# Pharmacist's Knowledge of High-risk/Alert Medications in Saudi Arabia

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## ABSTRACT

**Objectives:** To explore pharmacist's knowledge of High-risk/Alert medications in Saudi Arabia. **Methods:** It analyzes a cross-sectional survey discussing pharmacist knowledge of High-risk/Alert medications in Saudi Arabia. The survey consisted of respondents' demographic information about pharmacists, the High-risk/Alert medications assessment of basic knowledge, and The Resources used about the High risk or high-alert medications. The 5-point Likert response scale system was used with closed-ended questions. The survey was validated through the revision of expert reviewers and pilot testing. Besides, various tests of the reliability of McDonald's ω, Cronbach alpha, Gutmann's λ2, and Gutmann's λ6 been done with the study. Furthermore, the data analysis of the pharmacist's knowledge of High-risk/Alert medications is done through the survey monkey system. Besides, the statistical package of social sciences (SPSS), Jeffery's Amazing Statistics Program (JASP), and Microsoft Excel sheet version 16. **Results:** A total number of 442 pharmacists responded to the questionnaire. Of them, more than one-third responded from the Central region (183 (40.40%)), and one Quarter responded from the Western part (119 (26.92%)), with statistically significant differences between the provinces ($p$=0.000). Males responded more than females (264 (59.59%)) versus 179 (40.41%)), with statistically significant differences between all levels ($p$=0.000). Most of the responders were in the age group of 24-30 years (266 (59.91%)) and 31-35 years (78 (17.57%)), with statistically significant differences between all age groups ($p$=0.000). Most of the pharmacists were staff pharmacists (323 (72.75%)) and pharmacy supervisors (56 (12.61%)), with statistically significant differences between all levels ($p$=0.000). The average score of knowledge of pharmacists about High-risk/Alert medications was (3.71). The pharmacists familiar with prohibited abbreviations during High-risk/Alert prescribing medications obtained the highest score (4.42). The element "heard about the concept of High-risk/Alert medications" got the second highest score (4.39), with a statistically significant difference between the responses ($p$<0.000). Followed by the pharmacists familiar with look-alike sound-alike of High-risk/Alert medications (4.30) and know the narcotics and controlled medications (4.27) ), with a statistically significant difference between the responses ($p$<0.000). The most used resources for High-risk/Alert or high-alert medication information were Drug information resources (Lexi comp-drug information, Micromedex, Epocrates etc. 345 (78.05%), and Scientific literature 222 (50.23%). They were followed by Health practitioners 206 (46.61%) SFDA website 157 (35.52%). **Conclusion:** The pharmacist's knowledge of High-risk/Alert medications is adequate in Saudi Arabia. However, an expanded basic and advanced understanding of High-risk/Alert areas is needed to improve pharmacy performance, patient safety, and quality of life in Saudi Arabia.

**Keywords:** Pharmacist, Knowledge, High-risk, Alert, Medications, Drugs.

## INTRODUCTION

The National medication safety program at the Ministry of Health in Saudi Arabia was developed more than seven years.[1,2] It was part of the pharmaceutical care services strategic plan.[3-4] Besides, it was one of the requirements of the Saudi Center for Accreditation of healthcare institutions (CBAHI) in the local country and international standards.[5,6] The program includes various subjects, including medication error prevention and reporting, adverse drug reactions prevention and reporting, drug quality reporting system, looks like sound alike, essential medicine Safety education, and High-risk/Alert medication system.[1] Each medication safety element implicated prevention of drug-related programs and avoided economic burden on the health care system.[7-14] For example, medication error prevention in pediatric institutions avoids more than 110,000 USD which contains some high-risk medications. While at the general hospital, the saving of medication error prevention reaches 98,000 USD in the study period.[13,14] The prevalence of High risk/alert medications showed a wide range in the systematic review.[15] Therefore, the pharmacist plays an active role in the prevention High risk/alert medications errors.[9,16]

Moreover, the type of medication implicated in medication errors was High-risk/Alert medicine. The institution of Safe Medication Practice (ISMP) identified the High-risk/Alert medication and the prevention strategy

for committing mistakes.[17] Few studies conducted to evaluate the healthcare provider emphasized the pharmacist knowledge of high risks drugs locally or in other countries worldwide.[18-20] The awareness of medication safety was one essential part of the national patient safety strategy emphasizing High-risk/Alert medication. The objective of the current study is to assess pharmacist knowledge of High-risk/Alert medicine with various aspects in the kingdom of Saudi Arabia.

## METHODS

It analyzes a cross-sectional survey that discussed Pharmacist knowledge of High-risk/Alert Medications in Saudi Arabia. It self-reported an electronic survey of the pharmacist, including pharmacists from internship to consultant, pharmacist specialties, and Saudi Arabia. All non-pharmacist or students, non-completed, non-qualified surveys will be excluded from the study. The survey consisted of respondents' demographic information about pharmacists, the High-risk/Alert medications assessment of basic knowledge, and The Resources used about the High risk or high-alert medications.[9,15,16,18-21] The 5-point Likert response scale system was used with closed-ended questions. According to the previous litterateur with an unlimited population size, the sample was calculated as a cross-sectional study, with a confidence level of 95% with a z score of 1.96 and a margin of error of 5%, a population percentage of 50%, and a drop-out rate 10%. As a result, the sample size will equal 380-420 with a power of study of 80%.[22-24] The response rate required for the calculated sample size is at least 60-70 % and above.[24,25] The survey was distributed through social media of what's applications and telegram groups of pharmacists. The reminder message had been sent every 1-2 weeks. The survey was validated through the revision of expert reviewers and pilot testing. Besides, various tests of the reliability of McDonald's ω, Cronbach alpha, Gutmann's λ2, and Gutmann's λ6 were done with the study. The survey monkey system analyzes the pharmacist's knowledge of High-risk/Alert Medications. Besides, the statistical package of social sciences (SPSS), Jeffery's Amazing Statistics Program (JASP), and Microsoft Excel sheet version 16. It included a description and frequency analysis, good of fitness analysis, and correlation analysis. Besides, inferential analysis of factors affecting pharmacist's High-risk/Alert medications assessment of essential knowledge and linear regression. The STROBE (Strengthening the reporting of observational studies in epidemiology statement: guidelines for reporting observational studies) guided the reporting of the current study.[26,27]

## RESULTS

A total number of 442 pharmacists responded to the questionnaire. Of them, more than one-third responded from the Central region (183 (40.40%)), and one Quarter responded from the Western part (119 (26.92%)), with statistically significant differences between the provinces ($p$=0.000). Most of the responders were from MOH Hospitals (157 (35.36%)), with a statistically significant difference between working sites ($p$=0.000). Males responded more than females (264 (59.59%)) versus 179 (40.41%)), with statistically significant differences between all levels ($p$=0.000). Most of the responders were in the age group of 24-30 years (266 (59.91%)) and 31-35 years (78 (17.57%)), with statistically significant differences between all age groups ($p$=0.000). Most of the pharmacists were staff pharmacists (323 (72.75%)) and pharmacy supervisors (56 (12.61%)), with statistically significant differences between all levels ($p$=0.000). Most of the responders held Bachelor's in pharmacy (1214 (48.20%)) and Pharm D (193 (43.47%)). Most pharmacists had a work experience of 1-3 years (125 (28.28%%)) and >1 year (99 (22.40%)), with a statistically significant difference between years of experience ($p$=0.000). Most pharmacists works at inpatient pharmacy (110 ((26.76%)) and outpatient (88 ((21.41%)) with statistically significant differences between all levels ($p$=0.000). There was a strong positive correlation between age (years) and years of experience based on Kendall's tau_b (0.744) and Spearman's rho (0.827) correlation coefficients, with a statistically significant difference between the two factors ($p$<0.000). There was a medium negative correlation between age (years) and current positions based on Kendall's tau_b (0.429) and Spearman's rho (0.474) correlation coefficients, with a statistically significant difference between them ($p$<0.000). There was a medium positive correlation between the site of work and current practice area based on Kendall's tau_b (0.322) and Spearman's rho (0.404), with a statistically significant difference between the two factors ($p$<0.000). There was a medium negative correlation between the site of work and years of experience based on Kendall's tau_b (0.323) and Spearman's rho (0.407), with a statistically significant difference between the two factors ($p$<0.000). (Tables 1 and 2).

The average score of knowledge of pharmacists about High-risk/Alert medications was (3.71). The pharmacists familiar with prohibited abbreviations during High-risk/Alert prescribing medications obtained the highest score (4.42). The element "heard about the concept of High-risk/Alert medications" got the second highest score (4.39), with a statistically significant difference between the responses ($p$<0.000). Followed by the pharmacists familiar with look-alike sound-alike of High-risk/Alert medications (4.30) and know the narcotics and controlled medications (4.27)), with a statistically significant difference between the responses (p<0.000). In contrast, the lowest score was obtained from the pharmacists who know the epidural and intrathecal medications (2.66) and pharmacists who know the moderate and minimal sedation agents, oral, for children (e.g., chloral hydrate, midazolam, ketamine (3.05)), with a statistically significant difference between the responses ($p$<0.000). Followed by The score for the element " the pharmacist knows the total Parenteral nutrition preparation" was (3.22), and for the component "the pharmacists know the neuromuscular blocking agents (e.g., Succinylcholine, Rocuronium, Vecuronium)" was (3.23), with a statistically significant difference between the responses ($p$<0.000). All aspects of the perception of pharmacists about scientific publications were statistically significant between responses ($p$<0.000) (Table 3). The most used resources for High-risk/Alert or high-alert medication information were Drug information resources (Lexi comp-drug information, Micromedex, Epocrates .etc 345 (78.05%), and Scientific literature 222 (50.23%). They were followed by Health practitioners 206 (46.61%) SFDA website 157 (35.52%) (Table 4). The score for single-test reliability analysis of McDonald's ω was 0.949, Cronbach's α was 0.947, Gutmann's was λ2, 0.950, Gutmann's λ6 was 0.959, and Greater Lower Bound was 0.975 with statistically significant ($p$<0.05).

### Factors affecting the knowledge of pharmacists about High-risk/Alert medications

Factors affecting the perception were analyzed. We adjusted the significant values using the independent samples Kruskal–Wallis test and the Bonferroni correction for multiple tests. Pharmacists' knowledge of pharmacists about High-risk/Alert medications includes location, worksite, age, years of experience, current position, Position Held, and practice area. There are non-statistically significant differences between all Five locations ($p$=0.823), which affected pharmacists' knowledge about High-risk/Alert medication. Seventeen worksites affected the knowledge of pharmacists about High-risk/Alert medicines. The King Faisal Specialist Hospital and National Guard Hospital showed the highest

**Table 1: Demographic, social information.**

| Nationality | Response Count | Response Percent | *p*-value (X2) |
|---|---|---|---|
| Central area | 183 | 41.40% | 0.000 |
| North area | 31 | 7.01% | |
| South area | 45 | 10.18% | |
| East area | 64 | 14.48% | |
| West area | 119 | 26.92% | |
| Answered question | **442** | | |
| Skipped question | **2** | | |
| **Site of work** | **Response Count** | **Response Percent** | **p-value (X2)** |
| MOH Hospitals | 157 | 35.36% | 0.000 |
| Military hospitals | 34 | 7.66% | |
| National Guard Hospital | 33 | 7.43% | |
| Security forces hospitals | 5 | 1.13% | |
| University Hospital | 22 | 4.95% | |
| MOH primary care centers | 11 | 2.48% | |
| Private hospitals | 50 | 11.26% | |
| Private ambulatory care clinics | 5 | 1.13% | |
| Private primary healthcare center | 2 | 0.45% | |
| Community pharmacy | 81 | 18.24% | |
| Pharmaceutical company | 19 | 4.28% | |
| Academia | 3 | 0.68% | |
| King Faisal Specialist Hospital and Research Center | 5 | 1.13% | |
| SFDA | 5 | 1.13% | |
| Royal Commission | 1 | 0.23% | |
| Non employed | 1 | 0.23% | |
| Intern | 10 | 2.25% | |
| Answered question | **444** | | |
| Skipped question | **0** | | |
| **Gender** | **Response Count** | **Response Percent** | |
| Male | 179 | 40.41% | 0.000 |
| Female | 264 | 59.59% | |
| Answered question | **443** | | |
| Skipped question | **1** | | |
| **Age** | **Response Count** | **Response Percent** | |
| 24-30 | 266 | 59.91% | 0.000 |
| 31-35 | 78 | 17.57% | |
| 36-40 | 46 | 10.36% | |
| 41-45 | 28 | 6.31% | |
| 46-50 | 16 | 3.60% | |
| > 50 | 10 | 2.25% | |
| Answered question | **444** | | |
| Skipped question | **0** | | |

**Table 2: Demographic, social information.**

| Pharmacist Qualifications | Response Count | Response Percent | *p*-value (X2) |
|---|---|---|---|
| Diploma in Pharmacy | 2 | 0.45% | |
| Bachelor in Pharmacy | 214 | 48.20% | |
| Master | 63 | 14.19% | |
| Pharm D | 193 | 43.47% | |
| Ph. D | 8 | 1.80% | |
| PGY 1 | 16 | 3.60% | |
| PGY 2 | 10 | 2.25% | |
| PGY 3 | 3 | 0.68% | |
| Fellowship | 3 | 0.68% | |
| Answered question | **444** | | |
| Skipped question | **0** | | |
| **Position Held** | **Response Count** | **Response Percent** | |
| Director of Pharmacy | 44 | 9.91% | 0.000 |
| Assistant Director of Pharmacy | 12 | 2.70% | |
| Supervisor | 56 | 12.61% | |
| Pharmacy staff | 323 | 72.75% | |
| Pharmacy intern | 9 | 2.03% | |
| Answered question | **444** | | |
| Skipped question | **0** | | |
| **Years of experience as a pharmacy career** | **Response Count** | **Response Percent** | |
| Less than one year | 99 | 22.40% | 0.000 |
| 1-3 | 125 | 28.28% | |
| 4-6 | 76 | 17.19% | |
| 7-9 | 46 | 10.41% | |
| 10-12 | 25 | 5.66% | |
| >12 | 71 | 16.06% | |
| Answered question | **442** | | |
| Skipped question | **2** | | |
| **The practice area** | **Response Count** | **Response Percent** | |
| Inpatient Pharmacy | 110 | 26.76% | 0.000 |
| Outpatient Pharmacy | 88 | 21.41% | |
| Satellite Pharmacy | 2 | 0.49% | |
| Narcotics and Controlled | 5 | 1.22% | |
| Extemporaneous Preparation | 2 | 0.49% | |
| Clinical Pharmacy | 59 | 14.36% | |
| Inventory Control | 9 | 2.19% | |
| Drug Information | 19 | 4.62% | |
| IV admixture | 11 | 2.68% | |
| Community pharmacy | 66 | 16.06% | |
| Pharmacy administrations | 6 | 1.46% | |
| Pharmaceutical company | 18 | 4.38% | |
| Drug Regulation administration | 6 | 1.46% | |
| Medication safety | 3 | 0.73% | |
| Pharmacy intern | 1 | 0.24% | |
| All hospital pharmacy area | 5 | 1.22% | |
| Academia activities | 1 | 0.24% | |
| Answered question | **411** | | |
| Skipped question | **33** | | |

**Table 3: High-risk/Alert medications assessment of basic knowledge.**

| No | Items | No knowledge | | Little knowledge | | Partial knowledge | | Incomplete knowledge | | Complete knowledge | | Total | Weighted Average | *p*-value (X2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Have you ever heard about the concept of High-risk/Alert medications? | 0.68% | 3 | 3.19% | 14 | 14.58% | 64 | 19.13% | 84 | 62.41% | 274 | 439 | 4.39 | 0.000 |
| 2 | Are you familiar with the safety of High-risk/Alert medications? | 2.50% | 11 | 5.91% | 26 | 19.32% | 85 | 19.09% | 84 | 53.18% | 234 | 440 | 4.15 | 0.000 |
| 3 | Do you know the narcotics and controlled medications? | 0.45% | 2 | 3.86% | 17 | 18.18% | 80 | 23.18% | 102 | 54.32% | 239 | 440 | 4.27 | 0.000 |
| 4 | Are you familiar with prohibited abbreviations during High-risk/Alert prescribing medications? | 2.95% | 13 | 4.99% | 22 | 10.43% | 46 | 10.66% | 47 | 70.98% | 313 | 441 | 4.42 | 0.000 |
| 5 | Are you familiar with the look-alike sound-alike of High-risk/Alert medications? | 2.49% | 11 | 5.67% | 25 | 13.61% | 60 | 15.65% | 69 | 62.59% | 276 | 441 | 4.30 | 0.000 |
| 6 | Do you know the anesthetic agents, including the general, inhaled, and IV (e.g., propofol, ketamine)? | 3.88% | 17 | 13.93% | 61 | 26.94% | 118 | 23.97% | 105 | 31.28% | 137 | 438 | 3.65 | 0.000 |
| 7 | Do you know the total Parenteral nutrition preparation? | 12.47% | 55 | 20.41% | 90 | 24.72% | 109 | 17.01% | 75 | 25.40% | 112 | 441 | 3.22 | 0.000 |
| 8 | Are you familiar with narrow therapeutic index medications | 7.03% | 31 | 14.29% | 63 | 25.17% | 111 | 17.23% | 76 | 36.28% | 160 | 441 | 3.61 | 0.000 |
| 9 | Do you know the off-labeled or non-approved indications for High-risk/Alert medications? | 12.47% | 55 | 14.51% | 64 | 23.81% | 105 | 24.04% | 106 | 25.17% | 111 | 441 | 3.35 | 0.000 |
| 10 | Are you familiar with medication reconciliation for High-risk/Alert medications? | 10.00% | 44 | 13.41% | 59 | 22.50% | 99 | 16.59% | 73 | 37.50% | 165 | 440 | 3.58 | 0.000 |
| 11 | Do you know the antiarrhythmics, IV (e.g., lidocaine, amiodarone) | 3.63% | 16 | 9.98% | 44 | 26.53% | 117 | 22.00% | 97 | 37.87% | 167 | 441 | 3.8 | 0.000 |
| 12 | Do you know the epidural and intrathecal medications | 22.45% | 99 | 27.66% | 122 | 22.90% | 101 | 15.42% | 68 | 11.56% | 51 | 441 | 2.66 | 0.000 |
| 13 | Do you know the neuromuscular blocking agents (e.g., succinylcholine, rocuronium, vecuronium) | 10.45% | 46 | 22.50% | 99 | 25.00% | 110 | 18.18% | 80 | 23.86% | 105 | 440 | 3.23 | 0.000 |
| 14 | Are you familiar with drug-drug interactions of High-risk/Alert medications | 6.14% | 27 | 16.82% | 74 | 28.41% | 125 | 24.77% | 109 | 23.86% | 105 | 440 | 3.43 | 0.000 |
| 15 | Do you know the moderate and minimal sedation agents, oral, for children (e.g., chloral hydrate, midazolam, ketamine [using the parenteral form]) | 14.12% | 62 | 22.55% | 99 | 26.20% | 115 | 18.45% | 81 | 18.68% | 82 | 439 | 3.05 | 0.001 |
| 16 | Do you know the thrombolytics (e.g., alteplase, reteplase, tenecteplase) | 4.78% | 21 | 10.25% | 45 | 22.78% | 100 | 22.55% | 99 | 39.64% | 174 | 439 | 3.82 | 0.000 |
| 17 | Are you familiar with adrenergic agonists, IV (e.g., EPINEPHrine, phenylephrine, norepinephrine) | 4.11% | 18 | 13.70% | 60 | 22.60% | 99 | 19.63% | 86 | 39.95% | 175 | 438 | 3.78 | 0.000 |
| 18 | Do you know the anticoagulant medications? | 1.14% | 5 | 6.61% | 29 | 17.31% | 76 | 22.32% | 98 | 52.62% | 231 | 439 | 4.19 | 0.000 |
| | Answered | | | | | | | | | | | 441 | | |
| | Skipped | | | | | | | | | | | 3 | | |

**Table 4: The Resources used for the High risk or high-alert medications.**

| | Responses | |
|---|---|---|
| Health practitioners | 206 | 46.61% |
| Scientific literature | 222 | 50.23% |
| Peer discussions | 114 | 25.79% |
| Medical association literature/guidelines/recommendations | 98 | 22.17% |
| Drug information resources (Lexi comp-drug information, Micromedex, Epocrates.. etc | 345 | 78.05% |
| SFDA website | 157 | 35.52% |
| Drug Bulletin | 131 | 29.64% |
| Relatives and friends | 15 | 3.39% |
| Medication errors education courses | 145 | 32.81% |
| Internet | 145 | 32.81% |
| The drug information center at the hospital | 172 | 38.91% |
| Awareness lectures in a hospital | 96 | 21.72% |
| Awareness lectures at the primary healthcare center | 11 | 2.49% |
| Healthcare care awareness events at the market | 12 | 2.71% |
| **Answered** | **442** | |
| Skipped | 2 | |

scores (4.7549) and (4.2630), respectively, affecting the knowledge of pharmacists about a High-risk/Alert medication with a statistically significant difference between working sites ($p$=0.000) with significance among all sites. The male (3.8015) were affected more than females (3.6562) by knowledge of pharmacists about a High-risk/Alert medication with statistically significant between them ($p$=0.037). The age of the responders affected Pharmacists' knowledge of pharmacists about High-risk/Alert medications. Pharmacists aged 24-30 showed the lowest score (3.5611), with a statistically significant difference between all age groups ($p$=0.000). Six levels of work experience affected pharmacists' knowledge about High-risk/Alert medication. The lowest score (3.5015) was obtained for those with work experience of 1-3 years and less than one year (3.5578), with a statistically significant difference between all levels ($p$=0.000). Six levels of the position affected the perception of pharmacists, with the lowest score (3.2073) obtained for the assistant pharmacy intern with a statistically significant difference between all levels ($p$=0.000). The practice site affected the knowledge of pharmacists about High-risk/Alert medication. The pharmaceutical companies obtained the lowest scores (3.1327) and the Community Pharmacy (3.4469) with a statistically significant difference ($p$=0.000).

The relationship between pharmacists' knowledge about a High-risk/Alert medication and factors such as location, worksite, age (years), gender, position held, years of experience, and practice area in a pharmacy career. The multiple regression analysis considered perception as the dependent variable and factors affecting it as an expletory variable. There was a weak relationship (R=0.297 with $p$=0.000) between pharmacists' knowledge of High-risk/Alert medication and its factors. Six out of seven were non-significant differences ($p$>0.05). However, multiple regression analysis confirmed that one factor (i.e., working site) explained 18.9 % of the negative relationship to the variation in knowledge, with a statistically significant difference ($p$=0.001). The bootstrap model was also confirmed. Furthermore, the relationship was verified by the non-existence of multicollinearity with a variance inflation factor (VIF) of 1.508, less than three or five as a sufficient number of VIF (Table 5).[28-30]

## DISCUSSION

In the current cross-sectional study, with an appropriate sample size through convenience subjects and high-reliability analysis number of knowledge assessments about High-risk/Alert medication which better than previously in the sample size and reliability analysis.[18-20] The study contained young with bachelor's degree responders as pharmacy staff with low experience as expected in the pharmacy practice. The responders worked at different healthcare sites emphasizing inpatient and outpatient services. The considerable variability in subject characteristics properly ordinary reality at the Saudi pharmacy society was similar to previous studies.[18,20] The findings showed appropriate knowledge of High-risk/Alert medication in pharmacy practice, similar to prior studies.[18-20] Most respondents are familiar with the concept of High-risk/Alert medications, prohibited abbreviations while prescribing, and look-alike sound-alikes of High-risk/Alert medications. All that information is expected because there are requirements for healthcare accreditation from CBAHI and international standards.[5,6] Narcotics and controlled medication as High-risk/Alert drugs are well-known by responders that have expected because there are required during Saudi Pharmacy Board Examination. In the contract, the pharmacy staff with insufficient knowledge of some High-risk/Alert medications. Such as epidural and intrathecal medications. Besides, inadequate understanding of the neuromuscular blocking agents because most pharmacy services do not have unique Pharmacy and aesthesia services through satellite pharmacy or clinical pharmacy services. Another area for improvement was oral sedatives for children and Total parental nutrition, similar to the previous study.[18] That's related to the unavailable pharmacy services or a shortage of staff experts in sedative and TPN preparation and dispensing. Most responders had promising approaches to High-risk/Alert knowledge through referral to appropriate drug information and scientific literature, which is better than previous studies; they referred to internal policy and procedures.[19] That's related of responders were non-pharmacists and they unfamiliar with drug information references.

Various factors might have affected pharmacist knowledge of High-risk/Alert medication, such as lower age, shortage of experience, and job level as a pharmacy intern; that's expected because the high risk might not have been appropriately discussed during pharmacy school or there is no orientation program for new pharmacy staff. That differed from the previous study;[20] The working site is another factor of insufficient knowledge of was working area and practice site. Two Working sites understood High-risk/Alert medication well, such as King Faisal and Research center and National Guard hospital, because their excellent medication safety program emphasized High-risk/Alert medicines. Besides, the working side affected explained 18.9 % of the negative relationship to the variation in knowledge. In contrast, the pharmacist practice area, such as pharmaceutical companies or community pharmacies, had insufficient understanding of High-risk/Alert medication. Again, that's related to medication safety education not developing well at two practicing sites. Thus, there is no previous investigation to compare with the current findings

**Table 5: Multiple regression of Factors affecting the knowledge of pharmacists about High-risk/Alert medications.**

| Model | | R | R Square | F | Sig. | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95.0% Confidence Interval for B | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | B | Std. Error | Beta | | | Lower Bound | Upper Bound | Tolerance | VIF |
| 1 | (Constant) | .297 b | .088 | 5.444 | .000b | 4.098 | 0.298 | | 13.753 | 0.000 | 3.512 | 4.683 | | |
| | Location | | | | | 0.004 | 0.025 | 0.007 | 0.146 | 0.884 | -0.045 | 0.052 | 0.965 | 1.036 |
| | Site of work | | | | | -0.037 | 0.012 | -0.189 | -3.211 | 0.001 | -0.060 | -0.014 | 0.663 | 1.508 |
| | Age (years) | | | | | 0.076 | 0.061 | 0.111 | 1.263 | 0.207 | -0.043 | 0.195 | 0.300 | 3.330 |
| | Pharmacist gender | | | | | -0.061 | 0.088 | -0.034 | -0.687 | 0.492 | -0.234 | 0.113 | 0.929 | 1.077 |
| | Years of experience in a pharmacy career | | | | | -0.001 | 0.047 | -0.002 | -0.027 | 0.979 | -0.093 | 0.091 | 0.275 | 3.639 |
| | Position Held | | | | | -0.089 | 0.050 | -0.098 | -1.783 | 0.075 | -0.187 | 0.009 | 0.762 | 1.312 |
| | Practice area | | | | | 0.014 | 0.011 | 0.067 | 1.248 | 0.213 | -0.008 | 0.036 | 0.792 | 1.262 |

a. Dependent Variable: knowledge of pharmacists about High-risk/Alert medications, Predictors: (Constant), location, Worksite, Age, Years of experience, Current position, Position Held, and Practice area.

| Bootstrap for Coefficients | | | | | | | |
|---|---|---|---|---|---|---|---|
| Model | | B | Bias | Bootstrap[a] | | | |
| | | | | Std. Error | Sig. (2-tailed) | 95% Confidence Interval | |
| | | | | | | Lower | Upper |
| 1 | (Constant) | 4.098 | -0.001 | 0.307 | 0.001 | 3.466 | 4.680 |
| | Location | 0.004 | -0.001 | 0.025 | 0.872 | -0.044 | 0.052 |
| | Site of work | -0.037 | 0.000 | 0.012 | 0.002 | -0.061 | -0.013 |
| | Age (years) | 0.076 | -0.002 | 0.054 | 0.150 | -0.028 | 0.181 |
| | Pharmacist gender | -0.061 | -0.002 | 0.090 | 0.492 | -0.236 | 0.124 |
| | Years of experience in a pharmacy career | -0.001 | 0.002 | 0.049 | 0.980 | -0.094 | 0.092 |
| | Position Held | -0.089 | 0.001 | 0.054 | 0.101 | -0.191 | 0.021 |
| | Practice area | 0.014 | 0.000 | 0.011 | 0.196 | -0.008 | 0.035 |

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

### Limitations

Despite the comprehensive information from the current research and the required sample size, high-reliability results and various validation techniques were used. However, various limitations were found, such as convenient sampling, not random methods. The subjects not represented from each location or age, or positions were equal. The prevalence of knowledge is measured at present and might change in the future. Therefore, another study in the future with random sampling and identifying characteristics of demographic information is suggested. Besides, an assessment of the survey with advanced biostatistics analysis of crucial factors analysis to choose the best and appropriate questions with the highest score is highly recommended.

## CONCLUSION

The pharmacist's knowledge of High-risk/Alert medications is sufficient. Most High-risk/Alert medication elements were prohibited abbreviations used during prescribing and looked like sound-alike and narcotic drugs. In contrast, epidural and intrathecal medications, sedation drugs, neuromuscular blocking agents, and Total Parenteral nutrition had the lowest knowledge. Various factors, such as location and age, might affect the pharmacist's knowledge, such as Experiences and pharmacist positions. The working site is the most dependable factor that might negatively affect understanding. The pharmacist knowledge expansion is favorable to cover the other essential High-risk/Alert medication through additional education and training opportunities in the pharmacy practice in Saudi Arabia.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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### Consent for Publications

Informed consent was obtained from all the participants

### Ethical Approval

This research was exempted from research and ethical committee or an institutional review board (IRB) approval.

https://www.hhs.gov/ohrp/regulations-and-policy/decision-charts-2018/index.html

## ABBREVIATIONS

**MOH:** Ministry of Health; **KSA:** Kingdom of Saudi Arabia; **CBAHI:** Saudi Center for Accreditation of healthcare institutions; **ISMP:** The Institution of Safe Medication; **SPSS:** Statistical Package of Social Sciences; **JASP:** Jeffery's Amazing Statistics Program; **STROBE:** Strengthening the reporting of observational studies in epidemiology statement.

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