Review Article

International Journal of Research in Pharmaceutical Sciences

Published by JK Welfare & Pharmascope Foundation Journal Home Page: https://ijrps.com

# Pharmacovigilance in Saudi Arabia: A Narrative Review on Adverse Drug Reaction Reporting

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*Article History:*

Received on: 02 Sep 2023
Revised on: 05 Oct 2023
Accepted on: 06 Oct 2023

*Keywords:*

Adverse Drug Reaction,
Pharmacovigilance,
Post-Marketing Surveillance,
Saudi Food and Drug Authority,
Saudi Vigilance System

## Abstract

Adverse drug reaction (ADR) reporting is an important aspect of pharmacovigilance (PV) in ensuring drug safety during the post-marketing surveillance phase. Currently, the National Pharmacovigilance Center (NPC) established by the Saudi Food and Drug Authority (SFDA) is the regulatory authority receiving ADR reports in Saudi Arabia. Spontaneous ADR reports from healthcare professionals and the public are received by the NPC through an electronic platform known as the Saudi Vigilance System. Signal analysis of the received ADR reports aids the decision-making initiatives related to the reported drugs. Stakeholders' contribution to ADR reporting, and implementation of effective electronic platforms are important factors affecting the national PV performance. The concept of stakeholders reporting on ADR is relatively new in Saudi Arabia, especially to the public. In this narrative review the national studies describing the stakeholders' knowledge, perception and barriers toward ADR reporting, and the incidence of ADR reporting by healthcare institutions in Saudi Arabia were evaluated. The findings indicate that more efforts are needed by the SFDA to educate stakeholders about the importance of ADR reporting. The study recommends ADR electronic systems integration between the SFDA and healthcare institutions to improve the frequency and quality of ADR reports, and regular feedback on decisions made about ADR reports should be provided by the SFDA to stakeholders to improve their awareness of the importance of ADR reporting and enhance their contribution to PV and ADR reporting process.

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ISSN: 0975-7538

DOI: https://doi.org/10.26452/ijrps.v14i4.4452

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IJRPS | https://ijrps.com



## INTRODUCTION

Adverse drug reaction (ADR) is characterized as an unintended—and difficult-to-predict—harmful effect of medication, resulting from the utilization of otherwise normal drug doses intended for therapeutic or prophylactic effects [1, 2]. Pharmacovigilance (PV) is a process concerned with assessing, detecting, and reporting ADR to ensure drug safety during the post-marketing surveillance phase [3]. The initial post-marketing surveillance system implemented in Saudi Arabia was established by the Ministry of Health (MOH) in 1990s, to collect unexpected and serious ADR from main hospitals and private community pharmacies in main regions of the country via Adverse Drug Event reporting forms [4, 5]. After the establishment of the Saudi Food and Drug Authority (SFDA) in 2003, drug safety monitoring became the responsibility of the SFDA [3].

In 2009, the SFDA established the National Pharmacovigilance Center (NPC), and became a member of the World Health Organization (WHO) pharmacovigilance program. The NPC provides local data on ADR to the WHO Uppsala Monitoring Center (UMC) [4, 6] and contributes to the worldwide efforts in monitoring drug safety. In 2018, the NPC established the Saudi Vigilance System (SVS) an electronic reporting system to receive PV reports from stakeholders. The Saudi PV model and infrastructure resources were developed based on the adoption of the European and US regulatory authorities models [4].

The NPC receives spontaneous ADR reports from Healthcare Professionals (HCPs) and the public through paper forms, online reporting forms, direct verbal communication, and via fax or phone. Awareness campaigns were conducted by the SFDA to enhance the HCPs and the public knowledge of the importance of PV and ADR reporting [3, 4, 6]. To facilitate communication between the NPC and different healthcare institutions around the country, the NPC assigned PV volunteering coordinators in the main provinces of the country [4]. The assigned coordinators play a role in increasing the public awareness of the NPC, mediating communication between the NPC and their institutions, highlighting the importance of ADR reporting, and suggesting improvements to the national reporting system. In a recent review of the Saudi PV Program, Alharf et al. summarized the challenges faced by the SFDA and the NPC, namely underreporting, lack of cooperation with some hospitals and institutions, and the need to hire qualified personnel in PV [4].

Underreporting is a challenge facing different international drug regulatory authorities around the world and was also reported by national studies in Saudi [2, 3, 7]. The voluntary nature of the reporting system is causing another obstacle facing the SFDA, which is the level of completeness and quality of the received ADR reports [8]. Many fields of the ADR reporting forms are incomplete, affecting the usefulness of the collected data and interfering with the proper detection of safety signals that could aid the decision-making initiatives expected to be concluded from these reports [8, 9]. Thus, stakeholders' knowledge and perception of their roles in ADR reporting,and the implementation of efficient electronic platforms that encourage the stakeholder's engagement in submitting any experienced ADR are the major factors in improving the national performance of ADR reporting [2, 9].

This narrative review aims to describe the current status of ADR reporting in Saudi Arabia by exploring the knowledge, perception and barriers facing HCPs, pharmacy students, and the public toward reporting ADR. The review also evaluates the incidence rates of ADR reported by hospitals, community pharmacies and the NPC, to develop recommendations to improve the contribution of stakeholders to the national ADR reporting system and increase the frequency and quality of the received ADR reports by the NPC.

## MATERIALS AND METHODS

National studies published from January 2010 to April 2023 were retrieved from PubMed and Scopus databases using the following keywords: Adverse Drug Reaction OR ADR OR adverse drug reaction reporting OR ADR reporting AND Pharmacovigilance OR PV AND Saudi Arabia OR Saudi Food and Drug Authority OR SFDA. The search was limited to English full-text studies specifically conducted in Saudi Arabia describing the knowledge, perception, and barriers facing the HCPs, pharmacy students and the public toward ADR reporting. Studies that described the incidence rates of ADR, patients' groups, medications and affected organs that were reported by hospitals, community pharmacies and NPC were also included. Twenty-seven studies involving stakeholders' knowledge and perception toward ADR reporting and incidence rates of ADR reported by hospitals, community pharmacies and NPC in Saudi Arabia met the inclusion criteria and were evaluated for the purpose of this narrative review.

## RESULTS AND DISCUSSION

### Stakeholders' Knowledge, Perception and Barriers Affecting their ADR Reporting

Several studies evaluating the knowledge and perception of HCPs, pharmacy students and the public toward ADR reporting were conducted collectively in the three largest regions in Saudi Arabia, namely central, western, and eastern regions, surveying mostly physicians, nurses, and pharmacists, beside pharmacy students and the public are summarized in Tables 1, 2 and 3.

### Healthcare Professionals Perspectives

HCPs had generally good knowledge of PV [10, 11], and ADR reporting and believe that ADR reporting should be mandatory [11, 12], and could improve patients' safety [12]. HCPs' awareness of the regulatory authority to whom the ADR should be reported is essential in stimulating their compliance and participation in reporting.

**Table 1: Summary of the National Studies Evaluating Healthcare Professionals Knowledge, Perception and Barriers Toward ADR Reporting**

| Author | Sample Size | Instrument | Setting/City or Region | Results |
|---|---|---|---|---|
| Alshammari et al. [10] | 332 | questionnaire | 12 Government and Private Hospitals / Riyadh, Jeddah, Dammam | 36.9% identified NPC as regulatory authority monitoring ADR.<br>78.4% believed it is their professional obligation to ADR.<br>Barriers:<br>34.7% indicated that lack of time prevented them from reporting ADR. |
| Almandil [11] | 331 | questionnaire | King Fahd University Hospital / Khobar | 71.6% indicated that all types of ADR should be reported.<br>62.2% unaware of the existence of NPC.<br>89.9% did not attend any courses and/or workshops about ADR reporting.<br>36.1% believe ADR form is the best way to report ADR. |
| Moinuddin et al. [12] | 339 | questionnaire | King Saud Medical City / Riyadh | 55.1% reported ADR during their practice.<br>93.8% believed ADR reporting should be mandatory.<br>94.5% believed ADR reporting would improve patients' safety. |
| AlShammari & Almoslim [13] | 336 | questionnaire | 9 Tertiary care governmental and private hospitals / Riyadh, Qassim, and Eastern Region | 33% were aware of the NPC (50% were pharmacists).<br>20% involved in reporting ADR (62% were pharmacists, 26% were nurses, and 6% were physicians).<br>Barriers:<br>46% fear of incorrect reporting.<br>44% indicated that lack of time prevented them from reporting ADR. |
| Ali et al. [14] | 135 | questionnaire | Health Centers / Dammam | 73.33% unaware of NPC.<br>38.51% aware of ADR report forms and the electronic reporting system.<br>57.7% experienced ADR during their professional practice.<br>17.77% reported ADR.<br>76.29 % did not attend any training on ADR reporting.<br>86.66% unaware of the importance of ADR reporting. |

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*Table 1 continued*

| Author | Sample Size | Instrument | Setting/City or Region | Results |
|---|---|---|---|---|
| Khan [15] | 50 community pharmacists | questionnaire | Community Pharmacies / Alahsa | 90% unaware of the ADR reporting system.<br>30% willing to report the drug name associated with ADR but not the event.<br>20% believe over the counter medication associated ADR should not be reported.<br>Barriers:<br>86% unavailability of professional environment to discuss ADR reports.<br>44% unavailability of ADR reporting forms.<br>22% lack the knowledge of how to report ADR. |
| Mahmoud et al. [16] | 104 community pharmacists | questionnaire | Community Pharmacies / Riyadh | 22.1% aware of the ADR reporting process.<br>20.2% aware of the online ADR reporting system.<br>86.5% never reported ADR.<br>Barriers:<br>45.9% unaware of the ADR reporting method.<br>16.6% believe ADR reporting is the duty of physicians and hospital pharmacists.<br>76.9% managed ADR by referring the patient to a physician. |
| Aldryhim et al. [17] | 1870 (1,717 community and 153 hospital pharmacists) | questionnaire | Community and Hospital Pharmacies / Riyadh | 10.2% community pharmacists and 26.8% hospital pharmacists reported ADR.<br>36.9% aware of the SFDA ADR reporting process.<br>Suggested facilitators that might enhance ADR reporting:<br>72.8% knowledge of the seriousness of ADR.<br>69.3% continuous improvement in ADR therapeutic knowledge.<br>68.3% receiving appropriate continuous medical education. |
| AL-Mutairi et al. [18] | 289 hospital pharmacists | questionnaire | Tertiary care centers (public, private, and university medical centers) / Riyadh | 69.2% received training on ADR reporting.<br>70% reported ADR more than once a week.<br>Barriers:<br>96.9% insufficient information about ADR from patients.<br>96.9% being unaware of the importance of reporting ADR.<br>79.6% indicated that lack of time prevented them from reporting ADR. |

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*Table 1 continued*

| Author | Sample Size | Instrument | Setting/City or Region | Results |
|---|---|---|---|---|
| Alsheikh & Alasmari [19] | 1172 community pharmacists | questionnaire | Community Pharmacies / 5 regions in Saudi Arabia | 86.7% aware of NPC.<br>70.8% aware of the ADR reporting forms.<br>90.2% believe more training programs are required from SFDA on detecting and reporting ADR. |
| Alshabi et al. [20] | 102 hospital pharmacists | questionnaire | Government hospitals / Najran | 95% aware of the ADR reporting system.<br>88.9% aware of NPC.<br>71.3% reported ADR.<br>90.1% believed that ADR reporting is their professional obligation.<br>Barriers:<br>90.1%: lack of professional discussions on ADR.<br>78.2%: lack of knowledge in assessing ADR.<br>77.2%: unavailability of reporting forms. |
| Abdulsalim et al. [21] | 209 community pharmacists | questionnaire | Qassim area | 17.2% knew where to report ADR.<br>53.8% identified ADR during their practice.<br>21.9% reported ADR.<br>Barriers:<br>59%: unaware of how to report ADR.<br>33%: unaware of what information to report. |
| Alghazwani et al. [22] | 97 pharmacists (38 community and 57 hospital pharmacists) | questionnaire | Asir area | 56.7% identified the SFDA as the body collecting ADR data.<br>41.2% did not report ADR in a regular manner.<br>Barriers:<br>73.2% workload prevented them from reporting ADR. |

ADR: Adverse Drug Reaction, NA: Not Applicable, NPC: National Pharmacovigilance Center, SFDA: Saudi Food and Drug Authority

**Table 2: Summary of the National Studies Evaluating Pharmacy Students Knowledge, Perception and Barriers Toward ADR Reporting**

| Author | Sample Size | Instrument | Setting/City or Region | Results |
|---|---|---|---|---|
| Alkayyal et al. [23] | 259 senior pharmacy students | questionnaire | Governmental and private university /college | 59.5% knew SFDA as the regulatory authority monitoring ADR.<br>64.1% did not know how to report ADR to the regulatory authority.<br>82.2% need more education and training on ADR reporting in their curriculum. |
| Alwhaibi et al. [24] | 710 students | questionnaire | Governmental and private university/college | 40% defined ADR correctly.<br>39% indicated that they received PV education in their curriculum. |
| Alshayban et al. [25] | 315 pharmacists and interns | interviews or selfadministered questionnaire | MOH hospitals and other hospitals | 86.4% of interns were receptive of ADR.<br>76.5% of interns identified the SFDA as the body collecting ADR data.<br>48.1% of interns knew how to report ADR.<br>29.6% of interns believed that PV is well covered in their curriculum.<br>30.9% of interns believed that they have acquired enough knowledge about ADR reporting. |

ADR: Adverse Drug Reaction, MOH: Ministry of Health, PV: Pharmacovigilance, SFDA: Saudi Food and Drug Authority

**Table 3: Summary of the National Studies Evaluating the Public Knowledge, Perception and Barriers Toward ADR Reporting**

| Author | Study Period | Sample Size | Instrument | Setting/City or Region | Results |
|---|---|---|---|---|---|
| Sales et al. [26] | June 2012 | 204 | questionnaire | Awareness campaign in two malls Riyadh | 23% correctly defined ADR.<br>15.7% familiar with the term pharmacovigilance.<br>8.6% aware of NPC.<br>73.2% believe HCPs should report ADR not consumers.<br>Barriers:<br>48.5%: not knowing whether the medication caused ADR or not.<br>46.1%: not knowing about the Pharmacovigilance Center.<br>40.7%: not knowing the importance of ADR reporting.<br>36.3%: not knowing how to report ADR. |
| Islam et al. [27] | Jan.–Mar. 2020 | 915 | questionnaire | Universities, social media emails and public places / Dammam | 37.2% knew the meaning of ADR.<br>39 % believe HCPs are responsible to report ADR.<br>2% believe that consumers are responsible to report ADR.<br>91% unaware of NPC.<br>93.1% believed ADR report should be available for the public. |
| Kassem et al. [28] | Jan.–Mar. 2020 | 15 | Semi-structured open-ended questions interview | Unaizah College of Pharmacy / Qassim | 73.3% aware of the term ADR.<br>80% did not attend ADR educational campaigns.<br>60% unaware of the ADR reporting system.<br>73.3% accepted the use of technology in reporting ADR reactions. |

ADR: Adverse Drug Reaction, HCPs: Healthcare Professionals, NPC: National Pharmacovigilance Center

**Table 4: Incidence Rates of ADRs Reporting in Hospitals, Community and NPC**

| Author | Sample Size | Method | Setting/City or Region | ADR Incident Rates and Associated Factors/Effects |
|---|---|---|---|---|
| Khan et al. [29] | 600 patients | retrospective analysis – prospective study | King Abdul Aziz University Hospital / Jeddah | 15% in patients receiving > 10 drugs<br>55.5% in patients over 60 years<br>57.6% associated with gastrointestinal tract<br>24.3% associated with antibiotics |
| Khan et al. [30] | 600 pediatric patients | retrospective analysis – prospective study | King Abdul Aziz University Hospital / Jeddah | 22.1% in patients receiving 5-6 drugs<br>40.7% in zero- to one-year-old patients.<br>42.9% skin-associated ADR<br>16.3% associated with anti-infective |
| Almubark et al. [31] | 5228 consumers | face-to-face cross-sectional survey | 282 community pharmacies / 13 Saudi Regions | 58.73% gastrointestinal disorders.<br>11% associated with nonsteroidal anti-inflammatory<br>19% required medical intervention.<br>30.26% were aware of the SVS<br>14.29% filed the ADR report. |
| Abu Esba et al. [32] | 1156 ADRs submitted by HCPs | retrospective analysis | Ministry of National Guard Health Affairs / (Central, Eastern and Western regions) | 87.8% associated with immune system disorders.<br>56.8% associated with antimicrobials.<br>87.6% reported by nurses. |
| Alshehail et al. [33] | 155 COVID - 19 patients<br>287 ADRs | retrospective observational study | King Fahad University Hospital / Khobar | 74.2% reported ADRs.<br>35.2% hepatic ADRs.<br>54.4% were hydroxychloroquine-related ADRs<br>>10 days hospitalization was associated with ADRs. |

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*Table 4 continued*

| Author | Sample Size | Method | Setting/City or Region | ADR Incident Rates and Associated Factors/Effects |
|---|---|---|---|---|
| Al-Shareef et al. [34] | 381 COVID - 19 patients | retrospective study | Royal Commission Medical Center / Yanbu | 37% reported ADR.<br>Prolonged hospitalization (14.13±7.87)<br>Number of the drugs used (9.74±5.51)<br>41.8% caused hepatobiliary disorders<br>23.4% associated with antiviral medication<br>16.3% associated with lopinavir/ritonavir |
| Bin Yousef et al. [35] | 17,730 ADR cases | retrospective study | NPC database | 54% were serious ADRs.<br>22.27% associated with anti-infective agents for systemic use.<br>2.7% associated with vancomycin. |
| Alenzi et al. [36] | 2,349 ADR reports | retrospective observational study | Tabuk Health Affairs hospitals | 56.1% male patients.<br>26.9% associated with antimicrobial drugs.<br>7.7% associated with ciprofloxacin. |

ADR: Adverse Drug Reaction, NPC: National Pharmacovigilance Center, SVS: Saudi Vigilance System

These studies, however, showed that HCPs were unaware of the NPC as the responsible body receiving and monitoring ADR [10, 14], unaware of the importance of ADR reporting, and only a few were aware of the ADR form provided by the SFDA to report the observed ADR. Although more than half of HCPs participating in these studies encountered ADR during their professional practice, only few of them reported the ADRs when they occurred. In terms of perception, some studies indicated that only a few HCPs attended a course or a workshop about ADR reporting and believed that the availability of ADR forms would facilitate their ADR reporting. Lack of time, difficulty in deciding upon the occurrence of ADR, the uncertainty of how to report ADR, and fear of incorrect reporting were among the major challenges reported by HCPs preventing them from reporting ADR.

Among the HCPs, clinical pharmacists are more aware of the ADR reporting system, and the availability of data about patients' medication records enables them to evaluate the suspected ADR [37]. Moreover, community pharmacists can develop a good background about patients' medications to ensure drug safety and report ADR by closely following up with patients in their community. Two of the earliest studies concerning community pharmacists' perception were conducted during the first few years of NPC establishment, indicating that the community pharmacists were unaware of the ADR reporting system in the country [15, 16], and more than half of them had never reported ADR [16].

Khan, et al. indicated that one-third of community pharmacists were willing to report the name of the drug associated with ADR but not the event itself, and only a few of those community pharmacists believed that reporting ADR resulting from over the counter medication is not important [15]. Later studies conducted between 2020–2021 showed that community pharmacists had better awareness toward the NPC [19], and were willing to report ADR, yet only a few did report ADR [21]. Unavailability of professional environment to discuss ADR, unavailability of ADR reporting forms [15], and lack of awareness on how or what to report [15, 16, 21] were among the major barriers in reporting ADR. Community pharmacists believe that more training programs on detecting and reporting ADR are required from the SFDA [19].

Studies focusing on the perception of hospital pharmacists showed that at least 70% of participating pharmacists reported ADR during their practice [18, 20], 69% of them acknowledged that they were trained on ADR reporting, and 90% believed that it is their professional obligation to report ADR. Workload and lack of time [22], insufficient information about ADR from patients, and lack of professional discussions on ADRs, were among the reported barriers preventing hospital pharmacist from reporting ADR. Knowledge of the seriousness of the reported ADRs and receiving appropriate continuous medical education [17] were suggested by pharmacists who participated in these studies as a possible solution to facilitate ADR reporting. It is worth mentioning that Cheema et al. conducted a randomized controlled trial to determine the effect of structured education in improving the knowledge of hospital pharmacists in Saudi Arabia toward ADR reporting. The guidelines produced by the SFDA was used as the educational material that was provided to the study participants. This intervention resulted in a significant improvement in the mean knowledge score of participating hospital pharmacists compared to the control group [38].

**Pharmacy Students Perspectives**

Providing quality patient care and assuring medication safety are among the most important objectives in preparing pharmacy students for their future careers. Alkayyal et al.'s study showed that more than half of the students did not know how to report ADR and indicated the need to include ADR reporting topics in their curriculum and training rotations. The study showed that there was no significant difference in the level of knowledge between students enrolled in the PharmD or BPharm programs [23]. Alwhaibi et al. showed that pharmacy students had a significantly higher interest in the ADR reporting process, and more knowledge of the regulatory authority and the reporting system used in the country compared to students enrolled in different healthcare programs, yet only few students indicated that PV was taught in their curriculum [24]. Alshayban et al. compared the knowledge and perception ADR reporting among pharmacy interns and hospital pharmacists, and showed that most participating interns were receptive to reporting ADR and knew the regulatory authority receiving and monitoring ADR reports. However, less than half of pharmacy interns included in the study knew how to report ADR or believed that they acquired enough information about ADR reporting in their curriculum [25].

**Public Perspectives**

Public contribution to ADR reporting is significant because they are the main stakeholders who are affected directly by the ADR of suspected medications. Generally, public awareness of ADR reporting and the NPC was low, and they believe that it is the

 

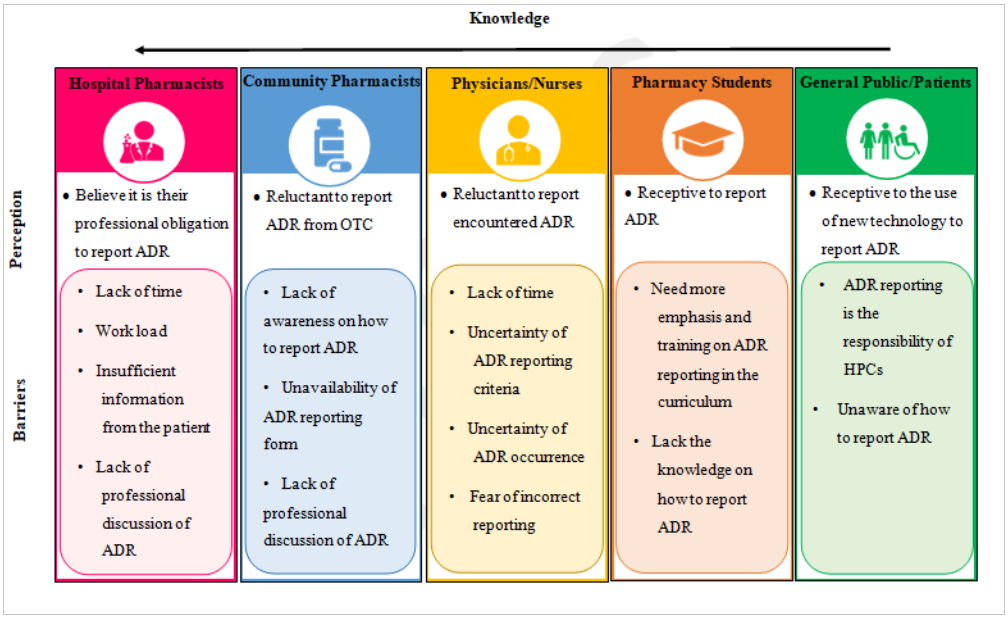


**Figure 1: Summary of stakeholders' knowledge, perception and barriers toward ADR reporting. ADR: Adverse Drug Reaction, HCPs: Healthcare Professionals, OTC: Over the Counter medication**

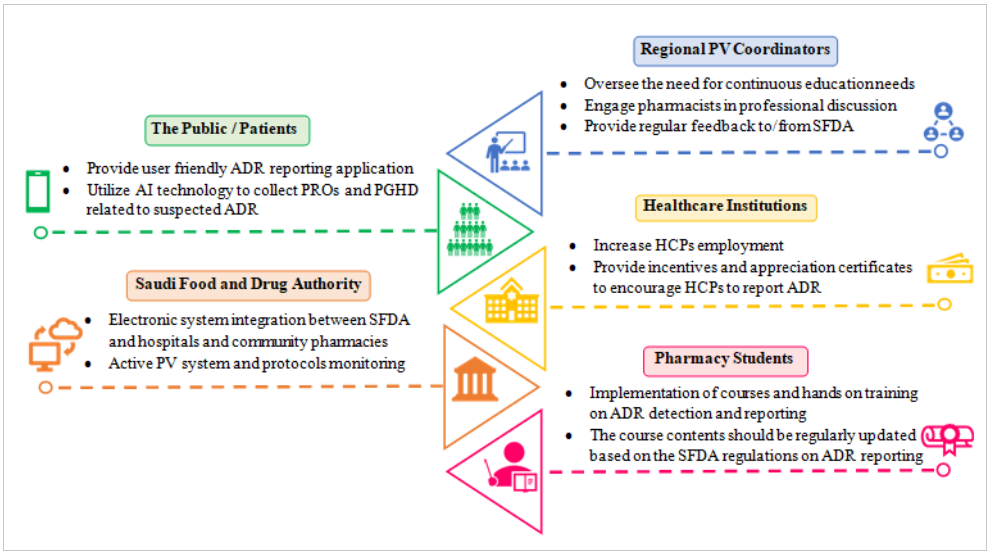


**Figure 2: Summary of recommendations to enhance stakeholders' contribution to ADR reporting. ADR: Adverse Drug Reaction, HCPs: Healthcare Professionals, PGHD: Patient Generated Health Data, PV: Pharmacovigilance, PROs: Patient-Reported Outcomes, SFDA: Saudi Food and Drug Authority**

responsibility of HCPs to report ADR [26, 27]. Some of the indicated reasons preventing patients from reporting ADR were the patient's inability to distinguish whether the ADR was from the medication or not, and their lack of awareness of the importance of ADR reporting or how to report them. Even though the majority of participants were unaware of the NPC, they believe that feedback about the reported ADR should be announced and made available to the public by the SFDA. Kassem et al. conducted qualitative interviews to investigate the community's opinion about using technology to enhance their contribution to ADR reporting. The finding of these interviews indicated that study participants were willing to utilize technology to report any ADR to the authorized body in the country, eventhough most of them were unaware of the term ADR or the ADR reporting system, and had never attended ADR reporting-related awareness campaigns before [28].

### Incidence Rates of ADR Reported by Hospitals, Community Pharmacies and the National Pharmacovigilance Center

ADR is a frequent cause of morbidity and mortal-

ity, and having active PV and well established ADR reporting systems can reduce the economic burden and frequency of hospital admissions associated with ADR [39]. National studies of ADR incidence rates are listed in Table 4.

In 2012, Khan et al. reported high incidence rates of ADR were seen in elderly patients [29]. The study indicated that patients receiving more than 10 drugs were more prone to ADR. The reported ADRs in this study were associated with antibiotics, and most of the reported ADRs caused gastrointestinal tract side effects. Low incidence of ADR was attributed to lack of awareness among HCPs of the importance of ADR reporting. A similar study on pediatric patients [30], found that high incidence of ADR was seen in zero- to one-year-old patients receiving more than five to six drugs, and the reported ADRs were associated with anti-infectives, and that the skin was the major organ affected in these ADR reports. The study concluded that comprehensive ADR assessment, ADR reporting by patients and evidence-based approaches will reduce the incidence of ADR and improve pediatric drug safety. Another study conducted in 2021 by Abu Esba et al. explored ADR reports in a tertiary care hospital complex, and found that ADRs were seen in adults, and were associated with immune system disorders and antimicrobial drugs. In terms of severity, the reported ADRs required that the suspected drug be stopped or discontinued, and antidote or other treatment to be administered with no effect on the duration of the hospitalization period [32].

Some national studies have evaluated the incidence of ADR reporting during COVID-19 pandemic among infected patients. Not surprisingly high incidence of ADR among those COVID-19 infected patients was reported [33, 34]. The reported ADRs caused mostly hepatic side effects, and were associated with hydroxychloroquine or antiviral medication; lopinavir/ritonavir. These studies also showed that the length of stay, and the number of medication had influenced patients' susceptibility to develop ADR. These studies highlighted the importance of the placement of an active PV system in hospitals, and the relevance of utilizing ADR medication and laboratory prompt indicators in improving the hospital's PV system.

Almubark et al. estimated the community occurrence of ADR by evaluating ADRs reported by consumers visiting different community pharmacies around the country. The study found that gastrointestinal disorders and non-steroidal anti-inflammatory drugs were most frequently associated with ADR and indicated that one-third of those who experienced ADR were aware of the SVS, and a few had actually filed an ADR report [31]. Bin Yousef et al. analyzed NPC data for ADR reporting patterns and found that most ADRs were serious and involved mostly adults, and Anti-infective for systemic disorders, and Vancomycin were associated with serious ADRs. This study embraces the communication and active role the NPC played in encouraging the stakeholders to report ADR and recommended the SFDA to increase awareness of the public and HCPs of the importance of ADR reporting.

In 2020, Alenzi et al. evaluated ADRs submitted to the regional spontaneous ADR database, and found that most of the reported ADRs were involving males, and older age patients' group. Antimicrobial drugs, and Ciprofloxacin were the most frequently reported drug group and drug respectively. The study concluded that the regional spontaneous database system had strengthened the role of ADR reports in monitoring the safety information of marketed drugs and investigating the signs associated with ADRs [36].

**Overview and Recommendations**

The SFDA being the regulatory authority in Saudi Arabia responsible of monitoring ADR reports and drug safety had dedicated tremendous efforts since the establishment of the NPC to provide infrastructure, evaluate stakeholders ADR reports, and conduct awareness campaigns about ADR reporting [4, 6]. A summary of the knowledge, perspectives and barriers facing stakeholders in reporting ADR based on the reviewed studies is illustrated in Figure 1.

Many reviewed studies indicated the need of regular continuous medical education courses and workshops on PV and ADR reporting to be provided by the SFDA to HCPs throughout the country. We recommend that the regional PV volunteer coordinators assigned by the SFDA can oversee this task, engaging HCPs in professional discussion about ADR, ensure the dissemination of information, and assess the needed PV and ADR reporting training levels required by each institution [40]. A summary of the recommendations suggested to enhance stakeholders' contribution to ADR reporting is illustrated in Figure 2.

In an earlier qualitative focused group discussion study of HCPs conducted in 2014, Aljadhey et al. recommended the implementation of strict regulatory requirements by the SFDA, effective collaboration and communication between SFDA and stakeholders, unification of the process of ADR reporting, and continuous education and training of HCPs to improve the PV practice in the country [9]. The reviewed studies which were conducted after still

echo the need for the implementation of those recommendations suggested by Aljadhey and his group. HCPs included in the reviewed studies indicated that workload and lack of time were among the barriers that hinder their ability to submit ADR reports when they were encountered. Increasing the task force in hospitals - especially in areas where ADRs are expected more frequently - will help in easing the constraints on the HCPs in this regard. At the same time offering incentives could help in enhancing the HCPs compliance in reporting ADR as they are encountered. An interventional study conducted by Ali et al. investigated the effect of incentives on the compliance of HCPs in reporting ADR and reported a significant increase in the ADR reports with an association of the profession of the reporting HCP and the seriousness of the reported ADR [41].

Studies that focused on evaluating pharmacy students' perspectives in ADR reporting indicated that the pharmacy students should be more prepared to assume their task of reporting ADRs and contribute to PV during their school years. We recommend that the pharmacy curriculum in both the governmental and private institutions nationwide to include at least one specialized course focusing on PV and SFDA regulations, and has hands-on training on the processes of detecting, evaluating, and reporting ADRs as well as the policies and procedures of ADRs reporting and follow-up processes. This course and training sessions should be developed and updated regularly by the SFDA to reflect the NPC standards, policies and procedures [25].

From a public ADR reporting perspective, currently almost all governmental services in Saudi Arabia are provided to citizens via electronic applications, and the public is well respective toward the utilization of electronic application for reporting ADRs [28]. Taking advantage of the public acceptance of the technological advancement in the country, the SFDA can invest in AI technology in collecting patient-reported outcomes (PRO) and patient-generated health data (PGHD) to directly collect information and biometric data about any suspected ADRs from consumers without previous interpretation from HCPs [42]. The collected information through the PGHD can feed into the ADR reporting database in the NPC to generate and detect signals for post-marketing surveillance of medication.

Observation of the incidence and reporting rates of ADR by hospitals and community pharmacies indicate that certain age groups, and patients with polypharmacy or who are hospitalized for chronic disease or serious infection are subject to ADR. Yet there is no indication that these reported ADR were reported effectively to the SFDA for feedback or follow up. Electronic systems incompatibility and the lack of electronic data integration [43] between SFDA and healthcare institutions were some reasons that SFDA is challenged with underreporting. Establishing collaborative agreements with the MOH, private hospitals, community pharmacies, and pharmaceutical companies to implement and integrate a unified ADR reporting system reporting directly to SFDA, could enhance the quality and frequency of the collected ADR reports, and aid driving actions regarding ADRs that can be announced and shared by SFDA with the public [9, 44, 45].

In healthcare institutions and pharmacies, having an active PV system and protocols for close monitoring of specific age groups and body systems that are associated with high risk for ADRs will help amplify signals to detect and characterize the most frequently reported drugs with ADRs. Finally, maintaining active communication with the NPC and providing regular feedback from HCP and the regional NPC coordinators with suggestions to improve the ADR reporting will enhance the quality and frequency of reporting ADRs.

## CONCLUSION

Adverse drug reaction reporting is an important pharmacovigilance process that is actively monitored by the National Pharmacovigilance Center in Saudi Arabia. Knowledge and perception of stakeholders toward reporting adverse drug reactions to the Saudi Food and Drug Authority are positively increasing, but need to be improved and followed constantly through the provision of awareness campaigns to the public and continuous education to healthcare professionals. Electronic systems integration between the National Pharmacovigilance Center and healthcare institutions throughout the country is suggested to improve the compliance of healthcare professionals in reporting adverse drug reactions, and to contribute to the drug safety signals collection by the national drug authority, to guide the decision-making efforts related to drug safety during post-marketing surveillance.

## Declarations

### Funding

The author declares that she has no funding support for this study.

### Conflict of Interest

The author declares no conflict of interest, financial or otherwise.

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