significant decrease (p=0.003). On the other hand, the knowledge about the Iraqi ADR Regulatory Body significantly rose from 35.6% pre-training to 52.2% post-training (p=0.021).

Awareness about the integration of PV in the National Drug Policy demonstrated a non-significant increase from 51.1% before the training to 61.1% after, but this change did not achieve statistical significance (p=0.2). Similarly, knowledge about PV training programs in Iraq showed only a slight nonsignificant increase from 57.8% pre-training to 60.0% post-training (p=0.9).

However, awareness regarding the existence of a local PV committee in the institution was significantly improved, with 41.1% being aware before the training and 58.9% being knowledgeable about it post-training (p=0.008). One of the most notable impacts of the training program was evident in the knowledge about common ADR monitoring methods, where a mere 5.6% of participants were familiar with these methods before the training, but this number soared to 31.1% post-training (p<0.001).

3.1. Attitude

The participants' attitudes before and after the educational training demonstrated several significant shifts [**Table** 3]. For the belief in the efficiency of reporting, the participants who strongly disagreed increased from 25.6% to 34.4% after training (p=0.003). Regarding the fact that only safe drugs are available in the market, there was a notable rise in the participants who strongly disagreed, moving from 25.6% before to 37.8% after training (p=0.007). Regarding the perceived complexity of the ADR form, the percentage of participants who strongly disagreed demonstrated a significant increment from 2.2% before to 12.2% after training (p=0.034). Notably, post-training, a considerable proportion of participants believed that there were no job risks associated with ADR reporting, with those who strongly disagreed with the idea of job risks increasing from 24.4% to 35.6% (p<0.001). Feelings of guilt for ADRs also significantly shifted after training, with those who strongly disagreed moving from 17.8% to 27.8% (p=0.035).

Although there was an increase in the percentage of participants who felt that ADR reports could enhance their career (from 8.9% to 21.1% strongly agreeing), this change was not statistically significant (p=0.2). However, the uncertainty in reporting ADR showed a significant decrease after training, with the percentage of participants who agreed to drop from 33.3% to 16.7% (p=0.002). Time constraints for reporting ADR were perceived to be less influenced post-training, as evidenced by the increase in participants who strongly disagreed from 31.1% to 30.0%, and those who strongly agreed changed from 10.0% to 35.6% (p=0.025). While participants expressed that they strongly disagreed with the idea of a monetary incentive for reporting increased from 28.9% to 41.1% after training, the change did not reach statistical significance (p=0.12). However, there was a significant decrease in the perceived knowledge gap in the ADR process, with those agreeing to drop from 36.7% to 17.8% (p=0.001).

The notion that ADRs increase healthcare costs shifted significantly after training, with those who strongly agreed increased from 14.4% to 32.2% (p=0.011). Similarly, the reporting of only severe ADRs showed significant changes, with the participants who strongly disagreed increasing from 25.6% to 35.6% post-training (p=0.022). In assessing the effectiveness of hospital ADR, the changes, such as those who strongly disagreed moving from 25.6% to 27.8%, were not statistically significant (p=0.14). Lastly, the conviction that patient safety is improved by ADR showed significant shifts, as the percentage of participants who strongly agreed increased from 16.7% before to 37.8% after training (p=0.003).

3.2. Practice

Before and after the educational training, notable changes were observed in the items of practice domain (Table 4). The proportion of participants who read the ADR prevention articles significantly improved after training (37.8% vs. 14.4%, p<0.001). Similarly, the number of individuals who had received prior ADR reporting training increased substantially post-training (33.3% vs. 15.6%, p=0.014). The percentage of participants who had seen the ADR Form also improved significantly post-training (44.4% vs. 18.9%, p<0.001). Those who experienced ADR in practice showed a marked increase after the training (48.9% vs. 31.1%, p=0.011). Furthermore, the percentage of participants who reported ADR to the PV Center showed a significant increase following training (37.8% vs. 10.0%, p<0.001).

3.3. Barriers

In the barrier domain, several significant changes emerged post-training (**Table** 5). The uncertainty surrounding whether a case constituted an adverse drug reaction diminished notably after the educational session (6.7% vs. 46.7%, p<0.001). Similarly, the lack of knowledge concerning ADR reporting rules demonstrated a significant reduction (12.2% vs. 48.9%, p<0.001). Post-training, fewer participants felt unsure about their judgments concerning known ADRs, as evidenced by a drop from 51.1% to 10.0% (p<0.001). Role uncertainty also decreased markedly after the training (10.0% vs. 36.7%, p<0.001). Constraints related to time were less frequently cited as barriers post-training (5.6% vs. 26.7%, p<0.001), and concerns about ADR Form availability also became less prevalent (3.3% vs. 25.6%, p<0.001). Similarly, participants reporting a lack of competence decreased after the training session (5.6% vs. 26.7%, p<0.001). Fewer participants felt that reporting ADRs wasn't their responsibility post-training (3.3% vs. 14.4%, p=0.024), and the number of participants lamenting the lack of RELIS feedback also diminished (1.1% vs. 10.0%, p=0.027). However, concerns about the absence of confidential space or worries over responsibility didn't show a statistically significant change (p=0.13 for both items).

3.4. Composite scores

For nurses, the composite score of knowledge nonsignificant increased post-training from 2.7±2.2 before training to 3.1±3.5 after training (p=0.6). Their composite score of attitudes showed a significant decrease after training from 36.0±8.5 to 31.6±15.7 (p=0.024). The Composite Score of practice for Nurses improved significantly from 5.7±1.3 pre-training to 6.5±2.3 post-training (p=0.033). For Physicians, all composite scores showed significant improvement post-training: knowledge from 5.1±2.4 to 6.9±3.5 (p=0.017), attitude from 39.5±9.6 to 45.1±14.4 (p=0.011), and practice from 7.4±2.5 to 11.2±2.6 (p<0.001). Pharmacists reflected a similar consistent trend with all their composite scores significantly improving after training: knowledge from 6.2±3.1 to 10.3±1.5 (p<0.001), attitude from 45.9±7.9 to 60.0±7.6 (p<0.001), and practice from 10.3±3.5 to 13.6±1.5 (p<0.001). Among nurses, the overall composite score for KAP displayed a nonsignificant decline from 44.5±9.4 before training to 41.1±18.0 after the intervention (p=0.067). However, this was concomitant with a statistically significant increase in the rate of ADR reporting, which rose from 5.0±2.2 to 6.7±3.8 (p<0.001). Contrastingly, physicians demonstrated a notable increase in their overall composite KAP score post-training, shifting from 52.0±11.3 before the program to 63.2±18.1 thereafter (p=0.001). This improvement was associated with a marked increase in their rate of ADR reporting, which shifted from 5.8±2.4 pre-training to 8.3±4.4 post-training (p=0.004). Pharmacists exhibited the most pronounced improvement in their overall composite KAP score among the groups studied. The score surged significantly from a baseline of 62.4±9.9 to 83.9±9.0 after the training (p<0.001). Accompanying this upswing was a more modest yet statistically significant improvement in their ADR reporting rate, which ascended from 6.4±2.4 before the training to 7.9±4.2 subsequently (p=0.018) [**Table** 6, Figure 1]. There were consistent significant differences among different healthcare professionals in terms of the change in the composite scores of knowledges, attitude, and practices, as well as the overall KAP scores after the training (p<0.001 for all); however, this was not reflected to a significant difference in ADR reporting rates, which was comparable among different professions (p=0.57). Pairwise comparisons suggested a superior improvement in the composite scores of knowledges, attitude, and overall KAP for pharmacists, followed by physicians, and were least with nurses (Figure 2). Composite scores of practices were comparable between pharmacists (p=0.71) and physicians, who demonstrated significantly higher than nurses (p= 0.001, <0.0001 for pharmacists and physicians, respectively).

3.5. Impact on reporting

Univariate Poisson regression indicated that the pre-training Composite Score of Knowledge significantly predicted higher reporting rates (IRR=1.05, p<0.001), and this trend was consistent post-training [Table 7]. Similar trends were observed for the composite scores of attitudes and practice with both pre- and post-training. The overall composite score of KAP post-training had a significant relationship with ADR reporting rates, though this relationship became non-significant in the adjusted multivariate model (IRR=1.00, p=0.7). Notably, the ADR rate pre-training had a strong predictive value (IRR=1.18, p<0.001), which persisted in multivariate regression after adjustment for baseline ADR rate. Among professions, Physicians had a significantly higher incidence rate ratio compared to nurses (IRR=1.23, p=0.020), while pharmacists showed a trend toward higher reporting compared to nurses but did not reach statistical significance (p=0.08). Level of education showed varied significance with those holding a diploma or master's degree having a significantly lower IRR than those with a bachelor's degree (IRR=0.60, p=0.004). However, these effects of the profession were insignificant when adjusted for baseline reporting rate and composite scores of KAP post-training (p=0.7).

Pharmacovigilance (PV) is a crucial procedure that strives to maintain patient safety when utilizing drugs that have previously been approved for sale on the market and supports public health initiatives by offering trustworthy data to weigh the risks and advantages of treatments before use (WHO, 2010). It is viewed as a form of ongoing monitoring of unintended effects and other medication safety-related concerns. Additionally, it is crucial for

Table 1. Baseline characteristics of participants (N=90)

Characteristic	**N = 90**[1]
Age (Years)	33.3±8.5
Gender	
Male	54 (60.0%)
Female	36 (40.0%)
Profession	
Nurse	47 (52.2%)
Physician	24 (26.7%)
Pharmacist	19 (21.1%)
Level of education	
Bachelor	42 (46.7%)
Diploma	28 (31.1%)
Master Degree	7 (7.8%)
PhD	13 (14.4%)
Department	
NICU	21 (23.3%)
Pediatric Ward	29 (32.2%)
Hospital Pharmacy	15 (16.7%)
Emergency Ward	25 (27.8%)
Average patients seen per day	19.9±7.6
Rate of ADR Reporting	5.5±2.4
[1]Mean±SD; n (%)	

Table 1. Comparing items of knowledge domain before and after the educational training program (N=90)

Characteristic	**Before Training**, N = 90[1]	**After Training**, N = 90[1]	**p-value**[2]
Understanding the Definition of ADR	35 (38.9%)	48 (53.3%)	0.026
Types of ADRs To Report	25 (27.8%)	44 (48.9%)	0.002
Definition of Pharmacovigilance	31 (34.4%)	48 (53.3%)	0.003
Purpose of Pharmacovigilance	18 (20.0%)	38 (42.2%)	<0.001
International ADR Center Location	10 (11.1%)	31 (34.4%)	<0.001
Awareness of Iraqi National PV Program	78 (86.7%)	62 (68.9%)	0.003
Iraqi ADR Regulatory Body	32 (35.6%)	47 (52.2%)	0.021
PV in National Drug Policy	46 (51.1%)	55 (61.1%)	0.2
PV Training in Iraq	52 (57.8%)	54 (60.0%)	0.9
Local PV Committee in the Institution	37 (41.1%)	53 (58.9%)	0.008
Common ADR Monitoring Method	5 (5.6%)	28 (31.1%)	<0.001
[1]n (%)			
[2]McNemar's Chi-squared test with continuity correction			

Table 2. Comparing items of the attitude domain before and after the educational training program (N=90)

Characteristic	Before Training, N = 90[1]	After Training, N = 90[1]	p-value[2]
Reporting Efficiency			**0.003**
Strongly Disagree	23 (25.6%)	31 (34.4%)	
Disagree	14 (15.6%)	8 (8.9%)	
Neutral	27 (30.0%)	12 (13.3%)	
Agree	13 (14.4%)	12 (13.3%)	
Strongly Agree	13 (14.4%)	27 (30.0%)	
Only Safe Drugs are Market Available			**0.007**
Strongly Disagree	23 (25.6%)	34 (37.8%)	
Disagree	24 (26.7%)	12 (13.3%)	
Neutral	25 (27.8%)	13 (14.4%)	
Agree	15 (16.7%)	18 (20.0%)	
Strongly Agree	3 (3.3%)	13 (14.4%)	
ADR Form Complexity			**0.034**
Strongly Disagree	2 (2.2%)	11 (12.2%)	
Disagree	16 (17.8%)	21 (23.3%)	
Neutral	24 (26.7%)	12 (13.3%)	
Agree	27 (30.0%)	24 (26.7%)	
Strongly Agree	21 (23.3%)	22 (24.4%)	
Job Risks from ADR Reporting			**<0.001**
Strongly Disagree	22 (24.4%)	32 (35.6%)	
Disagree	28 (31.1%)	13 (14.4%)	
Neutral	26 (28.9%)	12 (13.3%)	
Agree	12 (13.3%)	14 (15.6%)	
Strongly Agree	2 (2.2%)	19 (21.1%)	
Guilt for ADRs			**0.035**
Strongly Disagree	16 (17.8%)	25 (27.8%)	
Disagree	28 (31.1%)	13 (14.4%)	
Neutral	21 (23.3%)	15 (16.7%)	
Agree	15 (16.7%)	17 (18.9%)	
Strongly Agree	10 (11.1%)	20 (22.2%)	
ADR Reports Can Improve Career			0.2
Strongly Disagree	36 (40.0%)	34 (37.8%)	
Disagree	16 (17.8%)	16 (17.8%)	
Neutral	15 (16.7%)	6 (6.7%)	
Agree	15 (16.7%)	15 (16.7%)	
Strongly Agree	8 (8.9%)	19 (21.1%)	
Uncertainty in Reporting ADR			**0.002**
Strongly Disagree	15 (16.7%)	25 (27.8%)	
Disagree	17 (18.9%)	10 (11.1%)	
Neutral	15 (16.7%)	12 (13.3%)	
Agree	30 (33.3%)	15 (16.7%)	
Strongly Agree	13 (14.4%)	28 (31.1%)	
Time Constrains for Reporting ADR			**0.025**
Strongly Disagree	28 (31.1%)	27 (30.0%)	
Disagree	25 (27.8%)	13 (14.4%)	
Neutral	18 (20.0%)	11 (12.2%)	
Agree	10 (11.1%)	7 (7.8%)	
Strongly Agree	9 (10.0%)	32 (35.6%)	
Monetary Incentive for Reporting			0.12
Strongly Disagree	26 (28.9%)	37 (41.1%)	
Disagree	26 (28.9%)	11 (12.2%)	
Neutral	14 (15.6%)	13 (14.4%)	
Agree	11 (12.2%)	6 (6.7%)	
Strongly Agree	13 (14.4%)	23 (25.6%)	
Perceived Knowledge Gap in ADR Process			**0.001**
Strongly Disagree	5 (5.6%)	17 (18.9%)	
Disagree	13 (14.4%)	18 (20.0%)	
Neutral	27 (30.0%)	11 (12.2%)	
Agree	33 (36.7%)	16 (17.8%)	
Strongly Agree	12 (13.3%)	28 (31.1%)	
ADRs Increases Healthcare Cost			**0.011**
Strongly Disagree	18 (20.0%)	24 (26.7%)	
Disagree	19 (21.1%)	17 (18.9%)	
Neutral	16 (17.8%)	12 (13.3%)	
Agree	24 (26.7%)	8 (8.9%)	
Strongly Agree	13 (14.4%)	29 (32.2%)	
Severity Based Reporting			**0.022**
Strongly Disagree	23 (25.6%)	32 (35.6%)	
Disagree	20 (22.2%)	13 (14.4%)	
Neutral	23 (25.6%)	14 (15.6%)	
Agree	17 (18.9%)	11 (12.2%)	
Strongly Agree	7 (7.8%)	20 (22.2%)	
Hospital ADR Effectiveness			0.14
Strongly Disagree	23 (25.6%)	25 (27.8%)	
Disagree	19 (21.1%)	15 (16.7%)	
Neutral	23 (25.6%)	11 (12.2%)	
Agree	15 (16.7%)	17 (18.9%)	
Strongly Agree	10 (11.1%)	22 (24.4%)	
Patient Safety Improved by ADR reporting			**0.003**
Strongly Disagree	13 (14.4%)	23 (25.6%)	
Disagree	17 (18.9%)	8 (8.9%)	
Neutral	17 (18.9%)	10 (11.1%)	
Agree	28 (31.1%)	15 (16.7%)	
Strongly Agree	15 (16.7%)	34 (37.8%)	

[1]n (%)

[2]McNemar's Chi-squared test

Table 4. Comparing items of the practice domain before and after the educational training program (N=90)

Characteristic	Before Training, N = 90[1]	After Training, N = 90[1]	p-value[2]
Read the ADR Prevention Article			**<0.001**
No	69 (76.7%)	54 (60.0%)	
May be	8 (8.9%)	2 (2.2%)	
Yes	13 (14.4%)	34 (37.8%)	
Prior ADR Reporting Training			**0.014**
No	72 (80.0%)	59 (65.6%)	
May be	4 (4.4%)	1 (1.1%)	
Yes	14 (15.6%)	30 (33.3%)	
Seen ADR Form			**<0.001**
No	65 (72.2%)	45 (50.0%)	
May be	8 (8.9%)	5 (5.6%)	
Yes	17 (18.9%)	40 (44.4%)	
Experienced ADR in Practice			**0.011**
No	56 (62.2%)	43 (47.8%)	
May be	6 (6.7%)	3 (3.3%)	
Yes	28 (31.1%)	44 (48.9%)	
Reported ADR to PV Center			**<0.001**
No	77 (85.6%)	50 (55.6%)	
May be	4 (4.4%)	6 (6.7%)	
Yes	9 (10.0%)	34 (37.8%)	
[1]n (%)			
[2]McNemar's Chi-squared test			

Table 3. Comparing items of barrier domain before and after the educational training program (N=90)

Characteristic	Before Training, N = 90[1]	After Training, N = 90[1]	p-value[2]
Unsure If ADR	42 (46.7%)	6 (6.7%)	**<0.001**
Unknown Reporting Rules	44 (48.9%)	11 (12.2%)	**<0.001**
Known ADR Judgement	46 (51.1%)	9 (10.0%)	**<0.001**
Role Uncertainty	33 (36.7%)	9 (10.0%)	**<0.001**
Time Constraint	24 (26.7%)	5 (5.6%)	**<0.001**
ADR Form Availability	23 (25.6%)	3 (3.3%)	**<0.001**
Lack of Competence	24 (26.7%)	5 (5.6%)	**<0.001**
Non-Responsibility to ADR	13 (14.4%)	3 (3.3%)	**0.024**
Confidential Space Lack	4 (4.4%)	0 (0.0%)	0.13
Lack of RELIS Feedback	9 (10.0%)	1 (1.1%)	**0.027**
Responsibility Concern	4 (4.4%)	0 (0.0%)	0.13
[1]n (%)			
[2]McNemar's Chi-squared test with continuity correction			

Table 4. Comparing the composite scores of KAP before and after the educational training program among different healthcare professionals (N=90)

	Nurse			Physician			Pharmacist			Global p-value[3]
Characteristic	**Before Training,** N = 47[1]	**After Training,** N = 47[1]	**p-value[2]**	**Before Training,** N = 24[1]	**After Training,** N = 24[1]	**p-value[2]**	**Before Training,** N = 19[1]	**After Training,** N = 19[1]	**p-value[2]**	
Composite Score of Knowledge	2.7±2.2	3.1±3.5	0.6	5.1±2.4	6.9±3.5	**0.017**	6.2±3.1	10.3±1.5	**<0.001**	**<0.001**
Composite Score of Attitude	36.0±8.5	31.6±15.7	**0.024**	39.5±9.6	45.1±14.4	**0.011**	45.9±7.9	60.0±7.6	**<0.001**	**<0.001**
Composite Score of Practice	5.7±1.3	6.5±2.3	**0.033**	7.4±2.5	11.2±2.6	**<0.001**	10.3±3.5	13.6±1.5	**<0.001**	**<0.001**
Overall composite score of KAP	44.5±9.4	41.1±18.0	0.067	52.0±11.3	63.2±18.1	**0.001**	62.4±9.9	83.9±9.0	**<0.001**	**<0.001**
Rate of ADR Reporting	5.0±2.2	6.7±3.8	**<0.001**	5.8±2.4	8.3±4.4	**0.004**	6.4±2.4	7.9±4.2	**0.018**	0.57
[1]Mean±SD										
[2]Wilcoxon signed rank test with continuity correction. [3]Kruskal-Wallis ANOVA.										

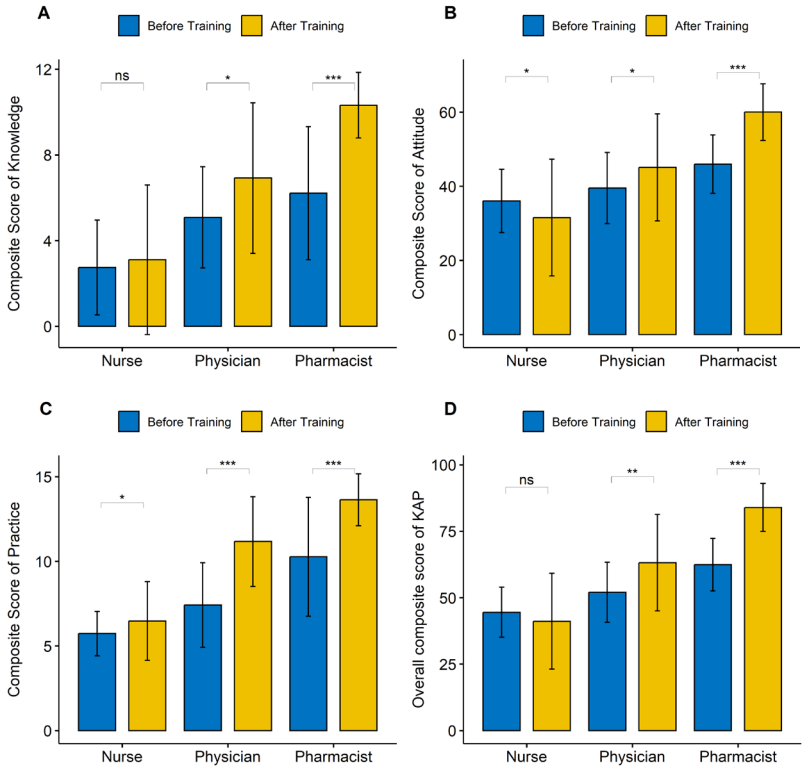

Figure 1. Bar plots comparing the mean composite scores of A) Knowledge, B) Attitude, C) Practice, D) Overall KAP among different healthcare professionals before and after receiving the training program. Error bars represent the standard error of the mean (SEM). Asterisks indicate significant differences with *: <0.05, **:<0.01, ***:<0.001. Nonsignificant differences were designated as '*ns*'.

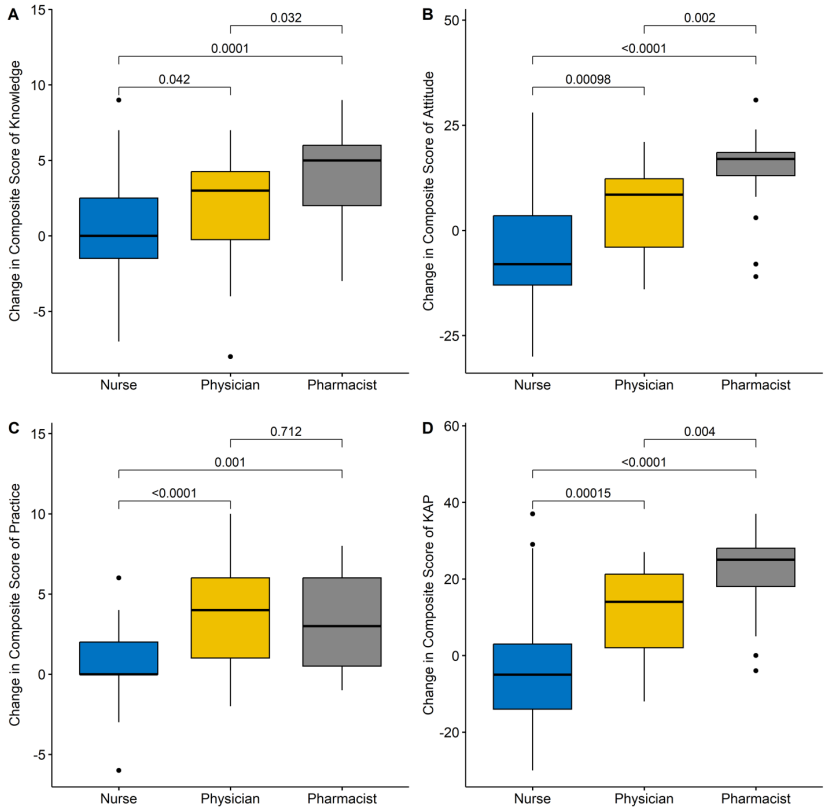

Figure 2. Box plots comparing the change of composite scores of A) Knowledge, B) Attitude, C) Practice, D) Overall KAP among different healthcare professionals after receiving the training program. For each comparison, p-values were adjusted using Bonferroni correction for multiple comparisons.

Table 5. Poisson regression analysis predicting the adverse drug reaction reporting rates (N=90).

	Univariate Poisson Regression				Multivariate Poisson Regression		
Characteristic	**N**	**IRR[1]**	**95% CI[1]**	**p-value**	**IRR[1]**	**95% CI[1]**	**p-value**
Composite score of knowledge (pre)	90	1.05	1.02, 1.08	**<0.001**			
Composite score of knowledge (post)	90	1.05	1.03, 1.06	**<0.001**			
Composite score of attitude (pre)	90	1.03	1.02, 1.03	**<0.001**			
Composite score of attitude (post)	90	1.02	1.01, 1.02	**<0.001**			
Composite score of practice (pre)	90	1.05	1.03, 1.08	**<0.001**			
Composite score of practice (post)	90	1.06	1.04, 1.08	**<0.001**			
Composite score of KAP (pre)	90	1.02	1.01, 1.03	**<0.001**			
Composite score of KAP (post)	90	1.01	1.01, 1.02	**<0.001**	1.00	0.99, 1.00	0.7
ADR rate (pre)	90	1.18	1.14, 1.21	**<0.001**	1.18	1.11, 1.25	**<0.001**
Profession	90						
Nurse		—	—				
Physician		1.23	1.03, 1.47	**0.020**			
Pharmacist		1.19	0.98, 1.44	0.080			
Age (Years)	90	1.00	0.99, 1.01	0.5			
Average patients seen per day	90	1.04	1.03, 1.05	**<0.001**	1.00	0.99, 1.02	0.7
Level of education	90						
Bachelor		—	—		—	—	
Diploma		0.83	0.70, 0.99	**0.044**	0.86	0.72, 1.03	0.10
Master's degree		0.60	0.41, 0.84	**0.004**	0.88	0.60, 1.25	0.5
PhD		0.92	0.73, 1.14	0.4	0.99	0.78, 1.24	>0.9
Gender	90						
Male		—	—				
Female		1.01	0.86, 1.17	>0.9			

[1]IRR = Incidence Rate Ratio, CI = Confidence Interval

drug use that is reasonable and economical (WHO, 2006; Rohilla and Singh, 2012). In clinical practice, pharmacovigilance and ADR reporting systems that are well-organized will result in intelligent, evidence-based drug use and the potential to prevent or reduce several ADRs. Healthcare personnel need to be educated and trained in ADR reporting if we're going to improve the ADR reporting procedure. Additionally, better ADR reporting will result in lower medical expenses. Our study's primary goal was to evaluate the contribution of an educational intervention to ADR reporting. Also investigate whether the same group of HCPs after training had better knowledge, attitude, and practice (KAP) regarding reporting ADRs. Finally, determine the most significant variables that inhibit ADR reporting. The survey was completed by almost 95% of the invited HCPs before and after the training program, indicating a general interest on the part of HCPs in understanding the PV and ADRs reporting system and improving the standard of medical service provided. In terms of the distribution of professions, nurses made up the majority (52.2%), followed by doctors (26.7%), and pharmacists (21.1%). HCP should be adequately knowledgeable about PV and the requirements for a valid report in order to deliver an appropriate ADR report (Gupta et al. 2015). In the current work, it was discovered that the baseline total knowledge scores of all HCPs were low. This was consistent with the findings of earlier studies conducted in Saudi Arabia (Abdel- Latif and Abdel- Wahab, 2015; Al-Shammari and Almoslem, 2018), Jordan (Suyagh et al. 2015; Abu Farha et al. 2018), Yemen (Alshakka et al. 2016), Turkey (Ergun et al. 2019), Malaysia (Hussain et al. 2020), India (Upadhyaya et al. 2015), South Africa (Bogolubova et al. 2018; Haines and Meyer, 2020), and Nigeria (Adisa et al. 2019). Most HCPs in the current study were unaware of the proper definition of PV, ADRs, or the objective of PV. Despite having poor baseline knowledge ratings in the current study, pharmacists outperformed other HCPs, which is consistent with findings from earlier investigations in Saudi Arabia (Abdel- Latif and Abdel- Wahab, 2015; Al-Shammari and Almoslem, 2018). This can be related to the background knowledge pharmacists acquired throughout their undergraduate training. Therefore, it is strongly advised that comprehensive and current PV courses be incorporated in undergraduate medical and nursing curriculum as well as CME programs. Following the educational training, a significant improvement in all participants' knowledge scores was noted in the current study. This finding is consistent with findings from studies that were previously published in Brazil (Varallo et al. 2017) and Jordan (Abu Farha et al. 2018), though there were differences in the amount of time needed to assess participants' knowledge after using the system and completing the post-education questionnaire. In the Jordanian study, the questionnaire was intended to measure participants' knowledge and awareness of PV immediately following the educational session (Abu Farha et al. 2018), while Varallo and her colleagues gave the participants the questionnaire 12 months after the educational workshop (Varallo et al. 2017). Three months between pre- and post-intervention assessments were used in the current study to examine knowledge in addition to assessing the effect of education on reporting ADRs. Most HCPs in the current study's post-education phase were able to define PV and ADRs accurately, and they were aware of exactly what they needed to report and how to do so to the institution's local PV Committee. Although many HCPs had a negative baseline attitude toward PV and ADR reporting, post-educational training was linked to a significant shift in participants' attitudes from negative to positive, and the majority of HCPs, particularly pharmacists and physicians, are now aware of their crucial roles in reporting ADRs and assisting the PV system. This demonstrates the value of continuing education programs in raising HCPs' knowledge of ADR reporting. An effective ADRs reporting system was introduced in their healthcare settings, according to the authors of a systematic study done in the United Kingdom in 2009, and this resulted in increased levels of PV knowledge among HCPs (Molokhia et al, 2009). In the current study, participants' baseline scores for PV practice were low, and only a small percentage (31.3%) of participants reported having ADRs with their patients. 10% of respondents said they had previously reported ADRs. The low knowledge score of HCPs at baseline in the current investigation was mirrored in the poor reporting practice. In a 2019 study conducted in Turkey, participants claimed to experience 1 to 10 ADRs per week, however only 8% of them informed the PV center about the discovered ADRs (Ergun et al. 2019). The participants in Al-Shammari and Al- Moslem's study on HCPs in Saudi Arabia reported low practice scores, too (Al-Shammari and Almoslem, 2018). According to a Jordanian study from 2015, HCPs had poor ADR reporting, which was linked to their lack of understanding and awareness of the entire PV system (Suyagh et al. 2015). Even though Germany's PV system was well-established and there were many reporting events, only 5- 10% of serious ADRs and even a smaller percentage of non-serious ADRs were reported, according to a German study published in 2018 (Laven et al. 2018). This was attributed to the lack of mandatory continuing education programs for PV for German HCPs. After receiving instruction in the current study, practice scores significantly improved, and the quantity of ADR reports dramatically increased (p-value 0.001). This conclusion is reinforced by earlier research that found that PV education and training enhanced the likelihood that HCPs would engage in PV activities and may boost spontaneous ADR reporting, which is a critical component of drug safety surveillance (Maigetter et al. 2015; Laven et al. 2018; Bogolubova et al. 2018). The current study's improvement in ADR reporting showed that

HCPs were more capable of identifying and disclosing ADRs after the educational session and that they understood what ADRs were and how crucial it was to report them. When adverse drug reactions are reported to the PV center, it is possible to more accurately estimate and identify the drug risk in the general population. This enables regulatory actions to be taken to improve patient safety with respect to the medications involved, such as changing the drug leaflets, issuing black box warnings, or even suspending or withdrawing the drug. These decisions are based on the strength and frequency of ADR signals that have been reported as well as the volume of supporting data (Sartori et al. 2020).

In terms of barriers that discourage reporting, we discovered that a few significant changes appeared post-training. Understanding these barriers is essential for designing targeted strategies that can increase the quantity and quality of ADR reports, which will ultimately increase the safety of pharmaceuticals.

4. Conclusion

In conclusion, our study in a single facility showed a clear improvement in Healthcare Professionals' performance and an increase in reporting Adverse Drug Reactions (ADRs). To ensure ongoing success, it's crucial to attain and sustain positive outcomes in the ADR reporting system and enhance practices on an inter-professional level through continuous education efforts.

Author contribution

Bootan Salih (BS), Omer Allela (OA), Raad Kaskoos (RK) and Javed Ahmed (JA) contributed to the conception, initiation of the research. BS and OA designed the experiments. OA supervised the study. BS and OA conducted the experiments. BS, OA and RK collected and analysed the data. BS wrote the first manuscript OA, RK and JA reviewed the manuscript. All authors approved the submitted version of the manuscript.

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Competing financial interests

The authors have no conflict of interest.

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