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Nurses' perceptions of patient safety culture and adverse events in Hail City, Saudi Arabia: a cross-sectional approach to improving healthcare safety

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ABSTRACT

Objective This study aimed to assess nurses' perceptions of patient safety culture (PSC) and its relationship with adverse events in Hail City, Saudi Arabia.

Design A cross-sectional study was conducted between 1 August 2023 and the end of November 2023 at 4 governmental hospitals and 28 primary healthcare centres.

Setting Hail City, Saudi Arabia.

Participants Data were collected from 336 nurses using 3 instruments: demographic and work-related questions, PSC and adverse events.

Results Nurses had positive responses in the dimensions of 'teamwork within units' (76.86%) and 'frequency of events reported' (77.87%) but negative responses in the dimensions of 'handoffs and transitions' (18.75%), 'staffing' (20.90%), 'non-punitive response to errors' (31.83%), 'teamwork across units' (34.15%), 'supervisor/manager expectations' (43.22%) and 'overall perception of patient safety' (43.23%). Significant associations were found between nationality, experience, current position and total safety culture, with p values of 0.015, 0.046 and 0.027, respectively. Nurses with high-ranking perceptions of PSC in 'handoffs and transitions,' 'staffing' and 'teamwork across hospital units' reported a lower incidence of adverse events than those with low-ranking perceptions, particularly in reporting pressure ulcers (OR 0.86, 95% CI 0.78 to 0.94, OR 0.82, 95% CI 0.71 to 0.94 and OR 0.83, 95% CI 0.70 to 0.99, respectively) ($p<0.05$). Nurses with high-ranking perceptions of PSC in UK 'handoffs and transitions' reported a lower incidence of patient falls. Similarly, those with high-ranking perceptions in both 'handoffs and transitions' and 'overall perception of patient safety reported a lower incidence of adverse events compared with those with low-ranking perceptions, especially in reporting adverse drug events (OR 0.83, 95% CI 0.76 to 0.91 and OR 0.75, 95% CI 0.61 to 0.92, respectively) ($p<0.05$).

Conclusion From a nursing perspective, hospital PSCs have both strengths and weaknesses. Examples include low trust in leadership, staffing, error-reporting and handoffs. Therefore, to improve staffing, communication, handoffs, teamwork, and leadership, interventions should focus on weak areas of low confidence and high rates of adverse events.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ High response rate (96%) with 336 nurses, enhancing reliability within Hail city.
⇒ A self-designed instrument was used to comprehensively understand nurses' perceptions of the patient safety culture and its relationship with adverse events.
⇒ This study was based on respondents' self-reports, which may have led to recall bias and errors.
⇒ This study was conducted in hospitals and primary health centres in Hail City to decrease its generalisability.
⇒ The study employed a cross-sectional design, which might not be adequate to ascertain how patient safety competency affects adverse events.

INTRODUCTION

Building a positive safety culture for healthcare workers is a prerequisite and a top priority for healthcare organisations. In defining patient safety (PS), the WHO states that 'it is imperative to minimise an acceptable healthcare-related risk that prevents patients from experiencing any avoidable harm during their healthcare experience'.[1] Unsafe medical practices can lead to injuries, fatalities, long-term disabilities and death. The prevalence of these incidents has spurred global recognition in the healthcare sector, reflecting the importance of improving PS culture (PSC).[2]

As the focus on PSC intensifies, with the aim of minimising risks, improving healthcare services and ultimately achieving better outcomes,[3] the need to cultivate a patient-centred approach within healthcare policies is emphasised. Despite the growing global attention on this issue, extensive research and analyses[4 5] continue to demonstrate persistent vulnerabilities among patients worldwide, resulting in a concerning rate of

adverse events (AEs)[6 7] that range from 3% to 17% and have a significant impact on healthcare experiences.[8] For example, despite the prevalence of this issue, reports such as those from a British hospital highlight significant gaps in patient care safety.[9]

Benchmarked hospitals nurture PSC through proper information flow, mutual trust, leadership and management commitments, shared views on safety and a non-punitive approach to AEs and incident reporting.[3] PSC is the key strategy for reducing AEs and raising care standards.[10] Worldwide, over 300 million surgeries are performed annually; however, surgical errors persist, accounting for 10% of the avoidable harm caused to patients in healthcare. Patient falls, the most prevalent hospital AEs, result in injury in over one-third of cases, occurring at rates between 3 and 5 per 1000 bed days. Misidentification of patients can lead to severe issues, including critical AEs such as wrong-site surgery. Annually, 16 billion injections are administered, with unsafe practices posing risks of infectious and non-infectious AEs to both patients and healthcare workers.[1] Hence, prioritising safety is crucial in the ever-changing healthcare industry to guarantee patient health and safety.[10] Despite significant progress in diagnosis and therapy, AEs continue to cause concern for both patients and clinicians.[11 12]

At the global level, the Decade of PS 2021–2030, the PS Flagship, is a new programme from the WHO that aims to promote worldwide strategic action to improve PS. It offers assistance and guidance at the global, regional and national levels to make the Global Patient Safety Action Plan 2021–2030 strategy for facilitating the cooperation of several key stakeholders to implement PS solutions effectively easier to put into action.[1] Moreover, the Saudi Patient Safety Centre defines serious events (SE) as AEs in healthcare delivery that lead to or have the potential for catastrophic outcomes.[13] Saudi Arabia has experienced a notable increase in complaints and claims related to AEs involving healthcare providers.[14] Before 2019, more than 700 AEs have been reported. The most common incidents were unexpected patient deaths (nearly 40%), maternal deaths (nearly 20%) and sudden limb or function loss (slightly more than 10%).[15] Consequently, prioritising the reduction of AEs and harm to patients is a foundational aspect of PS that demands continual enhancement. Therefore, establishing a Saudi Patient Safety Centre is consistent with Saudi Vision 2030, which aims to increase PS standards nationwide.[13]

Saudi Vision 2030 calls for fewer threats to the health sector and better defence against them by applying for the Health Sector Transformation Programme 2021–2025 (HSTP).[13] Given their positions as frontline caregivers for patients, their perspectives on the medical field and their focus on safety are vital for healthcare quality. Some studies[15 16] have addressed PSC within Saudi health facilities, although most of them were published before the implementation of the HSTP included in Saudi Vision 2030. However, a significant research gap remains regarding the nursing perspective related to the perception of AE reporting and PSC.[17] To our knowledge, no studies have been conducted in Saudi Arabia to date to assess the relationship between PSC and AEs. Therefore, this study aimed to assess nurses' perceptions of PSC and its relationship with AEs in Hail City, Saudi Arabia.

METHODS

Study design

This study used a cross-sectional research design and was conducted between 1 August 2023 and the end of November 2023.

Setting

Data were collected from nurses working at all governmental hospitals in and around Hail, Saudi Arabia, including (1) King Khaled Hospital, (2) Hail General Hospital, (3) King Salman Hospital and (4) Sharaf Hospital. The King Khaled Hospital has served more than 100 specialised clinics and outpatients. Hail General Hospital is considered the main reference hospital in Hail and has a capacity of 285 beds. The King Salman Hospital has a capacity of 500 beds The Sharaf Hospital has a capacity of 123 beds. In addition, this study included all primary healthcare centres in the Hail region. These centres provide continuous healthcare services for all populations and their dependents in different specialty clinics.

Sample and participants

Convenience sampling was used to select the participants. Nurses were included in the study if they had more than 1 year of full-time experience and agreed to participate. A minimum sample size of 306 nurses was estimated using OpenEpi, V.3.01 (www.openepi.com), a software program was used to determine the sample size for a proportional or descriptive study based on a population size of 1500 and 95% confidence level. However, 350 questionnaires were distributed, of which 336 were returned, with a response rate of 96%.

Instruments

Data were collected using three instruments: demographic and work-related questions, PSC, and AEs.

Demographic and work-related questions

These questions pertained to the following areas: age, sex, marital status, education level, nationality, experience, department, position at work, weekly working hours, nurse-to-patient ratio, patient contact methods, safety evaluation rate, presence of an error incident reporting system, incidents encountered and whether safety and infection prevention and control training had been received.

Patient safety culture

The Hospital Survey on Patient Safety Culture (HSOPSC) is one of the most internationally used instruments that

was initially developed by the Agency for Healthcare Research and Quality in the USA in 2004.[18 19] It was designed to enable providers and other staff to assess the PSC in their hospitals. The HSOPSC consists of 42 questions that assess 12 aspects of PSC: 'openness in communication' (three questions), 'error feedback and communication' (three questions), 'frequency of reported events' (three questions), 'patient handoffs and transitions' (four questions), 'support from management for patient safety' (three questions), 'non-punitive approach to errors' (three questions), 'continuous learning and improvement in the organisation' (three questions), 'general perception of patient safety' (four questions), 'staffing levels' (four questions), 'expectations and actions of supervisors/managers promoting safety' (four questions) and 'teamwork within and across units' (four questions). Participants responded using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The average score for each dimension is calculated. The percentage of positive scores in the survey was derived from both positively and negatively framed items. For items worded positively, the score was the aggregate percentage of respondents who selected 'strongly agree' or 'agree'. For negatively worded items, the score was the combined percentage of respondents who chose 'strongly disagree' or 'disagree.' The combined percentage of all items was then divided by the number of items to calculate the positive response and mean score for each dimension.[18]

Adverse events

This study investigated AEs that occur frequently in hospitals and are sensitive to nursing care.[20 21] These AEs were estimated at the individual nurse level, offering a unique perspective on their occurrence. The AEs targeted in this study include: 'pressure ulcer,' 'patient fall,' 'adverse drug event,' 'surgical wound infection,' 'patients or their family complaints' and 'infusion or transfusion reaction.' Nurses were asked to report their experiences and the frequency of AEs over the past year using a seven-level rating system ranging from 'every day,' 'several times a week,' 'once a week,' 'several times a month,' 'once a month or less,' 'several times a year' and 'never happen.' Subsequently, the responses were divided into two categories: those who indicated that AEs 'never happened' were classified as 'not reported' and those who reported AEs occurring 'several times a year to every day' were categorised as 'reported.

To examine the feasibility and readability of the questionnaire, a pilot study was conducted with 35 nurses, who were not included in the main study. The results indicated that the questionnaire was easy to understand. We took the opportunity to obtain preliminary data on internal consistency using Cronbach's alpha.[22] The internal consistency was good, as revealed by the Cronbach's alpha coefficients of 0.821 and 0.942 for PSC and AEs, respectively.

Data collection

The researchers approached and invited the nurses to participate in the study. After explaining the purpose of the study, the researcher distributed questionnaires and informed consent forms to the nurses during their breaks and asked them to return the completed questionnaires to their department head. All measures were taken to maintain participants' privacy and prevent personal information from being identified by anyone other than the researchers. The participants were informed that their participation was entirely voluntary and that they could opt out at any time. Incentives were not provided to complete the survey. Confidentiality of the data and anonymity of the respondents were guaranteed.

Data analysis

The data were checked, edited and coded before being imported into the SPSS V.26 for comprehensive analysis. To assess the variations in composite scores across various safety culture dimensions in relation to AEs, both Mann-Whitney U and Kruskal-Wallis tests were employed. A binary logistic regression model was then fitted to identify AEs associated with different PSC dimensions. Before fitting the binary logistic regression model, it is crucial to verify these assumptions. The assumption of linearity between the independent variables was scrutinised by generating a correlation matrix of Spearman's correlation coefficients for all predictor variables. The variables exhibited correlations ranging from 0.004 to 0.637, thereby satisfying the linearity assumption.

Patient and public involvement

Patients and/or the public were not involved in this study.

RESULTS

Sociodemographic characteristics, health-related factors and their association with total safety culture

Most of the nurses surveyed were between 30 and 40 years of age. More than half (54.2%) were female and 59.2% were married. The predominant education level was bachelor's degree (77.1%) and the majority were of Saudi nationality (68.8%). Most had less than 5 years of work experience (37.5%), with 31.5% working in an internal ward and 31.3% working in an intensive care unit. The majority worked for at least 48 hours per week (51.5%), and the most prominent current position was registered nurses (75.6%). Most nurses (94.9%) had direct contact with patients and most reported having an incidence reporting system at their hospitals (87.8%), with 81.8% having received training in PS and 90.5% in infection and prevention control. Most nurses (64.0%) did not report any incidents of PS. Significant associations were observed between total safety culture and nationality, experience and current position, with p values of 0.015, 0.046 and 0.027, respectively (table 1).

Exploring PSC dimensions: a positive response analysis on nurses' perceptions

Certain dimensions emerged as areas of concern in the landscape of PSC, with positive response rates

Table 1 Relationship between nurses' demographic characteristic and work-related factors and safety culture perception

Demographic characteristic and work-related questions	Overall n (%)	Total safety culture	
		Mean rank	P value
Age (years)			
<30	101 (30.1)	155.9	0.285
30–40	188 (56.0)	174.7	
>40	47 (14.0)	170.7	
Sex			
Male	154 (45.8)	173.6	0.370
Female	182 (54.2)	164.1	
Marital status			
Single	123 (36.6)	168.7	0.349
Married	199 (59.2)	165.8	
Divorced/widowed	14 (4.2)	204.7	
Education level			
Diploma	42 (12.5)	177.6	0.647
Bachelor	259 (77.1)	168.6	
Master	35 (10.4)	156.9	
Nationality			
Saudi	231 (68.8)	159.8	0.015
Non-Saudi	105 (31.3)	187.7	
Experience			
<5 years	126 (37.5)	152.1	0.046
5–10 years	104 (31.0)	175.0	
>10 years	106 (31.5)	181.6	
Department			
Intensive care unit	105 (31.3)	173.3	0.114
Internal ward	106 (31.5)	177.5	
Emergency	78 (23.2)	145.2	
Outpatient clinics	47 (14.0)	176.2	
Current position			
Assist nurse	17 (5.1)	225.9	0.027
Registered nurse	254 (75.6)	160.9	
Head nurse	22 (6.5)	175.5	
Supervisor	43 (12.8)	187.0	
Working hours per week			
<48 hours	163 (48.5)	164.0	0.414
≥48 hours	173 (51.5)	172.7	
Patient contact methods			
Direct	319 (94.9)	166.3	0.066
Indirect	17 (5.1)	210.6	
Is there a system for incidents reporting in the hospital?			
No	41 (12.2)	162.2	0.658
Yes	295 (87.8)	169.4	
How many incidents that you reported?			
None	215 (64.0)	167.0	0.545
1–2	81 (24.1)	171.8	
3–5	24 (7.1)	167.8	
6–10	7 (2.1)	126.4	
>10	9 (2.7)	209.4	
Did you receive patient safety training?			
No	61 (18.2)	151.8	0.137
Yes	275 (81.8)	172.2	
Did you receive infection control training courses?			
No	32 (9.5)	172.8	0.791
Yes	304 (90.5)	168.0	

falling below 50%: 'handoffs and transitions' (18.75%), 'staffing' (20.90%), 'non-punitive response to errors' (31.83%), 'teamwork across units' (34.15%), 'supervisor/manager expectations and actions promoting patient safety' (43.22%) and 'overall perception of patient safety' (43.23%). These dimensions signify the need for intervention. Conversely, dimensions such as 'teamwork within units' (76.86%) and 'frequency of events reported' (77.87%) had positive response rates exceeding 75%, indicating areas of strength. This dichotomy underscores the complexity of the PSC and the need for a nuanced approach to enhancing it (figure 1).

Nurses reported various AEs that had occurred in the previous year. Daily and several times a week, 14.6% and 16.1% of the nurses, respectively, had complaints from patients or their families. Pressure ulcers were also noted, with 15.2% of the participants reporting a single instance and 15.8% reporting multiple instances within a week. Reports of patient falls were similar, with 15.8% and 14.6% of the nurses indicating that falls occurred once and several times a week, respectively. Notably, a significant proportion of nurses (32.4% and 30.4%, respectively) reported that drug events and infusion or transfusion reactions did not occur. These data provide valuable insights into the challenges that nurses face and areas for potential improvement in patient care (table 2).

The frequencies of the six AEs were consolidated into binary variables (not reporting vs reporting). They reported that the prevalence of AEs such as pressure ulcers (77.1%) and infusion or transfusion reactions (69.6%) were associated with several factors, including 'communication openness,' 'handoffs and transitions,' 'non-punitive response to errors,' 'overall perception of patient safety,' 'supervisor/manager expectations and actions promoting patient safety,' 'staffing,' 'teamwork across units' and overall safety culture ($p<0.05$). Falls, adverse drug events 67.6% and surgical wound infections were reported in 70.5%, 67.6% and 74.1% of

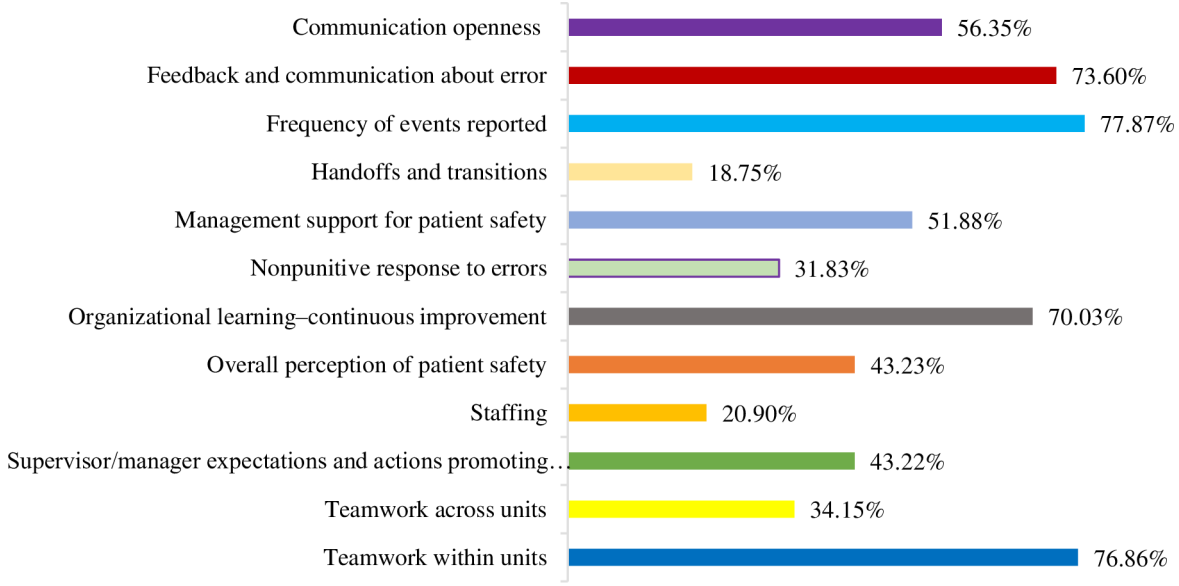

Figure 1 Nurses' positive response to the dimensions of patient safety culture.

patients, respectively. These AEs were also associated with the above-mentioned factors except 'staffing' (p<0.05). Furthermore, complaints from patients or their families were reported in 88.1% of cases and were associated with 'communication openness,' 'handoffs and transitions,' 'overall perception of patient safety' and the total score for safety culture perception (p<0.05) (table 3 and online supplemental appendix 1).

AEs associated with nurses' perceptions of PSC dimensions

Nurses with high-ranking perceptions of PSC in the areas of 'handoffs and transitions,' 'staffing' and 'teamwork across hospital units' reported a lower incidence of AEs compared with those with low-ranking perceptions, particularly in reporting pressure ulcers (OR 0.86, 95% CI 0.78 to 0.94, OR 0.82, 95% CI 0.71 to 0.94 and OR 0.83, 95% CI 0.70 to 0.99, respectively) (p<0.05). Nurses with high-ranking perceptions of PSC in the UK 'handoffs and transitions' reported a lower incidence of patient falls. Similarly, those with high-ranking perceptions in both 'handoffs and transitions' and 'overall perception of patient safety' reported a lower incidence of AEs compared with those with low-ranking perceptions, especially in reporting adverse drug events (OR 0.83, 95% CI 0.76 to 0.91 and OR 0.75, 95% CI 0.61 to 0.92, respectively) (p<0.05). However, for those with high-ranking perceptions in 'non-punitive response to errors,' the incidence of reporting of adverse drug events was 1.17 times higher (p<0.023). Nurses with high perceptions of the safety culture dimensions of 'communication openness,' 'handoffs and transitions' and 'overall perception of patient safety' reported a lower incidence of surgical wound infection (OR 0.83, 95% CI 0.70 to 0.99, OR 0.90, 95% CI 0.83 to 0.99 and OR 0.74, 95% CI 0.60 to 0.92, respectively) (p<0.05) (table 4).

DISCUSSION

This study explored nurses' perceptions of PSC and its relationship with AEs in Hail, Saudi Arabia. This exploration of PSC indicates that some issues require attention, such as communication during handoffs, staffing levels, how errors are handled, how teams work together and

Table 2 The prevalence of adverse events among nurses over the last year

Adverse events	Never happen n (%)	Several time a year n (%)	One a month or less n (%)	Several times a month n (%)	Once a week n (%)	Several times a week n (%)	Everyday n (%)
Pressure ulcer	77 (22.9)	59 (17.6)	54 (16.1)	14 (4.2)	51 (15.2)	53 (15.8)	28 (8.3)
Patient fall	99 (29.5)	66 (19.6)	44 (13.1)	5 (1.5)	53 (15.8)	49 (14.6)	20 (6.0)
Adverse drug event	109 (32.4)	64 (19.0)	41 (12.2)	9 (2.7)	44 (13.1)	44 (13.1)	25 (7.4)
Surgical wound infection	87 (25.9)	71 (21.1)	39 (11.6)	25 (7.4)	38 (11.3)	48 (14.3)	28 (8.3)
Patients or their family complaints	40 (11.9)	54 (16.1)	49 (14.6)	40 (11.9)	50 (14.9)	54 (16.1)	49 (14.6)
Infusion or transfusion reaction	102 (30.4)	71 (21.1)	35 (10.4)	7 (2.1)	46 (13.7)	51 (15.2)	24 (7.1)

Table 3 Examining the association between adverse events and nurses' perception of safety culture*

Adverse events	n (%)	Total safety culture perception	P value
Pressure ulcer			
Not reporting	77 (22.9)	192.5	0.013
Reporting	259 (77.1)	161.4	
Patient fall			
Not reporting	99 (29.5)	204.6	<0.001
Reporting	237 (70.5)	153.4	
Adverse drug event			
Not reporting	109 (32.4)	202.9	<0.001
Reporting	227 (67.6)	152.0	
Surgical wound infection			
Not reporting	87 (25.9)	207.2	<0.001
Reporting	249 (74.1)	155.0	
Patients or their family complaints			
Not reporting	40 (11.9)	198.9	0.035
Reporting	296 (88.1)	164.4	
Infusion or transfusion reaction			
Not reporting	102 (30.4)	215.3	<0.001
Reporting	234 (69.6)	148.1	

*Independent t-test.

expectations from supervisors. Low safety ratings indicate that nurses may not have confidence in their organisation's dedication to AEs. This uncertainty may be related to past accidents or transparency issues in addressing PS concerns. Some studies have examined how healthcare professionals and patients view the safety culture in hospitals. For example, He *et al*[23] studied PSC among clinical managers at tertiary hospitals and found that the dimension 'non-punitive response to errors' had the lowest mean score, indicating the need for improvement. Another previous study found that the lowest PS scores were associated with 'staffing' and 'non-punitive response to errors' when comparing the perceptions of physicians and nurses in public hospitals.[24] Similarly, Kakemam *et al*[25] studied nurses' perspectives regarding PS and found positive response rates below 50% for all facets of PSC, which demonstrated room for improvement in this area. However, in contrast to previous research, the current study identified areas of strength in teamwork among employees and AE reporting. According to previous studies, collaborative efforts and effective communication play critical roles in enhancing PS and well-being.[26] Better communication and teamwork between doctors and other clinical staff can benefit patients by improving treatment and reducing medical mistakes, leading to higher patient satisfaction.[26] Furthermore, research indicates that promoting cooperation among team members

Table 4 Adverse events associated with nurses' perception of patient safety culture dimensions using Binary logistic regression model

	Reporting events*			
Adverse events	B	Sig.	OR	95% CI
Pressure ulcer				
Communication openness	−0.07	0.432	0.93	(0.78 to 1.11)
Handoffs and transitions	−0.15	**0.001**	0.86	(0.78 to 0.94)
Non-punitive response to error	0.12	0.100	1.13	(0.98 to 1.30)
Overall perceptions of patient safety	−0.02	0.852	0.98	(0.79 to 1.22)
Staffing	−0.20	**0.005**	0.82	(0.71 to 0.94)
Suprv/manager expectations and actions promoting patient safety	0.10	0.255	1.10	(0.93 to 1.30)
Teamwork across hospital units	−0.18	**0.037**	0.83	(0.70 to 0.99)
Patient fall				
Communication openness	−0.12	0.164	0.89	(0.75 to 1.05)
Handoffs and transitions	−0.19	**<0.001**	0.82	(0.75 to 0.90)
Non-punitive response to errors	0.09	0.189	1.09	(0.96 to 1.25)
Overall perception of patient safety	−0.13	0.215	0.88	(0.71 to 1.08)
Supervisor/manager expectations and actions promoting patient safety	0.13	0.103	1.14	(0.97 to 1.33)
Teamwork across units	−0.15	0.069	0.86	(0.74 to 1.01)
Adverse drugs				
Communication openness	−0.07	0.405	0.93	(0.79 to 1.10)
Handoffs and transitions	−0.18	**<0.001**	**0.83**	(0.76 to 0.91)
Non-punitive response to errors	0.16	**0.023**	1.17	(1.02 to 1.35)
Overall perception of patient safety	−0.29	**0.005**	0.75	(0.61 to 0.92)
Supervisor/manager expectations and actions promoting patient safety	0.07	0.376	1.07	(0.92 to 1.25)

Continued

Table 4 Continued

Adverse events	Reporting events* B	Sig.	OR	95% CI
Teamwork across units	−0.13	0.114	0.88	(0.75 to 1.03)
Surgical wound infection				
Communication openness	−0.18	**0.038**	0.83	(0.70 to 0.99)
Handoffs and transitions	−0.10	**0.024**	0.90	(0.83 to 0.99)
Non-punitive response to errors	0.01	0.933	1.01	(0.88 to 1.15)
Overall perception of patient safety	−0.30	**0.006**	0.74	(0.60 to 0.92)
Supervisor/ manager expectations and actions promoting patient safety	0.15	0.068	1.16	(0.99 to 1.35)
Teamwork across units	−0.14	0.090	0.87	(0.74 to 1.02)
Patients or their family complaints				
Communication openness	−0.17	0.123	0.84	(0.68 to 1.05)
Overall perception of patient safety	−0.38	**0.002**	0.68	(0.54 to 0.87)
Infusion or transfusion reaction				
Communication openness	−0.17	0.059	0.84	(0.70 to 1.01)
Handoffs and transitions	−0.17	**<0.001**	0.84	(0.77 to 0.93)
Non-punitive response to errors	0.11	0.146	1.11	(0.96 to 1.28)
Overall perception of patient safety	−0.38	**0.001**	0.69	(0.55 to 0.86)
Staffing	−0.11	0.113	0.89	(0.78 to 1.03)
Supervisor/ manager expectations and actions promoting patient safety	0.06	0.449	1.06	(0.91 to 1.25)
Teamwork across units	−0.15	0.076	0.86	(0.73 to 1.02)

*Reference=not reporting, B, coefficient of predictor variables.
Sig, significance.

and involving patients and their families in the care process can enhance PSC.[27 28]

Regarding patient satisfaction, care delivery and safety, the nurses in this study reported a high frequency of patient complaints, pressure ulcers and falls in the previous year. Notably, infusion/transfusion reactions and medication errors occurred less frequently, indicating that these areas have adequate safety precautions. As pressure ulcers are common, problems may arise with patient positioning, skin care procedures or staffing levels. Accordingly, a high frequency of patient complaints indicated possible problems with patient satisfaction. Patient complaints in the healthcare system must be reviewed.[29] This will help to highlight both the complexity of complaints and the valuable data they provide. The fall rates are also alarmingly high, raising safety concerns. Falls and pressure ulcers are medical errors that are deemed 'never events' and should never happen.[30 31] Discussions on the substantial financial and physical costs associated with patient falls in hospitals emphasised the significance of fall prevention techniques and requirements for successful interventions to reduce the frequency of falls and enhance PS.[32 33] Mitigating a patient's preexisting fall risk and making the physical environment as safe as possible are key components of fall prevention in hospitals, and studies have shown that almost one-third of falls can be prevented.[32 34]

The incidence of reported medication errors in this study was very low and may indicate under-reporting or other factors that need to be examined. Studies have shown that interventions are effective. Research indicates that multifaceted interventions such as education, system changes and workforce strategies can reduce PS risks by 27% and 28%, respectively.[35–37] These interventions acknowledge that many different factors contribute to AEs.[38] For example, Rosen *et al* suggest establishing PS leadership roles, creating feedback mechanisms, using interactive data dashboards and promoting teamwork, open communication and collaboration among clinical staff members and their supervisors.[39] The Agency for Healthcare Research and Quality (2018)[19] defined PSC as the degree to which an organisation's culture supports and upholds patient well-being. This includes several components such as open communication, organisational learning, teamwork and error responsiveness. Recognising and rewarding teamwork, collaboration, open communication and accountability are only a few of the many steps required to develop a culture of safety in healthcare settings.[39] Improved patient outcomes are related to a PSC based on effective communication between healthcare providers and within teams.[40] To improve PS and satisfaction, healthcare staff should strive to promote transparent communication, smooth handoffs and a culture of accountability with open communication (or a non-punitive environment that encourages error reporting).[26]

Research on the role of staff and specific interventions to prevent AEs in healthcare is ongoing. Several studies and recommendations have emphasised the significance of nursing interventions and staffing strategies in preventing AEs. For example, a multisite, longitudinal study at the patient level aimed to investigate correlations between nurse staffing practices and the likelihood of AEs and set safe levels for nurse staffing.[41] In addition, the Nurse Staffing Task Force (2023)[42] developed

recommendations to address nursing shortages. These recommendations highlight the need to implement safety management systems, strengthen professional governance committees and support nurses in promoting and maintaining a positive work environment. Furthermore, PS can be improved through interventions that increase nursing staff engagement and provide adequate staffing.[43]

Previous studies examined the association between PSC, nursing staff perceptions and AEs, and the results have consistently indicated that nurses who perceive a more positive safety culture in their hospitals tend to experience fewer AEs. Areas such as handovers, transitions, staffing and teamwork between hospital units were particularly influential in this study. For example, a recent national questionnaire survey in Iran demonstrated that PSC plays a critical role in the ability of hospitals to effectively address and mitigate AEs.[25] According to a study by Moosavi *et al*[44] conducted with 360 nurses in Iranian hospitals, PSC is an important predictor of AEs and can be improved to reduce them. Acknowledging treatments targeted at enhancing nurse involvement and ensuring appropriate staffing as strategies to promote PS highlights the significance of nursing perceptions and staffing in preventing AEs.[43]

AEs affect 10% of hospital patients, which are healthcare-related incidents causing quantifiable harm unrelated to the underlying condition.[45] Hafezi *et al*[46] linked fear of punishment to under-reporting of AEs, highlighting the importance of a positive safety culture. Our study supports this notion, as nurses with positive perceptions of a non-punitive response to errors reported fewer drug events. This reinforces the established link between the culture of fear and increased AEs.[45]

Although this study investigated and highlighted an important issue regarding the relationship between nurses' perceptions of PSC and AEs, it had some limitations. First, it was conducted in the hospitals and primary health centres of Hail City only, which decreased the generalisability of the results. Second, it employed a cross-sectional design, which might not be adequate to ascertain how PS competency affects AEs. Other study designs, such as longitudinal and intervention studies, should be taken into account for future research.

Study implications

This study highlights the importance of a supportive PSC in reducing AEs. Nurses who perceived their work environment as being more transparent and personable and promoted cooperation, communication and a non-punitive approach to mistakes reported fewer AEs. This indicates that healthcare facilities in Ha' il and elsewhere should prioritise the development of a positive safety culture by implementing programmes such as transparent error-reporting procedures, open communication training and efficient error-reporting systems. This study identified specific areas of concern regarding PSC: teamwork, supervisor expectations, error handling, staffing levels and communication during handoffs. Prioritising improvements in these areas will enable the implementation of targeted interventions, such as leadership development programmes that emphasise collaboration and transparent communication, standardised handover protocols, appropriate staffing ratios and error-reporting systems with support networks. In addition to emphasising the staffing levels, this study highlights the need for a comprehensive approach to PS. This requires integrating interventions to address workforce issues with additional tactics, such as nurse training programmes, systems-based changes to improve practices and cultural initiatives to promote open dialogue and collaboration. The association found in this study between a positive safety culture and higher rates of reported AEs highlights the importance of creating an environment in which nurses can report errors without fear of consequences. Some methods for achieving this include implementing private reporting systems, offering support and debriefing after mistakes and promoting a 'just culture' that prioritises learning from mistakes over assigning. This study also provides opportunities for future investigations of targeted interventions that can improve PSC in various settings, including Hail. This can guide the development of targeted initiatives and tactics tailored to a region's unique healthcare needs and challenges. Therefore, the implications of this study go beyond the Hail region and provide insightful analyses and helpful suggestions for healthcare organisations worldwide, aiming to maximise PS protocols. Health systems can help create safer and more patient-centred care environments by emphasising a positive safety culture, addressing key areas of concern, and implementing a multifaceted approach.

Methodological considerations

We used a cross-sectional design in this study, which provides an important snapshot of how nurses feel about their work at one point in time but cannot be used to establish causation between PSC and AEs. The selection of participants was based on convenience sampling, which may have resulted in failure to obtain a sample that is fully representative of the nursing population within Hail City. Furthermore, self-reporting methods were employed to ascertain the perception of PSC and the occurrence of AEs, which are liable to recall and social desirability biases. Moreover, focusing on AEs experienced by nurses over the past year might encourage under-reporting for various reasons, such as fear of blame or trouble recalling specific incidents. Finally, while binary logistic regression was conducted to discern correlations between safety culture dimensions and occurrence rates of AEs, other unmeasured variables could also affect the AE rate. Therefore, it is important to recognise these limitations when interpreting our findings. In addition, future research could take advantage of employing a longitudinal design, a more representative sampling procedure or even objective measures for assessing AEs.

CONCLUSION

The PSC differs among nurses and is complex in nature. However, there are positive aspects such as strong teamwork among units and a high frequency of reporting events. However, there is still room for improvement. In addition, the culture of reporting is one of its strengths that calls for its maintenance. Nevertheless, areas such as communication, handoff procedures, staffing levels, nonpunitive response to errors and supervisors' actions that promote safety require urgent attention, and hospital administrators must prioritise these areas. The study highlights the importance of improving nurses' safety culture perception that may help in the reduction of AEs in healthcare settings. As such, interventions in weak areas identified herein can create an environment where PS will be given priority over all other issues, including staff and the welfare of staff nurses.

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