Voices of change: Saudi radiology trainees' insights on safety and professionalism in the workplace (#108390)

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Voices of change: Saudi radiology trainees' insights on safety and professionalism in the workplace

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In the radiology department, where advanced technologies and multidisciplinary collaboration are crucial, establishing a strong safety culture is particularly challenging.This study examines the challenges of establishing a safety culture in radiology, focusing on how Saudi radiology trainees perceive and respond to safety and unprofessional conduct. It evaluates their willingness to voice concerns and the factors influencing this, including workplace culture, potential patient risks, and demographics. This study surveyed Saudi radiology residents and interns at two tertiary hospitals using a validated questionnaire. A non-probability total population purposive sampling method was employed. Descriptive statistics, Mann-Whitney U test, and Kruskal-Wallis H test were used to analyze differences in willingness to speak up across demographic groups. Participants felt encouraged by colleagues to address patient safety and unprofessional behavior, with over 70% and 56% respectively agreeing. Residents showed significantly greater support for raising safety and unprofessional conduct concerns than interns ($p = 0.009$). They also believed more strongly that speaking up led to meaningful changes ($p = 0.033$), and observed others addressing these issues more frequently ($p = 0.015$). Trainees from different hospitals showed significantly varied perceptions regarding colleague support in addressing patient safety and unprofessional behavior ($p < 0.0001$), the impact of raising concerns ($p = 0.004$), and the frequency of observing these issues being addressed ($p < 0.0001$). Radiology trainees are particularly vigilant about unintentional breaches of sterile technique, often addressing these issues with nurses (66.7%). The clinical environment supports safety concerns but less so for unprofessional behavior, with residents being

more proactive. Promoting open communication in radiology requires leadership education, multifaceted strategies, alternative channels for concerns, and future research to assess and track cultural attitudes.

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ABSTRACT

In the radiology department, where advanced technologies and multidisciplinary collaboration are crucial, establishing a strong safety culture is particularly challenging. This study examines the challenges of establishing a safety culture in radiology, focusing on how Saudi radiology trainees perceive and respond to safety and unprofessional conduct. It evaluates their willingness to voice concerns and the factors influencing this, including workplace culture, potential patient risks, and demographics. This study surveyed Saudi radiology residents and interns at two tertiary hospitals using a validated questionnaire. A non-probability total population purposive sampling method was employed. Descriptive statistics, Mann-Whitney U test, and Kruskal-Wallis H test were used to analyze differences in willingness to speak up across demographic groups. Participants felt encouraged by colleagues to address patient safety and unprofessional behavior, with over 70% and 56% respectively agreeing. Residents showed significantly greater support for raising safety and unprofessional conduct concerns than interns ($p = 0.009$). They also believed more strongly that speaking up led to meaningful changes ($p = 0.033$), and observed others addressing these issues more frequently ($p = 0.015$). Trainees from different hospitals showed significantly varied perceptions regarding colleague support in addressing patient safety and unprofessional behavior ($p < 0.0001$), the impact of raising concerns ($p = 0.004$), and the frequency of observing these issues being addressed ($p < 0.0001$). Radiology trainees are particularly vigilant about

unintentional breaches of sterile technique, often addressing these issues with nurses (66.7%). The clinical environment supports safety concerns but less so for unprofessional behavior, with residents being more proactive. Promoting open communication in radiology requires leadership education, multifaceted strategies, alternative channels for concerns, and future research to assess and track cultural attitudes.

Keywords:
Organizational culture, Patient safety, Professional communication, Radiologic technolgy, Speaking up, Healthcare system, Saudi Arabia

INTRODUCTION

Building a safer healthcare environment requires an understanding that safety culture is a multifaceted and interconnected system of shared values that prioritize safety within clinical settings (Slawomirski & Klazinga, 2022; Chau, 2024). Safety culture is a dynamic framework composed of collective norms, and assumptions that guide behavior and decision-making in healthcare (Bisbey et al., 2019). It goes beyond simply implementing safety measures, focusing instead on establishing the foundational elements that sustain safe behaviors over time (Bisbey et al., 2019; Tear et al., 2020). By adopting this holistic approach, healthcare organizations can create a more resilient, adaptable, and effective safety culture, ultimately leading to improved patient safety and enhanced organizational performance (Kilcullen et al., 2021).

Fostering an environment where employees feel empowered to voice their concerns not only strengthens trust but also serves as a catalyst for enhanced performance, satisfaction, retention, productivity, innovation, and overall growth within the organization (Detert & Burris, 2007; Detert

& Treviño, 2010; Luff et al., 2021). Leadership is crucial in cultivating a culture of safety within healthcare settings. Healthcare leaders are tasked with transforming the organization's vision and strategies into concrete safety measures (Birken et al., 2018; Boutcher et al., 2022). The critical role of managers emphasizes the need for clear communication and transparency to strengthen the safety culture. Leaders cultivate an atmosphere where psychological safety thrives, empowering staff to voice concerns and contribute ideas openly, free from the worry of repercussions (O'donovan & Mcauliffe, 2020). This strategy is essential in developing a workplace where employees feel secure and supported (Birken et al., 2018; O'donovan & Mcauliffe, 2020; Boutcher et al., 2022).

In the medical field, experts emphasize that transparent communication about safety issues, such as adherence to hand-washing protocols and addressing unprofessional conduct, is crucial for cultivating robust safety cultures and achieving optimal outcomes (Martinez et al., 2017). Similarly, radiology patient safety leaders recognize that a strong organizational culture profoundly influences radiologic performance and outcomes, emphasizing the need for healthy team dynamics and respectful communication that empowers individuals to voice safety concerns or unprofessional conduct that could jeopardize patient safety (Larson et al., 2015; Siewert & Hochman, 2015; Siewert et al., 2018, 2019). Radiology departments play a vital role in patient care by providing essential diagnostic and therapeutic services that rely on advanced technologies and collaboration across various disciplines (Broder et al., 2018). The complexity of these services, coupled with the fast-evolving technology and the large number of patient interactions, creates unique challenges in establishing and maintaining a strong safety culture (Broder et al., 2018; Chau, 2024).

The level of empowerment that healthcare employees feel in voicing concerns about safety violations and unprofessional conduct in their work environment is becoming an important aspect of safety culture. Validated survey tools have been developed to measure this (Martinez et al., 2015; Richard, Pfeiffer & Schwappach, 2021), and research utilizing these tools has revealed that significant barriers to speaking up still exist in the healthcare setting (Liao et al., 2014; Martinez et al., 2015, 2017; Luff et al., 2021). A 2018 study examined the culture surrounding the practice of speaking up about safety incidents within a major academic radiology department in the United States (Siewert et al., 2018). The study, which included 363 employees, found significant obstacles to reporting safety concerns, primarily due to the department's hierarchical structure. Similarly, a 2021 study surveyed a group of 58 radiology trainees across nine different training programs in the United States (Luff et al., 2021). The findings highlighted deficiencies in workplace cultures related to speaking up, especially in relation to unprofessional behavior and the influence of team hierarchy.

Our study uniquely addresses a critical gap in the current literature regarding the culture of speaking up within the field of radiology, with a specific focus on the Saudi Arabian context. To date, there has been no research exploring the dynamics of this issue within Saudi Arabia, nor any studies that examine whether these dynamics are consistent across different countries. Our research seeks to understand how these conditions impact radiology trainees (i.e., residents and interns), the influence of safety event severity on the willingness to speak up, and the role of hierarchical structures in shaping individuals' willingness to voice concerns related to both traditional safety issues, such as non-sterile techniques, and unprofessional behavior. Given the well-documented links between a culture of respect and safety, as well as the connection between unsafe or disrespectful behavior and malpractice (Leape et al., 2012; Riskin et al., 2015; Webb et al., 2016;

Cooper et al., 2017, 2019), our study is significant in contributing valuable insights into these critical aspects within radiology.

In this study, we adapted previously validated instrument tailored for medical and surgical trainees(Martinez et al., 2015), as well as radiology residents and fellows (Luff et al., 2021), to conduct a survey among radiology residents and interns at two tertiary hospitals in Saudi Arabia. Our study aimed to: a) explore how these trainees perceive the culture of their work environments in relation to voicing concerns about safety and unprofessional behavior, b) evaluate their expected willingness to voice medical errors to radiology colleagues, and c) identify the factors that influence this likelihood, including their perceptions of the speaking-up culture, the risk of patient harm associated with the error, and demographic factors.

MATERIALS AND METHODS

Participants and Procedure

A descriptive cross-sectional study was carried out from January to February 2024, targeting radiology trainees at two tertiary hospitals in Saudi Arabia: King Abdulaziz Medical City (KAMC) in Jeddah at the Ministry of the National Guard - Health Affairs (MNG-HA), and King Saud Medical City (KSMC) in Riyadh. The study encompassed the entire cohort of 81 radiology trainees, consisting of 39 residents and 42 interns. Participants were selected through non-probability total population purposive sampling and were invited to participate via email and WhatsApp. The questionnaire was distributed online using Google Forms as the survey platform after securing the necessary permissions from the original source.

156 ***Study Measures***

157 Radiology residents and interns were asked to complete established and previously validated
158 scales. These scales had been used in prior studies to assess internal medicine and surgery trainees,
159 as well as radiology residents and fellows, regarding their perceptions of the workplace
160 environment, specifically in relation to speaking up about traditional safety concerns and
161 unprofessional behavior (Martinez et al., 2015, 2017; Luff et al., 2021). To ensure relevance and
162 clarity for our study's demographics, the questionnaires were reviewed by two radiologists and
163 two senior radiology specialists with extensive experience in the field. This review ensured that
164 the questionnaires were appropriately tailored, clear, and maintained a focused and purposeful
165 approach.

166
167 The self-administered questionnaire was structured into three main sections. The first section
168 included five demographic questions covering gender, age, academic level, training hospital, and
169 clinical experience. The second section contained 5 domains and 10 items assessing participants'
170 views on the level of support for voicing concerns about patient safety and unprofessional conduct
171 in their clinical environments using a 5-point Likert scale (1 = strongly disagree, 5 = strongly
172 agree). The third section presented a hypothetical scenario, originally published and tailored for
173 radiology, where a clinician accidentally compromises sterile technique during an imaging-guided
174 central line placement (Martinez et al., 2017; Luff et al., 2021). The scenario reads: "You are
175 working in the radiology suite when a clinician arrives to place a central catheter on a patient under
176 radiographic guidance. The clinician sets up the supplies, prepares the patient, The clinician puts
177 on a sterile gown and gloves, but then accidentally touches a nonsterile part of the ultrasound
178 machine before proceeding to grab the catheter to place the line." Participants were then asked two
179 questions: a) their likelihood of raising concerns about the clinician's breach of sterile technique

and the likelihood that trainees would report this error to different staff members (attending radiologist, nurse, resident, or intern) using a 5-point Likert scale (1 = not at all likely, 5 = completely likely); and b) their assessment of the potential risk to the patient in this scenario, also using a 5-point Likert scale (1 = very low, 5 = very high).

Ethical consideration

This study received approval from the local Institutional Review Board (IRB) of King Abdullah International Medical Research Center under protocol number SP23J/138/08. Participation was entirely voluntary, and written informed consent was obtained from all participants prior to completing the questionnaire. The consent form was embedded at the start of the Google Form survey, requiring participants to carefully read and confirm their agreement before proceeding. To maintain anonymity and confidentiality, all responses were kept anonymous, and the study followed the principles outlined in the Helsinki Declaration. The electronic survey tool generated a password-protected Microsoft Excel file, ensuring that no identifying information about participants was included.

Statistical Analyses

The statistical analysis was carried out through a systematic four-step approach. Initially, descriptive statistics were generated, including frequencies and percentages to summarize participant demographics and their responses to the questionnaire. Next, a weighted average was computed for the items within each domain as well as across all five domains in the second section of the questionnaire. Following this, the Shapiro–Wilk test was employed to assess the normality of the data. Finally, to explore differences in radiology trainees' willingness to speak up across various demographic groups, the Mann-Whitney U test and the Kruskal-Wallis H test were

applied. The significance level was set at $\alpha < 0.05$, and all statistical analyses were performed using SPSS version 24.

RESULTS

Characteristics of the Participants:

Table 1 highlights the sociodemographic profile of 81 radiology trainees, with a gender distribution of 34 males (42%) and 47 females (58%). The age breakdown reveals that 43.2% of the trainees are between 20-24 years old, 28.4% are aged 25-29, and another 28.4% are 30 years or older. Academically, 51.9% are engaged in internship programs, while 48.1% are in residency. Most participants, 63.0%, have received their training at KSMC, while 37.0% were trained at KAMC. In terms of experience, 44.4% have less than 1 year, 30.9% have 1-5 years, and 24.7% have more than 5 years of experience.

Perspectives to Voice Safety Concerns and Address Unprofessional Conduct: Descriptive Analysis

Table 2 presents the perspectives of radiology residents and interns on speaking up about safety concerns and unprofessional behavior. Participants felt a strong sense of encouragement from colleagues to address both traditional patient safety issues (mean: 3.68; with 70.4% agreeing or strongly agreeing) and unprofessional behavior (mean: 3.47; with 56.8% agreeing or strongly agreeing). Contrary to expectations, participants did not find it particularly difficult to speak up about these matters, with mean scores of 2.62 for safety concerns and 2.86 for unprofessional behavior, as 58.1% and 53.1%, respectively, disagreed or strongly disagreed that voicing these concerns was difficult. Trainees expressed a firm belief that voicing these concerns led to meaningful changes, with mean scores of 3.60 for safety issues and 3.54 for unprofessional behavior, and 55.6% agreeing or strongly agreeing in both cases. Radiology residents and interns

also perceived the clinical culture as highly supportive of addressing safety concerns, with a mean of 3.59 and 60.5% agreeing or strongly agreeing, although the perceived support for tackling unprofessional behavior was slightly lower, with a mean of 3.26 and 46.9% in agreement. Additionally, participants noted frequent instances of others speaking up about safety concerns (mean: 3.59, with 59.2% agreeing or strongly agreeing) and unprofessional behaviors (mean: 3.48, with 50.7% agreeing or strongly agreeing).

Perspectives to Voice Safety Concerns and Address Unprofessional Conduct: Inferential Analysis

Tables 3 and 4 show the differences in radiology residents and interns' perspectives regarding the act of raising concerns about safety issues and unprofessional conduct across different demographic groups. The analysis revealed that residents exhibited significantly stronger overall support for raising concerns about safety and unprofessional conduct compared to interns ($p = 0.009$). Notably, residents were more likely to believe that speaking up led to meaningful changes ($p = 0.033$) and reported more frequent observations of others addressing these issues ($p = 0.015$) than their intern counterparts. Additionally, radiology residents and interns trained at KAMC showed significantly greater overall support for addressing safety concerns and unprofessional behavior compared to those trained at KSMC ($p < 0.0001$). KAMC trainees felt a stronger sense of encouragement from colleagues to address traditional patient safety issues and unprofessional behavior ($p < 0.0001$), were more likely to believe that raising these concerns resulted in meaningful changes ($p = 0.004$), and observed others addressing such issues more frequently ($p < 0.0001$) than their counterparts at KSMC. Gender, however, did not significantly influence the trainees' willingness to voice safety concerns or address unprofessional conduct ($p = 0.817$) (Table 3). Furthemore, individuals with less than one year of work experience and those aged 20-24

demonstrated significantly greater overall support for addressing safety concerns and unprofessional behavior compared to their counterparts with over five years of experience and those aged 30 or older ($p = 0.026$; $p = 0.017$, respectively). These younger and less experienced trainees were also more likely to observe others addressing these issues more frequently ($p = 0.003$; $p = 0.001$, respectively) than their more experienced, older peers (Table 4).

Addressing Medical Errors Within the Clinical Hierarchy:

Table 5 presents the factors influencing participants' likelihood of speaking up about a hypothetical scinario of unintentional breach of sterile technique by a clinician. Radiology residents and interns were likely or completely likely to address the issue with a nurse (66.7%), followed by an intern (59.3%), an attending radiologist (56.8%), and a resident (55.7%). Additionally, 54.32% of the 81 radiology trainees perceived this error as having a high or very high potential for patient harm (Figure 1).

DISCUSSION

Statement of principal findings

This cross-sectional study explores how Saudi radiology trainees perceive the culture of addressing safety and unprofessional behavior, evaluates their willingness to report medical errors, and identifies factors influencing this, including speaking-up culture, potential patient harm, and demographic factors. To the best of our knowledge, this is the first study to specifically examine these factors among radiology residents and interns, both within Saudi Arabia and across other medical disciplines in the country. This study reveals several key findings: firstly, radiology trainees, including both residents and interns, generally feel encouraged by their colleagues to address issues related to safety and unprofessional behavior. Importantly, more than half believe

that voicing their concerns leads to meaningful changes. Secondly, the clinical environment is perceived as supportive of addressing safety concerns, although there is slightly less perceived support when it comes to tackling unprofessional behavior. Third, radiology residents are notably more proactive and supportive in raising concerns about safety and unprofessional behavior compared to interns. Fourth, trainees, particularly those at KAMC and those with less than one year of experience, show a significantly stronger commitment to address safety concerns and unprofessional behavior than their more experienced colleagues and those trained at KSMC. Fifth, radiology trainees are particularly vigilant about unintentional breaches of sterile technique, often addressing these issues with nurses. Over half of the trainees view such errors as having a high potential for patient harm.

Interpretation within the context of the wider literature:

Our research indicates that radiology residents and interns recognize challenges in voicing concerns within their clinical settings, particularly when it comes to addressing unprofessional behavior. This observation aligns with the results of Luff et al. (Luff et al., 2021), who conducted a similar study involving 58 radiology trainees, as well as with the findings of Martinez et al. (Martinez et al., 2017), who surveyed a large group of 1800 medical and surgical interns and residents using the same five-domain, ten-item tool. Both studies also indicated that participants were less likely to report instances of unprofessional behavior than they were to raise concerns about safety issues. These findings are crucial as unprofessional conduct has been linked to reduced team effectiveness and adverse patient outcomes in healthcare (Leape et al., 2012; Riskin et al., 2015, 2019; Cooper et al., 2017, 2019; Dixon-Woods et al., 2018; Lagoo et al., 2018).

Our study revealed that radiology residents and interns were more likely to raise safety concerns and address unprofessional behavior with a fellow nurse than with an attending

radiologist or another resident or intern. This suggests that hierarchical structures may discourage trainees from speaking up. This observation is consistent with previous research, which has highlighted the widespread presence of hierarchical barriers that hinder open communication about safety concerns in various healthcare settings (Martinez et al., 2017; Luff et al., 2021). Previous studies have positioned radiology within a pervasive cultural context where clinical staff often feel limited in their ability to discuss safety issues across different levels of authority (Okuyama, Wagner & Bijnen, 2014; Martinez et al., 2017; Luff et al., 2021). Our study highlighted the significant role of workplace culture in either promoting or discouraging speaking-up behavior among radiology residents and interns, echoing similar results found in other clinical groups (Siewert et al., 2019). The data reinforces that cultures which encourage open communication foster not only enhance patient safety but also contribute to the well-being of trainees by offering psychologically safe environments for those who are vulnerable within a hierarchical structure (Okuyama, Wagner & Bijnen, 2014; Osseo-Asare et al., 2018). In contrast, environments that suppress open dialogue can result in moral distress, burnout, and emotional (Frazier et al., 2017; Newman, Donohue & Eva, 2017; Osseo-Asare et al., 2018).

The analysis reveals that radiology trainees at KAMC show a stronger commitment to addressing safety concerns and unprofessional behavior compared to their counterparts at KSMC. This suggests that the training environment is a critical factor in shaping the willingness to raise concerns, emphasizing the importance of cultivating a supportive culture in medical training programs to encourage open communication on safety and professionalism (Mistri, Badge & Shahu, 2023; Alsahli et al., 2024). Moreover, radiology residents demonstrate a notably higher level of proactivity and support in addressing safety concerns and unprofessional behavior compared to interns. This suggests that the extended experience and training that residents

receive—comprising seven years of medical school followed by a five-year residency—fosters a stronger sense of responsibility and confidence in managing critical issues within the clinical setting. In contrast, interns typically have only four years of radiological sciences education before beginning their internships, which may contribute to their more limited engagement in these areas.

Strengths and limitations:

One of the strengths of our study is that we conducted a survey among trainees from two major tertiary hospitals, providing a robust data set. To the best of our knowledge, this is the first study to explore the culture of speaking up among radiology residents and interns in Saudi Arabia. Our findings contribute to the existing literature by not only assessing traditional safety concerns but also examining residents' and interns' experiences and attitudes toward addressing unprofessional behavior. Nonetheless, our study does have limitations. While purposive sampling enables a deeper and more detailed investigation, enriching the study's overall insights, it also introduces inherent bias, which limits the ability to generalize the findings to a wider population and potentially affects the reliability of the study's findings. Furthermore, the patient safety scenario included in our questionnaire was hypothetical, which may not accurately reflect real-life behavior. Additionally, the survey did not include a scenario on unprofessional behavior, limiting the ability to assess how likely radiology residents and interns are to speak up about such issues. However, this limitation does not detract from our primary findings regarding residents and interns' perceptions of safety culture versus unprofessional behavior. Moreover, the study did not clearly define the specific types of unprofessional behavior referenced in the questions. As a result, participants might have interpreted unprofessional behavior differently, leading to varied perceptions of its severity. Additionally, radiology residents and interns' understanding of what

341 constitutes unprofessional behavior may differ depending on the context and the way the questions
342 were presented (Wong & Ginsburg, 2017). Unprofessional behavior can manifest in various ways,
343 ranging from overt harassment and misconduct to more subtle acts of unreasonable demands,
344 incivility, disrespect, and bullying (Dixon-Woods et al., 2018). Although these behaviors have
345 been acknowledged in the radiology literature, their frequency and associated impacts are not yet
346 fully understood (Rawson et al., 2013; Brown et al., 2014).

347 ***Implications for policy, practice and research***

348 Our findings highlight an increasing awareness within medicine and radiology of the need
349 for systemic reforms to cultivate professional cultures where staff feel confident in voicing safety
350 concerns and addressing unprofessional behavior (Pian-Smith et al., 2009; Kruskal et al., 2019;
351 Siewert et al., 2019; Luff et al., 2021). Crucial measures involve educating leadership about the
352 detrimental effects of unsupportive environments on both patient care and staff well-being, and
353 creating strategies to remove obstacles to open dialogue (Profit et al., 2014; Etchegaray et al.,
354 2017; Dixon-Woods et al., 2018). Some organizations have effectively employed simulation
355 exercises and educational programs to equip staff with the skills to address safety concerns
356 constructively (Pian-Smith et al., 2009; Okuyama, Wagner & Bijnen, 2014; Dixon-Woods et al.,
357 2018). Leadership must exemplify these behaviors to successfully build and maintain a culture that
358 encourages open communication (Etchegaray et al., 2017). Promoting a culture of speaking up in
359 radiology likely demands a multifaceted approach, as training alone may be insufficient (Raemer
360 et al., 2016). Suggestions include establishing alternative channels for raising concerns, ensuring
361 diverse voices are heard, and creating informal settings where hierarchical structures do not inhibit
362 honest communication (Luff et al., 2021). Anonymous online reporting tools can also empower
363 staff to express concerns (Webb et al., 2016; Martinez et al., 2017; Siewert et al., 2019). Tackling

these barriers, alongside issues of unprofessional behavior, can provide valuable insights for future research and interventions aimed at enhancing open communication within radiology departments (Siewert et al., 2019).

Future initiatives should involve conducting an extensive national survey across Saudi Arabia that explore the cultural attitudes toward addressing safety concerns and unprofessional behavior within the field of radiology. This survey should aim to capture real clinical incidents and include a diverse participant group to ensure comprehensive insights. The instrument adapted for this study can serve as a valuable tool for longitudinal assessments, allowing researchers to measure cultural shifts in radiology over time, particularly following the introduction of interventions designed to encourage more open communication and reporting of safety issues.

CONCLUSIONS

This cross-sectional study provides valuable insights into how Saudi radiology trainees perceive the culture of voicing concerns about safety and unprofessional conduct, and their propensity to report medical errors, and the factors influencing these behaviors. Radiology trainees, both residents and interns, feel encouraged by peers to address safety and unprofessional behavior, with over half believing their concerns lead to change. While the clinical environment supports safety concerns, there's less support for unprofessional behavior. Residents, particularly at KAMC, are more proactive than interns, likely due to their extensive training. Trainees also demonstrate strong awareness of potential patient harm, especially regarding sterile technique breaches. Overall, these findings highlight the importance of fostering a supportive culture for speaking up within clinical environments, particularly in radiology, where the proactive involvement of trainees can significantly enhance patient safety and professional conduct. This study serves as a foundational

step for future research and interventions aimed at strengthening the culture of safety and professionalism among medical trainees in Saudi Arabia.

Abbreviations

KAMC - King Abdulaziz Medical City

MNG-HA - Ministry of the National Guard - Health Affairs

KSMC - King Saud Medical City

IRB - Institutional Review Board

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Conflict of interests

The authors have declared that there are no conflicts of interest associated with this study. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethics and other permissions

The ethics committee of the King Abdullah International Medical Research Center granted approval for this study, designated as Study Number: SP23J/138/08. This research was conducted without the support of any specific grants from funding agencies in the public, commercial, or not-for-profit sectors. Furthermore, we confirm that written informed consent was obtained from all participants in the study, adhering to the ethical principles outlined in the Declaration of Helsinki.

We obtained permission to utilize the questionnaire from the corresponding author of the research titled "Radiology Trainees' Perceptions of Speaking up Culture Related to Safety and Unprofessional Behavior in Their Work Environments" by Luff D, O'Donnell M, Johnston PR, et al. (Am J Roentgenol 2021; 216:1081–7).

Author Contributions

- Khalid M. Alshamrani conceived and designed the study, performed the investigation, analyzed the data, prepared figures and/or tables, authored or reviewed drafts of the article, and approved the final draft.
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594 **Figure legends:**
595
596 ***Figure 1:*** *Risk of Patient Harm Due to Unintentional Breach of Sterile Technique by Clinician*

597 **Table legends:**
598 ***Table 1:*** *Characteristics of the Participants.*

599 ***Table 2:*** *Radiology Trainees' Perspectives on Speaking Up: Comparing Views on Safety Concerns*
600 *and Unprofessional Behavior*

601 ***Table 3:*** *Radiology Trainees' Perspectives on Speaking Up: Analyzing Inferential Statistics by*
602 *Gender, Academic Level, and Training Hospital*

603 ***Table 4:*** *Radiology Trainees' Perspectives on Speaking Up: Analyzing Inferential Statistics by*
604 *Years of Experience and Age.*

605 ***Table 5:*** *Likelihood of Addressing a Medical Error in the Hypothetical Scenario: Odds of*
606 *Speaking Up.*

Table 1(on next page)

Table 1 : Characteristics of the Participants.

Table 1: *Characteristics of the Participants.*

Variable		Total Sample = 81	
		n	**%**
Gender	Male	34	42.0
	Female	47	58.0
Age (years)	20-24	35	43.2
	25-29	23	28.4
	≥ 30	23	28.4
Academic Level	Internship	42	51.9
	Residency	39	48.1
Training Hospital	King Abdulaziz Medical City (KAMC)	30	37.0
	King Saud Medical City (KSMC)	51	63.0
Clinical Experience (year)	<1	36	44.4
	1-5	25	30.9
	>5	20	24.7

- Percentage of Responses (%) $= \frac{\text{Number of Responses (n)}}{81} \times 100$

Table 2(on next page)

Table 2: Radiology Trainees' Perspectives on Speaking Up: Comparing Views on Safety Concerns and Unprofessional Behavior

1 ***Table 2:*** *Radiology Trainees' Perspectives on Speaking Up: Comparing Views on Safety Concerns and Unprofessional Behavior*

Domain / Item	Strongly Disagree	Disagree	Natural	Agree	Strongly Agree	Mean	σ	95% CI	Overall Perception Level
Colleague Encouragement:	**Weighted Average = 3.57**								
a) I am encouraged by my colleagues to speak up about traditional patient safety concerns.	4 (5%)	10 (12.3%)	10 (12.3%)	41 (50.6%)	16 (19.8%)	3.68	1.08	3.44-3.92	High
b) I am encouraged by my colleagues to speak up about unprofessional behavior.	4 (5%)	14 (17.3%)	17 (20.9%)	32 (39.5%)	14 (17.3%)	3.47	1.12	3.22-3.72	
Difficulty Speaking up:	**Weighted Average = 2.74**								
a) In my clinical area, it is difficult to speak up if I have traditional patient safety concerns.	6 (7.4%)	41 (50.7%)	13 (16.0%)	20 (24.7%)	1 (1.2%)	2.62	0.98	2.40-2.83	Moderate
b) In my clinical area, it is difficult to speak up if I observe unprofessional behavior.	12 (14.8%)	31 (38.3%)	13 (16.1%)	21 (25.9%)	4 (4.9%)	2.86	1.16	2.42-2.94	
Meaningful Change:	**Weighted Average = 3.57**								
a) Speaking up about traditional patient safety concerns results in meaningful change in my clinical area.	1 (1.2%)	5 (6.2%)	30 (37.0%)	34 (42.0%)	11 (13.6%)	3.60	0.84	3.42-3.79	High
b) Speaking up about unprofessional behavior results in meaningful change in my clinical area.	2 (2.5%)	10 (12.3%)	24 (29.6%)	32 (39.5%)	13 (16.1%)	3.54	0.98	3.32-3.76	
Clinical Culture:	**Weighted Average = 3.43**								
a) The culture in my clinical area makes it easy to speak up about traditional patient safety concerns that do not involve me or my patients.	0 (0%)	10 (12.3%)	22 (27.2%)	40 (49.4%)	9 (11.1%)	3.59	0.84	3.41-3.78	Moderate
b) The culture in my clinical area makes it easy to speak up about unprofessional behavior that does not involve me or my patients.	4 (4.9%)	13 (16.1%)	26 (32.1%)	34 (42.0%)	4 (4.9%)	3.26	0.95	3.05-3.47	
Observe others speaking up:	**Weighted Average = 3.54**								
a) In my clinical area, I observe others speaking up about traditional patient	0 (0%)	11 (13.6%)	22 (27.2%)	37 (45.6%)	11 (13.6%)	3.59	0.89	3.40-3.79	High

	safety concerns even if they are not directly involved in the patient's care.								
b)	In my clinical area, I observe others speaking up about unprofessional behavior even if they are not directly involved in the patient's care.	1 (1.2%)	10 (12.3%)	29 (35.8%)	31 (38.4%)	10 (12.3%)	3.48	0.91	3.28-3.68
	Overall Weighted Average =						**3.35**		

$$\text{Percentage of Responses (\%)} = \frac{\text{Number of Responses (n)}}{81} \times 100$$

σ = Standard Deviation
CI = Confidence Interval
The levels of the mean scores on 5-point Likert Scale: <1.5 = Very Low; 1.5-2.5 = Low; 2.5-3.5 = Moderate; 3.5-4.5 = High; 4.5-5 = Very High

Table 3(on next page)

Table 3: Radiology Trainees' Perspectives on Speaking Up: Analyzing Inferential Statistics by Gender, Academic Level, and Training Hospital

Table 3: *Radiology Trainees' Perspectives on Speaking Up: Analyzing Inferential Statistics by Gender, Academic Level, and Training Hospital*

Domain	Gender			
	Mean Rank		Mann-Whitney U	P-value
	Male	Female		
Colleague Encouragement	43.62	39.11	710.0	0.338
Difficulty Speaking Up	42.19	40.14	758.5	0.692
Meaningful Change	38.93	42.5	896.5	0.490
Clinical Culture	43.31	39.33	720.5	0.438
Observe Others Speaking Up	39.72	41.93	842.5	0.670
Total	41.71	40.49	775.0	0.817
Domain	**Academic level**			
	Mean Rank		Mann-Whitney U	P-value
	Radiolgy Residency	Internship		
Colleague Encouragement	44.51	77.21	671.0	0.157
Difficulty Speaking Up	41.62	40.33	793.0	0.802
Meaningful Change	46.24	35.36	599.0	0.033*
Clinical Culture	45.63	36.01	624.5	0.058
Observe Others Speaking Up	46.98	34.56	568.0	0.015*
Total	47.58	33.91	542.5	0.009*
Domain	**Training Hospital**			
	Mean Rank		Mann-Whitney U	P-value
	KAMC	KSMC		
Colleague Encouragement	54.53	33.04	359.00	< 0.0001*
Difficulty Speaking Up	35.17	44.43	940.00	0.080
Meaningful Change	50.50	35.41	480.00	0.004*
Clinical Culture	46.90	37.53	588.00	0.074
Observe Others Speaking Up	55.28	32.60	336.5	< 0.0001*
Total	53.97	33.37	376.00	< 0.0001*

* Significance; KAMC = King Abdulaziz Medical City; KSMC = King Saud Medical City

Table 4(on next page)

Table 4: Radiology Trainees' Perspectives on Speaking Up: Analyzing Inferential Statistics by Years of Experience and Age.

Table 4: *Radiology Trainees' Perspectives on Speaking Up: Analyzing Inferential Statistics by Years of Experience and Age.*

Years of Experience					
Domain	**Mean Rank**			**Kruskal-Wallis H**	**P-value**
	<1	**1-5**	**>5**		
Colleague Encouragement	46.74	37.88	34.58	4.191	0.123
Difficulty Speaking Up	39.79	40.56	43.72	0.389	0.823
Meaningful Change	46.86	37.56	34.75	4.379	0.112
Clinical Culture	45.47	37.38	37.48	2.493	0.288
Observe Others Speaking Up	48.72	41.08	27.00	11.475	0.003*
Total	48.08	38.94	30.82	7.273	0.026*
Age (Years)					
Domain	**Mean Rank**			**Kruskal-Wallis H**	**P-value**
	20-24	**25-29**	**≥ 30**		
Colleague Encouragement	47.43	37.67	34.54	4.946	0.084
Difficulty Speaking Up	38.9	41.65	43.54	0.591	0.744
Meaningful Change	47.94	35.87	35.57	5.624	0.060
Clinical Culture	45.53	38.78	36.33	2.564	0.277
Observe Others Speaking Up	49.00	43.91	25.91	14.508	0.001*
Total	48.3	40.54	30.35	8.181	0.017*
* Significance					

Table 5(on next page)

Table 5: Likelihood of Addressing a Medical Error in the Hypothetical Scenario: Odds of Speaking Up.

Table 5: *Likelihood of Addressing a Medical Error in the Hypothetical Scenario: Odds of Speaking Up.*

Item	Not at all likely	Unlikely	Natural	Likely	Completely likely	Mean ±SD	Finding
	n (%)						
Nurse	3(3.7%)	10(12.3%)	14(17.3%)	20(24.7%)	34(42%)	3.89±1.19	Likely
Intern	9(11.1%)	9(11.1%)	15(18.5%)	16(19.8%)	32(39.5%)	3.65±1.38	Less likely
Resident	3(3.7%)	7(8.6%)	26(32.0%)	19(23.7%)	26(32.0%)	3.72±1.12	Likely
Attending Radiologist	7(8.6%)	12(14.8%)	16(19.8%)	23(28.4%)	23(28.4%)	3.53±1.28	Less Likely
Weighted average = 3.66							

$$\text{Percentage of Responses (\%)} = \frac{\text{Number of Responses (n)}}{81} \times 100$$

SD = Standard Deviation

Figure 1

Figure 1 : Risk of Patient Harm Due to Unintentional Breach of Sterile Technique by Clinician